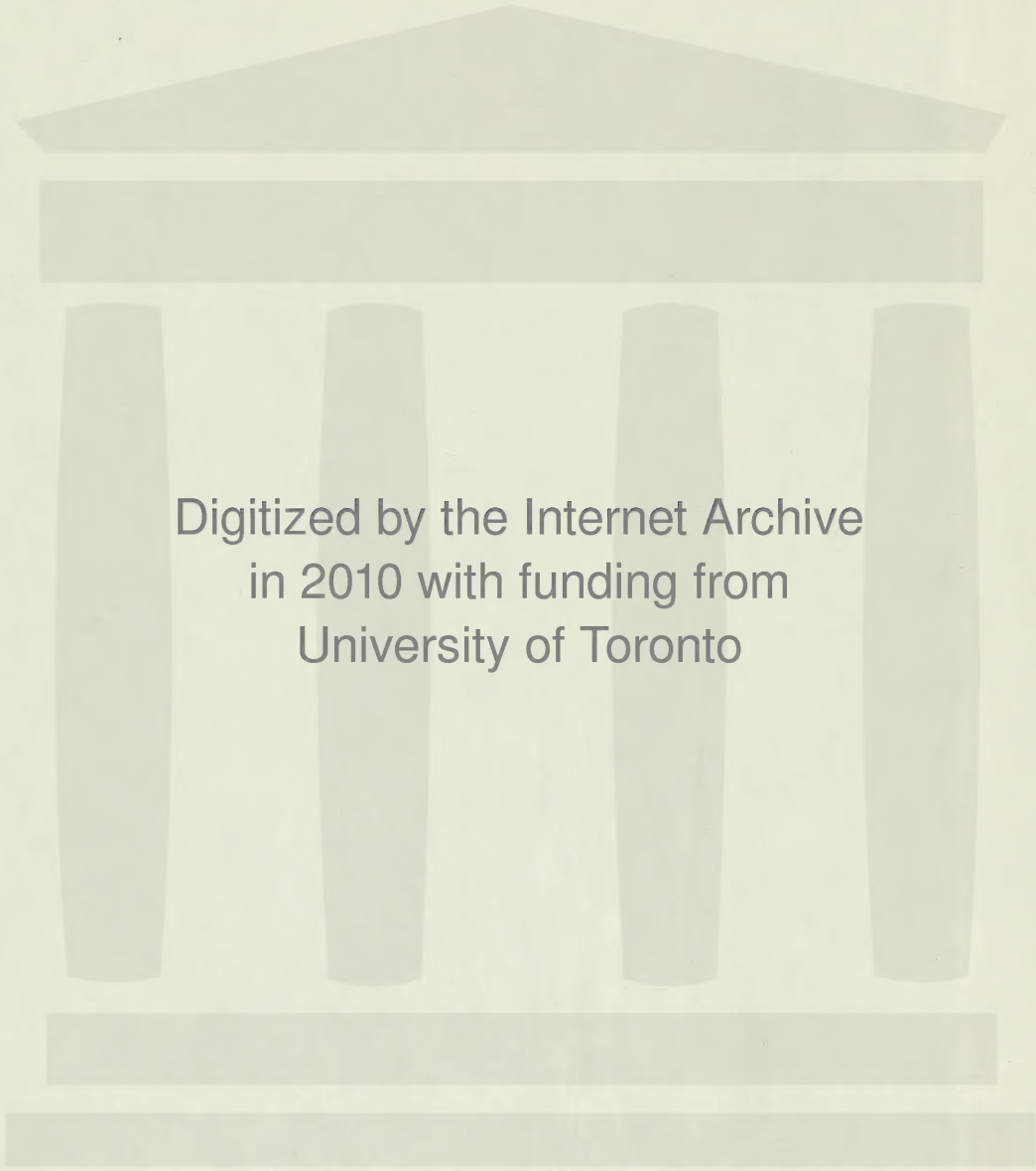

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The Chemical Exposition as An Adjunct to the College Course

TEACHERS of chemical engineering and industrial chemistry will find it worth while to make a special effort to bring their classes to the Chemical Exposition to be held in Grand Central Palace during the week of Sept. 11. As an educational adjunct it is doubtful if the Chemical Exposition can be surpassed, when one considers that in it are gathered together the products of the manufacturing brains of the industry. A few days at the Exposition under the intelligent guidance of an instructor, taking advantage of all the opportunities offered, should be equivalent to several industrial trips and plant visits.

By way of practical suggestion we offer the following: The students can be divided into groups and assigned to the study of exhibits of fundamental engineering equipment such as filters, evaporators, driers, etc., and required to make a written or verbal report for the benefit of the entire class. Lectures by specialists can be arranged in advance to be given by representatives of important exhibitors. Through the use of a stereopticon with reflectoscope attachment explanatory lectures can be given by the instructor based on the catalogs and other trade literature distributed at the Exposition. Meetings can be held for the discussion of new processes and equipment. Doubtless other means will suggest themselves for taking full advantage of the Exposition, but the principal thing is to take definite steps to get the students there in groups for two or three days. It is true that the Exposition is held just at the beginning of the school year, but it will well repay the effort to make use of it regardless of some slight inconvenience. Fortunately it is centrally located with respect to a great many colleges and universities.

Should Engineers Be Licensed?

IT IS DOUBTFUL if chemical engineers throughout the country are awake to the consequences of licensing laws that have been proposed or passed in many of the states. In fact it may be said that engineers of all classes were scarcely alive to the activities of a very energetic minority until bills had been passed affecting their right to practice. The unfortunate part of this lethargy is that whether he likes it or not, the engineer living in a state in which licensing is the custom comes under the terms of the law and finds himself restricted or hampered by incompetent legislation. The general attitude seems to have been one of *laissez-faire* in the thought that no particular harm could come from the licensing of engineers.

As a result of this attitude the movement has gone so far that many of those who are opposed to the policy feel that the most effective thing to do now is to guide and direct future legislation into the best channels. This is the view of the American Engineering Council. We think it is a grave question, however, whether any good can be accomplished from licensing engineers whose work requires the exercise of initiative, ingenuity, judgment or the creative faculties. It is conceivable that where the public safety and health are at stake licensing could accomplish some good. Thus engineers who are responsible for public works might be licensed with advantage to the community. But even this is questionable. The licensing system has not worked miracles with the medical profession. We still choose our physicians on recommendations other than those arising from the license to practice. So it is with chemical engineers, and we doubt not with many others. The stamp of state approval does not necessarily turn a poor engineer into a good one, and heaven knows plenty of poor engineers could get licenses.

New York is one of the states which has adopted the licensing system. The bill went into effect in April, 1921, and all engineers who are not licensed by April, 1923, will be subject to heavy fine if they attempt to practice. An examining board has been appointed to give examinations and issue licenses. We understand that the license entitles one to practice as an engineer without regard to the kind of engineering he is qualified to undertake. Being licensed, he may operate a chemical plant, design a skyscraper, build a bridge or lay out a system of sewerage! At least he is entitled to do these things as far as the license is concerned. It would certainly seem desirable to differentiate among engineers if they are to be licensed at all. But why license them? What do *Chem. & Met.* readers think about it from a chemical engineering viewpoint? We invite discussion.

Alas, Poor Potash, I Knew Him Well

ONE WEEK we get evidence of German pressure to eliminate the American potash producers, and the next week we receive manifestations that the American consumers of potash are very unfriendly toward the American industry. Now it is the National Fertilizer Association which objects to protection of the potash industry in this country. Every red blooded American, it says, would like to see the potash industry develop if it can be done along sound and permanent lines. Judging by subsequent sentences the sound and permanent lines seem to mean that American potash shall act as a kind of valet for the fertilizer industry and say "Yes, sir!" very loud whenever it is called.

If you object to American potash because it contains "too high a percentage of potash to obtain even distribution when used as fertilizer" and then object to it because the high freight rates in America militate against its use in potash consuming centers, you may still be consistent, despite the fact that the Panama

Canal makes cheap transportation possible from the producing points on the Pacific to the consuming centers on the Atlantic. But if the American potash were more dilute the freight would be higher. It looks as though the fertilizer industry wanted to have its potash cake and eat it too!

It is not strange that a consuming industry should object to protection for a producing industry. That happens all along the line. Textile manufacturers, in the opinion of some dye importing firms, object to adequate protection of dyes although they will protest vigorously if any reduction in the protection of textile goods is suggested. Similarly, some years ago the fight as to whether both zinc ore and spelter should be protected was bitter almost to the point of personal violence. As a country we do not seem to understand that when we start on a policy of protection all economically sound industries deserve like consideration. Protection of any industry inevitably must be paid for by the consumer. This is not an argument against protection, but it should invalidate the objection to a protective policy for any one article on that basis. We hold no more of a brief for potash than for any other American industry, but it seems that potash is about as hard pressed as any other chemical industry in an endeavor to stay alive. Therefore, if we stand in this country for protection, we should stand for protection of the potash industry, in which Americans have invested capital with the confidence that protection would be established. It seems to be only one more argument for a commission to determine and administer tariff rates in a manner analogous to that of the Interstate Commerce Commission. Such a commission will be non-partisan and expert. Some time this country will tire of the log-rolling, pork-barrel method of regulating vital industries. Speed the day! In the meantime the fertilizer industry ought to give fair and sympathetic consideration to the potash industry. If we read aright the trend in fertilizers, it is distinctly toward more concentrated products. Ultimately present methods will be abandoned and concentrated salts will come into their own. Foreign potash will not always hold the stage. Why not give a little thought to the next act on the program?

A Move to Kill Commercial Bribery

ON JUNE 1 the House of Representatives passed H. R. 10159, entitled "A Bill to Protect Interstate and Foreign Commerce Against Bribery and Other Corrupt Practices." This is the so-called commercial bribery bill. It is now in the hands of the Senate where favorable consideration is expected. The bill provides severe penalties for the payment of gratuities to employees for special favors: a fine of $3,000 or imprisonment for two years, or both. One of its questionable provisions is the granting of immunity to the person who first brings evidence of a particular illegal transaction. It is felt by many that this will lead to the development of a spy system and some concomitant evils. In spite of this the bill is generally considered to be a step in advance and one that should make considerable progress toward the elimination of a disgraceful commercial practice. This will be particularly true if prison sentences are imposed on 2 or 3 offenders. A fine would not be nearly as significant, but 2 years in prison would certainly be a strong deterrent.

The bill was aimed primarily at the dye industry, although that is a well-known offender. But excellent as the bill might be in this case we believe there is a surer remedy. The dyer in a textile mill is an important workman. It is in his power to make or break the mill. If his dyeing is successful, the material will be first grade and consequently high-priced goods. On the other hand, if he makes a small slip the material is relegated to the class of "seconds" and the price of such goods is considerably less. Thirty years ago and earlier the dyer occupied the same position with respect to the industry, but the employer gave him a pretty niggardly wage, somewhere in the neighborhood of $10 to $15 a week. Now the offering of a small wage to men in positions of responsibility is the surest way to foster a system of dishonesty. At any rate the practice of bribing dyers developed and dyes even now are sold on a basis of friendship and bribery. There are some firms that don the white garment of purity with regard to this point and yet practice it surreptitiously, either by means of Christmas presents or through a friendly and unscrupulous broker. So much for the origin and practice of the system.

We understand that a scheme for eliminating the bribing of dyers in German textile works was successfully instituted by a large German dye house, not through any virtuous motive, but because it was cheaper than bribing. According to this plan the textile firm was to set a certain cost which it was willing to incur for dyeing its material. This was to include the price of dyes and chemicals, salaries of the dye force, the overhead and amortization fund. Then if the dyer was successful in turning out a minimum of "seconds" the firm would agree to pay the dyer, in addition to his salary, all that he could save under that minimum cost. In other words, if a dyer was to cut the dyeing cost from 15c. per piece to 12c. per piece the dyer would get that 3c. in the form of a bonus. This plan puts a premium on intelligence, energy and good results. It brings the aims and desires of the employee into harmony with those of the employer; and when this principle is achieved, bills to prevent commercial bribery are unnecessary and ridiculous.

Why Not a Performance Standard For Carbon Black Plants?

A YEAR ago the U. S. Geological Survey announced that six plants producing carbon black made in 1920 less than one pound of carbon per thousand cubic feet of gas consumed. About thirty other plants made between one and two pounds of carbon per thousand feet of gas. In the recent report for the year 1921 the Survey gives the encouraging statement that some companies have attained a yield of 3.5 pounds of carbon per thousand feet of gas, a 75 per cent increase in yield above the maximum the year before. However, there evidently are still a number of plants making less than one pound per thousand, for it is recorded in the preliminary data just announced that one plant made as little as 0.2 pounds!

Carbon black is made from natural gas by incomplete combustion of the gas under more or less definitely controlled conditions. The percentage recovery of carbon from the gas is usually between 2 and 3 per cent. The thermal efficiency of the process is perhaps 1 per cent. These facts show that the carbon-black industry as now practiced in the United States still has problems of great importance on the score of technical efficiency.

The carbon-black industry has for some time also been the object of legislation. It has had to migrate from one gas field to another partly to secure gas at minimum cost, but also in part seeking always to keep ahead of that enlightened public opinion which precludes use of gas for carbon-black manufacture when there is demand for the gas for public utility supply and household use. It is time now to inquire whether the basis of legislation should not be changed.

It would be absurd to try to legislate this industry out of business, for the product of the industry is of great industrial importance. The public does, however, have the right to demand that the industry shall not be unduly wasteful in its manufacturing methods. The industry can well ask itself whether those plants which make less than one pound of carbon per thousand feet of gas burned should not improve their yields or be prevented from operating longer. If this question can be answered satisfactorily, it is quite likely that the industry will do much to eliminate the cause for criticism which has existed in the minds of state officials.

It is, of course, not feasible overnight to change a plant from one making 0.2 pound to one making 3.5 pounds per thousand. Moreover, maximum yield cannot be had without some sacrifice of the quality of the carbon black made. But given time any plant can reasonably be expected to reach at least a minimum yield in pounds per thousand or it should be compelled to cease operations. This would be not only in the interest of the general public, which wants the gas efficiently used, but also in the interest of the industry itself, which inevitably suffers most from unnecessarily poor technology. The time may never come when all will equal what is now the best, but certainly all of those now far below the average can reasonably be brought up to that performance which a majority of the plants demonstrate to be commercially feasible without undue sacrifice of quality of product.

Basing Wages On Performance

PUBLIC OPINION regarding the relations between employers and employed has changed materially in recent years. The feeling is much more general that the employee should receive a just proportion of the profits arising from the combined services of labor and capital. At the same time sound economics teach us that the sum total of wages paid cannot exceed the value of the goods which are available to the workman without that divergence tending to advance prices through competitive buying.

Accordingly the subject has been developed to a point where it is made plain that if workmen as a group are to obtain more for their wages their production as a whole must be increased and the question is how that is to be accomplished.

This question, instead of involving "the division between labor and capital" about which we have heard so much, is really a question of division between different classes of workmen. We have seen various labor leaders claiming that certain incomes ought to be paid the particular classes of men they represent, usually calling the sum "a living wage" with frequent reference to an imaginary "American standard." It is hardly to be supposed that these labor leaders do not know that they are claiming for their men more than the reasonable share of those men in the total production. It is a safer assumption that they know, but that they are in competition and are simply trying to get all they can.

An important problem, then, is that of increasing the total production of goods and the rendering of service, and then of allocating to each workman his share, in proportion to what he contributes in work.

There has been ample opportunity for everyone to observe that men in different classes of employment are not equitably remunerated, one with another, in proportion to the quantity of work they do. The market values of the work might be equal without the intrinsic value being equal, market prices of work being fictitious on account of various influences, including, just for one instance, the accident of one labor union having been more assiduous than another in controlling the number of apprentices.

The human element is the great factor to be considered. For example, it is common knowledge that in certain lines of work, such as construction, men are to be found who are inclined to nurse the job along. They do not know whether there is going to be another contract after this one or not. On the other hand the man in the factory, whether making bolts or bricks or what-not, is likely to feel that the better he works the longer his job will last. The coal miner, again, belongs to the other category, feeling that there is only so much coal to be mined in a year, hence he wants a six-hour day or indulges in a strike of a few months' duration.

The difference is in the conditions of employment, which need to be modified so that this vicious tendency of nursing the job should be eliminated. The great divergences in the quantity of work done now by different classes of workmen could be brought out by an intelligent study of how much workmen in different callings really do in a day, carpenters, bricklayers, coal miners, sheet mill rollers, pick and shovel men, railroad workmen and all others.

Responsible to Economic As Well as Business Laws

IN DISCUSSING one of its railway wage decisions the U. S. Railway Labor Board made the following statement:

> The labor board has never adopted the theory that human labor is a commodity to be bought and sold upon the market, and consequently to be reduced to stagnation wages during periods of depression and unemployment. On the other hand, it is idle to contend that labor can be completely freed from the economic laws which likewise affect the earnings of capital.

Thus it appears that another judicial body recognizes that labor and labor organizations cannot be exempt from the normal operation of economic laws. No impartial consideration of the subject could reach another conclusion.

Organized labor has consistently urged that the increasing cost of living made necessary increase in wages, and that labor was entitled to take advantage of the shortage of man-power through the acceptance of higher wages, or the expectation of a bonus from employers. No one will deny these rights and privileges if labor will at the same time admit that with decreasing cost of living and deflation in the industry, the employer has an equal right to expect reasonable reduction in wages and cancellation of bonus payments that may have been necessary during times of unusual industrial activity. It will be a poor rule that works only one way.

Readers' Views and Comments

Efficiency of Carbon Black Plants

EDITOR'S NOTE: Mr. Bubb at our request commented on a preliminary draft of the editorial in this issue entitled "Why Not a Performance Standard for Carbon Black Plants?" The comment, which follows, is so valuable that we take pleasure in publishing it in full.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I appreciate the opportunity to read your editorial. Your invitation to criticise it "vigorously" bespeaks a most commendable spirit of fairness. Except in a few points, I think your editorial admirable both in matter and manner.

Your argument that effort should be directed toward bringing all plants to the highest feasible standard of efficiency, instead of toward the destruction of an essential industry, is sound and convincing. Imperfections and inefficiency exist in most lines of manufacture. The remedy does not consist in suppressing the business or jailing the owner, but in devising more economical and efficient methods. But all legislation enacted, or attempted, against the carbon black industry has aimed, not to improve, but to destroy.

Three Criticisms Advanced

Three criticisms of your editorial occur to me.

WHOLE TRUTH NOT STATED ABOUT PERCENTAGE RECOVERY

1. In the first paragraph it is stated that "the percentage recovery of carbon from the gas is usually between 2 and 3 per cent." This is the truth, but not the whole truth. The inference is that the efficiency of the process is to be judged solely by the weight or volume of *carbon* recovered.

The element carbon is exceedingly common. It exists in many forms having a black color, such as coal, lignite, coke, animal and vegetable chars, graphite, gas-retort carbons, etc. These substances are black and are chiefly carbon, but they are very far from being "carbon black."

EFFICIENCY SHOULD BE JUDGED BY QUALITATIVE STANDARD

What is commercially called "carbon black" is a rather complex *pigment*, possessing certain remarkable properties—viz., unique brilliance and intensity of color, complete freedom from hard or gritty particles, unequaled minuteness of division, covering power when mingled with oil, and reinforcing power in rubber compounds. W. F. Weigand, the well-known rubber chemist, states that each cubic inch of carbon black contains 1,905,000 square inches (about one-third of an acre) of surface. The manufacturers' problem is not simply to dissociate the largest possible amount of carbon from hydrogen, but to make a uniform pigment possessing these unique properties, on which utility and value altogether depend. In other words, efficiency, as applied to this industry, must be judged by a qualitative more than a quantitative standard. Quantity alone means nothing.

Thus far no one has been able to attain the requisite power except by collecting the smoke or soot of a hydrocarbon gas flame. Yield and quality seem to be inseparably related. The higher the grade of black desired the greater the volume of gas consumed per pound.

HIGH PERCENTAGE OF RECOVERY MEANS TOTALLY INEFFICIENT CARBON BLACK

Several years ago a well-known industrial chemist, decomposing gas under intense heat in a retort, in the presence of a catalyst, succeeded in obtaining from 8 to 10 lb. of carbon from a thousand cubic feet of gas. But the material was grayish, gritty, utterly deficient in color and tinctorial power—in short, lacking in the very properties which impart value and usefulness to the product employed to print books and newspapers, make carbon papers, reinforce rubber compounds, etc. From a quantitative standpoint the process had an efficiency of more than 30 per cent. From a qualitative standpoint it was 100 per cent inefficient, because nobody wanted or could use the resulting product.

BY-USES OVERLOOKED BY CRITICS

Critics of the present process also overlook several other facts. Of course the "natural-gas gasoline" is first extracted from the gas. Next, advantage is taken of the expansion of the gas to furnish motive power to run the factory. This is done by piping the gas at line pressure into the cylinders of a steam engine, where it is expanded, thus furnishing power without expense, except for lubricating oil. The process is continuous and automatic and from a mechanical standpoint exceedingly efficient and economical.

AS TO "ENLIGHTENED PUBLIC OPINION"

2. I do not think the statement that the industry "has had to migrate from one gas field to another seeking always to keep ahead of enlightened public opinion" is quite a fair presentation of the case.

The fact is that the carbon black makers try to obtain their raw material, natural gas, where it is cheapest and most abundant. This has led them to sell their gas as soon as markets are created in which it can be sold more profitably than it can be used in their own business, and to undertake the pioneer work of developing new gas fields. This has not been compulsory. On the contrary, neither Pennsylvania nor West Virginia, the states in which the industry has been longest established, has ever passed any law forbidding or in any way restricting it. And I am not sure whether an "enlightened public opinion" would condemn the use of natural gas for a product so essential to the enlightenment of public opinion as printer's ink.

There is much common sense in G. A. Burrell's recent article in the *Oil and Gas Journal* in which he says: "It is hard to see why printer's ink, tires, etc., do not add as much to the happiness and comfort of the people as the burning of natural gas for heat and light."

YIELD OF 3.5 LB. PER THOUSAND DOUBLED

3. One other statement in your editorial needs

have attained a yield of 3.5 lb. per thousand." Possibly this may be attainable. Certainly nobody has yet commercially attained so large a yield of a true carbon black, possessing the properties and range of utility above mentioned.

Factors Governing Yield

Passing to the questions asked in your letter, I would say that the yield depends largely on two factors: (1) The composition of the gas. (2) The quality of black desired.

Composition of the Gas

Actual experience of our company has proved that the *identical factory*, when removed to a new location and using leaner gas, may show a diminution in yield of as much as 30 per cent. This is of course due to the difference in the composition of the gas. The following analyses of gas from three different states will illustrate:

	No. 1 Per Cent	No. 2 Per Cent	No. 3 Per Cent
CH_4	80 5	94 12	46 45
C_2H_6	18 0	3 44	43.10
CO_2	0.0	0.40	0.96
N_2	1 5	2.40	9.49

A standard type factory, operating on No. 1 gas, averaged 1.4 lb. per thousand cubic feet. The same factory, removed to a new location, using No. 2 gas, produced only 0.9 lb. per thousand. A factory of the same type and design, similarly equipped and operated, yielded an average of 1.75 lb. from No. 3 gas.

It is also a well-attested fact that more black will be produced by the same factory in the same field as the field grows older. The reason is that the leaner and lighter gas comes off first.

Grade of Black Produced

I have already pointed out that the yield can be materially increased by sacrificing quality. It is also true that the highest grade gas blacks, such as are used for the best inks, finest lacquers and varnishes, etc., invariably require *several times as much gas per pound as the ordinary grades.* Undoubtedly the yield of only 0.2 lb. mentioned by the Geological Survey represents the results attained at a factory manufacturing high-grade blacks. These blacks are produced only in limited quantities, and command a price of from 35 cents to 45 cents per pound, as compared with from 8 cents to 12 cents for ordinary grades. In such a case, one unacquainted with the grading of blacks might draw a wholly erroneous inference from difference in yield, which is explained by the differences in quality of the product.

Some Comparisons on Losses

While we are on this subject of efficiency, at the risk of imposing on your patience, I should like to draw a few comparisons.

Distribution Loss in Gas for Domestic Use

When gas is distributed for domestic use there are losses all the way, in transmission, in distribution and in utilization. The U. S. Geological Survey states that in 1919 the total waste of natural gas in production and transmission was 58,943,631,000 cu.ft. Carbon black factories, located in the field, in immediate proximity to the wells, are virtually free from transmission and distribution losses. According to S. S. Wyer, where gas is produced and distributed to domestic consumers, the domestic consumer's actual utilization is 8 per cent, the total losses being 92 per cent. Tests made by the bureau of home economics of the Ohio State University on gas ranges, burning gas at 4 or 5 oz. pressure, show an efficiency of 13 per cent on the gas supplied to the burner, which would be equivalent to about 6.5 per cent on the gas drawn from the well.

Loss in Gas and Coal for Power Plants

Oliphant's data on use of gas under the boilers of an ordinary well-pumping steam engine give an efficiency of 2 per cent. I have also seen in the public press the statement attributed to Dr. Steinmetz that the efficiency of the lava-tip burner used for lighting is less than 0.5 per cent. In an article published last October in the *India Rubber Review*, W. F. Clark, a specialist in power plant engineering, states that out of one ton of coal in the ground the average recovery brings to the surface 1,400 lb., the power to operate the mine takes 100 lb., and the coal actually turned into work at the point of application in small plants is 76 lb.

Undoubtedly some of these losses could be avoided; undoubtedly they ought to be. But no one advocates prohibiting the use of gas ranges, lava-tip burners or gas-fired boilers.

Again to quote Mr. Burrell: "One of the chief arguments used against the carbon black industry by its opponents concerns the low yield as compared to the theoretical yield obtainable. One might as well decry the fact that in burning natural gas only about 5 to 20 per cent of the gas is converted into useful work."

Columbian Carbon Co.,
Williamsport, Pa. N. B. Bubb.

Ido, the New Universal Language

To the Editor of Chemical & Metallurgical Engineering

Sir:—In a recent issue of your paper I noticed a letter by G. W. Lee, of the Esperanto Association of North America, written in answer to one I wrote in regard to Ido.

I am sorry that I cannot agree with him regarding the status of Esperanto in Europe, but I cannot. The spread of Ido since the war is great, and Esperanto has met with some reverses. (Ido also has had its reverses.) But the superior qualities of Ido are gradually bringing it to the fore.

There are about sixty existing systems of an international language, very few of which are at all worth considering. Many of them have come into existence, as has Anglido, by being created by someone who disagrees with the various academies and societies that have charge of the propagation of the language.

Mr. Lee expressed the wish that I place Esperanto, Ido and Esperantida side by side and compare their relative merits. I am unable to do so with Esperantida, but I have done so with Esperanto and Ido. In fact I subscribe to a magazine published in both languages. And frankly, the difference between Esperanto and Ido is very great. In addition to the six special letters of Esperanto, its vocabulary is limited, and in order to express the thoughts that are wholly international one must often use makeshift expressions.

Now, I wish to make the following proposition to Mr. Lee, and I hope that he will accept. That the Esperantists, Idists and the proponents of all other language systems get together and form an "International Language Association of America." Such an

association would devote itself to the propagation of the idea of the international language. That such an association shall publish a journal, whose pages will be open to the proponents of all languages, the journal to have the principal articles published in Ido, Esperanto Romanal, etc. (that is, the principal short articles). The body of the magazine shall be devoted to articles in English, about the languages and shall contain the authentic world news of such languages. In fact, it shall serve as a clearing house for all systems, and shall enable the idea of the international language to permeate all places and enable all those who would desire to study the international language to judge for themselves the merits of the languages and to select that which most appeals to them. As a representative of Ido I speak. I shall welcome advances from Mr. Lee in regard to this matter, and I am confident that if we get together and work together the cause of the international language will not lose out. I am an Idist because I believe that Ido is the logical solution of the problem of the international language, but if the public shows that it wants some other language, then I shall be content to accept what the public wants or what some authoritative body may decide upon as an official international language.

Elyria, Ohio. EARL WALTER SUTTON.

Melting Losses in an Aluminum Furnace

In the notes on John A. Lange's paper "Melting Aluminum for Rolling Into Sheet," contained in the report of the Foundrymen's Association (*Chem. & Met. Eng.*, June 14, 1922, vol. 26, p. 1110) the furnace losses are shown ten times too large. When melting virgin metal 0.9 per cent was lost; clean mill scrap lost 1.6 per cent, and oily stamping scrap lost 3.1 per cent.

News of the Italian Chemical Industry

FROM OUR SPECIAL CORRESPONDENT

GENOA, June 5, 1922.

WITH the hope of encouraging research which will result in substantial progress for the Italian chemical industry, the Associazione Chimica Industriale, of Turin, has arranged for a prize competition in which 5,000 lire has been offered for the best scheme proposed for the utilization of some chemical waste product, or for the new use of some chemical already known. The Federazione Fabbricanti Acidi and the firm of Stabilimento Ing. A. Vitale of Rumianca have also offered a prize of 3,000 lire for the most practical new use suggested for sulphuric acid. A similar prize is also offered by the chlorine producers. It is generally well known that, as a result of the war, considerable excessive manufacturing capacity exists in both of these industries. Since the Armistice, many firms have had to reduce their production on account of the large unsold stocks which had accumulated. The situation has been further complicated by the crisis in other Italian industries. Italy ordinarily produces more sulphuric acid than is consumed and therefore boasts of a modest export trade in this commodity. The production in 1918 reached the total of 835,440 tons. During the past year, imports have been practically nil, while exports amounted to 576 tons, of which quantity Switzerland received 328 tons and Egypt 14 tons.

The demand for superphosphates was scant during tinued at their usual rate. Consumption of this commodity is somewhat seasonable and the works are looking forward generally to good business later. Cyanamide is in demand, especially in some regions where its use has become rather thoroughly established. The demand for nitrate of soda and copper sulphate is also unusually good for this season. In the case of the latter commodity, the independent producers have had to meet the competition of plants which were working on contracts from the co-operative agricultural federations, prominent among which is the Società Anonima Vercellese Industria Solfato "Avis," with a capital of 2,000,000 lire.

The continued difficulties in the sulphur industry have resulted in the closing of many of the Sicilian mines, thus throwing thousands of operatives out of employment. In the hope of bettering this situation, a law has been proposed in Rome authorizing the Consorzio Solfifero Siciliano to issue obligations to the extent of 100,000,000 lire, and also requiring that a cash concession of 13,000,000 lire be paid to the same institution by the Bank of Sicily.

The production of Sicilian sulphur in 1921, according to Consul Edward T. Nathan at Palermo, amounted to 240,049 tons, or practically the same as in 1920, of which 80,000 to 90,000 tons are consumed annually in Italy. The exportation amounted to only 105,063 tons in 1921 while 188,868 tons were exported in 1920. As a result the stocks at the various mines on Dec. 31, 1921 were approximately 273,579 tons, as compared with 147,886 at the close of the preceding year.

At a meeting of delegates of the sulphur consortium and more than 200 sulphur-mine owners, held on April 27 at Palermo, resolutions were passed disclaiming acquiescence in the failure of the Government to grant the provisions requested, and the resignation of the consortium council was tendered. The crisis in the sulphur industry is due to the high cost of production, wages representing about 50 per cent which, combined with costly methods of extracting and refining, has led to a decline in exports through the inability of the producers to meet competition. As a result most of the Sicilian mines are either shut down or working on part time.

PETROLEUM RESOURCES

Among the important events of the past month was the signing of a commercial agreement between Italy and Russia, whereby the former country is to obtain extensive supplies of petroleum, coal and mineral oils. Some effort has also been exerted toward reaching an agreement with Rumania for the purpose of securing the free exportation of their crude oil which will be treated in the refineries at Trieste. It has also been announced recently that several new sources of petroleum have been discovered in Italy, at San Giovanni Incarico and at Ripi.

With the annexation of the Terento and Istrian regions, Italy came into the possession of the Idria mercury mines, which are third in importance as compared with the other mines of the world. In these mines, free cinabar is found in calcareous dolomites and occasionally in the carboniferous layers. The different minerals contain from 0.5 to 50 per cent of mercury. The yields of the mercury mines during 1920 were but 460 kilos per workman against 718 kilos in 1918. It is not known at this time whether this lower output is due to the depreciation of the deposits or to less intensive exploitation

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, June 15, 1922.

IT IS pleasant to be able to record a further improvement in business for nearly all classes of products, although there have been no important changes in market prices. Both for home and export chemicals are in good inquiry, and even in dye intermediates there is every prospect of improving demand. The end of the engineers' lock-out, the reduction in the bank rate and other factors have done much to restore confidence, and in financial as well as in trade circles there is talk of a minature boom before the close of the year. The engineering dispute has done far more damage to the chemical industry than is generally realized and in seriously reducing coke-oven output, sulphate of ammonia production as well as the trade in basic slag has been affected. On the other hand, heavy chemicals continue to do well and caustic soda, for instance, has been shipped in quantity to the Continent. There has also been a material increase in the quantity of Scotch coal shipped to Germany.

CRITICAL DAYS FOR THE DYESTUFFS INDUSTRY

"Of making books there is no end and too much learning is a weariness to the flesh" is a quotation in which "dyestuffs" might well be substituted for "books." The trials and tribulations of the manufacturer have been ventilated *ad nauseam* and the idea that the British Dyestuffs Corporation is negotiating with the German I. G. to impart its "secrets" seems almost the last straw. Whether this is partly the reason for Dr. Levinstein's offer to resign from the board of directors in order to express his dissent from their technical policy is a matter of conjecture. The *Times*, however, has really surpassed itself by a journalistic brainwave which recommends the handing over of the required information as partial satisfaction of reparations payments! Actually the Germans are inclined to treat with some concern the progress made in the British dyestuffs industry, and the prices paid for dyes made abroad are not considered prohibitive by users. It seems doubtful whether an arrangement similar to that made with France would be tolerated, and public opinion is on the whole determined that the country shall not slip back into its pre-war dependence on foreign countries. The annual meeting of the British Dyestuffs Corporation will be held next week and may throw some further light on these vexed questions. During the current year there has been a loss in trading of about $4,500,000, mainly on account of drastic writing down of stocks to correspond to current prices.

FURTHER DEVELOPMENTS AND NEW PROCESSES

The Brondse process for oxidizing, browning and coloring iron, steel and non-ferrous metal articles is likely to find extensive applications. The ordinary methods involve heat-treatment or chemical action for prolonged periods, whereas the process under review is an electrolytic one requiring a few minutes' treatment only in simple apparatus, and giving a variety of colors and finishes varying from brass and copper to shiny black. Accurate parts such as micrometers and gages can also be treated, as there is neither corrosion nor increase in size and it is unnecessary to remove rust as it is automatically removed in the process. It iron is actually deposited at a very low cost, and being extremely resistant to chemical action as well as to mechanical abrasion, the process should find increasing application in the chemical industry. Some well-known experts have been retained for the technical development of the Plauson colloid mill in this country, and among more recent applications the use of suspensions of bitumen and asphalt in water is indicated as a promising substitute for the present method of covering roads with the hot molten product. The use of titanium oxide as a paint material is also attracting attention and the Norwegian product has been found satisfactory in admixture with about three parts of barium sulphate and also in suitable proportions with other compounds. Sir George Beilby, director of the Fuel Research Station, recently delivered an address on his researches on the structure of coke, and these, together with the information contained in the report on low-temperature carbonization just issued, are considered to be of the greatest importance. Beilby was able to produce coke of an apparent density of 1.33, of which the internal reactive surface is quite equal to that of wood charcoal of half the density. The station is carrying out further investigations in regard to automatic carbonization, briquetting before carbonization and improved means for increasing the strength of briquets.

BRITISH CELLULOSE WRITES DOWN ITS CAPITAL

Drastic action in this case was, as foreshadowed in these notes, almost inevitable, but the formation of a holding company which takes over the Cellulose company's power station and a large slice of the debentures and preference shares in return for financial assistance has not been regarded as a favorable arrangement. The government and the preference shareholders are the chief sufferers, and it remains to be seen whether the reconstruction, together with the promised Swiss technical assistance, will enable the company to manufacture marketable products profitably, or whether further drastic steps will become necessary.

GENERAL NEWS AND NOTES

The annual meeting of the Society of Chemical Industry will be held in Glasgow early in July and Dr. Ruttan, Dr. Ellwood Hendrick and other visitors will receive a very hearty welcome both there and in London. Dr. Ruttan is to address the Chemical Engineering Group and the Chemical Industry Club on "The Training of the Chemical Engineer," and the Institution of Chemical Engineers, which was brilliantly inaugurated on May 2, will be well represented. The Institution is working in close co-operation with the American Institute, but is meeting with the usual difficulties in regard to its relationship and co-ordination with other qualifying bodies such as the Institute of Chemistry and the Institution of Civil Engineers.

The chemical ingredients of gas mantles are now subject to duty under the safeguarding of industries act and a further duty is now suggested under part 2 (dumping and depreciated currency) of the act. The inquiry has been adjourned to enable the German trade association to be represented, a procedure for which there is no precedent and which has occasioned considerable surprise.

Sir T. H. Holland is the new rector of the Imperial College of Science and Technology in succession to Sir

Niagara Falls Meeting of the American Institute of Chemical Engineers

Strong Technical Program, Interesting Excursions, Pleasant Entertainment Features and Scenic Beauty of Niagara Combined to Make Meeting a Great Success —Next Meeting Possibly at Richmond, Virginia

NIAGARA FALLS in now just such another joyful memory for the American Institute of Chemical Engineers as is Baltimore, Detroit, Savannah, Boston, New Orleans and so on back with half-yearly jumps until even the secretary, Dr. Olsen, becomes a little vague as to where the Institute convened. Niagara Falls was a happy choice of place, with the thrilling cataract—a kind of symbol of America—as a background and its vicinity alive with industries which allure the chemical engineer. It was a characteristic convention—stimulating, vigorous, live. If you ask a member of the Institute why he goes to the meetings he will give you any one of a score of reasons; the papers, the discussions, the industrial excursions, the meeting with other men in the profession, etc. But whatever the reason, twice a year about 20 per cent of the total membership of the Institute convenes, so there must be something in it.

The cub reporter had a memorable time which began when he pinned the blue badge on his lapel and ended when he left the Shredded Wheat factory four days later in a dash to catch the Buffalo train. It will be a long time before any of us forget the little page with a hundred silver buttons on his coat and the booming bass voice—"Call for Mister Reese." The asthmatic bus in Toronto which took thirty of us out toward Eastman's kodak factory is another memory. It broke down five times and finally died half a mile from the plant. Nor will we forget the enthusiastic songfest that was staged by the second carload coming back from Buffalo to the Falls. Led by Mr. de Beers and encouraged by the example of Messrs. Marshall, Stokes, Tunison and Richter, there was almost collegiate harmony throughout the trip.

Still another episode is remarkable. A new kind of game was developed by part of the crowd which went to see the Hydro-Electric power plant. It requires seventeen automobiles filled with people, all bound for a definite point. None of the people in the cars must know the location of the destination. A leader is chosen who starts off on what he believes to be the worst road in the vicinity—not necessarily in the direction of the destination. When the road becomes good, the leader is deposed and another leader elected who knows a worse road. A broken spring counts 10 points and "a good time may be had by all." By a process of elimination the destination is reached—and the Hydro-Electric plant was magnificent.

The local committee is to be congratulated upon the arrangement and plans which were excellently conceived. G. Prescott Fuller was chairman of the Niagara Falls committee and was assisted by Messrs. Lyster, Kellogg, Mauran, Lidbury, Tone, Snowden and Sergeant. An especial palm should be added to the decoration of chairman, and Messrs. Rippel, Howard, White, Spalding, Kerr and Heritage. The Buffalo program moved with even greater smoothness, if that is possible. The ladies were entertained by a committee headed by Mrs. A. H. Hooker and Mrs. C. B. Morey. Below is given in condensed form the program which was carried out as originally planned.

MONDAY, JUNE 19, 1922

8:00 a.m. Registration, Hotel Clifton, Niagara Falls, Ont.
9:30 a.m. Reading of Papers.
1:30 p.m. Luncheon at Hotel Clifton.
2:15 p.m. Automobile trip through Niagara Falls, Ontario, including inspection of Niagara Falls plant of Hydroelectric Commission and new power canal.
8:00 p.m. Public Lecture at Hotel Clifton.
"Geology of the Niagara district," by John Jackson, superintendent of the Queen Victoria Park at Niagara Falls, Ont.
"Niagara Power Development," by John L. Harper, Chief Engineer of the Niagara Falls Power Co.

TUESDAY, JUNE 20, 1922

8:10 a.m. Special cars for Queenston via gorge route, Canadian side.
9:00 a.m. Boat for Toronto.
9:15 a.m. Business session on boat.
12:30 a.m. Luncheon on boat.
1:00 p.m. Arrive in Toronto.

1. Visit to Kodak factory and automobile sightseeing through the city.
2. Visit to plant of the Consumers Gas Co. and rubber factory, followed by automobile trip through the suburbs.
3. Automobile sightseeing trip through the city.

5:45 p.m. Boat for Lewiston.
6:00 p.m. Dinner on Boat.
8:30 p.m. Arrive in Lewiston; special cars for Niagara Falls via gorge route, American side.

WEDNESDAY, JUNE 21, 1922

8:00 a.m. Special cars for Buffalo leaving Hotel Clifton.
10:15 a.m. Meeting at Hotel Lafayette. Papers.
1:00 p.m. Luncheon, Hotel Lafayette.
2:15 p.m. Automobile trip around Buffalo. Opportunity was afforded for visits to the following plants: Lackawanna Steel Co.; Wickwire Steel Co.; Buffalo General Electric Co., Steam Power Plant; Dold Packing Co. and Larkin Company.
8:00 p.m. Smoker, Hotel Lafayette.
10:30 p.m. Special cars for Niagara Falls.

THURSDAY, JUNE 22, 1922

9:30 a.m. Meeting at Hotel Clifton. Papers.
1:00 p.m. Luncheon at Hotel Clifton.
2:15 p.m. Automobile trip, Niagara Falls, N. Y. Optional trips to the following: Hooker Electrochemical Co.; Niagara Falls Power Co.; Niagara Wall Paper Co.; Kimberly-Clark Paper Co. and Shredded Wheat Co.

Visit to the Ontario Hydro-Electric Power Commission

On Monday afternoon the members took an automobile trip to see the famous cut and power station of the Ontario Hydro-Electric Commission. Water is taken from a point above the first rapids and delivered at a point below the whirlpool where the level is that of Lake Ontario. This gives a maximum drop of 315 ft. —over 150 ft. higher than the drop obtained by the power companies at the Falls. In order to accomplish this it was necessary to dig a very deep canal, 35 ft. of which is lined with concrete. It winds through the country in a rough semi-circle for a total length of 13 miles. The excavation work is prodigious and has been fully completed. The power house is now under construction, although two 55,000-hp. turbines have been installed and are now operating. Each turbine is fed by a 15-ft. diameter standpipe. The ultimate plan calls for nine such installations, the largest in the world, the total expenditure for which will be in the neighborhood of $70,000,000. The engineering is on a vast scale and it is an exceedingly impressive sight.

Public Lectures on the Niagara Gorge and Power from the Falls

That evening two public lectures were given, the first by John Jackson, superintendent of the Queen Victoria Park at Niagara Falls, Ontario, on the subject, "The Geology of the Niagara District." He traced the history of the Niagara gorge and showed the reasons for the narrowing and widening of the gorge at various geological periods. The two narrow parts of the gorge were undoubtedly caused by the fact that Lake Huron had another outlet to the east which drained a great deal of the water formerly going over the Falls. At these two periods in the geological history of the gorge there was undoubtedly somewhat less than 20 per cent of the water going over the Falls than at present. At other times, due to a rise in the land, the Falls were almost as large as they are now.

THE POWER OF THE FALLS

John L. Harper, chief engineer of the Niagara Falls Power Co., spoke next on Niagara power development. Mr. Harper's talk was most enjoyable and he developed a number of interesting points. He showed by statistics that at least twice as much water could be withdrawn from the Falls as is now being used and still have the scenic effect improved, if anything, over its present condition. His suggestion was that islands be constructed at appropriate points in the Canadian gorge to distribute the water over there. The Falls would then resemble more the effect produced by the American Falls, an accomplishment which should be perfectly practical, he said. At the present time, about 20 per cent of the water which normally would go over the Falls, is being used industrially. Another 20 per cent could easily be extracted without materially damaging the scenic wonder. Mr. Harper told of the new turbines which have been recently contracted for by the Niagara Falls Power Co. of a size even larger than those now installed by the Hydro-Electric Power Commission of Ontario. Each unit will have 70,000 hp. capacity. Splendid photographs and moving pictures of the Falls were shown by the lecturer.

The Toronto Trip

The trip on Tuesday to Toronto by way of Queenston and the boat on Lake Ontario was most enjoyable. The day was perfect and the sail across the lake a great treat. The inspection of the city of Toronto and of its various industrial plants was also interesting. Many expressed great surprise that Toronto was such a tremendous city, the reported population being over 700,000. The boat trip back landed us at Lewiston, on the American side, and we took the famous gorge trip along the Niagara River at the foot of the great cliff. The great volume of water which goes over the Falls is more evidenced in the gorge than anywhere else. The swirl is very impressive and mountains of water pile up in almost terrifying heights.

Industrial Buffalo and an Air Trip

Wednesday took us to Buffalo, where a number of very large industries opened their doors to us. Five separate trips were conducted to the Lackawanna Steel Co., the Wickwire Steel Wire Plant, the Dolt Packing Co., the Buffalo Steam Power Plant and the Larkin Co. In addition three members of the Institute went up in an airplane and saw Buffalo from the air. This opens up a new possibility. Show visitors the city by using the air route. Each of the Institute members expressed great enthusiasm for the air route and remarked on the unusual and complete perspective which can be obtained in the air.

After the industrial visits, a tour of the city was made by automobile, the residential part of Buffalo being unusually beautiful on account of the many trees.

In the evening a very enjoyable smoker was held at the Hotel Lafayette. The Institute opens its doors at its meetings on its plant trips, and in its business sessions, but its smokers must be a fraternal secret. Besides it would be wise on our part to refrain from comment because of the possibility of domestic difficulties among the members if it became known that the performers at the cabaret were extremely good looking.

A unanimous and enthusiastic vote of thanks was passed to the committee in charge of the smoker.

The meeting closed on Thursday with an inspection of some of Niagara Fall's industries. Of course, it was not unexpected that the industries at the Falls were in general unwilling to open their doors. Many of the industries depend for their very life on the secrecy of their processes and they will all do everything for visitors except show them the inside of their manufacturing plants. Tea at the Niagara Falls Country Club was tendered the members as a parting function by the local committee.

Important Business Transacted

The business meetings of the American Institute of Chemical Engineers are always worth-while. The Institute is a leader in so many activities that the questions discussed are always vital and pertinent to the chemical engineer whether he be a member of the Institute or not. Records of previous meetings were approved and an extensive report of the Council meetings was made. Among the subjects discussed at the Council meetings were local sections of the American Institute of Chemical Engineers. Provision was made for such a local section where there were over ten members in a city. Meetings were to be held four times annually and close contact maintained with the national body. In some cities there would obviously be a call for such an organization and in other cities it would be somewhat superfluous.

Appropriate resolutions were adopted by the council upon the death of three members, A. W. Ayer, William C. Carnell and Charles Baskerville.

Finally, the council has outlined a program of co-operation with the Institution of Chemical Engineers, the newly formed British body. The suggested basis of co-operation was first, to print the names and addresses of both societies in the membership list of each society. Second, to grant all privileges to members of either society in the other society, except the privilege of voting at meetings. Third, to send a copy of all bulletins issued by the society to the secretary of the other society, so that he might make the proper disposal of it and bring it to the attention of his members if it was important. Fourth, to make publications available to members of both societies at cost price. It was voted to donate a complete set of the transactions of the American Institute of Chemical Engineers to the Institute of Chemical Engineers.

The secretary reported that 27 active members and 4 junior members had been elected during the past six months, bringing the total membership to 1 honorary, 440 active and 104 junior members.

The Committee on Patents reported that the Lambert bill carrying with it half a million dollars additional appropriation for the patent office, had been passed and that the committee on patents of the Institute had worked with the National Research Council patent committee in furthering this bill. It was also announced that President Howard had been instrumental in inserting a working clause into the patent bill whereby it becomes necessary for a patent to be worked in this country inside of two years or it is declared invalid. This is in the interests of American industry so that foreign companies cannot take out patents in this country and hinder American manufacturers.

Engineering Abstracts

The committee on engineering abstracts told of the conferences with E. J. Crane, editor of *Chemical Abstracts*, one of the journals of the American Chemical Society. Mr. Crane has volunteered to give more space to patents and engineering articles. The committee recommended that better abstractors of engineering articles and patents volunteer to undertake this work. At the present time it is wholly unfeasible to publish an engineering abstract journal. The duplication in work would be great and the cost would be excessive. This, however was considered seriously as a future possibility.

VIEW OF THE FALLS FROM THE AIR, HOTEL CLIFTON IN THE FOREGROUND

The place for the next meeting was discussed at some length and the secretary was instructed to discover the points of interest of Richmond, Va., as an industrial center. If favorably considered, the council was empowered to decide upon it as the meeting place.

A committee was appointed to co-operate with the American Institute of Mining Engineers in regard to the licensing of engineers in New York State. Successful opposition to the licensing of chemical engineers has been carried out in Massachusetts and in Ohio. It seemed to be the sentiment of the meeting to oppose the licensing plan.

Chemical Engineering Education

Perhaps the most important subject discussed at the meeting was the subject of chemical engineering education. The council reported that a conference on the report of the Institute committee on education between the colleges and the technical men in industry had been called in Brooklyn in May and that this conference had been extremely successful. After considerable discussion it was voted to appoint a committee of eleven, all members of the Institute, composed of six technologists and five educators to carry out the details of the report. The thirteen points adopted by the conference in Brooklyn leave a great deal of detail work to be completed, such as the standardization of nomenclature and the proper weighting of courses.

It was suggested and enthusiastically endorsed as a function of this committee, that after due deliberation it should aim to differentiate good and bad chemical engineering courses and approve the courses in institutions which were of the proper standard. In this way the general tone of chemical engineering education could be more effectively improved than in any other way. This is the same function which the American Medical Association has adopted and it has practically completely eliminated the fly-by-night medical schools. It was the general sentiment of the meeting that the work of this committee would be watched with great interest and that it was possibly the most important work the Institute has in hand.

Technical Papers Presented

The first paper was presented by Peter S. Gilchrist and was entitled "Modern Methods of Concentrating Sulphuric Acid, Including Concentration of Sludge Acid and Acidproof Masonry Construction." This paper appeared in the June 24 issue of *Chemical and Metallurgical Engineering* to which you are herewith referred.

L. A. Thiele's paper on "Increased Capacity of Cascade Systems" describes a special corrugated bottom cascade basin through which the acid travels in a wave-like motion. Such a basin has an effective heating surface equivalent to 3 times that of a basin without corrugation and this gives greatly increased heating capacity. A string of 50 of these basins produced from 16 to 18 tons of 93 per cent acid. The basin is patented under U. S. Patent 1,380,689. Application of the same principle to a still was shown, this being used in the production of gasoline, oils, fats, greases and in the recovery of volatile solvents. A still 3-ft. 6-in. in diameter and 9-ft. long was shown to contain 150-sq.ft. of effective heating surface and to have a capacity of 2,500 gal. of gasoline per hour.

An abstract of a paper by L. J. Michael and J. R. Withrow on the "Solubility of Quartz Packing in the Glover Tower," outlined very briefly some work which had been done on this problem. Careful calculations seem to indicate the impossibility of explaining the contraction in the Glover tower packing as being due to the solubility of silica in acid. It was probably due to the fact that the Glover tower had been allowed at various times to cool off and then had been reheated. The unequal contraction and expansion resulted in a rearrangement of the packing and an apparent loss. The discussion which followed this paper seemed to confirm this point of view.

Cifford B. Carpenter read a paper on "Concentrating Dilute Nitric Acid Solutions" by himself and Joseph Babor. He apologized at first for the errors which had appeared in an article by him published in *Chemical and Metallurgical Engineering* last February,[1] due to the fact that the standard succinic acid solution used had been found to be inaccurate. The work had been repeated and the revised result will be published in an early issue of *Chemical and Metallurgical Engineering*. From the data which is presented in this paper it will be possible to predict the fractionating column which will be necessary to produce a given result. The paper aroused much favorable remark and F. C. Zeisberg, of the du Pont company, who has done considerable work along this line, expressed his commendation of this work.

Mr. Zeisberg then read a paper on "The Thermal Considerations of Sulphuric Acid Concentration." This article appears in this number of *Chemical and Metallurgical Engineering* and therefore no abstract will be necessary.

P. J. O'Gara Discusses Sulphur Dioxide and Fume Problems

The Institute was extremely fortunate in hearing P. J. O'Gara discuss the nine years of research which have been carried out under his direction for the American Smelting & Refining Co. The research is of the most comprehensive nature and was designed to study the effect of sulphur dioxide and other fumes on vegetation. Dr. O'Gara himself is a plant physiologist and not a chemist but his handling of the chemical problems which developed in the course of the research was always deft. He first discussed the various types of fume cabinets and showed the various objections to them. His own cabinet, which has been critically examined by every man in that field, was the result of overcoming the difficulties in the earlier cabinet and now can be assumed to be almost an ideal cabinet for this kind of work. Troubles with the earlier cabinets were due to the lack of circulation, the disregarding of the humidity, light and other conditions, the unknown absorption of SO_2 by plants and consequent variation in the gas concentration in various parts of the cabinet, etc.

Dr. O'Gara's experiments were carried out in the field on growing crops. Extensive and very complete records were kept of all experimental work, accurate analyses of the gas used was made, light conditions and humidity conditions were recorded. The conclusions reached are extensive and valuable and it is our privilege to announce that Dr. O'Gara's work will appear in subsequent issues of *Chemical and Metallurgical Engineering*. A great deal of valuable data have been obtained from a purely scientific standpoint and a unique amount of information has been gathered on crop injury and on

[1] *Chem. & Met. Eng.*, vol. 26, No. 10, March 8, 1922, p. 443.

the cure for such injury. The relation of stack height to crop injury has been studied carefully as has been the effect of solid fumes on the soil.

Considerable success has been obtained by the use of the Cottrell system in eliminating fumes. There was a great deal of trouble early in the use of the Cottrell process because basic fumes could not be handled and it was found necessary to acidify them with a certain amount of sulphuric acid. This has been found to be considerably cheaper than the old baghouse method of separating fumes.

New Hydrochloric Acid Absorbers

S. L. Tyler presented a paper describing a new form of absorber for hydrochloric acid. In essence it consists of an elongated and flattened S-bend with a trough in the bottom so that the gas passes over a shallow pool of ever changing liquid. A certain amount of acid is obtained by inclining the roof of the chamber toward the center from which the condensed acid will drop. By joining two or three or four of these units together a very effective absorption system is obtained. It embodies nearly every advantageous principle in the absorption of gas by liquid. A great deal of interest was expressed by producers of HCl in this apparatus which is made of quartz. The paper is an important one and will be published in *Chemical and Metallurgical Engineering* within a few weeks.

H. S. Taylor read a paper on "The Manufacture of Hydrogen and Nitrogen for Synthetic Ammonia." He pointed out a very significant fact—that about 75 per cent of the publicity had been devoted to the actual production of synthetic ammonia, whereas nearly 75 per cent of the cost of the ammonia was tied up in the hydrogen and nitrogen production. Dr. Taylor summarized all the processes by which nitrogen and hydrogen are usually made on a commercial scale and pointed out the economic reasons why the various processes were unsuccessful or successful. Most of the gas is produced by the water gas process. This, as it has been worked out, is fairly efficient and will produce one volume of hydrogen for every 1½ volumes of water gas made.

That particular gas ratio is the crux of the whole problem. If this ratio is high, the cost goes up proportionately because more coal is used. Dr. Taylor expressed some hope that the steam-iron contact process which gives hydrogen of very great purity, would be developed and indicated that Richardson's work was suggestive that this was entirely possible. Electrolytic hydrogen as a competitor of either of these other processes would have to have very cheap power and a much better cell of very high amperage before it could be a legitimate competitor. Dr. Taylor felt that it would not be feasible to use byproduct hydrogen in ammonia synthesis since it was extremely likely that ammonia synthesis would have to be carried out in very large units to be utlimately successful and that any byproduct hydrogen would be a very small drop in the bucket in a large unit.

A paper on "Some Economic Aspects of Ammonia Oxidation" by G. B. Taylor was read by F. C. Zeisberg, his colleague. This paper appeared in *Chemical and Metallurgical Engineering* for June 28[2] and it will be unnecessary to abstract it further.

Another paper presented by H. K. Moore of the Brown Co. and read by G. A. Richter, discussed the production of hydrochloric acid by direct union of hydrogen and chlorine. The paper was presented in abstract only and was extremely suggestive of the possible use of this method. Mr. Richter announced that very little trouble was had in the combustion chamber and that no catalyst had been employed, as the union of hydrogen and chlorine was extremely rapid without any catalyst. As a matter of fact, for months at a time no one had gone near the combustion chamber. The gases were produced by electrolysis, the hydrochloric acid gas being absorbed as usual in absorption chains and tourills.

N. T. Bacon then read a paper on "Vapor Tension at Low Temperatures." This was a theoretical paper and aroused considerable controversy.

Dr. Haslam then read a paper by Evans and Whitman on "The Bleaching of Nitric Acid with Air." This paper was undertaken as a study in the Graduate School of the Massachusetts Institute of Technology at one of their co-operating plants and gives a quantitative answer to a number of factors which have long been known to operating chemists. The bleaching of nitric acid with air is not new but a quantitative study of it has never been published. This paper will appear in a subsequent issue of this magazine.

Tank Cars for Hydrochloric Acid and Chlorine

J. M. Rowland of the Hooker Chemical Co. after discussing the unsatisfactory tanks made from impregnated wood and the high maintenance cost of these tanks, described a steel storage tank lined with unvulcanized para rubber. The rubber is cemented to the steel with a friction fabric. This tank has been quite successful in transporting the high quality "Hooker White" acid. This was so successful that they decided to try it out in tank cars and now have nine tank cars of 35-ton capacity which have been giving service for the last four months. Some of them have given even longer service.

F. C. Zeisberg then read a paper on hard-rubber lined tank cars and described a tank which had been constructed of steel with a hard rubber shell, the shell being protected from the steel with a lining of soft unvulcanized rubber. They have found this tank very satisfactory and anticipate the use of long tank cars if the present satisfaction is continued. One of the principal advantages of this tank is that it can be very easily cleaned and used for different liquids. G. A. Richter mentioned also the use of rubber lining for resistance to chlorine.

J. L. K. Snyder and H. C. Wells of the Niagara Alkali Co., read a paper on the transportation of liquid chlorine. The specifications for the 1-ton drums on the 15-ton tank cars were elaborated and the advisability of insulation and safety valves rather than fusible plugs was discussed. The present specifications which require three fusible plugs which would blow out at a temperature of 150 deg. would allow the liquid chlorine to blow out of the tank whereas a safety valve would simply blow off the gaseous chlorine which was causing the excess pressure. Another point of the specifications discussed concerned the desirability of having a check valve to prevent loss in case the outside valves were sheared off. Finally, the destruction of a liquid chlorine pool was discussed and the addition of water and earth was recommended. Chlorine hydrate, which is

[2] *Chem. & Met. Eng.*, vol. 26, No. 26, June 28, 1922, p. 1211

LARKIN CO. PLANT FROM THE AIR

formed when water is added to liquid chlorine, gives off chlorine vapor at a very slow speed.

Max Mauran discussed a new unit tank car for chlorine. In this car he placed 15 1-ton containers on a permanent cradle with proper bracing. This kind of car, he believes, would permit the minimum rate of transportation allowed on a tank car and at the same time would avoid demurrage charges, since the drums could easily be swung from place. Then, too, it would not tax the consuming company with large storage of liquid chlorine.

Phosphoric Acid by a New Process of Treating Phosphate Rock

W. H. Waggaman discussed the advances which have been made at the Bureau of Soils in the production of phosphoric acid. This process avoids the use of sulphuric acid which seems to set a definite low limit on the price of phosphoric acid. If a process could be devised which would produce phosphoric acid cheaply its natural advantages over sulphuric acid would displace this acid for many processes. Among other things which would have to be done would be the elimination of the selection and washing of phosphate rock at the mine. This would cut down the expense of mining considerably. In the sulphuric acid process a product containing 16 per cent phosphoric acid is obtained, whereas in the furnace method a very much purer phosphoric acid results. The furnace method, so-called, consists in heating silica and phosphate rock with or without carbon. It was first suggested by a French engineer in 1867 and was patented in the United States in 1895. However, it is still in an investigation stage although one plant designed by one of the men formerly with the Bureau of Soils, is now in operation in Alabama. Only short runs have been made on the furnaces and estimates over a run of 20 hours would indicate something on the order of 2½ cents per unit P_2O_5 which compares reasonably favorably with present market prices. Both electric and open hearth furnaces have been used and the comparison is very much in favor of the open hearth process, for with power at $25 per hp.-year we could pay $23 per ton for fuel, which is, of course, far above any market price. The efficiency of the electric process is however, better and there is undoubtedly less radiation. But as phosphate mines and electric power do not exist closely together, it is more than likely that if this process develops commercially the open hearth process will be used.

This paper elicited a great deal of very interesting discussion. Mr. Marshall suggested that 2½ cents per unit P_2O_5 is not an advantageous price as far as this new process is concerned and Mr. Landis of the American Cyanamid Co. said that he felt that there was one problem which distinctly militated against the success of this process—the lack of satisfactory refractory. Is there any refractory in existence which would stand up under the replacement of phosphate by silica? Without such a refractory the process was bound to fail. Mr. Landis stated that without using any carbon and thus going through the phosphorus stage from phosphate rock, the American Cyanamid Co. had obtained a 75 per cent recovery simply by replacement of phosphate with silica. This materially reduces the necessity for cheap power.

The final paper of the meeting was presented by G. T. Walker and discussed the crystallization of tri-sodium phosphate. First he presented theoretical curves showing that the true tri-sodium phosphate actually existed in solutions as far as the solubility curves could be interpreted and then discussed at some length the apparatus made by the Swenson Evaporator Co. and designed by himself, in which tri-sodium phosphate was crystallized successfully. This consisted of a tank through which the crystals were conveyed by means of a large conveyor and which was cooled on the outside by a water-cooled jacket.[3]

It is perhaps not inappropriate before writing *finis* to the Niagara Falls meeting, to comment on the generosity of the Institute toward its guests. Many of them invariably express their gratitude at being allowed to participate so completely in the activities of the Institute. A society with such unusually high standards of membership is not ordinarily so generous. Let this be considered therefore as a vote of thanks on behalf of the guests to the Institute.

New French Mill to Make Paper From Grass

The French paper industry is gradually emerging from the crisis caused by the difficulty in obtaining raw material from abroad. Every effort is being made to discover new material with which to manufacture paper pulp. A new company has just been organized under the name of "L'Alfa," with a capital of 8,000,000 francs, according to a report to the Department of Commerce from Commercial Attaché Huntington, for the purpose of producing paper pulp from plants, and especially from esparto or alfa grass, which is found in great quantities in Algeria and Tunis. The main office is situated at 124 Rue de la Boetie, Paris.

The new company has leased part of the Sorgues powder factory, near Avignon, and expects to produce pulp within a year. Other experiments are being made with vine shoote and have apparently proved satisfactory. Another effort is being made to acclimatize the Canadian poplar tree in France.

The French shipping company Les Armateurs Français is organizing a special service for the transportation of chemical wood pulp from Finland to France. The first shipment of 1,556 metric tons of paper pulp has just been discharged at Nantes and Bordeaux, coming from Hango, Finland. France hitherto has depended upon foreign ships for such transportation.

[3] *Chem. & Met. Eng.*, vol. 26, No. 15, April 12, 1922, p. 702.

American Society for Testing Materials

Pig Iron Specifications Criticised by Steel Foundrymen—Important Symposium on Impact Testing—Uncertain Whether All Metals Possess an Endurance Limit Against Fatigue—Silicon a Great Help in Making Sound Aluminum Alloy Castings

AFTER two years' absence, the American Society for Testing Materials returned to its "stamping grounds" at Atlantic City. Its meeting held during the week of June 26 was perhaps the best attended in its history and perhaps also the most comfortable—the Chalfonte-Haddon Hall hotels attending to their part admirably.

As is well known, most of the work of the Society is done in committee. The reports made to the open sessions cover only the points upon which substantial agreement has been reached, and very rarely indeed is any controversy excited. Perhaps this custom was partly responsible for the apathy with which a very large gathering of men received the important report of the Joint Committee on Sulphur in Rivet Steel.[1] Furthermore, the Committee itself declined to draw conclusions or discuss its published results, for reasons (not stated) which were said to justify its course. With such a stand taken by those who knew most about the tests, there was little left for others to do but hope that the Committee will speedily make known its mind on the effect of sulphur on rivet steel, thus erecting a target to shoot at.

Pig Iron Specifications

In refreshing contrast to this state of affairs, the Committee on Cast Iron was severely criticised in attempting to hold that its specifications for "Foundry Pig Iron" was suitable for steel foundries or malleable iron foundries. As a matter of fact, this specification specifies nothing much but allowable *variations* in chemical analysis (the actual analysis is supposed to be agreed upon for each individual lot according to the need of the foundryman or the supply at the blast furnace), and its method of sampling and inspection. This state of affairs was justified by saying that it would be impossible to specify chemical analysis for each style of casting, large or small, ranging from a washer to a hydraulic cylinder—composition must be adjusted by the foundryman to his molding, melting and pouring practice. On the other hand, it was pointed out that any clean pig of iron would conform to the specification. Steel foundrymen objected to purchasing pig with a phosphorus of 0.15 maximum; or with manganese varying plus or minus 0.20 per cent. These figures are called for in the specification, and any exception thereto would probably involve an increased price.

Fatigue of Metal

Professors Moore, Kommers and Jasper, of the University of Illinois, presented a short paper recounting some of the main findings of the Joint Investigation of the Fatigue of Metals.[2] There are three main indications that tough steel possesses a definite endurance limit. If the numerical values obtained at Urbana are plotted on cross-section paper or logarithmic paper there seems to be a definite change of direction at a certain stress, the line becoming horizontal beyond. L. E. Tuckerman of the Bureau of Standards replotted some of the results on log log paper and found even a more pronounced break in the curves. Second, if stress be plotted against rise in temperature caused thereby, a sharp change in direction occurs at approximately the same stress. Third, if a bar which has endured 100 million repetitions just below the endurance limit be immediately tested in tension, its ultimate strength will be found to be unchanged or even increased slightly.

D. J. McAdam, Jr., whose extensive tests on rotating cantilever beams were reported in *Chemical & Metallurgical Engineering* for Dec. 14, 1921, vol. 25, p. 1081, stated that he had recently completed a number of tests at rather high loads, causing quick failures. Combining these data with published tests on long-time runs on the same steels, and plotting the results on cross-section paper, a very smooth parabolic curve resulted, becoming almost horizontal for higher endurances. He still insists, however, that the data in his possession indicate that the curves possess an appreciable, though small inclination, and consequently fail to mark any definite endurance limit, below which that steel will never fail.

Commenting on this same point, Dr. Haakon Styri of the S. K. F. Research Laboratories remarked that one of their new testing machines induces reversed axial stresses in the specimen. The only run now available shows no break in continuity when the loads from 12,000 to 55,000 lb. per sq.in. are plotted against temperature rise, even though the temperature goes up very rapidly at the high loads.

Furthermore, R. L. Templin of the Aluminum Co. of America said that their extensive tests on aluminum and magnesium alloys indicate no such definite endurance limits as Dr. Moore finds for steel. Many of the SN curves show an arrest, but later the curve again changes in direction, becoming approximately parallel to that for heavier loads.

Analyzing the results of two independent investigations, Mr. Tuckerman noted that the only specimens in the two series capable of direct comparison were of ingot iron. The fatigue strengths at Annapolis were consistently lower, however, a fact which may be explainable by differences in severity of machining operations when preparing the specimens, which may induce internal stresses or even rather deep flaws glossed over by the final polish. Or it might be due to heat treatment: the Annapolis material was normalized, while that sent to Urbana was box annealed.

Prof. Moore emphasized that endurance tests were to be used in conjunction with other physical tests; even when short time tests were available, it would be continually necessary to operate fatigue tests out to hundreds of millions of reversals. Consequently it was

[1] Abstracted at length in *Chem. & Met. Eng.*, May 31, 1921, vol. 24, p. 1011, and 1019.

necessary to devise means whereby the alternations could be impressed at high speed. (Lacking endurance tests, it had already been demonstrated that a moderately close approximation for tough steels would be 45 per cent of the tensile strength or 250 times the Brinell hardness.) Endurance tests are naturally of prime importance to the builders of high speed machines, turbines or springs (with stops to prevent overload). Automobile manufacturers often prefer the Stanton repeated impact test: It is intermediate in severity between the alternating test and the Charpy, and very useful since motor parts are continually subjected to moderate but very seldom to overpowering shocks.

Non-Ferrous Metals and Alloys

Attached to the report of the Committee on Non-Ferrous Metals and Alloys was an appendix by John R. Freeman, Jr., of the Bureau of Standards on the physical properties of the 12 A. S. T. M. standard white metal bearing alloys. It was found that alloys made under commercial conditions have a slightly greater strength and hardness at room temperatures than similar alloys made under close laboratory control. When testing at 100 deg. C. these properties are reduced by approximately 50 per cent, and the order reversed. Cylindrical test specimens 1.5 x 1 in. are easier to handle and more reliable than those twice as long. Brinell hardness measured with a 10 mm. ball under 100 kg. load gives very slightly higher results than when tested under 500 kg. load.

Aluminum-copper-silicon alloys were discussed in a separate paper by E. H. Dix, Jr., and A. J. Lyon of the Army Air Service. In order to test the brittleness of various alloys when cooling in the mold, a "hot shortness" test was devised. It consisted of making a green sand casting of ½-in. test bars with enlarged end bosses. These bosses gripped pins held 12 in. apart by a heavy iron plate. Many popular aluminum compositions are not able to produce a sound bar when cast in such a way, but only one of the alloys noted in this report (85:6:9 Al:Cu:Si) cracked in this test. If these cold bars are pulled in a tension machine, they will show slightly higher strength than those cast without constraint. These results are really due to actual ductility just after solidification, since there is little difference in coefficient of expansion or in shrinkage in the new and old mixtures. Silicon should be 3 to 6 per cent, the lower limit being preferable if copper is added. Four per cent of the latter is recommended, especially when machinability is desired. Without copper, the alloys tear much the same as pure aluminum, and dull the tools very quickly. The recommended alloy can be cast around hard cores without danger of cracking, and the tendency to draw and shrink at joints between thick and thin sections is surprisingly small. Physical properties of two alloys at room temperature follow:

	94:6 Al:Si	93:3:4 Al:Si:Cu
Tensile strength	19,800 lb. per sq.in.	21,800 lb. per sq.in.
Elongation in 2 in.	4.2 per cent	2.1 per cent
Charpy impact	2.06 ft.lb.	2.13 ft.lb.
Scleroscope hardness	9.5	13.2
Brinell hardness (500 kg.)	37	55
Shrinkage	0.161 in. per ft.	0.164 in. per ft.
Coefficient of expansion	23.4×10^{-6}	24.1×10^{-6}
Specific gravity	2.63	2.71

Corrosion

Last year (*Chem. & Met. Eng.*, vol. 24, p. 1145) the Committee on Corrosion of Iron and Steel was able to report the definite superiority of copper bearing sheets when exposed to atmospheric corrosion in the Pittsburgh district. All the 22-gage sheets, both copper bearing and copper free sheets, have now completed their history with the exception of two heats of copper bearing bessemer steels, which have no failures at all. Some 16-gage copper free sheets are beginning to fail in the same order as noted in the lighter material; no 16-g. copper bearing sheet has yet been perforated. Exposure tests at Fort Sheridan, in open country, are beginning to develop failures in the light gage copper free sheets first to fail at Pittsburgh.

Another quick test for the amount of zinc on galvanized articles was reported by D. M. Strickland of the American Rolling Mill Co. If a 2¼ x 2¼ in. piece of the sheet is snipped off, immersed in 100 cc. of concentrated HCl and the rise in temperature noted by an accurate thermometer reading to 0.1 deg. C., the grains of zinc taken into solution (and for this size specimen, the ounces of zinc per sq.ft. of surface) equal the temperature rise multiplied by 0.168. The method is said to give quite accurate results, requires but a few seconds, and can be easily performed in the field. However, it gives no information on the uniformity of coating, or whether the same thickness of zinc is present on both sides of the sheet.

A very suggestive note, entitled "Preliminary Notes on Corrosion," by Prof. Wilder D. Bancroft of Cornell University, outlined some of the lines of research along which it is possible to approach the solution of the corrosion problem. He emphasized particularly the importance of studying the films which form in the atmosphere or other corroding media, films whose character influence subsequent action far more than that of the underlying metal. Calling attention again to the need of an accelerated test, he ventured the opinion that when it was found it would be a rapid electrochemical test.

In commenting on the latter point, F. N. Speller said that he had found a useful test for estimating expected corrosion in closed systems handling water. It consisted of measuring the oxygen extracted from solution while passing through a given length of the pipe or over a given surface. Many speakers emphasized the importance of the film action, and deplored the lack of information in this matter. George K. Elliott called attention to the fact that a high polish often produces an extremely resistant film, apparently by mechanical means. H. S. Rawdon pointed out that most of Prof. Bancroft's suggestions applied to pure metals or alloys of the solid solution type, while alloys containing more than one metallographic constituent would probably act far differently.

W. S. Calcott, of the du Pont Co., told of efforts they had made to translate laboratory experiments on corrosion to the operating department, when the latter was desirous of building a container for a certain liquid or vapor, for instance. It seemed that every problem was unique and no amount of work was able to express the results of various experiments in a simple formula until it was suggested that the corrosion action was really a compound action, consisting first of the *formation* of a reaction product, and second the *removal* of this product. Following this lead, it was found possible to develop an equation, say, for the rate of formation of oxide of aluminum by acetic acid. Another equation was constructed expressing the solubility of this oxide in acetic acid. Combining these two it was found possible to predict with a fair degree of accuracy the action of that acid on an aluminum container.

Impact Testing

Ten papers on Impact Testing occupied one evening's meeting, the whole subject being examined in considerable detail. Bound together the preprints total over 100 pages, and it is naturally impossible to abstract their contents adequately in a few lines. Each interested engineer will wish to study the pamphlet in detail.

H. L. Whittemore, of the Bureau of Standards, briefly sketched the historical development of the test and listed the literature. The earliest machines still survive in the falling tup used to test rails and axles.

D. J. McAdam, Jr., of the Naval Engineering Experiment Station, then described the dozen or more machines proposed and now in use (to some extent at least) for testing either notched or unnotched specimens in one of four ways: Tension, shear, as a simple beam, or as a cantilever. The author outlined published information indicating that the figures found for resilience of the metal will be substantially unaffected by considerable variations in the speed of the blow and weight of anvil, or small variations in the weight of the hammer—if that weight is accurately known. Theoretical considerations on the size and shape of the specimen and notch indicates that this is of major importance. Unnotched specimens under impact will develop crystalline or granular structures characteristic of metal broken with little plastic deformation only in the most brittle materials. A properly prepared specimen should show an outward region of fibrous fracture, underlain by a crystalline or granular area. In the toughest metal this may only be had if the notch ends in a curve of short radius.

The great difficulty in measuring the pressures, accelerations and forces involved in impact testing, where failure occurs within 0.0015 to 0.006 sec., was discussed by Messrs. C. E. Margerum, of the U. S. Naval Ordnance Plant, Armin Elmendorf, of the Haskelite Manufacturing Corp., H. F. Moore of the Univ. of Illinois, and E. B. Smith of the Bureau of Public Roads. On account of the great decellerations involved, the autographic recording instruments must be of minute mass and act directly—without gearing. Magnification must be subsequently done microscopically. After such a time-space curve is found, before the acceleration may be computed (and hence the force) its second derivative must be worked out by laborious computation or delicate instruments, a method giving ample opportunity for errors. Mr. Margerum therefore recommended the crusher gage commonly used to determine explosion pressures, where the pressure drives in a small plunger, shortening a tiny cylinder of copper.

In view of the fact that the tensile test is performed by static forces, while the impact test measures energy for almost instantaneous rupture, and in view of the just described difficulties of measuring the accelerations necessary to transform energy into force. Messrs. F. C. Langenburg and N. Richardson of Watertown Arsenal expressed the opinion that it is useless to expect a simple or constant relation between the indications of the two tests; it varies with the nature of the steel. They have experimented with steels which broke in static tension with an elongation across the notch of about 175 per cent, whereas under impact the elongation was only 30 per cent. Two distinct types of fractures naturally resulted, viz., fibrous and crystalline. In view of the fact, therefore, that tension and impact testing reveal two different properties of metal, the Watertown Arsenal now judges the acceptability of gun forgings by the Charpy machine regardless of the tensile results, having found that no gun jacket or tube possessing an impact value exceeding 6 ft.-lb. has ever ruptured in service from causes which cannot definitely be assigned to defective ammunition, excessive powder pressure, and such like.

C. L. Warwick, Secretary of the Society, reported that an extended questionnaire had developed the fact that much impact testing was being done in America to determine toughness in heat-treated metal and to control specified heat-treatment, to determine ductility, to study causes of failure, and for acceptance of materials to work under heavy shocks. In view of the wide variety of machines and bars being used, it seemed desirable to attempt to simplify existing practice, especially in the shape of bar and notch, so that comparable results might be obtained in different laboratories.

Busheled Merchant Bar Iron

W. M. Myers, of the Highland Iron and Steel Co., noted that about two-thirds of the "wrought iron" made in this country—in fact nearly all the merchant bars—is busheled scrap. Busheling consists in heating to a welding heat in a reverberatory furnace, miscellaneous iron, steel, or a mixture of iron and steel scrap cut into small pieces. After welding heat is reached, the pasty mass is balled up, removed from the furnace, squeezed and rolled exactly as is true wrought iron made from puddling pig. In fact, the process originated soon after cheap Bessemer steel entered the market, and many puddling mills started reworking scrap rather than go out of business.

Busheled merchant bar may be indistinguishable from wrought iron made by puddling by chemical analysis, and only with difficulty under the microscope if the scrap used contains no steel. As pointed out by James Aston, of the A. M. Byers Co., it involves a prohibitive cost to insure the use of nothing but good scrap, and since the nature of the metal is unchanged, busheled bar is no better than its raw materials. True wrought iron is a composite material, and both the metallic portions and its slag inclusions are essential ingredients. Slag in busheled bar is essentially an iron oxide, whereas slag in wrought iron is the reaction product from refining pig iron, i.e., phosphide and silicates of iron. If much steel is used in the busheling furnace, the fact may be indicated by chemical analysis, showing carbon and manganese greater than 0.10 per cent. The nick and break test is also apt to be more crystalline than fibrous.

Increased Requirements for Malleable Castings

Progress in the betterment of the iron used in malleable castings is recorded by the specifications of the American Society for Testing Materials. Specifications were originated in 1904 and no changes were made for eleven years. In 1915 the first revision was made. Four years later, in 1919, the requirements were materially increased. The tensile strength requirement was raised from 38,000 lb. per sq.in. to 45,000 lb. per sq.in. and the requirement for elongation was raised from 5 per cent in 2 in. to 7.5 per cent in 2 in. Malleable foundries have been working to these specifications for three years, and it has been decided that malleable iron could be made commercially with still better physical properties. Specifications were therefore revised at the recent meeting of the A.S.T.M., so that the required tensile strength is 50,000 lb. per sq.in. and the elongation 10 per cent in 2 in.

Chemists in Public Life

General Tendency of Chemists Is to Take Interest Only in Such Affairs as Concern Their Personal Welfare — A Survey Shows That Few Chemists Are Public Office Holders—Chemical Club Organizes Council to Promote Public Welfare—Midland, Mich., a City Run by Chemists

AN EDITORIAL SURVEY

ON MARCH 15 last we published an editorial about the part taken by chemists in public affairs which was merely another reminder of an opinion that we have held and mentioned at other times on divers occasions. In substance our contention was that the chemist is among the most essential of human factors in the development of civic and community welfare and advancement, and that we rarely hear of him in this respect. We held that as citizens chemists may contribute great and enduring services to the communities in which they live, and that, generally speaking, they do not come to the front and volunteer to contribute in the measure that lawyers do.

There are more lawyers in the country than are needed, and fewer chemists than might profitably be employed. True, there are many chemists looking for work and not finding it at the present moment, but that does not mean that work for them is lacking. There is work for them in abundance, but the people who direct affairs are ignorant in this respect, and they fail to see the need of chemistry in the very places where it is needed most.

BUSINESS OF CHEMISTS TO MAKE NEED OF CHEMISTRY KNOWN

Now it is the business of chemists to make these needs known, and they become known only when they are uttered as opinions by persons of eminence or in authority; by persons whose advice is sought and followed. This does not mean that they are to be spoken by someone in the public employ, whether elected or appointed; it means they must emanate from someone who has won the confidence of the community.

We thought we'd see whether we had guessed wrong or not, and we wrote to representative chemists in different parts of the country, asking each if there were in his section chemists who are participating in public activities. Were there any who held public or quasi-public office? Were there any who are prominent in public speaking or reform movements or any other phase of public welfare? We discovered from the replies we received that we had been wholly wrong in our opinion of the activities of chemists in regard to the general welfare in one single city, and that a small one of 5,500 inhabitants. And we hope soon to find ourselves in error in respect to one other. Before referring to these in particular, however, let us quote from a few of our other answers, some of which are less encouraging. Here is one:

"Chemists here are much like other human beings and are taking interest only in such affairs, public or private, as concern their personal welfare. They are heard in public only when they have an ax to grind. And the few who have axes to grind are the ones who are always ready to talk. . . . Personally I think we chemists should not talk in public about chemical affairs. Our unvarnished statements are too often dressed up to make interesting news items, and then we have to apologize."

That, if you please, about the members of a learned profession! If our correspondent had said, "Chemists are very like clerks in boot and shoe stores, or cigar stores, or like street railway conductors," the words that follow might have been convincing—if that is the kind of chemists they have in that region. At the same time it would have been manifestly unfair. When we remember that some of the most eminent savants in the country are neighbors of our correspondent, we feel that he has a wrong slant on the subject. We learn from him, however, that chemists are not active in public affairs in his region.

The following is from one of the smaller states devoted to agriculture rather than to industry:

"I am afraid there are no members in our section who are prominent office holders. We are mostly teachers, and, to some extent, investigators; and how in the world can such a man do his duty by his laboratories and have time to gain prominence in politics? I do know several chemists prominent in public affairs, but they are pretty poor chemists! The lawyer turns to public affairs and politics as naturally as a duck takes to the pond, and the way in which he has made himself known is oftentimes no cause for envy. It seems to me that laboratory men must in the nature of things be, to a considerable extent, recluses; but the results obtained by the craft as a whole are surely no cause for regret!"

CHEMISTS ARE CITIZENS WITH MORE THAN AVERAGE RESPONSIBILITIES

Of course the reference to chemists as craftsmen is a mere slip of the pen. We are firm believers in the teaching of sound laboratory craftsmanship, but how about the mind of the chemist? As a citizen he has the obligations of a citizen, which are, of course, no less than those of a cabinet-maker or pipe-fitter or any other craftsman. But in addition to this he has entered a profession on which rests the responsibility of seeking and finding the nature of things and of applying this knowledge to the advancement of human welfare. His professional preparation is supposed to have equipped him with the vision to see what is denied to others. Shall he then hold his peace when opportunity for helpfulness presents itself, lest he be misunderstood? He is one of the *illuminati* of the community in which he lives. Should he hide his light under a bushel?

Another letter tells us that the head of the department of chemistry of the local college is president of the Chamber of Commerce. That sounds right to us.

And the secretary of the local section of the A.C.S. is superintendent of the Presbyterian Sunday School, which also indicates merit. "Aside from these two public services," the writer says, "I do not believe any of the other chemists in this part of the state are affiliated in any way with public work outside their profession."

Still another names four gentlemen who have made many addresses before Kiwanis, Rotary and Women's clubs and high-school audiences, and says there are others who have done the same thing.

Chemists Active in University Towns

We learn that the head of the department of chemistry of a state university has achieved prominence in connection with chemical work for industrial companies (which is not what we were after) and that in Scottish Rite Masonry he has conferred no fewer than 15,000 32nd degrees. The one other chemist of the section has been an active organizer of chemical and other scientific societies, farmers' clubs, rural life betterment associations, and while never holding any elective public office, is very active in public speaking. He says, "The scientists are the men who actually have the goods, but they are the worst salesmen I have ever seen!"

In another state university one of the professors of chemistry has served for 15 years as a member of the Board of Education and is at present a member of the Board of Health. With one of his colleagues he is a member of the Kiwanis Club. Still another professor is prominent in giving addresses before various public organizations.

A letter from a city of from 150,000 to 200,000 inhabitants which is the center of a great chemical industry tells of one gentleman of the chemical profession who takes a rather active interest in industrial social relations and reform movements. Otherwise, so far as our correspondent knows, few or none of the chemists of the section "are prominent in public welfare work or in public speaking."

An interesting note in regard to this very city is that its greatest chemical industry has passed from the hands of its founders and organizers into those of a group of "investors" who, on obtaining control, dismantled research laboratories, discharged chemists and enjoyed a general and promiscuous chemical head- and heart-cracking party. The chemists remaining do not know whether they are afoot or ahorseback; most, if not all of them, punch the time clock and receive their instructions from a group of traders who are just such strangers to chemistry as they are to humility. The chemists have ceased to function as men of science, and have become a kind of indentured craftsmen. They are indentured because jobs are scarce. We should not expect much work for the general welfare from men who are broken in spirit.

Chicago Taking the Matter Up

From Chicago chemists we obtained a formal reply to the effect that a sub-committee of the local section had been appointed to take the matter up. We are informed, however, that on receipt of our letter, the members of the section, who are very live wires, said, "Well, what about it?" They appointed their committee, and discovered that one of their number was rather active in certain charitable enterprises, but that on the whole the members of the section were not playing a prominent part in public affairs. But the Chicago chemists are not broken in spirit, and we expect within a year or so to see them as active in municipal affairs as the members of the local branches of the American Medical Association or the Bar Association.

From another Middle Western source our correspondent writes that he knows of no one of their number "who is markedly active in public affairs, such as the lawyers of our community are." Then follows an argument to the effect that lawyers do not often make useful discoveries and inventions along scientific lines. Holy Writ is quoted, saying that no man can serve two masters, and that the man who is in the public eye is not of necessity a greater servant of humanity than the man who patiently and faithfully serves in the laboratory. "Of course," he continues, "there is nothing in this attitude which could be construed to mean that the chemist should not do his full duty as a citizen, taking part in the activities of his city and state whenever called upon. This should, however, be *as a citizen and not as a chemist.* In other words, citizenship should not recognize particular classes."

Obligation to the Community as Chemists

That is just where we take issue. Fifty to 60 per cent of the men and women of that community—unless its intelligence is clear above the average—have a mental age of not over 11 years. They do manual labor and can learn trades. They cannot co-ordinate or connect causes with effect. They can repeat political slogans, but they can't sense great principles. They're ready to say "Let's try" to anything that is proposed, which explains the amazing specimens of men who are elected to be mayors of various large cities. If chemists have no more mind than such morons, then they are not chemists at all; they are mere laboratory drudges. Where does professional obligation come in, we should like to know? The chemist must be able to use his head if he is a real one and not a mere laboratory laborer. That is part of his professional equipment, part of what he should have to offer. Chemistry determines pure water, knows paving and building materials, can take a city's list of materials needed and provide specifications that are sure to cut down taxes; can aid in warding off disease, and must be present in the organization of a health department or in sanitation; it touches public work on every side—and it is up to chemists to do the touching.

We must pass over a number of replies in which we learn of one or two chemists in whole districts who lecture occasionally in public or are engaged in university extension work or who "are members of the Rotary Club," etc. Even in so great a section as St. Louis the secretary does not recall any chemist who is interested to a great extent in public activities, although the value of chemists in civic work is recognized. We are under the impression that here at least two eminent chemists have been overlooked, Dr. Frerichs and Dr. Caspari, who, we believe, have contributed liberally in this respect. We have not heard from Cincinnati, but the great services as a citizen of Dr. John Uri Lloyd would call for comment, and so would, probably, that of Dr. Alfred Springer among others.

Philadelphia Has a List of Distinction

From Philadelphia we have a list of twenty names, and our correspondent is sure there are as many more of whom he does not have intimate knowledge. The list is one of great distinction.

The secretary of a numerous and live section tells us of one of their number who is member of a local school board, and of a second who, as city chemist, "has the privilege of examining many samples of police-captured 'hootch.'" He concludes by saying: "I really do not know of any chemist hereabout who is prominent in public affairs. Probably it is what you expected. Certainly it is one of our weaknesses."

From the foregoing it does appear as though chemists are addicted to the habits of the modest violet. As for those who are engaged in industries which are under the control of traders only, who hold that "anybody can make this stuff, but it takes genius to sell it," we cannot expect much. Their very profession is a badge of inferiority in such cases. Under long-continued control of this sort, it is men of the dray-horse type that settle down. When the day's work is over they want to rest. Imagination is a nuisance. They are excellent men; thoroughly sound and good, but not built for leadership, and those who, without the necessary qualifications, try to lead, and fail, are real nuisances. We merely wish to add the note that it does not require the quality of leadership to contribute.

But now let us turn to a couple of answers that give us real encouragement.

Tacoma Organizes Active Body to Co-operate in Civic Affairs

From Tacoma, Wash., we learn that the Olympic Chemical Club on April 11 last created an active body of six members to co-operate with other civic bodies in the upbuilding of the community. The committee consists of the head of a biological laboratory, a tar refiner, a gentleman who was formerly a dairy expert in the Municipal Health Department, the representative of the du Pont company, the local manager of a large analytical and assay laboratory of Seattle with branches at Portland, Ore., Tacoma, Wash., and Kobe, Japan, and the president of the club, who is manager of a nut butter concern.

It would be difficult for a layman to sense the value of the special lines of chemistry with which these gentlemen are familiar, but among the six members of the council there should be well represented the points of attack on civic problems from the various angles of chemistry. The council meets once a week at luncheon, and has already begun to carry out its duties in accordance with its charter, and is giving every evidence of filling a real need in the city.

The charter is so well drawn that we publish it herewith. It offers the best lead we can give as to how to organize.

The Olympic Chemical Club

Chemical Engineering Council for Public Welfare

The Chemical Engineering Council, hereafter called "The Council," shall be a permanent body of five members selected from among the membership of the Olympic Chemical Club for the purpose of promoting the general welfare of the community in matters pertaining to chemistry, and also to promote the welfare of the chemical profession.

The activities of the council shall be independent of the Olympic Chemical Club except that the members of the council shall be individually responsible to the club for carrying out the purposes of the council and maintaining the dignity of the profession at all times under penalty of impeachment as hereinafter set forth.

The details of organization and duties of the council shall be as follows:

Organization: The members shall be appointed by the president immediately, to serve for the term of the president. As soon as practical thereafter they shall meet and choose by any method they shall see fit necessary officers and shall adopt a system of bylaws, the same to be approved by the club. Vacancies in the council shall be filled by the president as soon as possible. The president of the club shall be a member of the council ex-officio.

Duties: The duties of the council shall be to promote the welfare of the community and the profession:

1. By aiding in the establishment of desirable new industries.
2. By assisting already established industries to devolop along sound and proper lines.
3. By leadership of the community toward better conditions in sanitation, water supply, food inspection, manufacturing and marketing conditions and any matters relating to health and safety as bearing upon and related to the science of chemistry.
4. By educating the public to the advantages of a better appreciation of chemistry and a larger use of professional chemists and chemical engineers.
5. By raising the professional ethics of chemists and chemical engineers.
6. By the exercise of constant vigilance to protect the public from false steps in matters related to chemistry, and from being victimized by ignorant or unscrupulous promoters in matters relating to chemistry.
7. By co-operating with other organizations and agencies in the upbuilding of the community, this co-operation to be limited, however, strictly to matters in which chemistry is involved.
8. By studying the industrial resources of the community and being prepared at any time to supply data to those seeking to establish or develop industries.

The council, however, is specifically directed to avoid, as far as possible, giving free consulting service, or encroaching upon the field of qualified experts. The work of the council is rather to promote public welfare by expanding the field in which professional chemists and chemical engineers can operate for a respectable remuneration. Nothing in this charter is to be construed to mean that free work of a consulting nature is to be done for anybody, except occasionally when it is thought that a strictly limited amount of such free work might be justified as advertising or as publicity directed toward the development of remunerative work.

The council shall submit a report of its activities to each regular meeting of the club.

Impeachment: Any member of the council may be impeached by the club for unprofessional conduct damaging to the council or the club. Such impeachment proceedings shall be conducted by the club with all due care and consideration for the rights of the accused.

The council has our best wishes, and we await with eagerness the reports of its progress.

Midland, Mich., Run by Chemists

We now come to a real little chemical city, which is Midland, Mich., with 5,500 inhabitants, of whom 55, or 1 per cent, are chemists. Note also, please, that its leading chemical industry was organized by a chemist who remains in control and that when hard times came along, instead of regarding its research laboratories as "dead wood" and cutting them out after the manner of some larger concerns under the leadership of bankers, the concern works all the harder to find what it can produce which is wanted.

The City Council is composed of eight aldermen and a mayor, and for 6 years past the mayor and three of the aldermen have been chemists.

One chemist is on the school board, ten are in the Chamber of Commerce, five are members of the Rotary Club, and sixteen, or 33 per cent, are in the Kiwanis Club. All reform movements and welfare organizations, together with most of the church activities in the city, are backed by a good number of chemists. Ten have been active in public speaking along lines in which chemistry touches the public interest. Four are especially considered as deserving attention, being inter-

ested respectively as member of the State Fair Board, director of Rotary Club, in philanthropy, as president of the board of control of Midland Community Center, as prominent in all reform movements, as president of the Midland County Welfare Association, president of Midland Americanization Society, secretary Kiwanis Club, and as health officer. Under the chemical health officer restaurants have been improved 100 per cent by strict enforcement of sanitation laws, and the milk situation has been brought up to a very high standard. But think of improving restaurants 100 per cent by a chemist! We've always maintained it could be done.

Midland is known in Michigan as "The Chemical City." It is small, but its chemical control has paved its streets, lighted it, provided for a filtration plant, and got things generally into shape.

Fifty-five chemists does not seem like a large number here in New York. We have one chemist who is president of the Citizens Union, but we think that if he had a special committee of fifty-five chemists and engineers in that body, keenly alive to the welfare of the city and earnest in their resolution, so far as the chemical and engineering aspects of public affairs were concerned they would be properly attended to. The practical politicians, the Hearst newspapers and Tammany Hall and a good part of the Republican County Committee undoubtedly would be kicking against the effrontery of "those theorists," but in the end we should have a better place to live in.

Legal Notes

By Wellington Gustin

Remedies of Seller on Breach of Contract

The remedies of a seller of goods where the buyer has breached his contract to buy are laid down by the United States Circuit Court of Appeals, Second Circuit, in an action brought by Isaac M. Simonin, trading as C. F. Simonin's Sons, against Sigmund Kranter. (Kranter vs. Simonin, 274 Fed., 791.)

The transaction out of which the suit arose appears to be: Simonin agreed on July 16, 1919, to sell and deliver to Kranter 1,000 bbl. of Ceylon grade coconut oil, not to contain over 7 per cent free fatty acid, at a price of 20c. per lb. net cash, without discount. The buyer agreed to furnish a 90-day confirmed bank credit for documents, payment to be made against an f.a.s. railroad bill of lading, Philadelphia weighmaster's weight certificate and certificate of analysis. By a supplemental agreement on Dec. 1, 1919, there was a substitution of "refined edible coconut oil at a price of 24c. per lb. to be made within one month of Dec. 1, 1919." In other respects the contract of July 16, 1919, was confirmed.

The seller alleged in his suit that on March 5, 1920, he delivered to the buyer 100 bbl. of refined edible coconut oil, and received payment according to the terms of the contract of Dec. 1, 1919; and again he delivered 136 bbl. of oil which buyer refused to accept or pay for. Further the complaint alleged that the seller was ready and willing to deliver, in accordance with the contract of Dec. 1, 1919, the remaining 900 bbl. and demanded shipping instructions, and so repeatedly notified the buyer, who, on each occasion, requested the seller not to ship but to hold the oil subject to his orders; and on May 21, 1920, the seller notified the buyer that he would no longer extend the time for delivery beyond May 21, 1920. The buyer failed to give shipping orders or instructions, or to furnish the confirmed bank credit, as required by the contract of Dec. 1, 1919, and for breach of the contract the seller asked damages of $15,000.

The buyer alleged that the bank credit for documents was waived by the mutual consent of the parties, and further that the seller delivered the balance of 900 bbl. and agreed to store them for the buyer, who agreed to pay for them from time to time as he removed them from the warehouse, and until their removal to pay interest on the purchase price, storage charges, etc., but later insisted on immediate delivery and payment.

Upon a trial the jury found the facts substantially as alleged by the seller. As to the law applying, the Court of Appeals says the seller had as remedies the choice of endeavoring to indemnify himself by storing or retaining the property for the buyer and then to sue him for the entire purchase price, or he could sell the property, acting as an agent for this purpose of the buyer, and recover the difference between the contract price and the price obtained on such result, or he could keep the property as his own and recover the difference between the market price at the time and place of delivery and the contract price. He could do this both under the common law and under the personal property law of New York State (Consolidated Laws, N. Y., chapter 41).

Seller Need Not Show Goods Were in Stock

Again, the court said where the buyer failed to give shipping instructions and to furnish a bank credit, as agreed, it was not necessary for the seller, in order to show readiness to deliver the oil, to establish that he had it in stock; he may have purchased it in the market and resold it to the buyer. The buyer breached the contract by his failure to give shipping instructions and to furnish the bank credit, which excused further performance by the seller, of whom was required only such readiness as was necessary to enable him to make delivery at the time fixed for delivery, such oil being obtainable in the market at the time fixed for delivery.

Use of Rotary Kiln in Making Magnesite Refractory Compound Not Invention

In the recent suit brought by Charles B. Stone against the American Refractories Co., plaintiff sought recovery for infringement of patent 792,822, issued June 20, 1905, to Davidson, for a process or method of making a refractory compound for furnace linings or similar purposes. The District Court dismissed plaintiff's bill, and he appealed. The U. S. Circuit Court of Appeals, Sixth Circuit, has affirmed the decree of the District Court. (274 Fed., 241.)

Claims 3 and 4 of the patent were sued upon. Claim 3 follows: "The process of making a refractory magnesite compound which consists in comminuting natural magnesite, silica and oxide of iron, mixing the ingredients in a dry state, burning the mixture to clinker and comminuting the clinker."

Claim 4 is the same as claim 3, except a rotary kiln is mentioned. Defendant contended claims were invalid and not infringed. The Court of Appeals found that as early as 1896 the most suitable material for making refractory furnace linings needed in certain steel

processes was a magnesite ore found in Austria. This was pulverized, heated to a high temperature, which caused it partly to fuse together in clinker form, and was then ground into a fine granular condition. It might be sold in this shape to the user, to be by him spread upon the floor of the furnace and fused into an unbroken lining, or it might be made up into bricks and used in that form. This ore contained magnesia, iron and silica, and it was commonly supposed that the iron was necessary as a flux for the magnesia, and that the silica was an undesirable element.

Davidson's substantial discovery, as the patent owner in suit contended, was that the silica played a useful part in the combination, in that it reduced the temperature necessary to frit the material. And the court says it may be conceded that this discovery, calling for a purposeful, instead of an incidental, presence of silica, would lend patentability to a claim for putting together by known processes the known ingredients of the natural material, if the necessary novelty existed.

Further the court found that several manufacturers, including the Harbison-Walker Co., had been engaged in making this class of material since long before the date of Davison's invention. About 10 years after the patent was issued this company altered its process, and the American Refractories Co., defendant herein, began to use the process of Harbison-Walker embodying this change. Upon this change the charge of infringement rests.

Was Inventive Step Involved?

In considering this change the court says if it did not involve an inventive step, so that defendant's present process is not patentably distinguishable from that which was used before Davison's invention, Davison can have no patent which can be construed broadly enough to support the charge of infringement and can at the same time be valid.

As far back as 1898 the Harbison-Walker Co., which had been using the Austrian magnesite for this purpose, found difficulty in obtaining this material. Thereupon it proceeded to import and use a Grecian magnesite ore, which was similar to the Austrian save for a deficiency in iron. This deficiency was supplied by adding iron ore, and then the mixture was pulverized, then moistened to make a thick paste. This was made up into small blocks or "dobies" and burned in kilns of the type used in burning bricks. By this process the carbonic acid gas was driven off and the material "dead-burned." It was then in fritted or clinker form and was ground and used as described above. The court assumed the Davison patent extended to the mixture of magnesite and silica, by using the raw material which naturally contained both, and found that it discloses nothing not previously in use by Harbison-Walker, except that Davison mixed his materials dry and burned them in a rotary kiln.

Steps in Court's Reasoning

Therefore the question was presented to the court whether in 1904, date of the application of Davison for his patent, it would have been invention to substitute in the Harbison-Walker process a dry mix and a rotary kiln for a wet mix and a stationary kiln. How the court solved this proposition is here set forth as a matter of information on how it arrives at judicial decisions. Was there a distinct advance in the art beyond what a skilled worker in the art could not do? One skilled in the art to whom this problem was presented would have before him his pulverized magnesite ore, containing silica and needing iron, and also his pulverized iron ore. It was said that he would know that these materials should be mixed as intimately and perfectly as possible and then burned to the fritting or clinker stage. He would know that the rotary kiln was an instrumentality in common use for simultaneous mixing and burning of material which was to be fused into a clinker form. It was then specially familiar in making portland cement. While the finished magnesite refractory and the finished cement are distinctly different products, it is not easy to point out any substantial distinction in the mixing, burning and fritting steps of making the one or the other.

Advantages of Rotary Kilns Well Understood

The substitution of the rotary kiln for the other method of burning, the court thought, was only the step which would have occurred to any one fairly familiar with this kind of work; and this belief was backed up by other patents and usages. The patents to Reid of 1874 and to Ransome of 1886 describe rotary kilns for burning pulverized gypsum, or lime, cement, etc., and specify the advantages of that device for accomplishing what Davison desired to accomplish. The Ransome patent especially points out that for this purpose the operator may take his choice between putting the material in blocks and burning in a stationary kiln, or pulverizing it and feeding it into a rotary kiln, and also points out that the ingredients, such as clay and chalk, may be mixed either wet or dry.

A patent to De Navarro in 1896 describes the distinct advantages of the rotary kiln for making portland cement, but points out that it contains the same ingredients which constitute the magnesite refractory—namely, silica, alumina, iron and magnesia. Though the proportions are very different, the process of mixing and burning is precisely that contemplated by Davison when he calls for a rotary kiln, said the court.

A patent to Krottnaurer in 1900 and one to Lossing in 1901 further describe the operation of rotary kilns to accomplish effective mixing and burning, not only to cement, but, in the latter patent, of earths and chemicals. That there are no such distinctions between burning magnesite and burning cement that the cement kiln would not be familiar to the magnesite worker, the court cited a British patent of 1902 to Kirkpatrick, where Kirkpatrick discusses the use of a rotary or any other suitable furnace or kiln in the manufacture of magnesite compositions for use in furnaces.

Substitution of Rotary Kiln Not Inventive Step

Now the court says putting these considerations with the fact that the use of the rotary kiln for burning magnesite was established in Europe, and that such European usage was known in this country, and with the testimony of experts as to the common knowledge of the rotary kiln and what it would do, it must find that it would not have been invention in 1904 to substitute this process of burning for the kiln burning which Harbison-Walker was using, in its then current method of manufacturing magnesite refractory materials. It follows that the patent cannot receive a construction broad enough to cover a continuation of the old Harbison-Walker method with only this change.

Therefore the Court of Appeals affirmed the decree, being against the claims of the complainant.

Thermal Considerations In Sulphuric Acid Concentration*

A Study of the Physical Properties of Sulphuric Acid Solutions With Curves for Determining the Heat Required for Concentration and the Thermal Efficiency of the Operation

By FRED C. ZEISBERG
Chemical Department, E. I. du Pont de Nemours & Co.

SULPHURIC ACID is universally concentrated by the application of heat. The first interest of the designer of apparatus to concentrate sulphuric acid must hence lie in the thermal properties of sulphuric acid. Several articles have been written on this subject[1] and one of them[2] at least has treated the subject very thoroughly and comprehensively. The results, however, are not most conveniently expressed, and the original article is not particularly accessible. This, then, must be the excuse for the present attempt to present an old subject from a somewhat different viewpoint.

Specific Heat

The first thermal property of sulphuric acid which interests us is its specific heat. Many determinations have been made[3] of this constant, in addition to those given in Landolt-Börnstein. The figures of Knietsch are out of line with those of other workers, while those of Pascal[3] seem the most probably correct, and are shown graphically in Fig. 1, by the full line. It will

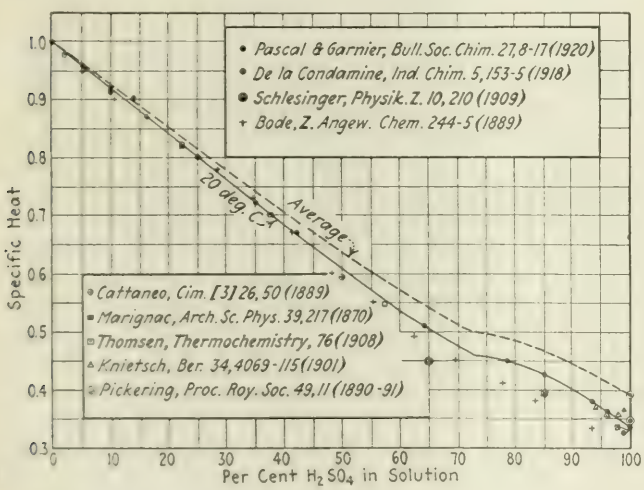
Pascal & Garnier, Bull. Soc. Chim. 27, 8-17 (1920)
De la Condamine, Ind. Chim. 5, 153-5 (1918)
Schlesinger, Physik. Z. 10, 210 (1909)
Bode, Z. Angew. Chem. 244-5 (1889)
20 deg. C.
Average
Cattaneo, Cim. [3] 26, 50 (1889)
Marignac, Arch. Sc. Phys. 39, 217 (1870)
Thomsen, Thermochemistry, 76 (1908)
Knietsch, Ber. 34, 4069-115 (1901)
Pickering, Proc. Roy. Soc. 49, 11 (1890-91)
Specific Heat
Per Cent H_2SO_4 in Solution

FIG. 1—SPECIFIC HEAT OF SULPHURIC ACID SOLUTIONS AT 20 DEG. C., AND AVERAGE BETWEEN 20 DEG. C. AND THE BOILING POINT

be noted that these are for 20 deg. C. As the temperature rises the specific heat increases slightly, but no extensive investigation of the change at various concentrations seems to have been made. Figures reported by de la Condamine[4] indicate that, if the increase of specific heat with the temperature is linear, the average specific heat of 100 per cent H_2SO_4 between 20 deg. C. and the boiling point is about 0.39. There has hence been drawn in Fig. 1 the dotted curve giving the probable value of the average specific heats between 20 deg. C. and the boiling point for all concentrations of H_2SO_4 solution. The values given by this dotted curve have been used in the calculation of the examples which follow.

Boiling Point

The next thermal property of sulphuric acid which interests us is the boiling point of various strength solutions. A number of investigators[5] have studied

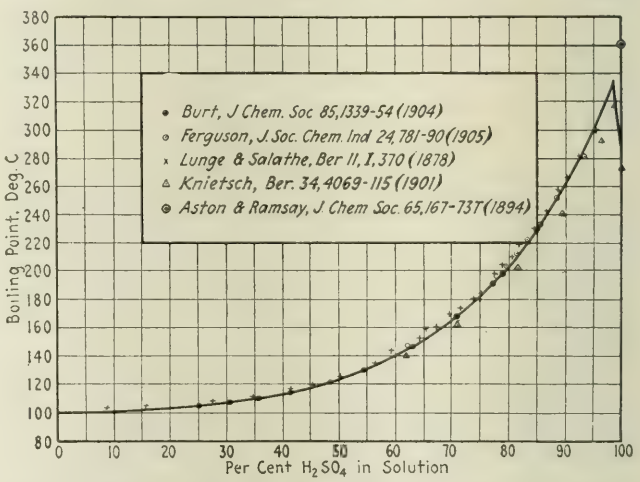
Burt, J. Chem. Soc. 85, 1339-54 (1904)
Ferguson, J. Soc. Chem. Ind. 24, 781-90 (1905)
Lunge & Salathe, Ber. 11, I, 370 (1878)
Knietsch, Ber. 34, 4069-115 (1901)
Aston & Ramsay, J. Chem. Soc. 65, 167-73T (1894)
Boiling Point, Deg. C.
Per Cent H_2SO_4 in Solution

FIG. 2—BOILING POINTS OF SULPHURIC ACID SOLUTIONS AT 760 MM.

this property, but the results of Burt's work appear the most trustworthy. In Fig. 2 the various data have been plotted, the curve being drawn with respect mostly to the points obtained by Burt and Ferguson. Here again it will be observed that Knietsch's results are out of line with those of other investigators. Values read from the curve have been used in the calculations which follow.

Partial Pressures of Vapors From Boiling Sulphuric Acid Solutions

Another thermal property which interests us is the composition of the vapor emitted by boiling sulphuric acid solutions. The literature appears to contain no definite figures, but numerous indefinite references such as that "boiling sulphuric acid solutions give off nothing but water vapor until 170 deg. C., equivalent to 72

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*A paper presented before the Acid Symposium at the fourteenth semi-annual meeting of the American Institute of Chemical Engineers, Niagara Falls, Canada, June 19 to 22, 1922.

[1] S. U. Pickering, *J. Chem. Soc.*, vol. 57, pp. 64-184, 331-369 (1890); R. Knietsch, *Ber.*, vol. 34, pp. 4069-4115 (1901); Norman Swindin, *Chem. Trade J.*, vol. 59, pp. 369-371 (1916); F. Colin Sutton, *Chem. Age London*, vol. 5, pp. 178-180 (1921); L. Cerutty, *Chem. Age London*, vol. 5, pp. 759-760 (1921).

[2] A. W. Porter, *Trans. Faraday Soc.*, vol. 13, pp. 277-305 (1918).

[3] Herman Schlesinger, *Physik. Z.*, vol. 10, pp. 210-215 (1909); C. de la Condamine, *Ind. Chim.*, vol. 5, pp. 153-155 (1918); Paul Pascal and G. Garnier, *Bull. soc. chim.*, vol. 27, pp. 8-17, 331-341; R. Knietsch, *Ber.*, vol. 34, pp. 4069-4115 (1901).

[4] C. de la Condamine, *Ind. Chim.*, vol. 5, pp. 153-155 (1918).

[5] R. Knietsch, *Ber.*, vol. 34, pp. 4069-4115 (1901); G. Lunge and F. Salathe, *Ber.*, vol. 11, No. 1, pp. 370-374 (1878); E. A. Aston and W. Ramsay, *J. Chem. Soc.*, vol. 65, pp. 167-173T (1894); E. C. Burt, *J. Chem. Soc.*, vol. 85, pp. 1339-1354 (1904); W. C. Ferguson, *J. Soc. Chem. Ind.*, vol. 24, pp. 781-790 (1905).

per cent H_2SO_4, is reached.[4] The du Pont company several years ago made some rough determinations of these partial pressures[6] which are shown in Fig. 3.

Heat of Dilution

Still another thermal property which must be known is the heat of dilution of sulphuric acid. This has been investigated by a number of investigators,[7] the values obtained by Thomsen[8] having been selected for use

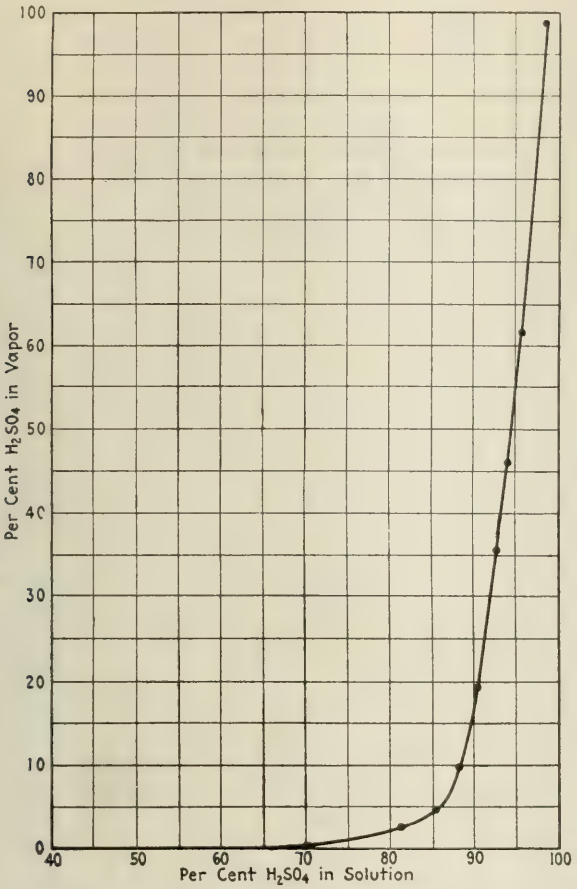


FIG. 3—COMPOSITION OF VAPORS IN EQUILIBRIUM WITH BOILING SULPHURIC ACID SOLUTIONS AT 760 MM.

herein. These values are shown graphically in Fig. 4, where both the curve obtained from the experimental results (full) and the one obtained by using the formula derived by Thomsen (dotted) are shown. This formula, it will be observed, agrees well with the experimentally determined points from about 20 per cent H_2SO_4 to 100 per cent. It will be obvious that the heat liberated in diluting from any given strength to any other strength may be read from the curve as the difference between the abcissas at those strengths.

Heat of Vaporization

The final property which interests us is the heat of vaporization of water. As is well known, this varies with the temperature, and Fig. 5 shows this variation graphically between 0 deg. C. and 350 deg. C., the values of Marks and Davis[9] having been used. In some cases, also, the heat of vaporization of H_2SO_4 itself

[6] W. C. Sproesser, private communication in du Pont files.

[7] R. Knietsch, *Ber.*, vol. 34, pp. 4069-4115 (1901); L. Pfaundler, *Ber.*, vol. c, pp. 798-800 (1870); J. N. Brönsted, *Z. physik. Chem.*, vol. 68, pp. 693-725 (1910).

[8] J. Thomsen, "Thermochemistry," p. 78, 1908.

[9] Marks and Davis, "Steam Tables and Diagrams," 1908.

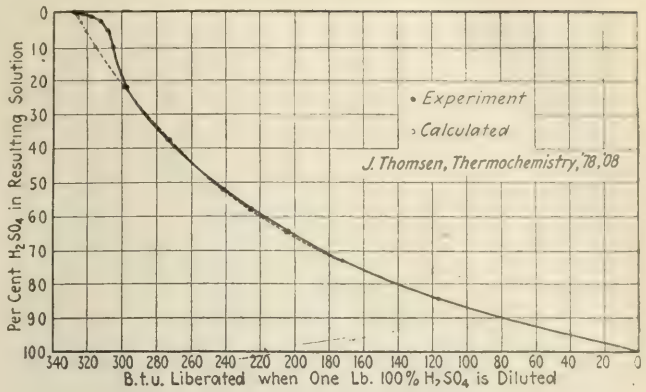


FIG. 4—HEAT OF DILUTION OF SULPHURIC ACID

may be of interest. This is 220 B.t.u. per lb. 100 per cent H_2SO_4.

Thermal Considerations in Concentration

If we now make the asumption that, in the concentration of a given quantity of sulphuric acid solution, it can be heated to the boiling point without the evaporation of any water until the boiling point is reached, the heat input up to the boiling point is made up solely of the sensible heat, which can be expressed by the equation

$$H_s = ws(t_b - t) \qquad (1)$$

in which H_s = sensible heat in B.t.u.
w = weight of acid in pounds.
s = specific heat of acid.
t_b = boiling point in deg. F.
t = original temperature.

After the boiling point is reached, continued input of heat accomplishes three things. Water is evaporated, hydrates of H_2SO_4 are decomposed, and the resulting more highly concentrated solution is raised to a new, higher boiling point. It is therefore perfectly

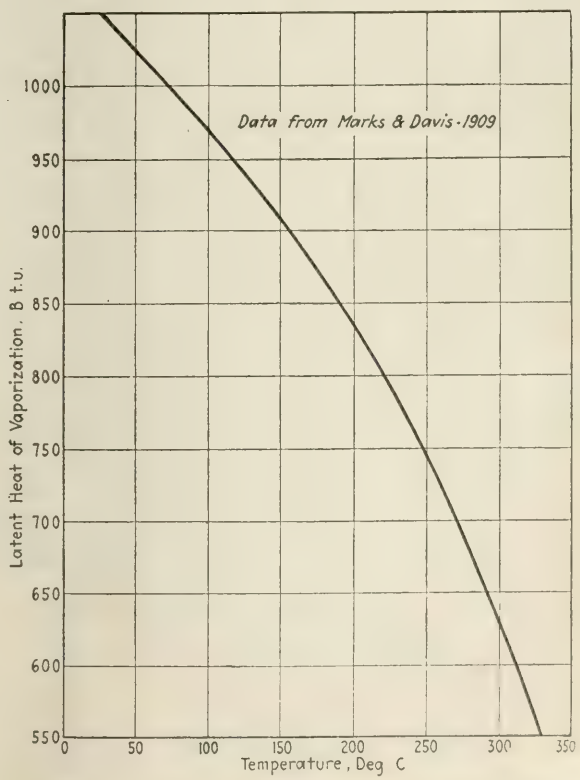


FIG. 5—HEAT OF VAPORIZATION OF WATER

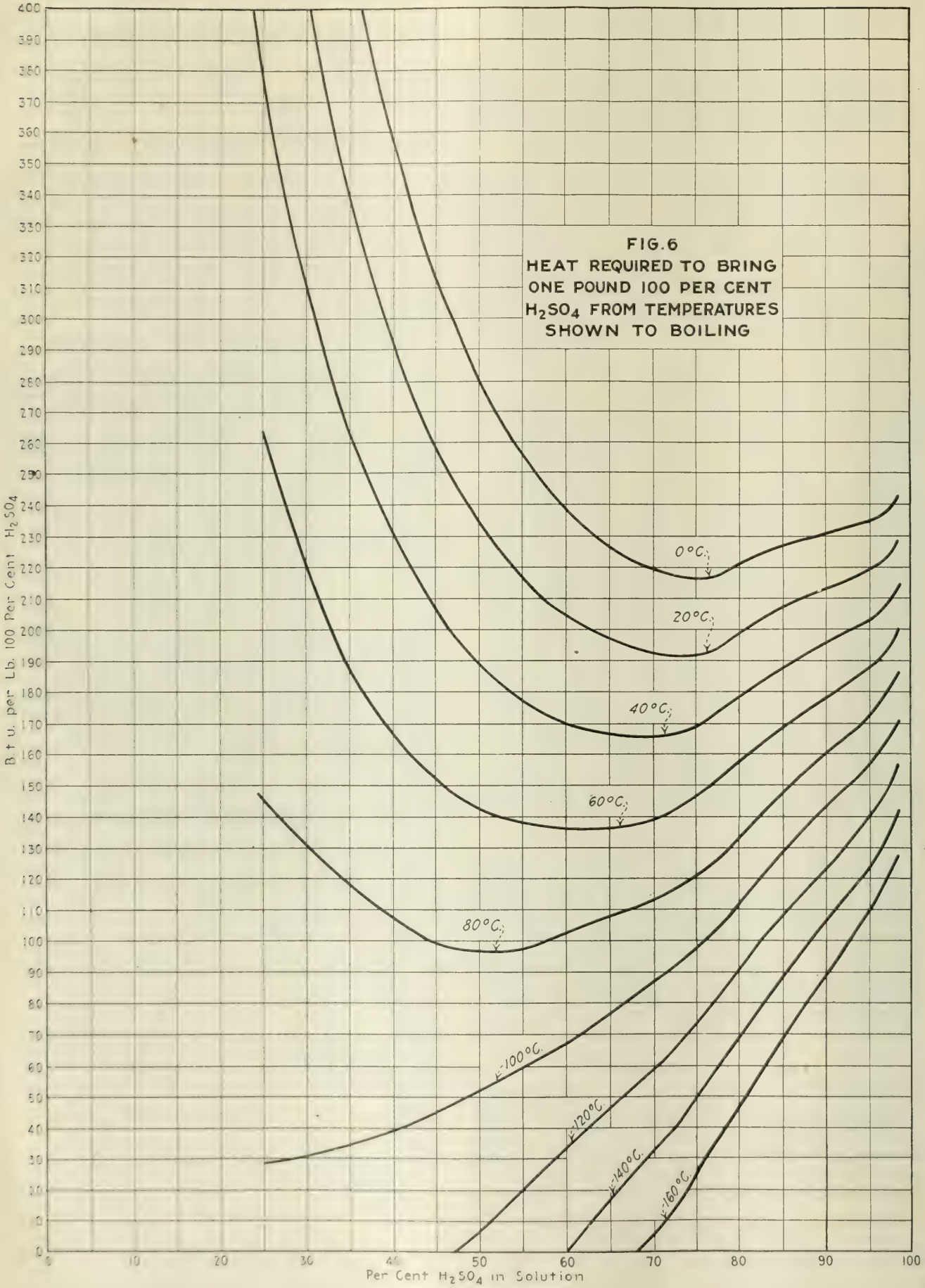


FIG. 6
HEAT REQUIRED TO BRING ONE POUND 100 PER CENT H_2SO_4 FROM TEMPERATURES SHOWN TO BOILING
B.t.u. per Lb. 100 Per Cent H_2SO_4
Per Cent H_2SO_4 in Solution
0°C.
20°C.
40°C.
60°C.
80°C.
100°C.
120°C.
140°C.
160°C.

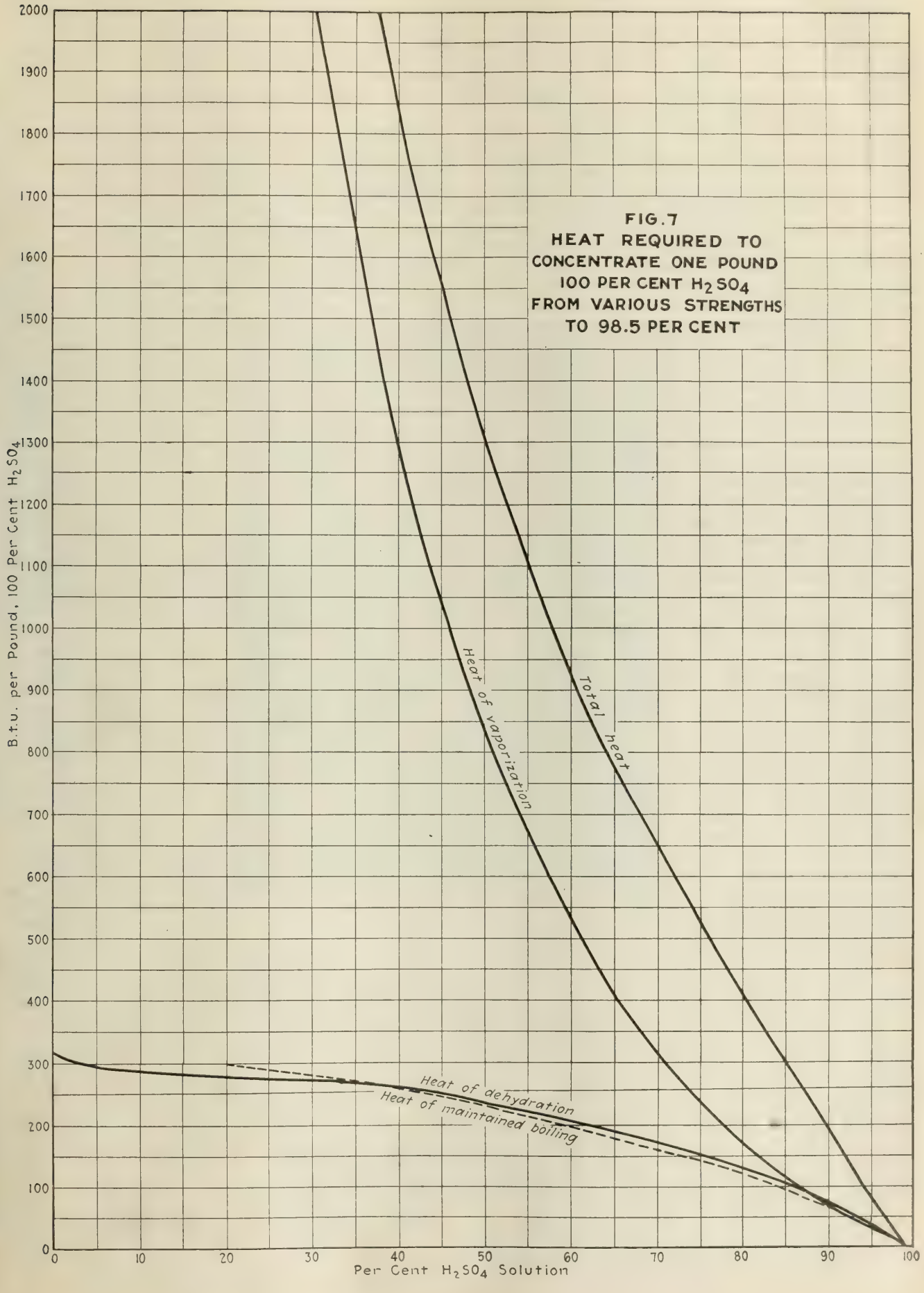


FIG. 7
HEAT REQUIRED TO CONCENTRATE ONE POUND 100 PER CENT H_2SO_4 FROM VARIOUS STRENGTHS TO 98.5 PER CENT
B.t.u. per Pound, 100 Per Cent H_2SO_4
Per Cent H_2SO_4 Solution
Total heat
Heat of vaporization
Heat of dehydration
Heat of maintained boiling
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100

proper to regard the heat necessary after the boiling point has been reached as made up of three components, which, for convenience, can be called the heat of vaporization, H_v; the heat of dehydration, H_d; and the heat of maintained boiling H_b.

Analysis of the Heat Quantities Involved in the Concentrating Operation

The heat of vaporization is made up wholly, at the lower concentrations, of the heat of vaporization of water. At the higher concentrations there is added to it the heat of vaporization of the sulphuric acid carried along with the water—viz., 220 B.t.u. per lb. H_2SO_4. Since in the best designed sulphuric acid concentrating units all of this H_2SO_4 vapor but a small amount is recondensed under such conditions that the heat liberated in condensing is usefully applied, only the heat of vaporization of water will be taken into account, except as noted later.

The heat of dehydration is simply the heat of dilution reversed—that is, there must be put into the solution the same amount of heat, in order to break up hydrates, in concentrating from *a* per cent to *b* per cent, that would be given up by the dilution of the same quantity of H_2SO_4 from *b* per cent to *a* per cent.

The heat of maintained boiling is the summation of the increments of heat necessary to raise the acid to its new, continually higher, boiling points. It is sensible heat, evaluated as the product of a continually decreasing weight, temperature increments between continually increasing boiling points, and a continually decreasing specific heat.

Heat Required Shown Graphically

For the convenient use of designers and operators these various values have been calculated over a wide range of concentrations and shown graphically. Fig. 6 shows the sensible heat, H_s, required to bring 1 lb. of 100 lb. H_2SO_4 at any strength from any temperature to the boiling point. It has been calculated using the dotted curve of Fig. 1 and the full curve of Fig. 2.

Fig. 7 shows the heat of vaporization H_v, the heat of dehydration H_d, the heat of maintained boiling H_b, and the total heat H_t, the sum of H_v, H_d and H_b, for 1 lb. of 100 per cent H_2SO_4 concentrated from any strength to 98.5 per cent H_2SO_4. This latter figure has been selected because it is the highest strength of H_2SO_4 solution which can be reached by simple boiling at atmospheric pressure. When this concentration has been reached, both H_2SO_4 and H_2O are driven off from the solution by further boiling in a constant ratio to maintain this strength.

It is of course obvious that H_t can be obtained for 1 lb. of H_2SO_4 concentrated from any one strength to any other strength below 98.5 per cent, by simple subtraction.[10] The value of H_t thus obtained added to the value of H_s read directly from Fig. 6 then gives the total heat required theoretically to concentrate 1 lb. H_2SO_4 from any concentration and at any original temperature to any other concentration and boiling temperature at that concentration. This theoretical figure divided by the amount of heat actually used then gives the thermal efficiency of the process, which may be expressed as a percentage. If the amount of H_2SO_4 lost by evaporation is appreciable, as may be the case with simple concentration in open pans, then the theoretical figures read from the curves must be increased, as will be shown below.

[10] It is noteworthy that the curve H_t is practically a straight line from 67 per cent to 98.5 per cent H_2SO_4, and therefore that less than a 1 per cent error will be introduced by assuming that 0.1 B.t.u. is required per lb. of H_2SO_4 per per cent difference in that range.

Illustration of Use of Curves

An example or two will illustrate the method of using the foregoing curves and data. Suppose 60 deg. Bé. sulphuric acid at atmospheric temperature is being concentrated in open pans, with no fume recovery, to 66 deg. Bé., there being required 500 lb. coal, of 13,000 B.t.u. per lb., per ton of finished acid. The recovery is known to amount to 96 per cent. What is the thermal efficiency of the apparatus?

The per cent H_2SO_4 in 60 deg. Bé. acid is 77.7; in 66 deg. Bé. acid, 93.2 One ton of finished acid thus contains $2{,}000 \times 0.932 = 1{,}864$ lb. H_2SO_4, which required $500 \times 13{,}000 = 6{,}500{,}000$ B.t.u., or 3,487 B.t.u. per lb. H_2SO_4. One lb. H_2SO_4 in the finished acid corresponds to $1 \div 0.96 = 1.042$ lb. H_2SO_4 in the original acid. To heat 1.042 lb. H_2SO_4 as 77.7 per cent acid from atmospheric temperature, say, 20 deg. C., to boiling, requires, from Fig. 6, $194 \text{ B.t.u.} \times 1.042 = 202$ B.t.u. To concentrate 1 lb. H_2SO_4 from 77.7 per cent, and boiling temperature, to 93.2 per cent, requires, from Fig. 7, $465 - 122 = 343$ B.t.u. To concentrate 0.042 lb. H_2SO_4 from 77.7 per cent to 98.5 per cent—i.e., completely—requires, from Fig. 7, $465 \text{ B.t.u.} \times 0.042 = 20$ B.t.u., exclusive of the heat required to volatilize the H_2SO_4 itself. This would be $0.042 \times 220 = 9$ B.t.u. The total theoretical heat required is hence, per lb. finished H_2SO_4

	B.t.u.
Sensible heat, H_s	202
Total heat, H_t	343
Heat in H_2SO_4 lost by evaporation	9
Total heat of this lost H_2SO_4	20
Total theoretical	574
Actually used	3,487

Theoretical thermal efficiency $574 \div 3{,}487 = 16.5$ per cent.

Application to Surface Evaporator

In the case of the surface evaporator described by Mr. Gilchrist of the Chemical Construction Co.,[11] 11 gal. of fuel oil will concentrate 1 ton of 66 deg. Bé. acid, starting with 55 deg. Bé. acid at atmospheric temperature.

One ton of 66 deg. Bé. acid contains, as we have seen, 1,864 lb. H_2SO_4. Assuming the fuel oil has a thermal value of 18,000 B.t.u. per lb. and weighs 8 lb. per gal., there is used $18{,}000 \times 8 \times 11 = 1{,}584{,}000$ B.t.u., or 850 B.t.u. per lb. H_2SO_4.

The per cent H_2SO_4 in 55 deg. Bé. acid is 69.7 From Fig. 6, 193 B.t.u. is required to heat 1 lb. H_2SO_4 at this strength from 20 deg. C. to boiling, and from Fig. 7 the concentration from 69.7 to 93.2 per cent requires $663 - 122 = 541$ B.t.u. In this case the H_2SO_4 lost is negligible, therefore the total heat theoretically necessary is $193 + 541 = 734$ B.t.u. per lb. H_2SO_4. $734 \div 850 = 86.3$ per cent thermal efficiency.

Numerous other applications of the data contained in the various figures will readily suggest themselves to the reader.

[11] *Chem. & Met. Eng.*, vol. 26, p. 1159.

Edwin F. Ladd, Sole Chemist in U. S. Senate

AFTER 36 years of active work in a chemical laboratory, Dr. Edwin F. Ladd, the junior Senator from North Dakota, is having some difficulty in adjusting himself to the slow grinding of the legislative mill in Washington. For 20 years Dr. Ladd has been engaged in active hostilities in connection with the enforcement of North Dakota's laws pertaining to pure foods and materials. During most of that time he has had from one to three libel suits pending against him, to say nothing of injunctions and other efforts made to discourage him in his determination to obtain compliance with the laws of his state—a course in which he has had the active co-operation of most manufacturers and dealers.

While Dr. Ladd has good reason to know that obtaining national legislation is a long-drawn-out process, he is displaying in Washington the same perseverance that characterized his work in North Dakota. In addition to doing his part in the disposal of each day's legislative grist in the Senate, he is bringing to bear all the pressure in his power on his bills providing for such things as the adoption of the metric system, the compulsory working of patents and the setting up of purity standards for paints.

As Dr. Ladd is the only chemist in the Senate, he is being called upon more and more for advice and suggestion in connection with legislation dealing with chemical matters.

Dr. Ladd specialized in chemistry at the Somerset Academy at Athens, Me., and in the University of Maine, the two institutions in which he received his education. He was graduated from the latter institution in 1884 and immediately took a position as chemist for the New York State Experiment Station at Geneva, N. Y. He held that position until 1890, when he was called to the North Dakota Agricultural College to act in the dual capacity of professor of chemistry and chief chemist of the State Agricultural Experiment Station. Despite the fact that he has been in Washington constantly for 2 years, he continues to this day to hold title to both those positions. In 1915 he was elected president of the North Dakota Agricultural College. During the war he was Federal Food Administrator for his state. In that position he came in close contact with Herbert Hoover—a relationship which is being continued now that Mr. Hoover is a member of the Cabinet and Dr. Ladd a member of the Senate.

For many years Dr. Ladd has been an active member in the Association for the Advancement of Science, in the Society for the Promotion of Agricultural Science, in the Association of Official Agricultural Chemists, and in the Association of Dairy, Drug and Food Officials. He has served each of the latter two organizations as president. For many years he has maintained membership in the American Chemical Society and in the American Public Health Association.

Just at this time Senator Ladd, as a member of the Committee on Agriculture, is making an intensive study of the Muscle Shoals project. Regardless of the policy which the government may adopt in regard to the disposal of its properties there, Senator Ladd recognizes that this power project will be the center of a great chemical industry. He wants to see that great water power put to use at the earliest possible moment. He is perfectly willing for the government to go ahead and complete the dam and then dispose of the power in a businesslike manner to private consumers, since it is apparent that delays will intervene before an agreement can be reached for the disposal of the property to private interests.

Photo. copyright by Harris & Ewing

SENATOR EDWIN F. LADD

When Dr. Ladd came to Washington he thought the government should undertake the operation of the nitrate plants. His observations since, however, have convinced him that the government would not be efficient in the conduct of a chemical manufacturing plant and he believes the government plants should be leased to the highest bidder. He would like to see some one give the government more than Henry Ford has offered, but if no one is willing to make a better offer than Mr. Ford, he believes that Congress can exact certain practical limitations which will permit the country to have the advantages from that great natural resource.

In concluding this brief biography it is fair to point out that many of the legislative proposals of the distinguished senator from North Dakota are not in accord with our editorial policies. On several occasions in the past we have been forced to criticize rather severely Senator Ladd's stand on the soldier bonus. His abortive proposal to enact a specific and burdensome tax on banking institutions is not likely to receive serious consideration by Congress, but certainly to our way of thinking it marks a trend in a very dangerous direction. The potential power in the hands of the farm bloc is a problem viewed with apprehension by all who are mindful of the future legislative program of this country. The chemical industry at this time is vitally concerned with national legislative problems and it is to be hoped that Senator Edwin F. Ladd will make the most of his unique opportunity to champion the cause of chemistry in America.

Fiat Electric Steel Furnace

By Dr. Alfredo Stromboli
Turin, Italy

STUDIES on the new Fiat electric furnace, originated by Cav. Masera, manager of the steel foundry at the Fiat Works, Turin, were begun in 1916. In September, 1917, furnaces of the 5- and 6-ton types were put into operation. After improvements in details and in view of the most excellent results obtained, all the other steel furnaces in the foundry were replaced by this new type, six being constructed of 5 to 6 tons capacity, and a small one of 1½ tons capacity.

The Fiat furnace is a "fast" furnace and of large output, and is characterized by a perfectly tight roof maintained by means of a special economizer to be described. As will be seen from Fig. 5, the furnace consists of a cylindrical steel plate shell, properly reinforced, having a hemispherical bottom to which are attached two circular shoes of cast steel which permit the whole unit to be rotated in either direction by suitable hydraulic pistons. The shell and the refractory material with which it is lined have only two openings. One larger one serves for charging with the material and for removing the slag; the other, directly opposite to the first, for pouring.

Fig. 5 clearly shows heavy steel lugs attached to the sides of the casing into which fit the pintles of a lattice framework. This frame forms a sort of overhead bridge to the furnace and serves as a support for the entire upper mechanism, composed as a whole of the three economizers or electrode-carriers. Economizers constitute the characteristic and essential part of this furnace; they insure that the roof is hermetically sealed around the electrodes, and absolutely prevent any escape of gas or flame through the openings.

Fig. 2, on page 30, shows a section of the furnace, with an enlarged section of the Fiat economizer. It is composed of a cylindrical water pocket *A*, through which the electrode passes. A series of insulating rings are provided inside this cylinder, serving as guides to the electrode during its movement and keeping it from contact with the metallic wall. In the upper part, a circular layer of asbestos *C*, held in place by a metallic ring, is provided, acting as a packing ring in which may glide a sealing bell, formed of a cylinder of copper attached to a steel disk *B*, forming the cover. This cover has a hole in the center for the passage of the electrode and at the sides are two lugs with screw thread for the raising and lowering machanism. On this cover is located an insulating disk *E* and on this, by means of suitably insulated bolts, is secured the bronze clamp *F*, which grips the electrode. The latter, together with its clamp, is thus solidly connected with the bell, the purpose of which is to obtain a hermetic seal about the electrode by means of the packing rings on which it glides, thus absolutely preventing the circulation of air through the furnace.

All those parts form a complete unit which can be placed on the furnace and removed with great ease by means of a crane and without interrupting the operation of the furnace, as is shown in Fig. 5.

As a result of this hermetic seal, oxidation of the electrode is prevented, and electrode consumption is greatly reduced. Butt ends may be used to the last, as shown in Fig. 3, showing an electrode removed from a Fiat furnace after twenty-one heats of 5 tons each. The end piece was originally 1½ meters long, with a weight of 120 kg. After twenty-one pourings it was reduced to a length of 25 cm. with a weight of 20 kg., the consumption (counting all three electrodes) being

$$\frac{100 \times 3}{21 \times 5} = 2.85 \text{ kg. per ton.}$$

Since this seal prevents any and all circulation of air in the furnace, the atmosphere above the bath is kept constantly neutral. This circumstance enables us to dispense with the use of cast iron or other carbonizing agent in the charge. The cross-section of the electrodes remains unaltered; therefore the furnace may be speeded up, putting into it a large amount of energy, employing larger cables, electrodes of larger cross-section and transformers of greater capacity. The effects of the short-circuits which take place in the furnace are rendered negligible in practice by a well-proportioned transformer, by properly calculated distribution mains and by the adoption of a single conductor.

Fig. 4 represents the general arrangement of the electrical equipment of a Fiat furnace. It is apparent that it is a three-phase furnace with three electrodes

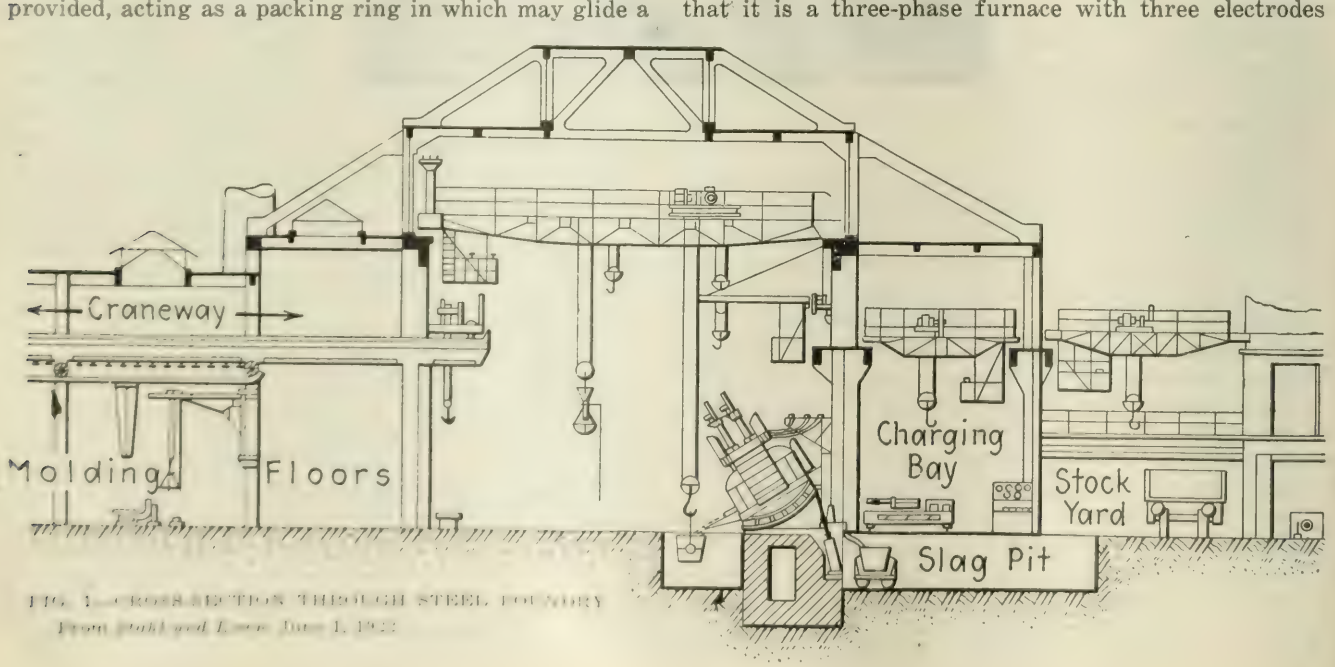
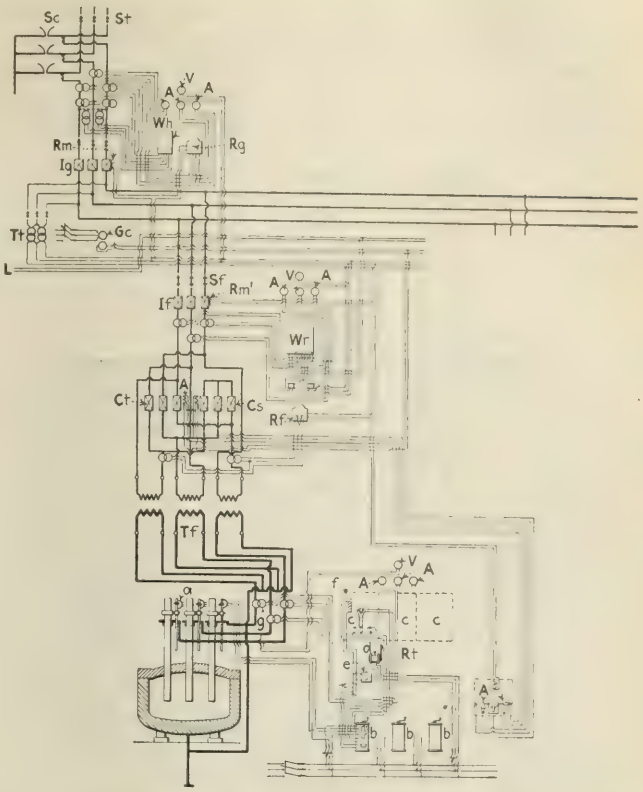


FIG. 1. CROSS-SECTION THROUGH STEEL FOUNDRY
From *Iron Trade Review*, June 1, 1922

arranged vertically above the bath in such a way that the arc is made directly on the metal.

FIG. 4—WIRING DIAGRAM

Sg—Main line.
Sc—Lightning arresters, Gola type with oil resistances.
Ig—Main automatic circuit breaker, oil type.
Rg—Quick-break relay, upper limit for *Ig*.
Rm—Quick-break relay, lower limit for *Ig*.
Wh—Main wattmeter.
Tt—Transformer for feeder to auxiliary apparatus.
Gc—Alternating to continuous current, converter for feeding continuous current.
La—Line of single phase alternating current, extraneous source for check on wattmeters.
Sf—Branch lines to the furnace.
f—Automatic circuit breaker, oil type, on lines to furnace.
Rf—Quick-break relay, upper limit for *If*.
Rm—Quick-break relay, lower limit for *If*.
Wr—Wattmeter, charging furnace.
{*Ct*} {*Cs*}—Group of circuit breakers, oil type, for commutation to Δ or λ primary.
A—Apparatus operating the commutators with distant control by direct current.
Tf—Three-phase transformer Δ and Y with neutral voltage 120 and 70, natural cooling in oil type.
Rt—Assembly of the automatic regulators for operating the furnace at constant intensity.
a—Motors operating the moving mechanism of the electrodes.
b—Controllers for operating motors *a* by hand in starting the furnace.
c—Thury regulators.
d—Motor for operating the regulators.
e—Additional resistance for regulation.
f—Electromagnet for regulating clutch.
g—Current transformers for feed to electromagnet *f* and ammeters.



High tension current (21,000 volts used at Turin works) is directly transformed to 120 or 75 volts by means of a static transformer, using oil and natural cooling. The whole electrical equipment has been calculated on the basis that a charge may be completed

FIG. 3—NEW ELECTRODES JOINED TO A BUTT

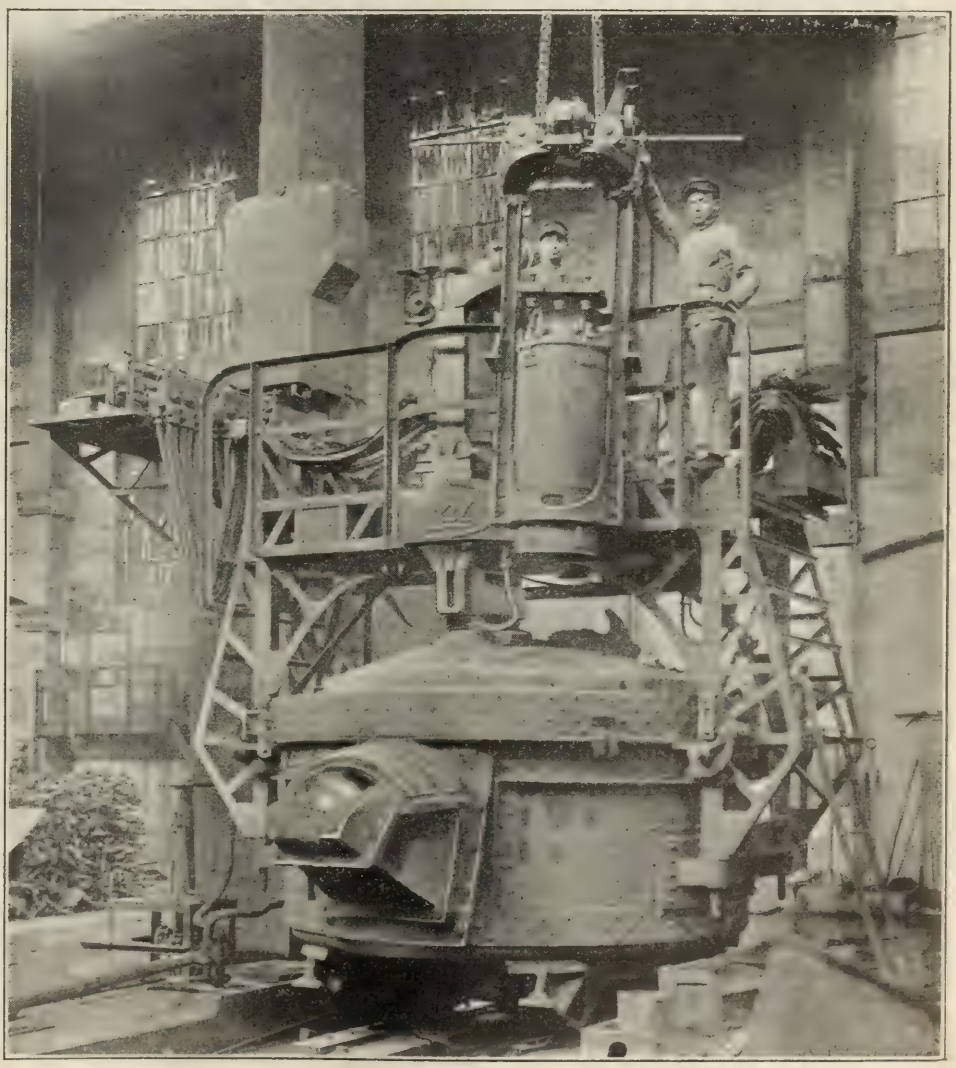


FIG. 5—PLACING AN ECONOMIZER ON A FIAT FURNACE

in 2 hours, 1½ hours of which is for melting and ½ hour for the refining period, wherein the temperature is carried to 1,750 deg. C. In fact, with the 5-ton Fiat furnace, the time required for a complete cycle is on an average 3 hours, filled exclusively by hand with scrap.

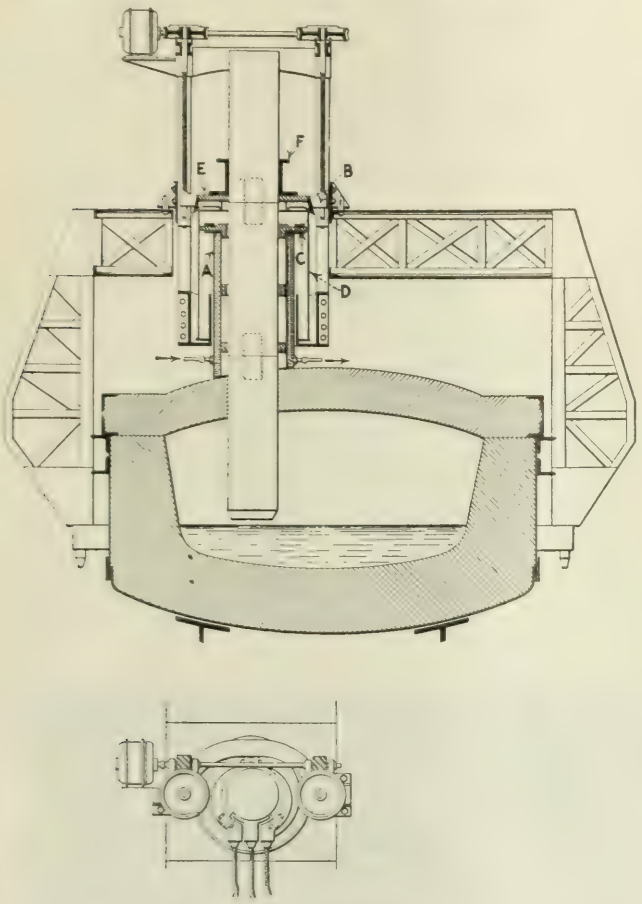


FIG. 2—DIAGRAM OF ECONOMIZER. (FURNACE LINES NOT DRAWN TO SCALE)

A power consumption test taken May 10, 1921, on furnace 6 (5 to 6 tons capacity) in the steel foundry of the Fiat works of Turin in the presence of several foreign metallurgical specialists gave the following results:

Beginning at 8:20 a.m., at the end of charge 56 and ending the next morning at the same hour with charge 65, exactly 24 hours was required for nine charges, including the time to fill by hand. Each charge consisted of 4,675 kg. of scrap without additions. The average time for each operation was 2.40 hours, in which the current was on 2.10 hours and ½ hour was used for charging.

Power consumption, measured by a watt-meter, totalled 25,100 kw.-hr. For 4,675 kg. × 9 × 0.94= 39,500 kg. of steel poured gives a consumption of less than 640 kw.-hr. per ton of steel cast.

How Much Steel in an Automobile?

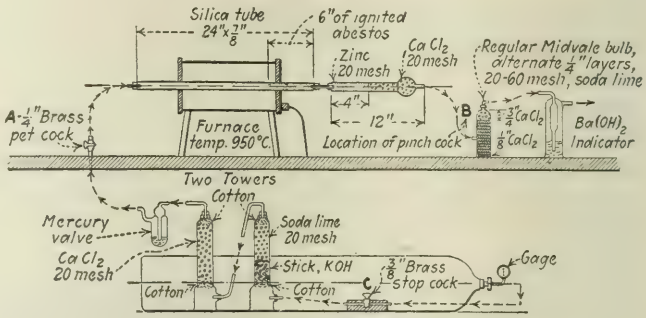
The burden the automobile industry places upon other industries is frequently overestimated. On an average, not much more than 1000 pounds of finished rolled steel is consumed per passenger automobile. Using round and conservatively high figures, taking 1200 pounds per passenger car the May production of passenger cars represented 125,000 gross tons of finished rolled steel, while the total production was about 2,350,000 gross tons. Automobiles, trucks, repairs and accessories hardly absorbed more than 7 per cent of the steel production last month.

Simple, Foolproof Carbon Combustion Apparatus

By William Kuebler

In the accompanying figure is shown a carbon combustion apparatus which has proved to be simple in operation and practically foolproof.

Determinations are made with full or one-half factor samples (20-mesh) using zirconia boats and 90-mesh R.R. alundum bed. A Davis-Bournonville gage on the oxygen tank is set so that the required rate of flow (200 to 250 bubbles per minute) is maintained. Once set, this gage is never touched until the tank is empty. When the apparatus is not in use, the supply of oxygen is shut off by means of stopcock *C*.



CARBON COMBUSTION APPARATUS

Having regulated the flow of gas, the pinch-cock *B* is closed, the stopper removed from tube and stop-cock *A* is closed. The boat with sample is then inserted in tube, tube closed and sample allowed to soak for 3 minutes. Meanwhile, the Midvale absorption bulb is weighed and connected. At end of 3 minutes open *A* and then pinch-cock *B*. Oxygen is allowed to flow for 7 minutes, this ordinarily being sufficient time for complete combustion. When oxygen first enters the tube and combines with the carbon and iron the flow is appreciably diminished, as will be shown by the indicator bottle. When the reaction is complete the flow of gas resumes its normal speed.

At the end of the 7 minutes remove the Midvale bulb, close pinch-cock *B*, remove stopper, close stop-cock *A* and remove boat. Immediately insert new sample, close tube and allow to soak the required 3 minutes while weighing bulb.

It has been the author's experience that the gage and a mercury valve give more consistent pressure than a water pressure tank and also eliminate the continual changing of the pre-purifying train due to moisture carried over with the oxygen. With the apparatus described, renewals of the pre-purifying train are made about every 6 months; of the zinc and calcium chloride tubes about every month. Renewals are governed by the number of determinations made and the behavior of standards run at the beginning, middle and end of each day's run.

The two towers shown supply five combustion trains, the division being made after the oxygen leaves the mercury valve. Arrows indicate tubing required and direction of current of oxygen. The rate of flow of oxygen is 200 to 250 bubbles per minute, which is sufficient if tubes, etc., are properly packed.

Synopsis of Recent Chemical & Metallurgical Literature

Dyes and Coal-Tar Chemicals in 1921

Tariff Information Series No. 25, recently published by the United States Tariff Commission, is a preliminary summary of the "Census of Dyes and Coal-Tar Chemicals, 1921," which has been prepared with the assistance of Warren N. Watson and C. R. DeLong for the use of the Senate Finance Committee. The report indicates that the total production of intermediates in 1921 by 107 different manufacturers was 70,899,912 lb., a decrease of 73 per cent in quantity from the 1920 output. The total sales in 1921 were 33,637,326 lb., valued at $8,483,463.

The number of intermediates reported in 1921 was 232, as compared with 236 in 1920. Of the total number reported in 1921, 49 were reported for the first time. The commission points out that the large decrease in the 1921 production of intermediates may be attributed to the following causes: (1) The loss of most of our export trade in dyes, (2) the large stocks carried over from the previous year, and (3) the general business depression. In general the intermediates used in producing those dyes consumed in the largest quantity show the most reductions.

Dyes and Other Finished Products

Dyes — The domestic production of dyes in 1921 by 74 manufacturers totaled 39,008,690 lb., a decrease of 56 per cent from that of 1920. The sales during 1921 totaled 47,513,762 lb., with a value of $39,283,956. The sales exceeded the production by 22 per cent, indicating that a part of the domestic consumption for that year was supplied from stocks carried over from the previous year's abnormal production. The average sales price of dyes for 1921 was 83c. per lb., compared with $1.08 for 1920 and $1.07 for 1919.

The production of dyes in 1921, grouped by classes according to method of application, is as follows: Acid dyes, 7,751,698 lb., or 19.87 per cent of the total production; basic dyes, 1,852,243 lb., or 4.75 per cent; direct cotton dyes, 6,787,634 lb., or 17.4 per cent; sulphur dyes, 10,239,255 lb., or 26.25 per cent; vat dyes, including indigo, 7,019,120 lb., or 17.99 per cent; the vat colors being divided as follows: Indigo, 6,673,968 lb. and other vats 345,152 lb.; mordant and chrome colors, 3,773,438 lb., or 9.67 per cent; lake and spirit soluble dyes, 697,444 lb., or 1.79 per cent; unclassified dyes, 887,858 lb., or 2.28 per cent.

Color Lakes—The total output by 43 firms of this class of pigments was 6,152,187 lb., compared with 10,983,538 lb., valued at $5,871,820 in 1920. Total sales of color lakes for 1921 amounted to 6,424,612 lb., valued at $2,863,189.

Photographic Chemicals — The production by 5 firms of these coal-tar chemicals used as photographic developers totaled, in 1921, 183,798 lb. compared with 440,759 lb. in 1920. Sales during 1921 amounted to 170,221 lb., valued at $248,041.

Medicinals—During 1921 conspicuous progress was made in the development of synthetic medicinals of coal-tar origin. The total production for 1921 was 1,545,917 lb., including a small quantity of disinfectants, the sales amounting to 1,876,246 lb., valued at $2,930,324. The 1920 production, including a considerable quantity of disinfectants, was 5,184,989 lb., valued at $5,726,776. Total production figures for 1920 and 1921 are, however, not strictly comparable, due to the large quantity of disinfectants of a relatively low value reported in 1920 and the small quantity of this group reported in 1921.

Perfumes and Flavors — The total output of flavors by 17 firms in 1921 was 901,245 lb., compared with 166,884 lb. in 1920. Sales for 1921 amounted to 933,662 lb., valued at $1,002,018. The production of perfumes by 15 firms in 1921 was 119,335 lb., compared with 99,740 lb. for the previous year. Sales in 1921 amounted to 119,691 lb., valued at $175,815.

Synthetic Phenolic Resins—These products are used as substitutes for amber in making pipestems and similar articles, electrical insulators, varnishes and lacquers. The 1921 production by three firms was 1,643,796 lb., compared with a production of 4,659,680 lb. during the previous year. Sales in 1921 amounted to 1,674,456 lb., valued at $1,352,166.

Synthetic Tanning Materials—The output of these products by four firms amounted to 1,902,597 lb. in 1921, compared with 3,142,861 ib. in 1920. The sales were 1,721,359 lb., valued at $141,005, during 1921.

Mechanical Handling of Superphosphate

In a recent issue of *Chemical Age* (London) George Frederick Zimmer presents a paper under this title which describes an installation for this purpose and built by S. S. Stott & Co., of Haslingden, England.

As should be well known, superphosphate is manufactured as follows: The ground phosphate rock and a certain amount of sulphuric acid are passed through a mixing machine which stands on a floor above the dens or cellars in which it must lie for some time to mature. After this mixing, the substance is permitted to run by gravity into one of the dens. Large wooden doors are provided for these dens, which are placed in position before they are filled, and when one of the dens is ready for discharging, the door is lifted away bodily, in modern plant, by a small overhead crane. Previous to the adoption of the mechanical handling devices which form the subject of this essay, the super-phosphate had to be cut from the pile in the dens by a gang of men with spades, shovels and wheelbarrows.

The mechanical excavator consists essentially of a carriage with flanged wheels which travels on a steel rail track reaching from end to end of a series of two, three or more dens. Superimposed upon this is a mild steel structure on a turntable. The excavator arm is located in such a way in a central position of the steel structure that it may be raised or lowered relative thereto as well as rotated therewith. With this provision the arm which carries the moving scrapers can be swung into the requisite position and made to enter any one of the dens (in this case only two).

The scraper arm is driven by a 7-b.h.p. electro-motor, supported on the inner end of the arm—i.e., within the steel structure—and the motor is raised or lowered vertically with the scraper arm. The scraper proper is an endless running chain conveyor fitted alternately with stirrers and prongs. The cantilevered arm is suspended by a cast-iron yoke from steel wire ropes and counterbalanced by a weight.

When a den is to be discharged, the door is removed by a small overhead crane; the scraper arm is then raised to its highest position, in which it is introduced into the den and started to work, cutting a slice of superphosphate a few inches deep from the top of the bed; when the material is thus raked out, it falls upon the tray conveyor in front of the dens. When the excavator has traveled laterally across the top of the deposit reaching the other wall, an automatic gear lowers the scraper arm a few inches and simultaneously reverses the motion of the machine, thus commencing another cut of the bed on its return travel. This operation is repeated until the den is empty.

It will be noticed that during these reciprocating journeys from side to side of the den the excavator travels alternately in the same and then in the reverse direction with the tray conveyor. When the former is the case the amount of superphosphate deposited into each individual tray of the conveyor is much greater than when the excavator travels in the reverse direction of the conveyor. It was, therefore, necessary to construct the tray conveyor for a maximum capacity, and it is, therefore, 24 in. wide.

On reaching the end of the tray conveyor the superphosphate is delivered to the boot of an inclined bucket elevator, 37 ft. long from center to center, with malleable cast-iron buckets 18 in. wide, by which it is lifted and delivered into tip wagons on the floor above the dens for conveyance on an overhead track to an adjoining shed to be stored.

The conveyor is 41 ft. 6 in. long from center to center, and 24 in. wide; it is carried on a single strand of No. 600 Ley's bushed chain, each tray having a mild steel axle with two cast-iron trodwheels. The inclined elevator carries buckets at a pitch of 18 in. which are

attached to a double strand of the same chain as the conveyor.

The electro-motor is one of 30 hp., and drives the mixer, the drag chain for traveling the excavator, as well as providing power for the tray conveyor and bucket elevator.

The two dens are 16 ft. wide each, they have a depth of 17 ft. from the open front to the back wall and are 18 ft. high from floor to ceiling. Their capacity is 50 tons each, which quantity can be removed by the plant in 2 hours. A very considerable saving of onerous labor is therefore effected by this installation, as almost the entire manual labor is deleted, with the exception of attendance.

Structure of Pearlite

A paper entitled "Inner Structure of the Pearlite Grain" was presented before the May, 1922, meeting of the Iron and Steel Institute by Colonel N. T. Belaiew. He assumes that in well-made steels, very slowly cooled through the transformation range, the austenite breaks up into parallel flat films of ferrite and cementite, the former about three times as thick as the latter. Under these circumstances all ferrite films are thought to be of substantially the same thickness in the same grain and in fact throughout the same piece of steel.

Granting these premises, the apparent distances between the fine workings in well-developed pearlite will depend upon the angle which the polishing plane makes with the crystalline plates comprising the grain. The finest, closest markings will represent the actual thickness of the plates, for that grain was cut normal to the structure. As the angle becomes less the pearlite appears coarser and coarser. As the angle between the films and plane of polish becomes less than 10 deg. the intersections become frayed during cutting or polishing so that the appearance of lamination vanishes.

Measurements on several steels showed that cementite lamellæ in "five lamellar and sorbitic" steel is about 25$\mu\mu$ thick. "Exceptionally coarse" pearlite has cementite plates about 300$\mu\mu$ thick. In both cases their adjacent ferrite plates are assumed to be three times as thick.

Cyanide From Calcium Cyanamide

Horace Freeman, in an interesting paper recently presented before the Chemists' Committee, Advisory Research Council in Ottawa, and published in the June issue of *Canadian Chemistry and Metallurgy*, describes the early development and later successful production of sodium cyanide from lime nitrogen (crude calcium cyanamide). The process now used at Niagara is carried out by mixing raw lime nitrogen, rock salt and calcium carbide. This mixture is fed into large crucible-shaped electric furnaces, lined with carbon blocks. The furnaces are wide at the top and constricted at the bottom, having a single centrally hung graphite electrode 12 in. in diameter, the lower end of which is about 12 in. from the bottom of the crucible. This is also electrically connected. Single-phase current is used. A tap hole leads from the extreme bottom of the crucible and is closed with an iron plug on a long rod.

The furnace is filled with raw materials to a depth of several feet, and as no foaming takes place and all heat is generated at the bottom, no gases or flames escape from the top of the furnace and the intense heat of the operation is not apparent until the furnace is tapped. A very high current density is employed so that the heating of the mixture between the electrode and the bottom of the furnace is extremely rapid. As the mixture melts the conductivity rapidly increases and the current correspondingly increases. When the current reaches a certain fixed upper limit, corresponding to a known temperature of the fused cyanide inside the furnace, the tap hole is opened by withdrawing the plug. The fused material flows down a conduit to a sump, from which it is rapidly taken up and cooled from its temperature of over 1,300 deg. C. by means of a rotating steel wheel having continuous water circulation through hollow shaft and rim. The temperature is reduced to a black heat by this means in a few seconds. The material is removed in the form of thin flakes by a scraper and packed in sheet iron or steel drums.

In the earlier experiments which Mr. Freeman had conducted at Vancouver, approximately 90 parts of salt were used with 100 parts of lime nitrogen. The efficiency of nitrogen formation to cyanide was 94 per cent and the product contained up to 36 per cent of cyanide calculated as sodium cyanide.

After a batch of material is tapped from the furnace the superimposed layer of partly heated material falls down and takes its place. The electrical contact is not broken, so that the temperature again rapidly mounts and the operation is repeated. The furnace is thus kept under complete electrical and heat control, and is mechanically operated except for the necessary attendant for tapping, who watches the ammeter.

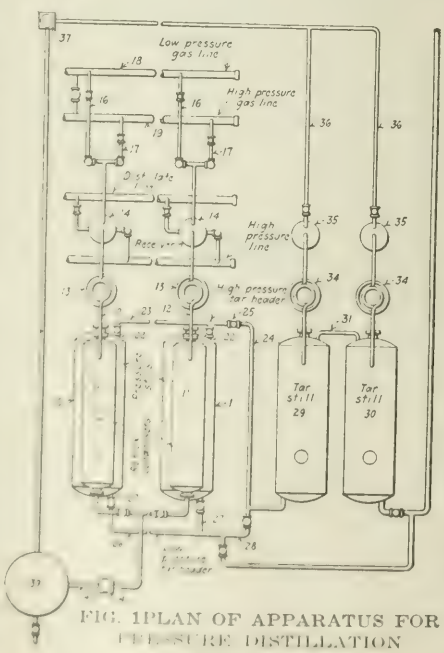


FIG. 1—PLAN OF APPARATUS FOR PRESSURE DISTILLATION OF PETROLEUM

Recent Chemical & Metallurgical Patents

Pressure Distillation of Petroleum.—A continuous process of distilling petroleum oils under pressure is the subject of a patent by Edgar M. Clark, assignor to the Standard Oil Co. of New York. Briefly the process consists in operating simultaneously a battery of pressure stills and separately condensing and collecting the distillate of each still. The withdrawn condensate is taken off through a common drawoff line and distilled in an ordinary tar still. The product of this distillation is returned to the pressure stills and is supplemented by a sufficient quantity of fresh oil to maintain a constant level in each still. A feature of the pressure stills is that they are constructed so that a uniform pressure is maintained in all stills by permitting a free interflow of uncondensed distillation products between the stills.

The apparatus is shown in plan in the figure. The battery of stills, which in general would consist of six to twenty stills arranged in a row, is indicated in the figure by the two end stills 1 and 10. Each is equipped with its individual reflux fractionating condenser 11, from which the vapor line 12 of each still is led to a water-cooled condenser 13 and thence to a receiving drum 14 for the distillate. Each receiving drum is connected by branching valved pipes, 16 and 17, to low- and high-pressure gas mains designated 18 and 19.

At a point below the normal liquid level in each still, the particular point being determined by the form of still employed, there is a valved high-pressure tar draw-off as indicated at 22 on the drawing. These tar draw-off lines from the several stills are manifolded to a common high-pressure tar header 23. At the end of the battery this high-pressure tar header discharges into a low-pressure tar line 24 through a pressure release and control valve 25. A separate low-pressure tar header designated 26 extends along the battery and is provided with valve connections 27 for each still, these low-pressure tar connections being tapped into the lowest point in the still, so that the latter may be completely emptied through them. The low-pressure tar header 26 communicates with the tar line 24 through a valve connection 28.

The tar line 24 discharges into a continuous tar still 29. For continuous operation it is often preferable to have a second tar still 30 connected with

the first by means of the overflow connection 31. Each tar still is equipped with its separate condenser 34 and receiver 35. From the receivers, distillate lines 36 lead to a tar distillate pump 37, which discharges by the line 38 into the feed-stock tank 39. Into the latter there is connected a feed line 40 through a pressure feed pump 41.

In the present discussion it is not possible to include the details of operation, for which the reader should consult the original specification. In this connection, however, the following statement of the patentee is of sufficient interest to be quoted.

"I have found that by continuously withdrawing a portion of the material under treatment from the pressure stills and continuously feeding a sufficient quantity of fresh stock to maintain a constant level therein, it is possible to prolong the continuous period of operation of the stills to such an extent that the output of light distillate from the equipment is substantially increased. I prefer to operate by charging each still into the battery initially and running off by the batch method—that is, without either feeding or withdrawing tar—approximately 20 per cent of the contents of the still before putting the still into communication with the high-pressure tar header and beginning the feed. I have found it easily possible to operate stills in this manner continuously for a week at a time without interrupting the pressure process for the purpose of cleaning the stills." (1,410,797; March 28, 1922.)

Recovery of Tungsten Trioxide From Tungsten Ores.—Tungsten ores are first calcined with chloride or chlorate of an alkali or alkaline earth at bright red heat. After pulverization the mass is treated with mineral acid and the impurities separated from the residue. Ammonia is then added, again separated and the ammonia driven off. Calcination at red heat leaves pure tungsten trioxide. (1,410,584, Simon Lubowsky, assignor to Metal & Thermit Corp.; March 28, 1922.)

Recovery and Elimination of Waste Sulphur Gases.—Twelve claims, all bearing on the purification of sulphur-bearing gases and concentration of their sulphur content, are made by Melville F. Coobaugh, of Golden, Colo. The process is based upon the ready absorption of SO_3 by iron oxide, Fe_2O_3, the oxidation of SO_2 to SO_3, by oxygen in the presence of Fe_2O_3. Both these reactions take place at about 450 deg. C. The ferric sulphate so formed can then be heated out of contact with air at temperatures around 700 deg. C., when it gives up its SO_3 in concentrated form. This will have application in metallurgical work where a minimum content of sulphur in exit gases is required by law. It also gives an opportunity to recover in usable form the large quantities of waste sulphur gases. (1,412,452; April 11, 1922.)

Gas Producer.—William B. Chapman, of Mount Vernon, Ohio, has patented a gas producer in which the operations of feeding the fuel, spreading the fuel, agitating the top surface of the fuel and removing the ash are performed continuously, automatically and in synchronism with one another. It is claimed that by this means the gas making can be scientifically regulated. This work is performed in this producer without moving the walls, top, ash-pan or other heavy and ponderous parts. It is claimed for this producer that the rate of fuel feeding, the thickness of the firebed and other conditions can be automatically regulated depending on the quality of fuel used and the rate of gasification desired. (1,412,921; April 18, 1922.)

Manufacture of Lithopone.—Formerly lithopone has been "muffled" in horizontal muffles, where poor control and uneven product result. Messrs. Singmaster and Breyer have passed the crude lithopone (zinc sulphide and barium sulphate mixture) through a vertical muffle 10 in. in diameter and 25 ft. long of wrought iron externally heated. In this apparatus the lithopone is first dried in the upper part of the tube and all the entrained air removed by the heat before it reaches the muffling zone. The tube dicharges directly into water. Continuous controlled operation is possible. They found the ratio of diameter to length very important, larger diameter giving uneven product. (1,411,696, Singmaster & Breyer, for New Jersey Zinc Co.; April 4, 1922.)

Vegetable Oil Extraction.—Hermann Bollmann, of Hamburg, has patented the application of the counter-current principle to the solvent extraction of oleagenous materials. The raw material is separated into batches and placed in receptacles provided with sievelike bottoms and open at the top. These are placed in the usual closed chamber in one direction and the solvent is caused to travel freely in the opposite direction consecutively through all receptacles, whereby the fat content of the solvent is progressively increased. This has the advantage of enabling loss of solvent to be avoided more efficiently and the passage through the material under extraction to be effected within the closed chamber from which the solvent vapors may be recovered and after condensation may again be utilized. (1,411,154; March 28, 1922.)

Manufacture of Soap — A quickly soluble white soap for laundry or toilet purposes is claimed to be made by a method which comprises disseminating a multitude of air bubbles throughout the soap while it is in a molten viscous condition and then diminishing the pressure under which the aeration took place so as to expand the air bubbles within the mass of soap. The puffed mass thus produced is permitted to cool and any excess moisture present is driven off so as to bring the product to the desired degree of dryness. (1,414,015, Truman, M. Godfrey, assignor to N. K. Fairbank Co. April 25, 1922.)

Book Reviews

ELEMENTARY CHEMICAL MICROSCOPY. By *Emile Monnin Chamot*. Second edition. New York: John Wiley & Sons, Inc. 479 pages, illustrated. Price $4.25.

This is a college text book on the use of the microscope in chemistry. The first part of the book contains descriptions of microscopes and accessories. This is followed by an explanation of microchemical technique, and finally by a detailed description of chemical reactions suitable for identifying the common elements under the microscope.

The author claims that microchemical methods have an enormous advantage over those of ordinary qualitative analysis in the saving of time, labor and material, as well as in the increased sensitiveness of the tests. In one of his lectures he illustrated the speed and sensitiveness of microchemical methods by describing the analysis of an antique coin. The edge of this coin was rubbed on a frosted glass plate, leaving a small mark. Part of the material in this mark was dissolved in a drop of acid. This drop was then split up into parts to which reagents were added, the reactions being observed under the microscope. In this way the composition of the coin was determined, the whole analysis requiring only twenty minutes.

The apparatus described in this book comprises chemical, metallurgical, petrographical, micrometer and ultramicroscopes and accessories. Elementary instructions are given for the use of each instrument. Critical comparisons are made of instruments designed for the same purpose, which makes the book valuable to refer to before buying microscopic equipment.

The most fascinating part of this book deals with microchemical technique. The author uses a microscope slide for a work bench. On this he places his microscopic fragments and drops of reagents, and performs the usual manipulations of qualitative analysis, such as solution, decantation, filtration, distillation and sublimation. In addition to chemical tests he uses melting points, refractive indices and polarized light phenomena in identifying microscopic materials and therefore devotes several chapters of his book to the description of these methods.

Following the explanation of microchemical technique is a detailed account of tests for each element. These tests differ from those of ordinary qualitative analysis in that they depend on the separation of crystals from relatively concentrated solutions, and afterwards identifying these crystals from their form, color and optical properties. It frequently happens that one reagent causes the separation of crystals characteristic of several elements at the same time. Each element can then be identified from its characteristic crystal

and this naturally results in a great saving of time and labor.

The book is thoroughly readable and authoritative in its field. After studying it under a figurative microscope the reviewer can only report that the examination merely corroborates the expectations that were aroused by the first glance at the title page which revealed the author's name. Dr. Chamot's work is worthy of his high position in his particular field.

OLIVER E. CONKLIN.

OIL SHALES. By *H. B. Cronshaw*, B.A., Ph.D., A.R.S.M. 80 pp., with map. London: John Murray, Albemarle St., W. Price 5s.

This small book forms a welcome and useful addition to the series of Imperial Institute Monographs on Mineral Resources, With Special Reference to the British Empire. A general account of the occurrence of oil shales throughout the world is condensed from the literature in a minimum of space. The selection of material is perhaps as judicious as possible, although, like any compilation, the work reflects here and there the inaccuracies of its sources. For example, we learn on page 6 that open-cut mining will probably prevail in the United States.

The first chapter is devoted to a general discussion of the character of oil shale and its utilization. The description of American distillation has, curiously enough, been confined to a published description of a single process, which might better have been omitted or supplemented. The remainder of the book summarizes the most important points of published descriptions of deposits throughout the world. Those interested in oil shales should have no hesitation in adding it to their libraries.

C. L. JONES.

THE PROGRESS OF ALLIED CHEMISTRY (Annual Report). Issued by the *Society of Chemical Industry*. Vol. 6, 1921. 7s. 6d. to members; 12s. 6d. to non-members, postpaid. Address 46 Finburg Sq., London, E. C. 2.

It is a pleasure to review this admirable and authoritative report on the progress of applied chemistry. It occupies much the same enviable position in industry which the reports of the Chemical Society do in theoretical chemistry. The report is subdivided into a very great many chapters, each chapter having to do with a particular field of chemical industry. Each chapter is compiled by an able critic in the special field and as a rule takes the form of a general review of the industry during the past year, followed by specific details as to progress made, with the names of the men who have made the contributions and the place where the article is published. The criticisms of such progress vary, of course, with the personality of the reviewer. This largely and quite rightly takes the form of a colorless announcement of the contribution. It usually is entirely too soon to pass a final and an adequate judgment on the value of a specific contribution. Occasionally, however, a few adjectives occur in the text which serve as an index of the reviewer's estimate of that particular work. While we must indorse the conservative practice which does not form a premature estimate, yet we do feel that the judgment of a man able to summarize the work done in the particular field is of inestimable value. We would, therefore, urge the reviewers not to lean too far backward in failing to give an estimate of the value of the work done. A reviewer selected by the Society of Chemical Industry may feel considerable confidence that his opinions will be received with respect throughout the industry. This will tend to make him conservative, naturally, but we sincerely hope it will not dull or sheathe the edge of his critical judgment, which is of most value to the readers of such a report.

We have been interested in the inclusion of a section entitled "Bleaching, Dyeing, Printing and Finishing." A chemical industry, to be sure, and one which has received from chemists and chemical engineers in this country all too little consideration. Any system of classification is difficult, and the custom in this country to regard fine chemicals as a much larger and inclusive class than do these reports is a source of some confusion. It would seem more logical to us to include, under a consideration of all organic chemicals, Coloring Materials and Dyes. The development of some organic materials has, I think, been overlooked or, if not overlooked, so placed as not to be easily accessible. For example, hydroquinone and metol have not been located.

With this criticism for omission or misplacement and the expression of the hope that the eminent reviewers will express their opinions of recent advances more freely, we may give vent to a distinct enthusiasm for the whole work and a praise which we hope will not become fulsome.

In general, most of the industries suffered from the widespread depression and the analysis of conditions in the individual industries is in almost every case keen and suggestive. In only one or two cases is there no attempt to make a general analysis of the status of each industry.

In many lines the statement is made that the depression which has existed throughout the industry has militated against research, due to the fact that the personnel has been largely dismissed. (This is also true in this country.) In very few lines is it said that notable advances have been made during the past year. Notable advances mean research, and research means a willingness on the part of manufacturing concerns to invest money in research and men. During the past year this has been practically eliminated. Again, referring to the review of coloring matters and dyes, the fearless statement of the reviewer in regard to the misuse of government subsidy in the dye industry of Great Britain is indicative of the best kind of review work. His criticisms are sound and constructive. It is a great pleasure to compliment the Society of Chemical Industry on continuing this very real contribution to applied chemistry. Technical men would do well to study this book and if only we could bring it to the attention of bankers and inventors who control too many of our chemical industries, we would feel that our mission in life had not been wasted.

CHARLES WADSWORTH, 3D.

ENTROPY AS A TANGIBLE CONCEPTION. By *S. G. Wheeler*, Eng. Lieut.-Commander, R. N. 76 pp., illus. New York: D. Van Nostrand Co., 1922. Price $3.

Many engineers and students of engineering are men of a wholly practical turn of mind, men who are by instinct doers, managers. The prime object of their studies is to acquire the tools which enable them to obtain results, to learn what to do; and not necessarily to learn why it is done.

Most of the methods employed in modern engineering find a basis in abstract mathematics. This is particularly true of thermodynamics, which is a science based on the hypothesis of an imaginary, ideal mathematical cycle which cannot be approached in practice. Such a theoretical basis for a science makes no pronounced appeal to the typical engineer. Consequently the whole subject of thermodynamics is more often than not only half digested by the man who must use it. He understands the way in which any set problem must be solved; but he distrusts the mathematics which must be employed, because he has not a sufficient grasp of the underlying principles to use these mathematics in a free and unhampered way.

Commander Wheeler has written a little book which is well called "an elementary treatise on the physical aspects of heat, entropy and thermal inertia." By a readily comprehensible analogy between the mathematically simple theory of kinetic energy and the obscure theories of thermodynamics, the reader is led by easy stages to a grasp of the physical conception of entropy and of the basis on which a steam chart is drawn.

This book cannot fail to be of value to all those—engineers and others—who are under the necessity of dealing with problems of steam engineering and who have not had the training in mathematics and abstract science necessary to a complete understanding of these problems. It is to be hoped the author will at some time extend his work to include more definitions; and the numerous and valuable charts and diagrams might be presented in a more clean-cut way to advantage. But as the book stands it is a worthy addition to the working library; and the author in writing it has pointed the way to a service which could well be done in other lines where practical men must use mathematics which they do not understand and hence distrust.

G. L. MONTGOMERY.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

American Electrochemical Society Moves

Headquarters Established in New York After 20 Years in Bethlehem, Pa.

After having been established at Lehigh University, Bethlehem, Pa., for about 20 years, the American Electrochemical Society has moved its national headquarters to Columbia University, New York City. This action was taken in order to facilitate the work of the secretary, Colin G. Fink, who has recently been appointed lecturer in electrochemistry and who will have charge of that division of the department of chemical engineering at Columbia University. The former headquarters was established in Bethlehem due to the fact that the late Joseph W. Richards, for many years secretary of the Society, was situated there as professor of metallurgy at Lehigh University. The present move has been under consideration for some time and will greatly facilitate the transaction of the Society's business.

In accordance with the recent amendment to the Constitution of the Society, the annual dues are now $8 and by action of the Board the annual charge to members for bound volumes will be $5 per year, effective Jan. 1, 1923. The charge for transactions to non-members will be $6.50 per volume and to public and scientific libraries $4 per volume.

The directors recently authorized the organization of a division of organic electrochemistry and appointed A. W. Burwell temporary chairman with the power to appoint his organizing committee and draw up a constitution and bylaws, to be submitted to the Board for approval at the Montreal meeting.

American Ceramic Society Summer Excursion Plans

"A family excursion: Bring yours!" Such is the slogan that the American Ceramic Society has adopted for its summer excursion meeting which is scheduled for Aug. 13 to 19 and will include visits to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo. The trip will be made by boat and will be strictly an "outing," affording opportunity for a taste of camp life and the exploration of the Thousand Islands. Among the ceramic points of interest which will be visited are feldspar mills, enamel, glass, tile, brick and porcelain works and the famous Canadian feldspar mines at Verona.

$400,000 for Helium Research

An appropriation of $400,000 for research work and for the production of helium will be available during the fiscal year beginning July 1. The effort of the Senate to reduce this amount to $300,000 was unsuccessful, as the conferees on the War Department Appropriation bill accepted the House figure.

Advisory Committee Lays Plans for Chemical Exposition

Only American Exhibits to Be Admitted. Several Societies to Meet at Exposition

At a dinner meeting held at the Chemists' Club, New York on June 29, the advisory committee of the National Exposition of Chemical Industries considered ways and means to insure the continued success of the exposition at the eighth exhibit to be held in Grand Central Palace during the week of Sept. 11, 1922. One of the most important matters discussed was the type of exhibit that should be permitted. As in previous years, the management has been confronted with the problem of keeping the exposition free from objectionable exhibits and confining it to a strictly national exposition of chemical industries. After considerable discussion and the consideration of a number of special cases, the advisory committee officially decided that only American companies and American products should be admitted to the Exposition except on special approval of the committee. This general principle was adopted for the guidance of the management which will subsequently bring before the committee any cases that are not satisfactorily covered by the resolution.

The programs that are being arranged comprise special meetings of the American Ceramic Society, the Technical Association of the Pulp and Paper Industry and the newly organized Technical Photographic and Microscopical Society. In addition to these the committee planned to obtain addresses by popular leaders who have a full appreciation of the importance of developing our chemical industries and who will bring a message that will impress this fact upon the general public.

The management reported to the advisory committee the results of a meeting held with the recently organized Chemical Equipment Association at which a number of moot points were settled to the satisfaction of the exhibitors. At a subsequent interview between the management and the chairman of a special exposition committee appointed by the Chemical Equipment Association some further matters of interest to exhibitors were discussed, and it is felt that as a result of these conferences the atmosphere has been thoroughly cleared and all questions relating to policy of the management have been satisfactorily answered.

Those in attendance at the meeting of the advisory committee were: CHARLES H. HERTY, chairman, president of the Synthetic Organic Chemical Manufacturers Association; M. C. WHITAKER, vice-president and general manager of the U. S. Industrial Alcohol Co.; P. C. KINGSBURY, the General Ceramics Co.; L. H. BAEKELAND, president, the Bakelite Corporation; T. B. WAGNER, consulting chemical engineer; R. P. PERRY, the Barrett Co.; BERNHARD C. HESSE, General Chemical Co.; JOHN E. TEEPLE, president of the Chemists' Club; DAVID WESSON, past-president of the American Institute of Chemical Engineers; HENRY B. FABER, National Aniline and Chemical Co.; CHARLES F. ROTH and F. W. PAYNE, co-managers of the Chemical Exposition and H. C. PARMELEE, Editor of *Chem. & Met.*

Steel Alloy Plant for Canada

The Dominion Alloy Steel Corporation, Ltd., has been organized with an authorized capitalization of $7,500,000 8 per cent cumulative preferred stock, $7,500,000 of common stock and $2,500,000 of bonds, of which $5,000,000 of preferred and $4,400,000 of common stock have been issued. The company has purchased a site on the River Ste. Claire, at Sarnit, Ont., and will erect a plant, consisting of open-hearth and electric furnaces, rolling mills, machine shops and laboratories, for the manufacture of special alloys and high-carbon steels. The plant will be a duplicate of the United Alloy Steel Corporation's plant at Canton, Ohio, some of the directors and stockholders being interested in both concerns, and will have a capacity of 100,000 tons of steel yearly. The production of the plant will be made mainly with a view to supplying the automobile manufacturers of Canada.

Harry Ross Jones, director and formerly president of United Alloy Steel Corporation, is chairman of the board of directors; William E. Boyd, Toronto, president; George Simpson, formerly sales manager of the Steel Company of Canada, vice-president; and Bert H. McCreath, second vice-president.

Government Appropriation for Muscle Shoals Carries Provision for Delay of Work

Appropriation for Construction of Wilson Dam Passed by Both Houses but Will Not Become Available Until October 1 on Account of Pending Action on Ford Offer

BY A VOTE of 145 to 105 the House of Representatives, on June 24, agreed to concur in the Senate amendment to the War Department appropriation bill which appropriates $7,500,000 for the reopening of construction work on the Wilson Dam at Muscle Shoals. The vote carried with it, however, approval of an amendment by Representative James, of Michigan, which provides that no portion of the $7,500,000 is to become available before October 1. The purpose of the amendment was to give additional time for Congress to pass definitely on the Ford offer. The amendment was actively supported by those favoring the Ford offer who saw in the Senate amendment an effort to delay definitely any action on the Ford proposition. The House voted down, however, another amendment proposing a delay until January 1 before use could be made of the appropriation provided by the Senate amendment.

While the Senate was practically unanimous in its disapproval of the action of the House in delaying the time at which the $7,500,000 appropriation for the reopening of construction work on the Wilson dam at Muscle Shoals, nevertheless the Senate voted to concur in the House amendment. Senator Norris, the chairman of the Committee on Agriculture, which has jurisdiction over the Muscle Shoals proposition in the Senate, submitted a motion to disagree with the House amendment and urged that the bill be sent back to conference and so altered that the appropriation would become available immediately, as had been provided by the Senate. This motion was lost, however, by a vote of 28 to 32.

Delay Caused by Ford Offer

Friends of the Ford offer in the House not only declared that the Senate amendment was conceived with the idea of killing the Ford offer, but stigmatized it as a piece of hypocrisy—the drawing of a herring across the trail, in an effort to deceive the people.

Senator Underwood and other advocates of the Ford offer, declared that they are entirely at a loss to understand the logic which prompted the House to accept, by a majority of 40 votes, the amendment by Representative James, of Michigan, which postpones until October 1 the availability of the $7,500,000 appropriation.

Senator Norris pointed out that the amendment originated in an entirely regular way in the Committee on Agriculture and had the unanimous support of each member of that committee. It was brought on the floor, explained to and adopted by the Senate without any attempt at concealment or any resort to sharp practice. He declared that he is at a loss to understand why his committee and the Senate is accused of hypocrisy in the matter. Senator Underwood, who is admitted to be the most powerful friend of the Ford offer, concurred with that expression by Senator Norris and declared the amendment could not be construed as being anti-Ford.

Delay Will Seriously Handicap Construction Work

Senator Norris, in his remarks, pointed out that a delay of three months in making the money available means the loss of a year's time on a portion of the work. He referred to foundation construction, which can be conducted only during July, August and September, when the stage of the river is low. Senator Norris estimated that fully $2,000,000 less work will be done with the appropriation by beginning the work October 1 than would have been the case had it started July 1.

Senator Underwood explained that he would vote to concur in the House amendment because he feared that the appropriation might be lost altogether were the bill sent back to conference. "The gentleman," he said, "who expressed the opinion as to the hypocrisy of the Senate, evidently thought it would be hypocrisy to build this dam in July but not hypocrisy to propose to build it in October."

Some days before the vote on the conference report, Senator Norris had pledged himself to do all in his power to bring the Ford offer to a final vote at the earliest possible moment. He took the ground, however, after the action of the House, that he now is released from that promise. As chairman of the committee having jurisdiction in the matter he is in a position to delay the consideration of the Ford offer in the Senate.

Senator Lodge made the following contribution to the discussion: "The amendment of the House is economically wrong. It is not right or fair to the tax-payers. It ought not to be accepted by the Senate. The amendment by the House is indefensible."

Muscle Shoals as a Political Issue

From a political standpoint, the House amendment is regarded as a victory by the Democrats. While they admit that the Senate may not vote on the Ford offer before October 1, this delay does embarrass the Republican leaders in the House since they must either put the Ford proposition to a vote or be accused of an attempt to kill the Ford offer by refusing to allow it to come to a vote. Each party recognizes the political possibilities of the situation. Largely through the very active efforts of the Farm Bureau Federation, large support for the Ford offer has been developed among the farmers of the Middle-west and Northwest, sections where fertilizer is beginning to play an important part in agriculture. In addition Mr. Ford has a large personal following, which the Republican leaders do not want to antagonize, especially just before an election. As a result of this latest maneuver Muscle Shoals is expected to remain on the tapis for several months.

Safety Code for Conveyors and Conveying Machinery

American Engineering Standards Committee Announces Preparation of Safety Specifications

An important step toward the solution of an accident problem has just been accomplished through the decision of the American Engineering Standards Committee that the development of a safety code for conveyors and conveying machinery be undertaken.

The introduction of mechanical conveyors in many industries has eliminated a large proportion of the accidents resulting from the manual handling of materials. At the same time, it has introduced new hazards, many of which can be prevented by a more general agreement among both users and manufacturers of conveying equipment as to safe practice in the manufacture, installation and operation of such equipment.

The American Society of Mechanical Engineers and the National Bureau of Casualty and Surety Underwriters have been appointed joint sponsors for this code. All interested national organizations will be asked to co-operate in the formulation of the code. This code will be intended as a guide for the safe operation and maintenance of conveyors and conveying machinery coming under the following main divisions: gravity, belt, chain, flight-bucket, apron, screw and jigging conveyors, car hauls, aerial cableways, overhead trolley, and pneumatic tubes.

All shafting, pulleys, belts, link belts, chains, gears, sprockets, couplings, clutches, etc., used on and in connection with conveyors and conveying machinery will be covered in the mechanical power transmission code now in preparation.

Chemical Warfare Appropriation Will Go for Research

Plans for the allotment of the $600,000 appropriated for the use of the Chemical Warfare Service during the fiscal year beginning July 1 have not been perfected as yet due to the illness of Brigadier-General Amos A. Fries, the head of the service. It is known, however, that most of the money will be expended on research work and on defensive training of troops.

Society for Improvement of Engineering Education Attempts Move for Broader Training

At the annual convention of the Society for the Promotion of Engineering Education which was held recently at the University of Illinois, Charles F. Scott, of Yale University, outlined a new and broader vision of engineering education based on the needs and demands of industry. In tracing the parallel development of university education and the economic trend of industry in this country he pointed out that all basic industries are looking not only for trained technicians but leaders of production and in administration, leaders who have a through understanding of the relationship of engineering to the economic development of this country's resources and business requirements of the future. The building up of efficient teaching staffs, he declared, is one of the prime functions of the society for the promotion of engineering education if that organization is to lead the requirements of industry and develop men who are prepared to deal with the new and changing problems of engineering. The council of the society adopted the following resolutions for the broadening of its actions:

> Resolved, That the president of this society appoint a committee of 5 members, including himself, to study the development of the society for the promotion of engineering education and to formulate an answer to the question, "What can the society do in a comprehensive way to develop, broaden and enrich engineering education?" and further that this committee shall report, as early as feasible, formulations of the answer back to the council for action on the committee's recommendations.

At the last session of the Council of the S. P. E. E., the plan of the midwest deans for a five-year course was presented but not endorsed. The midwest deans agreed among themselves to go ahead as a separate unit and develop the plan as originally laid down at the meeting in Chicago on May 10.

New Section Established

The Council at the same meeting decided to establish a new section within the society composed of deans and directors of engineering schools. This is the culmination of a discussion on this subject which started at the New Haven meeting last year. The new section of deans of the society will deal with general administrative matters. This new section does not incorporate the organization of midwest deans which is a separate organization without connection with the Society, that is working out the five year course for engineers.

The keynote of the discussions was the development of teachers who can train engineers along the lines of the plans that are now being studied to to make university training more effective. The plan of instruction for freshmen now being followed at Purdue University as inaugurated and explained by Dean A. A. Potter created much discussion. This plan aims to stimulate the interest of the student early in his course by introducing engineering problems that appeal to his instincts and deal with actual situations calling for solutions designed to train him to think clearly, act quickly and calculate accurately. It is also a rough measure of his fitness to pursue engineering work. The instruction includes general lectures, inspection trips and simple engineering problems. The discussion brought out the fact that similar work is being conducted in several other colleges and much interest in the results of the plan after another year or so of its application was expressed.

Officers Elected

The following officers were elected for the coming year: President, Charles F. Scott; vice-presidents, D. S. Kimball, of Cornell University, and F. G. Higbie, of Iowa State University. New members appointed to the council are: M. W. Alexander, National Industrial Conference Board; Edward Bennett, Wisconsin University; H. S. Evans, University of Colorado; E. A. Hitchcock, Ohio State University; H. J. Hughes, Harvard University; C. E. Magnusson, University of Washington; G. C. Shaad, University of Kansas.

Safety Congress to Meet in Detroit

Prospects for Very Successful Meet—Program for Chemical Division

The program of the eleventh annual safety congress of the National Safety Council at Detroit Aug. 28 to Sept. 1 is now complete. Indications are that the 1922 convention will be the largest and most complete in the history of the National Safety Council. Public officials, industrial executives, well known authorities in research, science and education have volunteered to appear on the programs to do their bit for national safety.

Complete discussion of the various phases of industrial and public safety will be had at the meetings of the twenty different sections into which the Council's activities are divided. These meetings will cover safety problems in the automotive, cement, chemical, construction, metals, paper and pulp, packers and tanners, rubber, textile, woodworking, electric railway, public utilities, steam railroads, mining, public safety, educational, engineering, drop forge, health service and women in industry divisions.

All meetings will be held in the new Cass Technical High School which has just been completed as one of the finest educational institutions of its kind in the country. The main auditorium will accomodate more than 3,000 persons. Other commodious facilities for sectional and committee meetings are included in the same building. Practically all available space is taken for the safety exhibit which will be held in a large hall immediately adjoining the main auditorium. The dust explosion exhibit of the U. S. Department of Agriculture has been secured as a feature. Special outside exhibits including a Ford Motor Company exhibit, a model safety street car exhibit and a night parade to demonstrate safety headlights for automobiles are planned.

Program of Chemical Section

The chemical section is under the chairmanship of S. H. Kershaw, of the Hercules Powder Co. and E. J. Reiderer, of the Atlas Powder Co. G. E. Minshull of the E. I. du Pont de Nemours and Co. is secretary.

The first session will be held Aug. 29 at 9:30 a.m. After the business meeting, committee reports, etc., Walter G. Whitman, professor of chemical engineering at Massachusetts Institute of Technology will give an address on "Safe Handling of Materials in Chemical Plants." F. J. Hoxie, engineer and special inspector for the Associated Factory Mutual Fire Insurance Companies.

The second session of this division on Aug. 30 will be featured by the report of the industrial poisons committee of which A. L. Watson, of the Hooker Electrochemical Co., is chairman. A paper on "Benzol Poisoning, Its Occurences and Prevention," will be presented by Charles F. Horan, of the Hood Rubber Co.

Journal of Scientific Instruments

The British Institute of Physics, 10 Essex St., London, has issued a specimen number of a proposed monthly *Journal of Scientific Instruments*, to be devoted to methods of measurement and the construction and use of instruments.

Heavy Chemical Freight Rates Protested

In a complaint to the Interstate Commerce Commission, the Mathieson Alkali Works of New York alleges unreasonable rates on chlorine gas from Niagara Falls to points on the Baltimore and Ohio railroad, because of the failure of the railroad to allow mileage on the tank cars of the alkali company either for the outbound or the return movement. The commission is asked to establish reasonable rates and regulations governing the use of the alkali company's tank cars in liquefied chlorine gas traffic.

In the complaint of the Hercules Powder Co., an Interstate Commerce Commission examiner recommends that the rates on sulphuric acid from Danville, Ill., to Ishpeming, Mich., are unreasonable.

Alien Property Disposal Would Be Investigated Under Bill Now Before House

Chemical Foundation Included in Scope of Bill Calling for Explanation of Activities of Former Alien Property Custodian

A BILL embodying the principles recently announced by the President with regard to the disposition of alien property has been introduced in the House of Representatives. An understanding as to the matters covered by this legislation was reached at a recent conference between the President, the Secretary of State, the Attorney General and the Alien Property Custodian.

In urging the adoption of the bill in the House, Representative Woodruff, of Michigan, declared that the Chemical Foundation and Bosch Magneto cases are instances of flagrant maladministration of trust property, calling for swift and drastic action. He referred to George J. Corbett as chief aid of former Custodian Garvan in putting over the "Chemical Foundation deal," the former becoming secretary of the concern on its organization and receiving substantial compensation out of trust properties for services rendered the custodian. He also said the matter of L. Vogelstein Co. in relation to the metal situation should be investigated.

Miller Interprets Scope of Bill

Discussing the proposed bill, Colonel Thomas W. Miller, the Alien Property Custodian, said: "One section provides for the return to the former owners of all property out of every trust not exceeding in value in any case the sum of $10,000. This means that smaller property owners whose property is valued at $10,000 and under will receive their property back in full at this time. Of the thirty-two thousand active trusts now administered by the Alien Property Custodian about 93 per cent are of the value of $10,000 and under. In addition, the property in every trust in excess of $10,000 will receive that sum from the Custodian on account.

"Another section provides for the extension of time in the filing of suits allowed under the various sections in the 'Trading with the Enemy Act,' made necessary by the expiration of said period under the present act.

"The third section refers to assignments and limits attorneys' fees.

"Section four provides means by which the President may, at his discretion, transfer funds on deposit in the Treasury so that the Alien Property Custodian may deposit the same in banks, said deposits being insured by Liberty Bonds as collateral, with a view to utilization in the economic relations between this country and Europe pending the time such funds are held for final disposition by this government.

"The last section will clear up claims of naturalized American citizens who have been under a presumption of expatriation by reason of their absence from the United States before the war and whose property was seized as a result of their being in Germany or an enemy country during the state of war.

"This bill embodies the recommendations made by the Alien Property Custodian's office to President Harding and represents the initial step of this administration in the final disposition of of the alien property situation. A claims tribunal will undoubtedly be created by the treaty under negotiation between the Department of State and the German Government which will adjudicate and settle the question of American claims against Germany and their relation to the alien property still to be held."

Chemical Foundation Suits Explained by Choate

In regard to widely published statements concerning certain law suits which have been instituted by the Chemical Foundation against several manufacturers, Joseph H. Choate, Jr., counsel for the Chemical Foundation has authorized the following statement:

> Statements which have recently appeared in the press in regard to the commencement of certain suits by the Chemical Foundation against a number of manufacturers have apparently produced a false impression. Some of these intimated that the companies thus sued were charged with improper, if not unlawful, acts. Nothing could be further from the truth. The suits are entirely friendly actions, brought to establish the title of the Foundation to the funds long since paid by the defendants as royalties for the use of patents now owned by the Foundation, under licenses issued by the Federal Trade Commission. The trading with the enemy act provided that these funds be held in the U. S. Treasury as a trust fund for the owner of the patents and for the licensees, as their respective rights might be determined by suits to be brought by the owner against the licensees. This provision compelled the Foundation, which would have no difficulty in agreeing with almost all of the licensees, to bring such suits as the only means of securing from the Treasury moneys to which it is entitled. The companies sued have, generally speaking, done everything that they should in the matter and nothing that they should not.

Marconi to Receive Medal

The John Fritz medal will be presented to Senator Guglielmo Marconi in the auditorium of the Engineering Societies' Building, 29 West 39th Street, New York, Thursday evening, July 6.

Federal Phosphorus Co. Denies Removal Report

Theodore Swann, president of the Federal Phosphorus Co., Birmingham, Ala., has issued a statement denying recently published reports to the effect that his company contemplated the removal of its Anniston plant to Jacksonville, Fla. The conference between the City Commission of Jacksonville and T. L. Long, who was reported to be the representative of the Federal Phosphorus Co., was entirely unauthorized and without the knowledge of Mr. Swann. There is no intention of moving the plant.

Metallographic Institute Organized in Sweden

Result of Co-operation of Government, Educators and Manufacturers

A Metallographic Institute was formally inaugurated in Stockholm, Sweden, on June 1. The exercises were presided over by Professor Svante Arrhenius and were attended by representatives of Stockholm University, the Ironmasters' Corporation (Jernkontoret), the Engineering Academy and the national government. Preliminary steps in the organization were instituted by Stockholm University and the new Institute has been financed by contributions from the leading manufacturers of Sweden, in co-operation with Jernkontoret. The Government has placed suitable quarters at the disposal of the Institute.

Carl Benedicks, the well known physicist and authority on physical metallurgy has been appointed head of the Institute. The object as embodied in the declaration of its founders is "To practice and further scientific resarch in metallography and allied subjects." In his inaugural speech, Dr. Benedicks announced that one of the actual aims of the Institute, and one upon which they have already embarked, is research work designed to determine the space lattices of atoms in pure metals and alloys. Besides such purely scientific research work, the Institute will answer questions, furnish advice and report upon specific metallographic problems of a more practical nature.

The Institute is thoroughly equipped with instruments and appliances of the most modern type. It has a special room containing several electric melting furnaces, including a Northrup high-frequency furnace, considerably improved by new appliances added by the staff of the Institute. It is also very well equiped with measuring and recording apparatus, including a double string galvanometer and a powerful du Bois electromagnet. The laboratories for microscopic photography and chemistry are very well equipped. In addition to this, the Institute has its own machine shop, possessing sufficient precise tools for the manufacture of new instruments and appliances which will be required from time to time as the work proceeds.

Chemical Warfare Gas Used as Fumigant

Cyanogen Chloride May Supplant Hydrocyanic Acid as Result of C. W. S. Research

Cyanogen chloride is expected to supplant hydrocyanide acid gas for ship fumigation as a result of co-operative research and experimentation on the part of the Chemical Warfare Service and the Public Health Service. In the course of this work it was developed a few months ago that the greatest objection to hydrocyanic acid gas could be overcome by mixing it with ordinary military tear gas. This ingredient made it possible to recognize the presence of the gas in the holds of vessels. As the work progressed, however, it was found that cyanogen chloride gas serves all the purposes accomplished by hydrocyanic acid gas and has the advantage of being readily recognizable.

This work along with the progress which has been made in the use of toxic materials in anti-fouling paints is pointed to at the Chemical Warfare Service as typical of what is being done by the Service in its co-operative research with other Government bureaus. The work on anti-fouling paints has been done in co-operation with the Navy's marine biological laboratory at Beaufort, S. C. Every effort is being made by the Chemical Warfare Service to make available to all concerned the results of the intensive work done by scores of chemists during the war on toxic materials.

Congress Will Not Incorporate Scientific Societies

The subject of incorporation of scientific societies was brought up in the House of Representatives by the introduction of a bill proposing the incorporation of the American Mathematical Society. Objections by Representatives Stafford of Wisconsin and Huddleston of Alabama prevented the passage of the bill. The former expressed the conviction that if Congress intended to incorporate every scientific society it should do so by a general law and not in special bills for each society and referred to the possibility that the American Automotive Society and the American Chemical Society might desire incorporation. Representative Huddleston opposed incorporation of societies by Congress on general principles.

Treasury Department Ruling on White Lead

The Treasury Department has ruled that the allowance for valueless waste incurred in the Carter process of manufacturing white lead shall not exceed 1 per cent of the quantity of lead used. The ruling was issued in connection with the payment of the drawback on white lead made from imported lead.

Civil Service Openings

The United States Civil Service Commission announces open competitive examinations for junior microanalyst in the Bureau of Chemistry at a salary of $1,400 to $1,800 and for junior aids in the Bureau of Standards at salaries of $540 to $840 per year. Junior assistants are afforded the opportunity of continuing their college work at local universities. Application should be made on form 1312.

Personal

F. W. BARKER, JR., who has been in the chemical division of the manufacturing department of the National Aniline and Chemical Co., Inc., has severed his connection with that company and is now associated with The Kaumagraph Co.

H. C. CUMMINS has been elected president of the Shaffer Oil and Refining Co., Chicago, Ill., to succeed GEORGE N. MOORE, resigned. Mr. Cummins was formerly vice-president and secretary, and has been succeeded as vice-president by W. H. CANNADY, heretofore manager of the refining department; and as secretary by W. R. FRANCISCO, who will also act as treasurer.

E. L. DOHENY has been elected chairman of the board of the Mexican Petroleum Co., of New York, N. Y., and its subsidiary organizations. HERBERT G. WYLIE, formerly vice-president and general manager, has been elected president to succeed Mr. Doheny.

C. R. DOWNS, formerly chief chemist of the research laboratory of The Barrett Co., Edgewood, N. J., is now with the National Aniline and Chemical Co., Buffalo, N. Y.

F. B. FOLEY has been relieved as a member of the drill steel field-survey committee and has returned to his station at the Bureau of Mines in Minneapolis, where he will resume his experimental work on this subject. C. Y. CLAYTON and H. S. BURNHOLZ are continuing this joint field study of the Bureau of Standards and Bureau of Mines, visiting the various mines which are co-operating in the drill steel study.

ERNEST A. HERSAM, of the University of California, has been appointed by the Bureau of Mines as a metallurgist to work on the survey of milling methods which is being done in co-operation with the American Institute of Mining and Metallurgical Engineers. Prof. Hersam's headquarters will be at the Massachusetts Institute of Technology where he will be associated with Prof. Locke. The work will include an extended survey under the general chairmanship of G. H. CLEVENGER of the Committee on Milling Methods of the Institute. This work also involves co-operation with the pulverizing committee of the Engineering Division of the National Research Council.

Senator GUGLIELMO MARCONI will receive the John Fritz medal July 6, 1922, in the auditorium of the Engineering Societies Building, New York.

I. E. NEIFERT, a chemist formerly with the Chemical Warfare Service, who now is a member of the faculty at Knox College, Galesburg, Ill., has been engaged by the Department of Agriculture to do research work during the Summer on grain fumigation. The Department is very anxious to develop a fumigating agent which does not carry with it a fire or poison hazard. Particular attention is to be given to the effects on grain of the use of chlorpicrin.

Dr. R. F. RUTTAN, the retiring president of the Society of Chemical Industry, and Dr. A. T. CHARION will represent Canada and the Canadian Institute of Chemistry at the Third annual meeting of the International Union of Pure and Applied Chemistry.

JAMES A. STADER has been appointed chief of the minerals section, Iron and Steel Division of the Bureau of Foreign and Domestic Commerce. He began work in the new position on July 1, giving special attention to the nonferrous metals and non-metallic mineral products, for which there has been no commodity division of the Bureau formerly. Mr. Stader is a graduate of the University of Missouri, and has had extensive experience in the Far East, Mexico and Europe. He was for some time a technical advisor of the Inter-Allied Industrial Commission dealing with problems of reparations of coal, oil and mineral products. He leaves a temporary connection with the Seiberling Rubber Co. to accept this Government appointment.

Prof. E. W. WASHBURN, head of the department of ceramic engineering, University of Illinois, will succeed Dr. FREDERICK G. COTTRELL as chairman of the division of chemistry and chemical technology of the National Research Council.

Obituary

ALEXANDER R. SMOLEY, and not Alexander R. Smalley, is the name that should have appeared in the obituary notice in our issue for June 21. His age was 27 and not 25 as given.

FRANK L. STILES, president of a number of New England brick manufacturing companies, died at his residence in North Haven, Conn., June 9, in his 69th year. At the time of his death he was president and treasurer of the I. L. Stiles & Son Brick Co., North Haven; and also president of the following companies: North Haven Brick Co., North Haven; Stiles & Reynolds Brick Co., Berlin, Conn.; Stiles and Hart Brick Co., Taunton, Stiles & Hart Brick Co., Taunton, Bridgewater, Mass. He enjoyed a national reputation in the industry, and was at one time a member of the Connecticut State Legislature.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

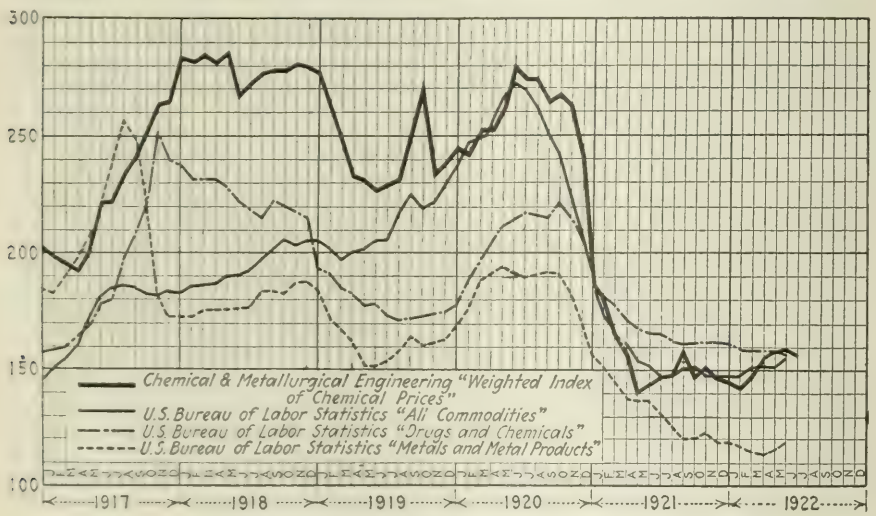
A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Business Conditions Steadily Improving

A Review of Fundamental Economic Conditions Shows That the Gains in the General Business Situation Are Becoming More Evident in the Chemical and Allied Industries

TO SURVEY the progress of business during the first six months of 1922 is to gain a new confidence in the thoroughness of its remarkable recovery. Each month since January has shown a gradual, consistent betterment in underlying business conditions and this has been accurately reflected in practically every line of industry. Improvement is still the predominating note in the business situation, notwithstanding that the gains made during June were somewhat less pronounced—due perhaps to the fact that certain industries have reacted to the common tendency for a seasonal lull in activities. For the most part, however, the basic lines of manufacture represented by the chemically controlled industries have continued to show the stimulating effects of business revival and the return of confidence in industry.

Factors favoring this improvement, or resulting directly from it, are the increased production in certain basic industries, the unusual building activity, the stable if not increasing prices, the growing commodity consumption as measured by car loadings, and the decrease in unemployment and in business failures. The trump cards in the hands of the business pessimist, on the other hand, are the continued labor difficulties in the coal fields and textile centers, the threatening railroad tie-up and the apparent reaction taking place in the stock market. Fortunately, there is growing evidence, however, that these cards may never be played. The administration's efforts toward reaching an early settlement of the coal strike and the widely held belief that the present decline in the market is only a temporary set-back are factors from which significant developments may yet be expected.



THE TREND OF WHOLESALE PRICES,
1917-1922

"CHEM. & MET." WEIGHTED INDEX OF CHEMICAL PRICES

Base: 100 for the Year July 1, 1913, to June 30, 1914

This week	157.52
Last week	156.89
July, 1921	145
July, 1920	274
April, 1918 (High)	286
April, 1921 (Low)	140

This week's index number shows a net gain of 63. Slightly lower prices for soda ash and caustic soda were more than compensated by advances in ammonium sulphate, barium chloride, copper sulphate, glycerine and linseed oil.

The Industrial Situation

Before considering any of these factors in greater detail, however, it is worth while to give attention to how the situation is being reflected in the different industries.

Iron and Steel. May, with a total production of pig iron amounting to 2,306,679 tons, represents a gain of 11.3 per cent over April and of 16 per cent over the first five months of 1921. Steel ingot production of 3,099,155 tons is 114 per cent of the output of May, 1921 and the largest since October, 1920. Furthermore, steel production in 1922 is 33⅓ per cent greater than during the corresponding period of last year.

Automobile. The National Automobile Chamber of Commerce estimates the May production of cars and trucks at 252,167, an increase of 15 per cent over April and 54 per cent above May, 1921. This is the largest previous month since March, 1920. At present only 14 per cent less people are employed in the Detroit industries than at the time of the 1920 peak.

Petroleum. While crude oil production has been continuing at a low rate, it is interesting to know that the output of gasoline in April, the latest month for which statistics are available, amounted to 472,920,000 gal. This is another new high record and compares with a consumption of 385,564,000 gal.

Construction. All previous construction records had been broken in April but apparently May's building contracts exceeded those of April by over 3 per cent. According to the F. W. Dodge Co., the May total for 27 northeastern states was $362,590,000 which was 50 per cent greater than in May of last year.

Leather. The leather industry as a whole is encouraged by the broader demand for its products. The recent price adjustments have done much to stimulate the tanning industry which has been suffering from the very narrow margin between hide costs and leather prices.

Paper. The total newsprint produced in May, 1922 was 129,950 net tons—an increase of 65 per cent over the 78,868 tons produced in May, 1921. The output during the first five months of 1922 totals 562,912 tons as compared with 528,678 tons during the corresponding period of last year.

Rubber. This industry has of course benefited by the activity in the automobile industry. Reports are to the effect that the Akron plants are running at maximum capacity based on present working forces. It is expected that production will continue at an even keel during July and any seasonal slackening will scarcely have effect before August.

Drugs and Chemicals. Valuable as an index of business sentiment are the results of a questionnaire on business revival sent to a trade group within this industry by the National Institute of Credit. The question: Has the revival of business activity reached your industry? was answered affirmatively by 86 per cent of the group.

Paint and varnish. One hundred per cent of the paint and varnish group testified to the effects of business revival, 78 per cent reported greater sales for May, 1922, than in May, 1921, and all but 4 per cent declared that May sales had exceeded those of April.

Cement. This industry is having difficulty in supplying the demand caused by the large volume of construction now under way. May figures, recently released by the Geological Survey, show an increase in production of 1,895,000 bbl. over that for May, 1921.

Wholesale Prices

Commodity prices since the first of the year have shown marked advances and it is only recently that the tendency to remain stationary has become evident. Bradstreet's monthly index during the past year has advanced ten times and decreased only twice and then to a minor extent. Wholesale prices according to this index are now 12.1 per cent above last year's.

The U. S. Bureau of Labor Statistics has recently revised its index numbers on the basis of a regrouping of commodities and the use of 1919 census data for weighting purposes. Unfortunately, this revision was not announced in time to make the necessary changes in the accompanying chart, which is continued on the old basis. The new index for all commodities is 143 for April and 148 in May, which is a most significant advance.

Chem. & Met.'s weighted index of chemical prices recorded a slightly lower level for June. This index had averaged 158.04 for April, 159.32 for May and declined to 157.48 for the month of June.

Other Significant Developments

Car loadings, which under certain circumstances may be considered a reliable index of distribution and therefore of consumption, have increased steadily. Loadings for the week ended June 17 amounted to 860,722 cars, the largest number of cars loaded in any one week since October 22, 1921. This compares with 750,645 in the week of June 3 and 846,002 in the week ended June 10. The largest increase was in merchandise, less than carlots of miscellaneous freight and ore loadings.

The financial situation has been featured by wide fluctuations in the markets for industrial stocks and foreign exchanges. The almost steady advance of the stock market which started last August experienced its first substantial set-back during June. However there is abundant evidence that this is a temporary reaction brought on by the wild speculation characterizing dealings in many issues. In the case of some of the chemical companies the reaction has caused almost disastrous depreciation. On the other hand certain oil stocks, notably those of Mexican Petroleum and allied companies, reached new levels during the speculative rise and have since maintained substantial gains.

Chemical Market During Second Quarter of 1912

THE COMMODITY MARKETS for chemical and allied products were without significant developments during the three months ended July 1, 1922. With the exception of a few of the more important basic materials, the improvement has been only moderate. Noticeable price fluctuations have for the most part been limited to items of a speculative nature. Minor changes have had a tendency to keep the market active, however, particularly to small-lot buyers.

Market Features

Among the important features of the market has been the significant recovery of barium products. Barium chloride had been quoted at $52 per ton in January, but steadily increased in price until it had reached a new high record of $105 in May. Competition, especially from increased imports, has tended to lower prices during June and at the end of the month dealers were quoting $95 per ton. The prussiates have also attracted a great deal of attention because of their wide fluctuations. Yellow prussiate of soda opened the year at 16c. per lb. During February and March it advanced to 18¼c. but declined in April to 16½c. per lb. The advance was renewed in May, however, and a new high level was established at 25c. per lb. June prices have averaged about 22c. Yellow prussiate of potash has shown a similar improvement, advancing from 25c. per lb. in January to 32c. toward the end of June. Red prussiate has been exceedingly scarce and prices as high as 90c. per lb. have been reported.

Caustic soda has been something of a disappointment to the producers, who claim that prices are not in line with the unusual heavy domestic and export demands. Prices, however, have shown considerable improvement. They opened the year at $3.25 per 100 lb. and steadily advanced to $3.70 in April and then to $3.90 per 100 lb. in May. June prices were reported around $3.80 per 100 lb. Manufacturers of oxalic acid increased prices from 11½c. per lb. in April to 14c. per lb. in June. Improved demand and higher costs have been directly responsible for the increase. Copper sulphate showed a net advance of ½c. per lb. during the interval.

Copperas, potassium bromide, acetate of soda, fluoride of soda, barium carbonate, salt cake and tartaric acid are other of the more important items to show increased prices during the second quarter. On the other hand, a number of declines were recorded. Perhaps the most important is in the case of sulphuric acid, the market for which is at present below pre-war levels. The decline since April has amounted to about $2 per ton and 66 deg. acid in tank cars, is now quoted at $15 per ton. Granular zinc chloride, nickel salts, formaldehyde, acetate of lead, acetic acid, methanol, glycerine, potassium bichromate and ammonium sulphate have also recorded fractional declines.

A monthly comparison of the average prices of 45 important chemicals in the New York market during the past six months is to be found in the accompanying table.

A SIX-MONTHS' REVIEW OF THE PRICES OF 45 IMPORTANT CHEMICALS, JANUARY-JULY, 1922

Article	Unit	Average Price for Month of— Jan.	Feb.	March	April	May	June	Price on July 1
Acetic acid, glacial	Lb.	$0.10	$0.09	$0.09	$0.09	$0.09	$0.08½	$0.08½
Muriatic acid, 20 deg.	100 lb.	1.25	1.15	1.15	1.10	1.10	1.10	1.10
Nitric acid, 40 deg.	Lb.	.06¼	.06¼	.06¼	.06	.06	.06	.06
Oxalic acid	Lb.	.14	.14	.14	.11½	.13½	.14	.14½
Sulphuric acid, 66 deg.	Ton	16.50	16.00	16.00	17.00	15.50	15.00	15.00
Acetate of lead	Lb.	.10⅝	.10⅝	.09⅝	.09⅝	.09⅝	.09¼	.09¼
Ammonia alum, lump	Lb.	.03½	.03½	.03½	.03½	.03½	.03½	.03¼
Aluminum sulphate, iron free	Lb.	.02½	.02½	.02½	.02½	.02½	.02½	.02½
Sal ammoniac, white gran.	Lb.	.06½	.06¾	.07	.07	.07	.06¾	.06¾
Ammonium sulphate	100 lb.	2.35	2.50	3.25	3.75	3.60	3.30	3.30
Amyl acetate	Gal.	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Arsenic, white powder	Lb.	.07	.07¼	.07¼	.07	.07	.07¼	.07¼
Barium chloride	Ton	50.00	56.00	75.00	95.00	105.00	93.00	95.00
Bleaching powder	100 lb.	2.25	2.10	1.75	1.60	1.60	1.60	1.60
Calcium acetate	100 lb.	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Camphor	Lb.	.90	.92	.90	.82	.79	.79	.80
Copperas	Ton	15.00	15.00	15.00	15.00	20.00	20.00	20.00
Copper sulphate, crystals	100 lb.	5.65	5.60	5.55	5.50	5.75	6.00	6.50
Epsom salts, U.S.P.	100 lb.	2.65	2.65	2.60	2.50	2.50	2.50	2.00
Formaldehyde, 40%	Lb.	.10½	.10	.08¾	.08½	.08½	.08¼	.08¼
Fusel oil, refined	Gal.	2.50	2.50	2.50	2.15	2.15	2.25	2.25
Glaubers salt	100 lb.	1.25	1.15	1.00	.85	.90	.95	.90
Glycerine, c.p.	Lb.	.16½	.16½	.16	.15½	.15	.14½	.14½
Methanol, 95%	Gal.	.61	.59	.58	.57	.57	.57	.57
Nickel salt, single	Lb.	.12	.11	.11	.11	.11	.10½	.11
Phosphorus, red	Lb.	.45	.45	.45	.45	.45	.45	.45
Potassium bichromate	Lb.	.10½	.10⅛	.10⅛	.10⅛	.09¼	.09¼	.09¼
Potassium bromide, gran.	Lb.	.14	.13½	.18	.17	.17	.17	.17
Carbonate of potash, 80-85%	Lb.	.04½	.04½	.04½	.05	.04½	.05	.05
Chlorate of potash, crystals	Lb.	.05½	.05½	.05¾	.06¼	.06½	.06½	.06½
Caustic potash, 88-92%	100 lb.	6.00	5.75	6.00	5.80	5.85	5.75	5.75
Permanganate of potash, U.S.P.	Lb.	.14	.13½	.15	.15	.14½	.14	.14
Prussiate of potash, yellow	Lb.	.25	.25	.26	.27	.31	.32	.33
Salt cake, bulk	Ton	17.00	17.00	17.00	18.00	20.00	20.00	20.00
Soda ash, light, 58%	100 lb.	1.75	1.70	1.80	1.80	1.90	1.80	1.75
Bichromate of soda	Lb.	.07½	.07¾	.07¾	.07½	.07¼	.07¼	.07¼
Fluoride of soda	Lb.	.10½	.09½	.09½	.09½	.09	.10	.09½
Cyanide of soda	Lb.	.26	.23½	.23½	.22	.22	.22	.22
Caustic soda, solid 76%	100 lb.	3.25	3.35	3.65	3.65	3.85	3.80	3.75
Nitrate of soda	100 lb.	2.37½	2.37½	2.85	2.90	2.70	2.55	2.55
Prussiate of soda	Lb.	.17½	.18	.17½	.16½	.21	.22	.21¼
Sulphide of soda, 60%	Lb.	.04¼	.04¼	.04⅜	.04¼	.04¼	.04¼	.04¼
Sulphur, crude	Ton	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Zinc chloride, gran.	Lb.	.09	.09	.06	.05½	.05½	.06	.06
Zinc oxide	Lb.	.07½	.07½	.07½	.07½	.07½	.07½	.07½

The New York Market

NEW YORK, July 2, 1922.

Practically the only trading noticeable in the chemical market during the past week was for small lots of comparatively unimportant commodities. Oxalic acid has been an outstanding feature of the week's activities. Producers have announced an advance at the works and consumers have been buying in moderate proportions. Acetate of soda continued to display a very firm attitude and prices were quoted higher during the latter part of the week. Tartaric acid remained strong, with a good seasonable inquiry recorded from the consuming trades. Copper sulphate is somewhat higher on spot and supplies seem to be very scarce. Caustic soda has shown the effects of its prolonged activity and prices have declined to $3.75 per 100 lb. for export. Potash alum has also been reduced by leading dealers, in addition, prussiate of soda and barium chloride have recorded slight decreases.

GENERAL AND SPECIAL CHEMICALS

Acetate of Soda—It is rather doubtful if better than 6½c. per lb. can be done for spot goods. Large producers are quoting 5½@6c. per lb., f.o.b. works, depending on quantity.

Bicarbonate of Soda—Manufacturers quote $1.75 per 100 lb. for barrels, f.o.b. works. There has been no outstanding features of interest in this market, outside of regular contract shipments.

Caustic Soda—The demand for this product has slackened considerably and July shipment is being offered at $3.75 per 100 lb. f.a.s. The domestic demand continued rather steady with 3¾c. per lb. named for spot goods. Contract prices remain at 2½c. per lb. basis 60 per cent, f.o.b works, for car lots.

Copper Sulphate—The spot market is exceptionally strong with goods practically sold up and dealers quoting July material around 6½c. per lb.

Muriatic Acid—Large contracts for the 18 deg. acid have been placed as low as 1c. per lb. while the 20 deg. is held at $1.10 per 100 lb.

Oxalic Acid—Sales for spot goods have been recorded around 14½@15c. per lb. Material at the works is quoted at 14½@14¾c. per lb.

Potash Alum—Foreign stocks have depressed prices in the local market to 3c. per lb., with the range from 3@3½c. per lb.

Sulphuric Acid—Producers of this material quote the 66 deg. in tanks at $15@$17 per ton and drums at $18@$20 depending upon the quantity. Sales of 60 deg. were recorded at $9.50@$10 per ton.

WAXES

Beeswax—Crude wax was somewhat easier during the week, due to the increased stocks. Pure white wax was held at 40@45c. per lb.

Candelilla Wax—Spot material was exceptionally scarce and prices ranged around 40c. per lb. for odd lots.

Carnauba Wax — Material on spot was offered in larger amounts than have been noted for several weeks and prices were easier. No. 3 North Country was available at 16½c. per lb. No. 1 regular was quoted at 40c.

Japan Wax—A better inquiry was noted for this material and prices remained steady during the interval. The market for spot goods was held around 16@16½c. per lb. Forward business was transacted at 15c. per lb.

NAVAL STORES

Turpentine—During the early part of the week prices showed an advance from $1.25 per gal. to $1.48. Consumers and exporters were not eager to purchase at these high levels and prices reacted to $1.25 per gal. Quotations heard during the latter part of the week ranged around $1.30 per gal.

Rosins—The market showed the effects of the sudden decline in turpentine and all grades were reduced from 5 to 20c. per bbl. B-D was quoted at $5.40 per bbl. and W-G, W-W at $7.65@$8.30 per bbl.

The Iron and Steel Market

PITTSBURGH, June 30, 1922.

The steel market has grown progressively quieter in the past six or eight weeks, as to the actual tonnage turnover, and now at the beginning of the July-August midsummer period is ready for the dullness that usually characterizes those two months.

The trade is prepared for a dull period in the market. The mills are well sold up and buyers as a rule are well covered. In many departments mills are sold up very fully for two months and in some cases for a longer time. Merchant steel bars, in particular, are well sold ahead for about three months.

There is good ground, therefore, for expecting the steel market to weaken in case there is little activity for a number of weeks, or perhaps even for two months. The mills are really quite well fortified. They have more business on their books than even the more sanguine expected at the beginning of the year.

MILLS CONSERVATIVE

The mills as a rule refuse to admit that the lighter turnover in steel products in the open market is due to a change of attitude on the part of buyers. The mills state that the cause is their own reserve in the matter of selling, that they could book large additional tonnages if they cared to accept the business. The mills have endeavored as far as possible to limit their commitments to tonnages sufficient to cover the known requirements of customers.

While it is no doubt true that mills are conservative and could secure more business, in contracts or other form, than they are accepting, it does not follow that buyers also have not become somewhat more conservative. There is probably less disposition than two or three months ago to buy all the steel the mills will sell. There have been developments that would cause buyers to recede from their former position. There is, probably, no decrease in the rate of consumption and no diminution in the good prospects of steel consumers, but there are two developments of consequence, one being the maintenance of steel production in face of the coal strike, the other being the disinclination of steel prices to advance much if any beyond their present level.

Steel sellers and steel buyers alike have ground for allowing the market to drift for a time, and as to the future the chief point to be observed is which party shall first come into the market again in a large way. The crucial test will probably come shortly before or after September 1. The preponderating view seems to be that the mills will have the advantage at that time, whereby there may be a strong market for some time. On the other hand, it is doubtful whether such production of steel as has obtained lately can be continued beyond the end of the present year.

STEEL PRICES

Finished steel prices are quotable as follows: Bars, shapes and plates, 1.60c to 1.70c.; hoops and bands, 2.40c. to 2.50c.; blue annealed sheets, 2.40c. to 2.50c.; black sheets, 3.15c. to 3.30c.; galvanized sheets, 4.15c. to 4.30c.; automobile sheets, 4.50c. to 4.75c.; tin plate, $4.75; wire nails, $2.40 to $2.50; standard steel pipe, 71 per cent basing discount. In commodities in which a price range exists the higher price is usually for early delivery, though the character of specifications has something to do with the price.

THE COAL STRIKE

Rumors are prevalent as to operators beginning to make an effort to break the coal strike next week, these referring both to the Pittsburgh district operators, whose mines have been union, and to the Connellsville region, which has been nonunion for over 30 days, but which has had strikes that hang on rather well. Production in the Connellsville region has been increasing for almost two months, but at a very slow rate, close comparisons being necessary to show any change.

Connellsville coal weakened about 10 cents a ton late last week, but this week has regained the loss, being now quotable at $3.50 to $3.75 for steam mine-run. Connellsville coke is about 50 cents higher in the week, at $8.00 to $8.50. An interesting point is that there is practically no market in regular foundry coke. At most operations it is found difficult to produce coke of regular foundry grade, *i.e*, carefully selected, and rather than jeopardize reputations several operators are offering their coke as coke.

The pig iron market remains practically stagnant, with quotations unchanged, though now largely nominal, at $25 for Bessemer and basic and $24 to $25 for foundry, f.o.b. valley furnaces.

The Chicago Market

CHICAGO, Ill., June 27, 1922.

The demand for industrial chemicals during the past two weeks was rather dull but a slightly better movement was in evidence today. Consumers are holding off to a certain extent waiting for the lower freight rates which will be effective after July 1. This, and the approach of the slow summer season are the reasons given in most quarters for the present dullness and it is also believed that the uncertain tariff situation is having an adverse effect on the market. Prices have been very steady and only a few adjustments were noted while stocks in the hands of both jobbers and consumers were reported as low.

GENERAL CHEMICALS

The alkali market was without change and the movement was only routine. *Ground caustic soda* 76 per cent was quoted at $4.35@$4.50 per cwt. for moderate lots and the solid at $3.85@$3.95. *Caustic potash* lacked quotable change and was reported to be moving in a fair way at 6½@6¾c. per lb. for the 88-92 per cent material. *Soda ash* was quiet with only a routine movement reported. The 58 per cent material was quoted in cooperage by manufacturers or their agents at $2.20 @$2.30 per cwt.

Alums were in a firm position with prices generally maintained. *Ammonia alum* was quoted at 3¾@4¼c. per lb. for the lumps and 4¼@4¾c. for the powdered. *Potash alum* was in fair demand with the lumps available at 4½@5c. per lb. and the powdered at 5½@6c.. *Barium* products were in an easier position with imported material for shipment from the East available at lower prices. *Barium chloride* was offered at $100 per ton for moderate quantities. *Copper sulphate* was very firm and scarce with practically all holders asking 6½@7c. per lb. for the small lots that they had. Only a routine demand was reported for *sal ammoniac* and the prices were unchanged at 7¾@8c. per lb. for the white granular and 17@18c. for the lump. *White arsenic* attracted but little attention and was available at 8c. per lb. *Carbon bisulphide* was rather slow and only small lots changed hands at 7@ 7½c. per lb. *Carbon tetrachloride* was unchanged both as to demand and price. Large drums were available at 10c. per lb. *Formaldehyde* was very dull and weak with at least one factor offering single bbl. lots at 9c. per lb. delivered.

Refiners advanced their schedules on C. P. *glycerine* to 14¾c. per lb. bulk basis but the demand continued light.

The bichromates were without change in price and moved only in a routine way. *Sodium bichromate* of standard brand was available at 9c. per lb. in single cask lots and similar quantities of the potash salt at 11¾c. One holder was asking $1 per lb. today for *red prussiate of potash* for spot delivery. Small lots were available for shipment from the East at 85@90c. but no quantities were available at any price. The *yellow prussiate of potash* is in a very firm position and only small supplies were available at 34@36c. per lb. *Potassium permanganate* was slightly firmer at 16@16½c. per lb. for the U. S. P. small crystals.

LINSEED OIL

A prominent factor in this field reports a good movement of the oil and says that the tendency is toward slightly higher prices. The movement which is described as good consists mainly of small lots as there is a reluctance on the part of the consumer to anticipate his requirements very far ahead. The boiled oil was quoted today in 5-drum lots at 93c. per gal. and the raw in similar quantities at 91c.

Turpentine is apparently too high priced at the present time to move in very large quantities although dealers report a very good volume of business for small or moderate lots. Today's price for 5-drum lots was $1.25 per gal. *Rosin* was not moving as well as turpentine and the WG grade was quoted at $9 per 280 lb. for less than car lots.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... -	$0.38 - $0.40
Acetone	lb.	$0.10 - $0.10½	.10¾ - .11
Acid, acetic, 28 per cent	100 lbs.	2.25 - 2.50	2.55 - 3.00
Acetic, 56 per cent	100 lbs.	5.00 - 5.25	5.30 - 5.50
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	8.50 - 9.00	.50 - 9.75
Boric, crystals	lb.	.11 - .11½	.11½ - .12
Boric, powder	lb.	.11 - .11½	.11½ - .12½
Citric	lb.	..... -	.45 - .46
Hydrochloric	100 lb.	1.10 - 1.20	1.25 - 1.70
Hydrofluoric, 52 per cent	lb.	.11 - .11½	.11½ - .12
Lactic, 44 per cent tech	lb.	.09½ - .10	.10½ - .12
Lactic, 22 per cent tech	lb.	.04 - .04½	.04½ - .05
Molybdic, c.p.	lb.	3.00 - 3.25	3.30 - 3.75
Muriatic, 20 deg. (see hydrochloric)		..... -	..... - .....
Nitric, 40 deg	lb.	.06 - .06½	.06¾ - .07
Nitric, 42 deg	lb.	.06½ - .06¾	.07 - .07½
Oxalic, crystals	lb.	.14¾ - .14¾	.15 - .15½
Phosphoric, 50 per cent solution	lb.	.08 - .08½	.08¾ - .09½
Picric	lb.	.22 - .24	.24½ - .30
Pyrogallic, resublimed	lb.	..... -	1.65 - 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 - 10.00	..... - .....
Sulphuric, 60 deg., drums	ton	12.00 - 14.00	..... - .....
Sulphuric, 66 deg., tank cars	ton	15.00 - 16.00	..... - .....
Sulphuric, 66 deg., drums	ton	19.00 - 20.00	20.50 - 21.00
Sulphuric, 66 deg., carboys	ton	..... -	..... - .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 - 20.00	..... - .....
Sulphuric, fuming, 20 per cent(oleum) drums	ton	22.00 - 22.50	23.00 - 24.00
Sulphuric, fuming, 20 per cent(oleum) carboys	ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.	lb.	..... -	60 - .75
Tannic (tech.)	lb.	.40 - .45	.46 - .50
Tartaric, imported crystals	lb.	..... -	.29 - .29½
Tartaric acid, imported, powdered	lb.	..... -	.29½ - .30
Tartaric acid, domestic	lb.	..... -	..... - .30
Tungstic, per lb. of WO	lb.	..... -	1.00 - 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... -	4.75 - 4.95
Alcohol, methyl (see methanol)		..... -	..... - .....
Alcohol, denatured, 188 proof No. 1	gal.	..... -	.26 - .30
Alcohol, denatured, 188 proof No. 5	gal.	..... -	.26 - .30
Alum, ammonia, lump	lb.	.03¼ - .03½	.03¾ - .04
Alum, potash, lump	lb.	.03 - .03¼	.03½ - .04
Alum, chrome lump	lb.	.05¼ - .05¾	06 - .06½
Aluminum sulphate, commercial	100 lb.	1.50 - 1.65	1.70 - 2.25
Aluminum sulphate, iron free	lb.	.02½ - .02¾	.03 - .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½ - .07½	.07½ - .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 - .30½	.30½ - .31
Ammonium carbonate, powder	lb.	.07 - .07½	.07½ - .08
Ammonium nitrate	lb.	.06 - .06½	.06¾ - .07½
Amylacetate tech	gal.	..... -	2.00 - 2.25
Arsenic, white, powdered	lb.	.07¼ - .07½	.07¾ - .08
Arsenic, red, powdered	lb.	.12 - .12½	.12¾ - .13
Barium carbonate	lb.	.03 - .04	.04½ - .05
Barium chloride	ton	95.00 -100.00	105.00 -110.00
Barium dioxide (peroxide)	lb.	.20 - .21	.21½ - .22
Barium nitrate	lb.	.07 - .07½	.07½ - .08
Barium sulphate (precip.) (blanc fixe)	lb.	.04 - .04½	.04½ - .04¾
Blanc fixe, dry	lb.	.04 - .04½	..... - .....
Blanc fixe, pulp	ton	45.00 - 55.00	..... - .....
Bleaching powder	100 lb.	1.60 - 1.75	1.85 - 2.50
Blue vitriol (see copper sulphate)		..... -	..... - .....
Borax	lb.	.05½ - .05¾	.06 - .06¾
Brimstone (see sulphur, roll)		..... -	..... - .....
Bromine	lb.	.27 - .28	.28½ - .35
Calcium acetate	100 lbs.	1.75 - 2.00	..... - .....
Calcium carbide	lb.	.04½ - .04¾	.05 - .05½
Calcium chloride, fused, lump	ton	24.00 - 24.50	24.75 - 27.00
Calcium chloride, granulated	lb.	.01½ - .01¾	.02 - .02½
Calcium peroxide	lb.	..... -	1.40 - 1.50
Calcium phosphate, tribasic	lb.	..... -	.15 - .16
Camphor	lb.	..... -	.80 - .83
Carbon bisulphide	lb.	.06½ - .06¾	.07 - .07½
Carbon tetrachloride, drums	lb.	.09½ - .10	.10½ - .12
Carbonyl chloride, (phosgene)	lb.	..... -	.60 - .75
Caustic potash (see potassium hydroxide)		..... -	..... - .....
Caustic soda (see sodium hydroxide)		..... -	..... - .....
Chalk, precip.—domestic, light	lb.	.04½ - .04½	..... - .....
Chalk, precip.—domestic, heavy	lb.	.03½ - .03¾	..... - .....
Chalk, precip.—imported, light	lb.	.04½ - .05	..... - .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 - .05½	.05½ - .06
Chloroform	lb.	..... -	.25 - .32
Cobalt oxide	lb.	..... -	2.00 - 2.10
Copperas	ton	20.00 - 22.00	23.00 - 30.00
Copper carbonate, green precipitate	lb.	.19 - .20	.20½ - .21
Copper cyanide	lb.	..... -	.58 - .60
Copper sulphate, crystals	100 lb.	6.50 - 6.60	6.65 - 7.00
Cream of tartar	lb.	..... -	.23½ - .25
Epsom salt (see magnesium sulphate)		..... -	..... - .....
Ethyl acetate com. 85%	gal.	..... -	.60 - .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... -	.90 - .95
Formaldehyde, 40 per cent	lb.	.08¼ - .08½	.08¾ - .09
Fullers earth, f.o.b. mines	net ton	16.00 - 17.00	..... - .....
Fullers earth—imported powdered—net ton		30.00 - 32.00	..... - .....
Fusel oil, ref	gal.	..... -	2.25 - 2.65
Fusel oil, crude	gal.	..... -	1.45 - 1.50
Glauber's salt (see sodium sulphate)		..... -	..... - .....
Glycerine, c. p. drums extra	lb.	..... -	.14½ - .15
Iodine, resublimed	lb.	..... -	4.20 - 4.25
Iron oxide, red	lb.	..... -	.12 - .18
Lead acetate	lb.	..... -	.09½ - .11½
Lead arsenate, powd	lb.	.13 - .13½	.13¾ - .14½
Lead nitrate	lb.	..... -	.15 - .20
Litharge	lb.	.07½ - .08	.08½ - .09
Magnesium carbonate, technical	lb.	.08 - .08½	.08¾ - .09
Magnesium sulphate, U. S. P.	100 lb.	2.00 - 2.25	2.30 - 2.50
Magnesium sulphate, technical	100 lb.	..... -	1.00 - 1.80
Methanol, 95%	gal.	..... -	.57 - .58
Methanol, 97%	gal.	..... -	.59 - .60
Nickel salt, double	lb.	..... -	.11 - .11½
Nickel salt, single	lb.	..... -	.10 - .10¼
Phogene (see carbonyl chloride)		..... -	..... - .....
Phosphorus, red	lb.	..... -	.40 - .45
Phosphorus, yellow	lb.	..... -	.30 - .35

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Potassium bichromate	lb.	.09¾ – .10	.10¼ – .10
Potassium bromide, granular	lb.	–	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb.	–	.50 – .52
Potassium hydroxide (caustic potash)	100 lb.	5.75 – 6.00	6.25 – 6.50
Potassium iodide	lb.	–	3.20 – 3.35
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.14 – .14½	.14¾ – .15½
Potassium prussiate, red	lb.		.90 – .95
Potassium prussiate, yellow	lb.	.33 – .33¾	.33½ – .33¾
Rochelle salts (see sodium potas. tartrate)			–
Salammoniac, white, granular	lb.	.06½ – .07	.07¼ – .08
Salammoniac, gray, granular	lb.	.07¼ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	20.00 –25.00	–
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.65 – 1.70	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06¾ – .06½	.06¾ – .07
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07⅞	.07¾ – .08
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12 00 –13 00	–
Sodium cyanide	lb.	.22 – .23	.23½ – .25
Sodium fluoride	lb.	.09¼ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.50	3.80 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.75 – 3.80	3.85 – 4.20
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.85 – 4.00	4.30 – 4.50
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03½	.03½ – .04
Sodium nitrite	lb.	.08¼ – .08¾	.09 – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	–	.18 – .21
Sodium prussiate, yellow	lb.	.21¾ – .22	.22¼ – .22½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04¼ – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	–
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	–	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	–
Talc—domestic powdered	ton	18 00 –25 00	–
Tin bichloride	lb.	.09 – .09½	.09½ – .10
Tin oxide	lb.	–	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.06 – .06½	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.30 — .31
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.50 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.22 — .24
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb	.32 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.59 — .65
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.95 — 1.00
Monochlorbenzene	lb.	.09 — .11
Monoethylaniline	lb.	1.10 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06 — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.11 — .12
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.15 — .17
N-W acid	lb	1.15 — 1.30
Ortho-amidophenol	lb.	2.40 — 2.50
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.70 — .75
Ortho-nitro-toluene	lb.	$0.10 — $0.13
Ortho-toluidine	lb.	.14 — .18
Para-amidophenol, base	lb.	1.25 — 1.30
Para-amidophenol, HCl	lb.	1.30 — 1.35
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .75
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.90 — 1.00
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.14 — 15
Pyridine	gal.	1.75 — 2.75
Resorcinol, technical	lb.	1.30 — 1.35
Resorcinol, pure	lb.	1.75 — 1.80
R-salt	lb.	.60 — .70
Salicylic acid, tech., in bbls.	lb.	.25 — .25½
Salicylic acid, U. S. P.	lb.	.26 — .26½
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.27 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .18
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — ....
Xylene, commercial, in drums, 100 gal	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.21 — $0.22
Beeswax, refined, dark	lb.	.30 — .32
Beeswax, refined, light	lb.	.34 — .35
Beeswax, white pure	lb.	.40 — .42
Candelilla, wax	lb.	.40 — .42
Carnauba, No. 1	lb.	.40 — .42
Carnauba No. 2, North Country	lb.	.24 — .25
Carnauba, No. 3, North Country	lb.	.16½ — .16¾
Japan	lb.	.16 — .16½
Montan, crude	lb.	.04½ — .04¾
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04½ — ....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02¼ — ....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03⅞ — .03¼
Paraffine waxes, refined, 125 m.p.	lb.	.03½ — .03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ — .04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05¼
Stearic acid, single pressed	lb.	.09 — .09½
Stearic acid, double pressed	lb.	.09½ — .09¾
Stearic acid, triple pressed	lb.	.10½ — .10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.40 —	$5.80
Rosin E-I	280 lb.	5.85 —	6.40
Rosin K-N	280 lb.	6.45 —	7.60
Rosin W. G.-W. W.	280 lb.	7.65 —	8.30
Wood rosin, bbl.	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1 30 —	1.35
Wood turpentine, steam dist	gal.	.85 —	....
Wood turpentine, dest. dist.	gal.	.70 —	.70
Pine tar pitch, bbl.	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	10.00
Retort tar, bbl.	500 lb.	—	9.00
Rosin oil, first run	gal.	.36 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.46 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist.	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref.	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N.Y.	100 lb.	3.35 —	3.45
Blood, dried, f.o.b., N. Y.	unit	3.50 —	3.60
Bone, 3 and 50, ground, raw	ton	32.00 —	35.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.55 —	2.60
Tankage, high grade, f.o.b. Chicago	unit	3.10 —	3.20
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	3.75
Tennessee, 78-80%	ton	7.00 —	7.50
Potassium muriate, 80%	ton	33.00 —	33.50
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0.18 —	.18¼
Upriver coarse	lb.	.12¼ —	.12¾
Upriver caucho ball	lb.	.13¼ —	.14
Plantation—First latex crepe	lb.	.15¼ —	.15¾
Ribbed smoked sheets	lb.	.15¼ —	.15½
Brown crepe, thin, clean	lb.	.13¾ —	....
Amber crepe No. 1	lb.	.14½ —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.11 —	$0.11¼
Castor oil, AA, in bbls.	lb.	.12 —	.12¼
China wood oil in bbls.	lb.	.13¼ —	1

Coconut oil, Ceylon grade, in bbls	lb.	.08 —	.08¼
Coconut oil, Cochin grade, in bbls	lb.	.09¼ —	.09½
Corn oil, crude, in bbls	lb.	.11¼ —	.11½
Cottonseed oil, crude (f. o. b. mill)	lb.	$0.10 —	$0.10
Cottonseed oil, summer yellow	lb.	.11¼ —	.12
Cottonseed oil, winter yellow	lb.	.12 —	.13
Linseed oil, raw, car lots (domestic)	gal.	.87 —	.88
Linseed oil, raw, tank cars (domestic)	gal.	.83 —	.84
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.92 —	.93
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07⅞ —	.07
Palm, Niger	lb.	.06⅛ —	.06
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09½ —	.10
Peanut oil, refined, in bbls	lb.	.12½ —	.12¾
Rapeseed oil, refined in bbls	gal.	.84 —	.85
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.12¼ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.10¼ —	....
FISH			
Light pressed menhaden	gal.	$0.51 —	....
Yellow bleached menhaden	gal.	.53 —	.54
White bleached menhaden	gal.	.55 —	.56
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$900 00	$1200.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	90 00	—125.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	22.00	— 28.00
Barytes, ground, white, f.o.b. mills	net ton	17 00	— 23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	— 21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	— 24 00
Barytes, crude f.o.b. mines	net ton	8.00	— 9.00
Casein	lb.	.14	- .15
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	— 8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8 00	— 9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	— 20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00	— 20.00
China clay (kaolin), imported, lump	net ton	14 00	— 20.00
China clay (kaolin), imported, powdered	net ton	30.00	— 35.00
Feldspar, No. 1 pottery grade	long ton	6.40	— 6.75
Feldspar, No. 2 pottery grade	long ton	5.75	— 5.90
Feldspar, No. 1 soap grade	long ton	7.00	— 7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00	— 22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05	— .05½
Graphite, Ceylon chip	lb.	.04	— .04½
Graphite, high grade amorphous crude	ton	35.00	— 50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	— ....
Kieselguhr, f.o.b. N. Y	per ton	55.00	— 60.00
Magnesite, calcined (crude)	per ton	8.00	— 12.00
Pumice stone, imported	lb.	.03	— .05
Pumice stone, domestic, lump	lb.	.05	— .05½
Pumice stone, domestic, ground	lb.	.06	— .07
Shellac, orange fine	lb.	.81	— .82
Shellac, orange superfine	lb.	83	— .84
Shellac, A. C. garnet	lb.	.68	— .69
Shellac, T. N.	lb.	.79	— .80
Silica, glass sand, f.o.b. Indiana	per ton	1.25	— 2 25
Silica, sand blast material, f.o.b. Indiana	per ton	2 25	— 4 50
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16 00	— 16.00
Silica, building sand, f.o.b. Pa	per ton	2.00	— 2.75
Soapstone	ton	12.00	— 15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00	— 12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7 50	— 12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16.00	— 20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00
Chrome brick, f.o.b. Eastern shipping points	net ton	40–42
Chrome cement, 40-50% Cr_2O_3	net ton	24–32
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23 00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	28–35
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–28
Magnesite brick, 9-in. straight (f.o b. works)	net ton	53
Magnesite brick, 9-in. arches, wedges and keys	net ton	70
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	30–32
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	33–35
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	27–30
Silicon carbide refractory brick, 9-in.	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11 —	....
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.12 —	....
Ferromanganese, 78-82% Mn, domestic	gross ton	67.00 —	69.00
Ferromanganese, 78-82% Mn, German	gross ton	66 00 —	66.50
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2 25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58 00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.45 —	.50
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried	net ton	$6 00 —	$9.00
Chrome ore, Calif concentrates, 50% min. Cr_2O_3	ton	20.00 —	21.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	20 00 —	21.00
Coke, foundry, f.o.b. ovens	net ton	8 00 —	8.50
Coke, furnace, f.o.b. ovens	net ton	8 00 —	8.00
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.27½ —	28
Manganese ore, chemical (MnO_2)	net ton	60 00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.50 —	....
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27 00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13¼
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	3.25 —	3.50
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent	19.00–20.00
Antimony, wholesale lots, Chinese and Japanese	4.95–5 00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32 00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32 00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	30.75
Lead, New York, spot	5.75
Lead, E. St. Louis, spot	5.50–5 55
Zinc, spot, New York	5.625
Zinc, spot, E. St. Louis	5.275

OTHER METALS

Silver (commercial)	oz.	$0.70½
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.10
Platinum	oz.	87.50
Iridium	oz.	170.00@175.00
Palladium	oz.	55.00@ 60.00
Mercury	75 lb.	54.75@ 55.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.25
Copper bottoms	27.75
Copper rods	19.25
High brass wire	16.75
High brass rods	14.25
Low brass wire	18.25
Low brass rods	18.75
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	20.75
Seamless high brass tubing	18.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	10.25@10.50
Copper, heavy and wire	10.00@10.25
Copper, light and bottoms	7.75@ 8.25
Lead, heavy	3.90@ 4.15
Lead, tea	2 2¼
Brass, heavy	4 50@ 4.75
Brass, light	4 00@ 4.25
No. 1 yellow brass turnings	4.00@ 4.25
Zinc	2.00@ 2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2 58	$2.58
Soft steel bars	2.48	2.48
Soft steel bar shapes	2.48	2.48
Soft steel bands	2.98	3.08
Plates, ¼ to 1 in. thick	2.58	2.58

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The Tennessee Coal, Iron & Railroad Co. is perfecting plans for the early erection of a new foundry for the production of steel castings at the plant of its subsidiary organization, the Chickasaw Shipbuilding & Car Co., Fairfield, Ala. The company is also planning for the remodeling of the foundry at its Ensley, Ala., works, with extensive increase in capacity for the production of iron castings, ingot molds, etc.

California

PITTSBURG — The Pioneer Rubber Co., 68 Sacramento St., San Francisco, will soon call for bids for the erection of a 1-story building here, 80x200 ft., estimated to cost about $150,000, including equipment. Benjamin G. McDougall, 381 Bush St., San Francisco, is architect.

OAKLAND—The Pennzoil Co., Oil City, Pa., affiliated with the Penn-American Refining Co., has acquired property, totaling about 2 acres on Powell St., near San Pablo Ave., for the construction of a new plant for Pacific Coast Service. Plans will be prepared at an early date.

Connecticut

HARTFORD—The Skat Co., Francis Ave., manufacturer of soaps, soap powders, etc., will call for bids at once for the erection of a 1-story plant addition, 46x61 ft. Plans have been prepared by F. C. Walz, architect, Hartford.

MANCHESTER—The Oxford Soap Co. will soon commence the erection of its proposed new plant on Hilliard St., to be 2- and 3-story, 70x150 ft. Plans have been completed. The structure will be used as an addition to its existing works.

Illinois

ROCK ISLAND—The Service Rubber Co., 401 Central Trust Bldg., is taking bids on a general contract for the erection of a new 3-story plant, 60x200 ft., estimated to cost about $100,000, including machinery. Carrin & Horn, 311 Safety Bldg., are architects. J. T. Crowley is one of the heads of the company.

Indiana

ST. MARYS—Joseph Entwhistle has leased the former plant of the Terre Haute Vitrified Brick Co., St. Marys, near Terre Haute, and is organizing a company to operate the property. The plant has been closed down for about 2 years past. The new owner will make a number of improvements, and will remodel the works for the production of face brick, instead of paving brick as heretofore produced. It is planned to commence operations at an early date and develop a maximum production of 40,000 bricks per day.

INDIANAPOLIS—The Majestic Tire & Rubber Co. has acquired a portion of the brewing plant at Crouse and Daly Sts., heretofore owned by the Home Brewing Co., for a consideration of about $32,000. The structure will be remodeled for a new rubber mill.

BIPPUS—The Bippus Tile Co. has been reorganized under the name of the Bippus Clay Products Co., with capital of $55,000, the new company being headed by H. V. D. King, Godhen, Ind., and associates. A tract of 36 acres of land adjoining the present plant has been acquired, and plans are under way for extensive operations. The company will manufacture tile and other burned clay products. John H. Sell, Bippus, is interested in the new organization.

PRINCETON—The Premier Refining Co., a subsidiary of the Consolidated Oil Development Co., recently organized, has work under way on a new gasoline process plant in the Oatsville field, near Princeton. A crude oil plant will also be operated by the company, and plans are now being perfected for the establishment of a distributing plant on site selected at Princeton. C. L. Herber, Terre Haute, is president; and L. C. Nicholson, Indianapolis, vice-president.

Kansas

ARKANSAS—The Moore Refining Co., recently organized with a capital of $1,000,000, has acquired the local oil refinery of the Milliken Refining Co., and has placed the plant in operation. The refinery has a capacity of 2,500 bbl. per day, and tentative plans are under consideration to increase this to more than 5,000 bbl. daily, with the construction of a large extension. George N. Moore, formerly president of the Shaffer Oil & Refining Co., Chicago, Ill., heads the new organization. E. R. Perry and W. R. Layne, both of Tulsa, Okla., are interested in the new company.

WICHITA—The Kansas-Texas Oil Co., a subsidiary of the Kansas-Texas Oil Corp. of New York, has acquired the local refinery and lubricating oil plant of the Derby Oil Co. Possession will be taken on July 1, and extensive operations are planned. The refinery has a rating of 1,800 bbl. per day, and was secured for a consideration of about $100,000. The Derby company is completing the erection of a new oil refinery on an adjoining tract, and will commence production at an early date. This latter plant will have an output of about 5,000 bbl. per day.

Louisiana

ALEXANDRIA—Bonds have been approved in an amount of $110,000, for the construction of a new municipal gas plant. Plans will be prepared at an early date. The City Council is in charge.

Maine

FAIRFIELD—The Keyes Fibre Co., has work under way on enlargements in its local pulp mill. A new conveying system will be installed in connection with other equipment for increased production.

Maryland

TEXAS—The Maryland Calcite Co., P. O. Box 102, recently organized with a capital of $100,000, has plans under way for the erection of a new local plant for the manufacture of whiting, marble flour and kindred specialties. Three 1-story buildings will be constructed, 20x88 ft., 16x20 ft., and 14x20 ft., respectively. The installation will comprise crushing machinery, rolls, elevating equipment, buhr mills, screens, etc., to provide for an initial output of about 100 tons per day. R. L. Lovell is president, and Richard E. Tome, secretary.

BALTIMORE—The Standard Acid Works, Inc., 1150 South Division St., will commence the immediate installation of a new steel tank and auxiliary equipment at its plant.

FROSTBURG — The Frostburg Sewer Pipe Co. is being organized with a capital of $200,000, to construct and operate a local plant for the manufacture of vitrified sewer pipe and affiliated burned clay products. A site for the plant has been selected, including clay properties for raw material supply. It is said that the initial works will cost in excess of $50,000. The Frostburg Commercial Club, T. C. Carrington, secretary, is interested in the project.

Massachusetts

PEABODY—The Wetan Leather Co., Danversport, Mass., has acquired the local plant of the Formal Leather Co., Central St. The structure will be remodeled and occupied by the new owner for the manufacture of a general line of upper leather. It will be used to replace the Danversport plant lately destroyed by fire.

Michigan

LAWTON—The Schlangen Brothers Co., 2435 Irving Park Blvd., Chicago, Ill., manufacturer of machine equipment, etc., has acquired a site at Lawton, for the erection of a new plant, 50x400 ft., for the manufacture of brass products. It is said that the present plant of the company will be removed to the new location in the near future.

LANSING—The Lansing Paint & Color Co., operating at the plant of the Lansing Chemical Co., acquired a number of months ago, will electrify all departments of the works heretofore using steam power, and will abandon the latter type of operation entirely.

CADILLAC—The Cadillac Malleable Iron Co., is completing the erection of a new foundry and will install equipment at an early date. It is planned to commence production at the plant early in the fall, giving employment to about 100 men. J. C. Ford is president, and George T. Mitchell, vice-president.

Nebraska

OMAHA—The Metropolitan Utilities District has plans under consideration for the installation of a new filtration plant at the waterworks, to cost about $600,000, including equipment. Plans will be prepared at once. F. D. Wead is chairman of the board.

New Jersey

YARDVILLE—The Spartan Rubber Co. has been organized with a capital of $100,000, to take over and operate the local plant of the Zee Zee Rubber Co., recently acquired from the receiver by Edward D. Newman, 29 Broadway, New York, N. Y., for $58,000, and who will be vice-president and secretary of the new organization. The plant will be improved in a number of departments and operations resumed at an early date for the manufacture of tires and other rubber products. It is planned to give employment to about 200 men, under a full time production schedule. Arthur Newman is president of the company, and Stanley Newman, treasurer.

NEWARK—The Premier Rubber Co., recently organized, has acquired the factory buildings at 218-24 New St., at Hoyt St., for the establishment of a new plant for the manufacture of rubber products. Equipment will be installed at once and it is proposed to commence production early in August.

DELAIR—The Kieckhefer Paper Co., Thorne St., Camden, has construction under way on its proposed new local plant for the manufacture of paper containers and kindred products. J. W. Kieckhefer is president.

PERTH AMBOY—The Perth Amboy Oil & Terminal Co., First National Bank Bldg., recently organized, has plans nearing completion for the construction of its proposed oil distributing plant on site, lately acquired at Woodbridge, near Perth Amboy. The new plant will consist of a number of buildings, estimated to cost $130,000, including tanks, machinery, etc. It will give employment to more than 150 men. Luke Mooney is president, and John E. Toolan, secretary.

New York

AMBOY—The Syracuse Pottery Co., 711 East Division St., Syracuse, has awarded a contract to Grassman, Jackson & Hunter, South Crouse Ave., Syracuse, for the construction of a new plant at Amboy. It will be 1-story, 40x140 ft., including kiln department. Work will be commenced at once.

North Carolina

WINSTON-SALEM—The John Reich Co., manufacturer of paints, varnishes, etc., has plans under way for the construction of a 2-story plant, 60x75 ft., to replace its factory recently destroyed by fire.

Ohio

BELLAIRE—The C. L. Dorer Foundry Co. has awarded a contract to the Riverside Bridge Co., Martins Ferry, O., for the construction of a 1-story addition to its foundry, 32x60 ft. C. L. Dorer is president and general manager.

NEWTON FALLS—The Newton Steel Co. has awarded a contract to the McClintic-Marshall Co., Pittsburgh, Pa., for the construction of a new plant addition, estimated to cost close to $750,000, including machinery. It will be equipped as a sheet mill.

Oklahoma

ARDMORE — R. H. Harris & Son, Ada, Okla., have plans in progress for the construction of a local brick-manufacturing plant, with capacity of 20,000 bricks daily.

Pennsylvania

GLASSMERE—Fire, June 19, destroyed a portion of the local plant of the Allegheny Plate Glass Co., with loss estimated at about 50,000, including equipment.

destroyed structure was 3-story, 50x100 ft., and was used primarily for a clay pot department. It is planned to rebuild at once.

PHILADELPHIA — Thomas Savill's Sons, 1310 Wallace St., manufacturers of pipe, etc., have awarded a contract to Seeds & Steinmetz, 1101 Divinity Pl., for the construction of their proposed 2-story foundry, 52x60 ft., at 635-37 North Watts St.

PITTSBURGH — Fire, June 21, destroyed two buildings at the plant of the Ball Chemical Co., Butler Plank Road, Wittmer district, with loss approximating $200,000, including equipment. The company manufactures paints, varnishes, etc. Its headquarters are in the Fulton Bldg. It is said that the plant will be rebuilt at an early date.

PHILADELPHIA—The Shingle Leather Co., 315 Vine St., has taken title to property at 54th St. and Grays Ferry Ave., 120x300 ft., to be used as a site for the construction of a 1-story plant, estimated to cost $50,000, for which contract recently was awarded to the Bowden Construction Co., 1713 Sansom St. Work will be placed under way at once.

NEW OXFORD—The Susquehanna Casting Co., Wrightsville, Pa., manufacturer of iron and steel castings, has commenced the construction of a new local foundry on property recently acquired.

South Carolina

GREENVILLE—The city Water Commission is planning for the installation of a new chlorinating plant at the municipal water works. W. C. Beecham is chairman.

Tennessee

KNOXVILLE—The Davis Mfg. Co. has plans in progress for the construction of a 4-story and basement plant on Asylum Ave., to be equipped for the manufacture of extracts. It will cost close to $250,000, with equipment. Grover C. Davis is president.

COLUMBIA — The American Agricultural Chemical Co., 2 Rector St., New York, N. Y., is reported to be planning for the construction of a new plant here, for the manufacture of commercial fertilizers, with capacity of about 150 tons per day.

Texas

WICHITA FALLS — The Texhoma Oil & Refining Co. has acquired the local oil-refining plant of the Bankers' Refinery Co., and will place the works in operation at once. It is proposed to develop an output of close to 4,000 bbl. per day.

Virginia

FREDERICKSBURG — The Natural Tanning Extract Co. has taken over the local dye plant of Walter Wilson & Brothers, and will operate the works for the manufacture of tanning extracts, including sumac, etc. The companies are affiliated. Walter Wilson is president of both organizations.

West Virginia

NITRO—The Charleston Paper Mfg. Co., Charleston, W. Va., has plans nearing completion for the establishment of its proposed paper-manufacturing plant on local property, improved with a number of buildings, lately acquired. The works will be remodeled; the main structure will be 60x560 ft. The project will involve about $400,000, with machinery. Charles G. Hartje, Steubenville, O., is president.

Canada

KIMBERLEY, ONT.—The Consolidated Mining & Smelting Co., Ltd., Montreal, Que., will commence the immediate erection of its proposed new concentrating plant on site near Kimberley, estimated to cost in excess of $1,000,000. It will be electrically operated in all departments and will have an initial capacity of close to 1,500 tons per day.

New Companies

THE ENGLISH CHEMICAL CO., Paterson, N. J., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are Fred G. Parker, Henry Benkes, Jr., and Henry Smith, 297 Main St., Paterson.

THE BLACK-IRON STOVE POLISH CO., Lawrence, Mass., has been incorporated with a capital of $70,000, to manufacture polishes and kindred products. Alvin L. Hofmann is president; and Richard P. Fiedler, 40 Swan St., Methuen, Mass., treasurer.

THE NONPAREIL GELATOID PRODUCTS CO., New York, care of A. G. Scheer, 149 Broadway, representative, has been incorporated with a capital of $10,000, to manufacture imitation celluloid and other composition products. The incorporators are M. Hicks and J. A. Pierce.

THE J. M. STOEVER CO., Chester, Pa., is being organized under state laws to manufacture chemicals and chemical byproducts, extracts and kindred specialties. Application for a state charter will be made on July 17. The company is represented by Kingsley Montgomery, Law Bldg., Chester.

THE FARMERS' COTTON OIL MILL & GINNERIES CO., Shellman, Ala., has been incorporated with a capital of $50,000, to manufacture oil products. The incorporators are W. J. Oliver, J. M. Bell and W. R. Terry, all of Shellman.

THE STRATFORD RUBBER MFG. CO., 1736 South Michigan Ave., Chicago, Ill., has been organized under state laws to manufacture rubber products. The incorporators are Paul P. Harris, Fred W. Reinhardt and John A. Russell.

THE ACID RECOVERY CO., Brooklyn, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, has been incorporated with a capital of $150,000, under Delaware laws, to manufacture acids and affiliated products. The incorporators are L. Lieberman, Walter K. Simonson, Brooklyn; and Otto Mantius, Englewood, N. J.

THE AMERICAN ASBESTOS MFG. CO., 336 Wayne St., Jersey City, N. J., has been incorporated with a capital of $50,000, to manufacture asbestos products. C. J. Skinner is one of the incorporators.

THE IRONIDE FOUNDRY, INC., Ware, Mass., has been incorporated with a capital of $50,000, to manufacture iron and other metal castings. Edward A. Johnson is president; and Stephen R. Jones, 220 North Main St., Brockton, Mass., treasurer.

THE BLUEBIRD OIL CO., Delmar (Albany County), N. Y., care of H. B. Casey, Albany, N. Y., representative, has been incorporated with a capital of $12,000, to manufacture oil products. The incorporators are J. O. Chamberlain, L. Arnold and E. C. Haswell.

THE COMBINED PRODUCERS OIL CORP., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $3,000,000, to manufacture petroleum products.

THE FRENCH COMPACT PRODUCTS CORP. OF AMERICA, Providence, R. I., has been incorporated with a capital of $10,000, to manufacture composition products. The incorporators are E. R. and Charles Z. Alexander, and Francis A. Cullen, all of Cranston, R. I.

THE A. C. RUBBER CO., Elyria, Ohio, has been incorporated with a capital of $10,000, to manufacture rubber products. The incorporators are W. R. Huntington and J. W. Dewhurst, both of Elyria.

THE PIONEER PETROLEUM CORP. OF AMERICA, El Dorado, Ark., has been incorporated with a capital of $1,000,000, to manufacture petroleum products. The incorporators are James A. Clark, George Irving and L. C. Harper, all of El Dorado.

THE RENNIEBUT RUBBER CO., 8 Van Wagenen St., Newark, N. J., has filed notice of organization to manufacture rubber products. The company is headed by Charles H. Tisserand, 177 Broad St., Newark.

THE KITTANNING GREY BRICK CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $100,000, to manufacture pressed brick and other burned clay products, with plant in Pennsylvania.

THE STANDARD CHEMICAL PRODUCTS CO., Hoboken, N. J., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are A. Lincoln Lavine, Henry Ruegg, Jr., and Louis L. Grombacher, 1021 Grand St., Hoboken.

THE SIMMONS INK CO., Indianapolis, Ind., has been incorporated with a capital of $5,000, to manufacture ink and kindred products. The incorporators are Richard Budlong, Paul Simmons and Earl Stansbury, all of Indianapolis.

THE AMERICAN ADAMITE CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws, with capital of $1,000,000, to manufacture special steel products.

THE LIMESTONE FERTILIZER & BALLAST ROCK CORP., Golconda, Ill., has been incorporated with capital of $150,000, to manufacture fertilizers and affiliated products. The incorporators are John O. Kluge, Thomas H. Lackland, and John B. King, 1000 Peoria Life Bldg., Peoria, Ill.

THE SUNSET RUBBER CO., Everett, Wash., has been incorporated with a capital of $150,000, to manufacture automobile tires and other rubber products. The incorporators are C. E. Powley, W. C. Cloud and William Sheller, 326 Stokes Bldg., Everett.

THE MEADOW OIL CO., Newark, N. J., has been incorporated with a capital of $25,000, to manufacture oil products. The incorporators are Armond R. Schorner, Richard Betterman and George N. Aubertin, 196 Market St., Newark.

THE SOUTHERN & WESTERN GLASS PRODUCTS CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under state laws with a capital of $2,500,000, to manufacture glass caskets and other glass products.

MARQUETTE & CO., INC., Haverhill, Mass., has been incorporated with a capital of $50,000, to operate a local tannery. George H. Marquette is president; and Oliver C. Frost, 66 Fountain St., Haverhill, treasurer.

THE WOOD COUNTY COTTON OIL CO., Mineola, Tex., has been incorporated with a capital of $56,000, to manufacture oil products. The incorporators are R. Bergfeld, W. W. Perry and H. W. Meredith, all of Mineola.

THE PYORHINE CHEMICAL CO., Seattle, Wash., has been incorporated with a capital of $40,000, to manufacture chemicals and chemical byproducts. The incorporators are David T. Lloyd and S. Ross Parker, 1603 Terry Ave., Seattle.

THE PLEASANTVILLE CONCRETE PRODUCTS CO., Pleasantville, N. J., has been incorporated with a capital of $50,000, to manufacture cement and concrete specialties. The incorporators are A. J. Milliken, Philip S. and Carlton Godfrey, 317 Guarantee Trust Bldg., Atlantic City, N. J.

THE HANDY GLASS CO., Philadelphia, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., has been incorporated under Delaware laws, with a capital of $200,000, to manufacture glass products.

THE CAPITAL FIBRE CORP., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under state laws, with capital of $2,000,000, to manufacture fiber products.

THE ERNFINE TRADING CORP., New York, N. Y., care of Latson & Tamblyn, 66 Broadway, representatives, has been incorporated with a capital of $75,000, to manufacture fire prevention chemicals. The incorporators are W. N. Wilkinson, J. T. Barry and W. N. Wilkinson.

THE TROGIN PRODUCTS CO., 244 Wayne St., Jersey City, N. J., has filed notice of organization to manufacture chemicals and chemical byproducts, drugs and kindred products. The company is headed by H. George Tilleman and L. A. Sista.

THE CLAYTON OIL & REFINING CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $850,000, to manufacture refined petroleum products.

THE PAN AMERICAN SOAP CO., Brooklyn, N. Y., care of Louis Horwitz, 772 Broadway, Brooklyn, representative, has been incorporated with a capital of $5,000, to manufacture soaps and kindred products. The incorporators are B. Gerber, M. Klaits and E. Schneider.

THE CENTURY CHEMISTS, INC., Room 1224, 202 South State St., Chicago, Ill., has been incorporated with a nominal capital of $1,500, to manufacture chemical specialties and preparations. The incorporators are F. King, P. Stolz and H. H. Sharpe.

THE KY-IND-O OIL CORP., Lexington, Ky., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are S. G. Smelser and George N. Snyder, both of Richmond, Ind., and Z. O. Avry, Lexington.

THE MINEOLA TILE MFG. CO., Mineola, L. I., care of Seabury, Seaman & Gehrig, Hempstead, L. I., representatives, has been incorporated with a capital of $50,000, to manufacture tile and other ceramic products. The incorporators are E. Schmidt, A. A. Lein and E. J. Armstrong.

THE VITROLITE PRODUCTS CO., 218 North Union Ave., Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture composition products. The incorporators are F. J. and Thomas C. Downs, and J. F. Hardin.

THE SIX MEDALS CHEMICAL CO., New York, N. Y., care of J. M. Frost, 174 Rivington St., representative, has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are H. Kaufman and L. Perlstein.

THE P. T. L. MFG. CO., 219 Ave. E. Bayonne, N. J., has filed notice of organization to manufacture chemical specialties,

disinfectants, etc. Isadore Hollender heads the company.

THE BLOOD RIVER OIL CO., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated with a capital of $300,000, under state laws, to manufacture petroleum products.

THE OTIS-GRAY CO., 208 South La Salle St., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture petroleum and other oil products. The incorporators are L. L. Losey, Max Haleff and D. D. Stansbury.

THE MARYLAND CALCITE CO., Texas, Md., has been incorporated with a capital of $100,000, to manufacture lime and affiliated products. The incorporators are Raymond L. Lovell, Richard E. Tome and Palmer R. Nickerson, all of Texas, Md.

THE AMALGAMATED PETROLEUM & REFINING CO., New York, N. Y., care of Leonard E. Wales, Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,500,000, to manufacture refined petroleum products. The incorporators are Martin V. McTuigg, Arthur W. White and George L. Barney, New York.

THE LANE RUBBER CO., INC., Norwich, Conn., has been incorporated with a capital of $50,000, to manufacture rubber products. The incorporators are George E. Hall, R. E. and C. E. Lane, 46 Hamilton Ave., Norwich.

THE ALBEMARLE SOAPSTONE CO., Esmont, Va., has been incorporated with a capital of $150,000, to manufacture commercial soapstone products. H. P. McCary is president; and E. W. Scott, Jr., secretary, both of Esmont.

THE NORTHWEST REFINING CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated with a capital of $1,300,000 under Delaware laws, to manufacture petroleum products.

THE SWANSON OIL CORP., East Peoria, Ill., care of William J. Peck, Jefferson Bldg., Peoria, Ill., representative, has been incorporated with a capital of $25,000, to manufacture refined oil products. The incorporators are Otto B. and Edward A. Swanson, and Oakley Marlott.

Industrial Developments

RUBBER—The B. F. Goodrich Co., Akron, O., has advanced production from 18,000 to 22,000 tires a day at its local plant.

All tire-manufacturing plants at Columbus, O., have been placed on a capacity basis, under two-shift operation.

The Goodyear Tire & Rubber Co., Akron, O., has increased production to a maximum of 32,000 tires a day at its Akron, O., California and Canadian plants; the output of the first noted factory is now rated at 26,000 tires daily.

The Republic Rubber Corp., Youngstown, O., has increased production from 1,500 to 1,800 tires a day at its local plant. The mechanical rubber goods department is running full, and orders in this branch are said to be in excess of output.

The Firestone Tire & Rubber Co., Akron, O., has advanced operations to a maximum of 25,000 tires a day at its local plant.

The rubber specialty departments of mills at Akron, O., have developed the heaviest production during the past few weeks than evidenced for more than a year past. A number of plants are working an extra night shift.

The Continental Rubber Co., Torreon, Mex., is curtailing operations at its local plant owing to the unsatisfactory labor conditions in this district and the low price of crude material.

The Miller Rubber Co., Akron, O., has increased manufacture from 6,500 to 7,500 tires per day.

CERAMIC—Clay products plants at Irondale, near Salineville, O., are increasing production and making additions to their working forces. The McClane Fire Brick Co. is operating both of its local plants at capacity; the Benfield Clay Co. has advanced production to 100 per cent, giving employment to about 75 men; the East Ohio Sewer Pipe Co. is running full at its No. 2 plant, giving work to a regular quota. The No. 1 plant of the last noted company is still idle, but is expected to resume in the near future.

All brick manufacturing plants in Texas are running at maximum capacity, according to a report made at the recent annual meeting of the Texas Brick Manufacturers' Association, and the present year is expected to be the greatest in the history of the state industry.

IRON AND STEEL—The Bon Air Coal & Iron Co., Nashville, Tenn., has resumed operations at its Goodrich blast furnace, following a suspension since November, 1920. It is planned to develop capacity at an early date.

The Crucible Steel Co., Pittsburgh, Pa., is running at from 70 to 80 per cent of capacity at its different plants. Each month is showing an improvement over the previous one, it is stated.

The United Alloy Steel Co., Canton, O., is operating at capacity at its heat-treating department and cold-drawing mills. All bar mills are in service, and production is being advanced in the open-hearth department. The company is said to have orders on hand for at least two months' maximum capacity.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., is planning to blow in its No. 4 stack at Bessemer, Ala., at an early date. It will produce foundry pig iron.

The Sharon Steel Hoop Co., Youngstown, O., will blow in its blast furnace at Lowellville, O., at once, making the sixth unit to be placed in service by the company since the commencement of the coal strike. The Lowellville furnace will be used for supplying the local mills.

The Robesonia Iron Co., Robesonia, Pa., has placed its recently relined furnace in blast, following an idleness of several months. Employment will be given to about 150 men, with the unit operating on a basis of 250 tons per day. An advance of 10 per cent has been made in wages at the plant.

The Midvale Steel & Ordnance Co., Philadelphia, Pa., is now operating at about 75 per cent of normal at its plants.

Mudge & Co., operating a blast furnace at Sharpsville, Pa., has increased the capacity of the plant to about 400 tons a day. Four hot blasts are now being added.

The Republic Iron & Steel Co., Youngstown, O., is planning to light another furnace at an early date for the production of Bessemer iron. Closely following, it is expected to resume at the steel-making mills, which have been idle for a number of months.

The Eastern Steel Co., Pottsville, Pa., is resuming operations in all departments of its plant, with the exception of the open-hearth furnaces. The plant has been on a curtailed basis for the past 18 months.

The Charcoal Iron Co. of America, Ashland, Wis., is resuming operations at three of its four plants, including the local mills and works at Newberry and Manistique, Mich. The Ashland plant has been improved and extended, and a new 175-ft. stack built. It will run on pig iron- charcoal, alcohol and byproducts, giving employment to about 600 men. The blast furnace department will engage a quota of 150 operatives. The plant of the company at Boyne City, Mich., is still shut down, and is not expected to resume until later in the year.

METALS—The Shasta Zinc & Copper Co. has resumed operations at its plant at Winthrop, Cal., giving employment to about 200 men. As soon as conditions warrant, operations will be advanced to maximum, totaling close to 300,000 lb. of copper, and 2,000,000 lb. of zinc oxide per month.

The Canada Copper Corp. is considering the resumption of production at its plant at Princeton, B. C., early in August. The mill has a capacity of about 2,000 tons a day.

The Eureka Metallurgical Co., Salt Lake City, Utah, is completing a new test mill on site south of the city, and plans to place the unit in service at an early date.

The International Smelting Co., Salt Lake City, Utah, has resumed operations at its Utah plant, following a suspension for more than a year past. One of the copper reverberatory furnaces has been blown in, to operate with a daily capacity of approximately 300 tons. A number of lead furnaces will be placed in service, to develop an output of 400 tons a day of lead ores and concentrates.

MISCELLANEOUS—The Pennsylvania Glass Sand Co. has resumed operations at its Dawson Works, Vineyard, Pa., following a suspension for a number of months.

The Lehigh Portland Cement Co., New Castle, Pa., has placed its three local mills on a capacity basis, giving employment to an increased working force.

The Atlas Portland Cement Co. is maintaining operations at its large mill at Northampton, Pa.

The General Leather Co., Newark, N. J., specializing in automobile leathers, will soon commence production in its new local plant, which has been in course of construction for some time past. The structure forms a complete duplicate plant unit, and is expected to double the output.

Capital Increases, Etc.

THE COMMERCIAL SOLVENTS CORP., Terre Haute, Ind., manufacturer of alcohol solvents, etc., is disposing of a stock issue of $1,800,000, the proceeds to be used for general expansion. P. G. Mumford is president.

THE CHICAGO BRICK CO., 38 South Dearborn St., Chicago, Ill., has filed notice of increase in capital from $10,000 to $250,000, for expansion.

THE SANIWAX PAPER CO., Kalamazoo, Mich., has filed notice of increase in capital from $20,000 to $215,000, for general expansion.

THE RACINE HORSESHOE TIRE CO., Racine, Wis., manufacturer of automobile tires, etc., is disposing of a bond issue of $300,000, the proceeds to be used for general expansion. J. B. Lawrence is president.

THE INDEPENDENT PAPER MILLS, INC., 68 35th St., Brooklyn, N. Y., has filed notice of increase in capital from $50,000 to $100,000.

THE UNITED GLUE CO., Indianapolis, Ind., has filed notice of dissolution under state laws.

THE WHITTEMORE GLASS CO., Dunbar, W. Va., manufacturer of window glass, is arranging for an increase in capital to $500,000, for general expansion. A. P. Whittemore is president.

Grayson Stetson has been appointed receiver for the TEMPLER LEATHER CO., Salem, Mass.

THE COLLOIDAL PROCESS PAINT CO., Baltimore, Md., has arranged for an increase in capital of $100,000, the proceeds to be used for general expansion, at the same time filing notice of change of name to the National Bitumens Corp.

THE MISSOURI PORTLAND CEMENT CO., St. Louis, Mo., has arranged for a bond issue of $2,000,000, a portion of the proceeds to be used for expansion.

THE LION OIL & REFINING CO., Kansas City, Mo., has filed notice of increase in capital from $450,000 to $750,000.

THE FIRESTONE TIRE & RUBBER CO. OF CANADA, LTD., Hamilton, Ont., a subsidiary of the Firestone Tire & Rubber Co., Akron, O., is disposing of a bond issue of $1,500,000, a portion of the proceeds to be used in connection with the erection of a new local plant, general operations, etc.

THE CENTRAL SHALE OIL CORP., Highland Blvd., Pittsburgh, Pa., has filed notice of increase in capital from $1,000,000 to $1,500,000.

THE WAUKEGAN CHEMICAL CO., Waukegan, Ill., has filed notice of increase in capital from $10,000 to $25,000, for general expansion.

The foundry and property of the EMERY STEEL CASTINGS CO., South Charles and Hanover Sts., Baltimore, Md., will be sold by Albert R. Stuart, trustee in bankruptcy.

THE MESABI IRON CO., 25 Broad St., New York, N. Y., a Delaware corporation, has filed notice of increase in capital from $53,000,000 to $103,000,000, for general expansion.

THE LION TIRE & RUBBER CORP., Lafayette, Ind., has filed notice of increase in capital from $500,000 to $700,000, for general expansion.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold a summer excursion meeting to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo, Aug. 13-19.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
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Demand on Chemical Foundation For Return of German Patents

WHEN a bomb explodes, either literally or figuratively, a close observer will at first be conscious only of a series of scattered and disconnected impressions. Afterward a coherent story comes out of the experience. That is exactly what happened in the chemical industry when President HARDING'S letter to the Alien Property Custodian was published last Saturday. The President directed him to demand the return of all patents, trade marks, etc., sold to the Chemical Foundation, Inc., and to act upon the advice of the Attorney-General in carrying out the instructions. The Attorney-General has since subpœnaed the Foundation's books and papers before a grand jury in Washington.

The first reactions among those interested in the chemical industry and the Chemical Foundation were rather vague and indefinite. How much politics was involved in the President's order? What agencies had succeeded in thus crystallizing sentiment against the Chemical Foundation? Had that organization been guilty of anything not legally or morally straight in its transactions? What would be the effect of the President's order on the chemical industry, particularly the dye industry of the country? Were German propaganda and influence, as represented by dye importers, in any way responsible for persuading Washington to take this step? These and other questions flashed through the mind without apparently throwing any light on the situation. But out of all the speculation that has been rife we may now single a few outstanding facts and probabilities, and on them base with some degree of assurance a reasonable prediction.

The basis of the President's order is that "it appears that the sale was made at so nearly a nominal sum that there is reason to believe that this government has not faithfully observed the trust which was implied in the seizure of this property." No one can find fault with this basis for the demand. Under the trading with the enemy act, the Alien Property Custodian seized enemy property and held it in trust for its owners. Presumably that property or its value was at some time to be returned to those from whom it was seized. If it was sold, the sale presumably should have been at a price commensurate with the value of the property. The President, therefore, cannot be criticised for desiring "to maintain the sacred character of the trust to which the Alien Property Custodian is committed by the law." The natural consequence is, to use the President's own words, "that full investigation becomes a public duty."

By all means let's investigate and let the fullest publicity be given to the investigation. If, as in the case of Senator KING'S investigation of the dye industry, the original charges prove to be fictitious, the Chemical Foundation will be more firmly established than ever. If, on the other hand, it can be proved that more should have been paid for these patents than was paid under the direct orders and with the full approval of the government, then let a proper adjustment be made. But before any such settlement is made, and particularly before any charges of corruption and unfairness are entertained let all the facts be known. The Chemical Foundation has been under fire before now. Its scheme of organization, its methods of conducting business, its resources and the disposition of its income have been the subject of public inquiry. But if we were the Chemical Foundation we would not only welcome but would now demand a clean-cut investigation.

There can be no doubt, however, that behind the President's order there is some yielding to political clamor. Our Washington correspondent says that while there is no tendency to charge ulterior motives to the Administration, it is nevertheless felt that the Attorney-General, who has been subject to repeated attacks in Congress, welcomes any action that will serve as a smoke screen to divert from him the unwelcome attention he has been receiving. Further, there is in Congress a group of partisans, mainly Republicans but with some Democratic adherents, who would like nothing better than to see former Attorney-General PALMER and former Alien Property Custodian GARVAN skinned out of their political hides. Finally, there is the ever-present animosity of dye importers whose views sometimes find favor in strange political quarters.

But what will be the ultimate result and the intervening consequences of the President's order? It may almost be set down as a certainty that the Chemical Foundation will never return or be obliged to return the property it bought. The men who organized it and the chemical companies who are stockholders in it have as good business and legal minds as there are in the country, and it is not likely that they would have invested capital or taken licenses on patents if the business were on so flimsy a basis as to be summarily overthrown. As to the intervening consequences, the legal battle that will follow the demand of the Alien Property Custodian is certain to be long and tedious, for there is no better legal talent in the country than will be arrayed against the Attorney-General in this case.

It is, of course, unfortunate that the President issued his order at this time, because it may seriously affect matters of great importance to the chemical industry now pending in Congress, notably the dye embargo. As for production under the licensed patents, however, it seems unlikely that this will be adversely affected, because arrangements undoubtedly can be made for licensees to continue manufacture under a court order for periodical accounting. Temporary disturbance seems inevitable, but in the end we hope for a clean-cut verdict—a vindication or a conviction.

"Seein' Things at Night" In Our Patent System

EVER since the war revealed the deplorable dependence of our organic chemical industries, notably the making of dyes, Congress has made recurring attempts to modify our patent system by compelling patentees to work their patents in the United States within a period of 2 to 5 years on pain of granting licenses to others who would put them into productive operation. The motive behind these various proposals has been to prevent foreigners from patenting their inventions in the United States and then operating them in their own countries and exporting the products to America.

It is an old bugaboo—this fear of foreign brains and ingenuity—and one that will not be laid low by the proposed compulsory working and compulsory licensing amendments to our patent law. England has experienced and survived the same fears. The United States enacted a compulsory working clause in 1832, but repealed it in 1836. Since then attempts to enact similar legislation have been made by OLDFIELD in 1912, PAIGE in 1915 and STANLEY in 1921 and 1922.

Senator STANLEY has been particularly persistent in his efforts. His first bill, in 1921, proposed to compel *foreigners* who patented their inventions in the United States to put them "in operation so as to result in actual production" in this country within a period of 2 years from the date of issue, failing which the United States would reserve the right to license anyone for purposes of domestic manufacture. This bill was invalid because it violated the International Convention for the Protection of Industrial Property, to which the United States is a party and which has been interpreted to mean that any country which is a party to the Convention cannot discriminate against foreign nationals of Convention countries. So Senator STANLEY redrafted his bill to provide that "*any* patent . . . shall contain a proviso to the effect that if such patent . . . is not worked or put in operation so as to result in actual production in the United States . . . within a reasonable time from the date of its issue . . . the United States reserves the right to license any person or persons for purposes of manufacture in the United States." This proposal aroused considerable opposition and on April 20, 1922, Senator STANLEY proposed a further amendment providing in effect that if a United States patentee fails to work his invention in this country within 2 years of the issuance of his patent, and if it is worked in a substantial manner in a foreign country, he can be compelled, on the petition of any reputable American citizen or business organization brought in the U. S. Circuit Court of Appeals, to grant a license to the petitioner upon equitable terms.

We regard this proposal as pernicious regardless of its various legislative forms, and are firmly of the opinion that if enacted into law it would, in the long run, have a baneful influence on American chemical industry. It is true that the Stanley bill apparently has received some substantial support from the Manufacturing Chemists Association, the American Institute of Chemical Engineers, and lately from the American Chemical Society. But we think it is fair to point out that this support comes from laymen and not from those who are most familiar with patent procedure. Further, that most of the support is due to the activities of Mr. HENRY HOWARD, whose energy and determination we admire, but with whom we are obliged to differ on this question. An imposing array of testimony against the measure has been collected and published by the American Patent Law Association giving almost indisputable proof of the futility and folly of the bill. The reader will also find on another page in this issue a thoughtful analysis of the consequence of compulsory licensing, prepared by Dr. D. B. KEYES.

Incidentally, the support apparently given by the American Chemical Society does not carry conviction. The action was taken by the Committee on National Policy in opposition to the advice and opinion of the society's Patent Committee. It was reported editorially under the misnomer "Patent Progress" in the June issue of the *Journal of Industrial and Engineering Chemistry*. Reading between the lines, one may conclude that the editor had but little heart for this particular job, for he wrote a halting and apologetic defense of the action of the Committee on National Policy in overriding the more expert advice of its Patent Committee. The chairman of the latter, Mr. E. J. PRINDLE, naturally resigned. The editor further was misled into stating that the STANLEY bill as now amended "applies only to American patents which are also taken out in foreign countries (less than 10 per cent)." Such is not the case. Senator STANLEY'S latest amendment provides that "2 years after issuance of *any* United States patent . . . if it is shown that the invention covered by such patent is being worked in substantial manner in a foreign country, and that the owner thereof has failed to work it in the United States . . . then on the petition of any reputable American citizen, corporation or partnership . . . the court shall order a non-exclusive license granted to the petitioner." The wording is so clear as to preclude misunderstanding, and the proponents of the measure use a specious argument in claiming that the bill applies only to American patents which are also taken out in foreign countries. It applies to *any* American patent. Yours, for instance!

Isn't it true that fear of the foreigner, and particularly the German dye chemist, is at the bottom of this move? Isn't it the purpose to erect another artificial barrier like the tariff or the dye embargo? No voice has been raised louder than ours in behalf of an American organic chemical industry. But in all the effort that has been made to obtain a protective tariff, even an embargo, for the dye industry of this country it has been clearly recognized that time is the essential element to permit us ultimately to meet foreign competition. It has been our boast that we have the brains, the ability and the materials. All we have asked is time in which to solve our problems, and it has been assumed that we would work out our own salvation.

But we cannot always support a spoon-fed industry. Some time we must quit playing with palliatives. Some time we shall have to stop nursing the industry along with business nostrums. Sooner or later we must depend upon research and development, and these will not be fostered by the Stanley bill in any of its forms. Under the Stanley bill industrial research will wane because it will be cheaper to take licenses; chemical education will not thrive because there will be no demand for chemists; the poor inventor will become extinct because corporations looking for licenses can easily bring him to terms; and as for the national defense, we shall be quite at the mercy of the nations that conduct research and from which we take licenses. In short we shall develop a fine case of fatty degeneration of industry in the United States.

In our judgment the Stanley bill is not only per-

nicious but it is short-sighted and futile. It is looking for something for nothing. Instead of indorsing it our chemical industry should oppose it; and as for the War Department, Secretary WEEKS will be well advised to turn his attention to organized and continuous research and see that the Chemical Warfare Service is supplied with adequate funds for the purpose.

Let's quit "seein' things at night" and go to work! Let's quit breaking up technical organizations and start on a campaign of supporting chemists and research. Let's quit worrying about the other fellow and do some thinking on our own account. Let's quit tinkering with the patent system and make use of a plan that, with all its faults, has developed and fostered the inventive ingenuity of the American people. Compulsory working or compulsory licensing will never foster a dye industry or any other chemical industry in this country.

"Blue" Gas for Heating Coke Ovens And Other Industrial Furnaces

IT HAS been customary to heat coke ovens with a portion of the gas driven off from the coal treated in them. In some cases use is made of the lean-gas produced in the latter portion of the carbonizing period, in others a portion of the run-of-oven gas is used. But in either case only about half of the total gas output is available for use elsewhere in the plant or for sale. In fact, this "surplus" is often much less than half the total and rarely exceeds 60 per cent of the production.

As a consequence of this oven-heating practice, there has been little flexibility in coke-oven installations with respect to the ratio of yields of coke and of gas. Some variation is possible by increasing or decreasing the coking time, but the change in the ratio is not large. The newer idea, which has been applied in a number of plants recently, has been to heat the ovens with producer-gas or blue-gas made in outside generators. When operating on this scheme all of the oven-gas can be considered "surplus," or a part of it may be used for heating the ovens, as conditions may determine.

Where there is a ready market at a good price for practically all the gas made in the coke oven, this separate system of heating is of great importance. And in localities where the controlling product from the ovens is really gas, because this is used in public utility distributing systems, flexibility in gas output relative to coke production is of greatest importance. This has been a question of great financial concern during the past year or two when the demand for gas in such plants continued about as formerly, but the market for coke was at a very low ebb, in some cases almost nil.

In one or two plants gas producers have been installed to meet this situation, and producer gas is now used for heating the ovens part or all of the time. The use of blue-gas, however—that is, uncarburetted water gas—has under certain circumstances distinct advantages over the use of producer gas. The blue-gas can, if necessary in an emergency, be mixed with coke-oven gas and distributed through the public utility system. Thus the blue-gas generator affords standby equipment for the gas system as well as an agency permitting greater flexibility in the operation of the coke ovens. Moreover, both gas producer and blue-gas generator are coke consumers as well as gas-making devices; thus either serves doubly in the effort to reduce the coke output relative to gas output when this is a desirable end.

The plant of one local company which has met this situation very successfully is described by an article in this issue. The results presented by Mr. O'MALLEY in that article will be of interest to members of the gas industry and coke-oven operators generally. They should also appeal strongly to many chemical industries that have a problem of fuel gas to consider.

Blue-gas is one of the finest industrial fuels. Its manufacture on a small scale is possible either with continuous or intermittent operation of the generator. Industrial application of blue-gas has not been general, but more attention should be given to the possibilities of this very fine fuel. Those who have high-temperature heating problems will do well to study particularly the chart in Mr. O'MALLEY'S article, which shows the advantages of blue-gas.

As It Was In the Beginning?

IT WAS our good fortune to spend our earlier days in a small country town. Without making any invidious comparisons we shall always hold that there can be no better place in which to grow up. There are, however, certain aspects of village life which are not, perhaps, as fine when you have to live through them as they are humorous when you look back upon them.

As a case in point, there was Uncle Billy Palmer. Uncle Billy was our village rich man—the man who owned the most property, paid the largest tax, and, consequently, whose word carried the greatest weight in town meeting. He held, in the eyes of the village, a position of Czar and Grand Pooh Bah rolled into one.

From time to time the even flow of life in our town would be disturbed by an outbreak of typhoid. This was in the days before anti-typhoid inoculation was known and when the means of prevention through sanitation were only in their infancy. After much search, the spread of the disease was, however, traced to the contamination of certain wells and a town meeting was called to see what could be done.

The general opinion of the meeting was that a sewerage system should be installed and estimates were called for from the county engineer. But here the meeting met a snag. Uncle Billy fought the proposition tooth and nail. His father and his grandfather before him, he said, had got along without sewers and he'd be eternally danged if he'd ever stand for such new-fangled notions. To make a long story short, the town got no sewers until Uncle Billy was gathered to his fathers. Health and happiness were compelled to wait on stubborn conservatism and old-fashioned ideas.

This tale holds a lesson for those of us who control the affairs of an age which we like to think of as enlightened and progressive. You will find in this same issue an account of what one company has done toward progress in the manufacture of porcelain. This has been accomplished in spite of the strongest kind of opposition from porcelain men within this company, and under the ridicule and doubt of porcelain manufacturers in general. Since the new system of manufacture has proved successful the general attitude of the industry has been that it may work in that particular plant, but it would never work in any other.

Are those responsible for production methods in the porcelain industry going to be unclebillypalmers and compel progress to await their demise? Or are they going to see the light of a new day of manufacture, and by bringing their methods up-to-date, place themselves in a position to compete with foreign products.

Readers' Views and Comments

The Stanley Patent Bill

To the Editor of Chemical & Metallurgical Engineering

SIR:—On May 13, 1922, the committee on national policy of the American Chemical Society unanimously adopted a resolution stating that the society was "in favor of the principle of the Stanley bill, S. 3410, as amended April 20 (calendar day May 4) 1922." This resolution, I understand, was unanimously opposed by the patent committee of the society. Evidently there is a difference in opinion as to what really is the "principle" back of the Stanley bill.

The resolution adopted at that time also stated that the society suggested that "public welfare and the national defense" be considered of equal importance, if the bill is to be modified. It is important to consider the probable effect on the national defense and the public welfare if the bill should be passed as it now stands.

Briefly the bill states that if two years after an American patent is issued the invention is being worked in a foreign country and not in this country, the inventor must grant a license at reasonable terms to any American who desires it. The terms and the general question are to be decided by a United States Circuit Court of Appeals.

The Effect on Industrial Research

The concern which employs a large staff of skilled research chemists might find it not only cheaper and more practical but also safer to buy from someone else the results of research. This last point needs some explanation.

It has been stated that the bill will affect only those patents for which there are corresponding foreign patents, and it is estimated that this includes only 10 per cent of our patents. This, however, is not the case. The bill makes no mention of a foreign patent, but does state that the invention must be in the process of being worked in a foreign country. In other words, the bill applies to *any* American patent that is not being worked in this country, if for any reason at all it is being worked in a foreign country. There is no reason why an American who wishes to seize an unused U. S. patent should not prevail on some one to work the invention in a foreign country, or do it himself. Under the workings of the Stanley bill the American concern that has employed a large staff of skilled research chemists would discover that the value of the patents produced by their staff had diminished. Some of these patents would probably be seized by competitors. The natural attitude would be to discharge the research staff on buying the results of research work from others and especially from the Germans, who do all they can to foster research.

The Effect on Educational Institutions

Professors and instructors in chemistry are hired by our universities to train young men to satisfy the demand of our chemical industries. Anything which affects this demand will affect the salary and number of professors employed. This bill gives the manufacturer the privilege of buying the results of foreign investigators at a nominal sum. It is quite evident that the manufacturer will not fail to seize this opportunity and the need for American professors and instructors in chemistry will be diminished.

The Effect on Subsidized Research

The chemical manufacturer often pays universities, private institutions and consulting chemists to solve his problems. If he should suddenly find that he could purchase the solution at a lower figure from some foreigner, he would be inclined to do so. Business efficiency would demand it, even though our American research men would suffer. Industrial fellowships would be cut down to a minimum and the demand for American consulting chemists would become less.

The Effect on Government Research

Our own government, which employs a vast number of research workers, may also come to the conclusion that in many instances it will be cheaper to buy foreign ideas and the results of foreign research rather than to maintain large research organizations of its own.

The Effect on the Individual Inventor

The research chemist, inventor and patentee who is not employed by any one else must be considered. His chances of obtaining adequate compensation for his work will be less than ever if the Stanley bill becomes a law. As I have already explained, a corporation can easily bring him to terms advantageous to itself by merely working the invention in a foreign country.

The Effect on the National Defense

The War Department is interested in this bill because it believes there would be a tendency to prevent a foreign country from checking the development of American industries necessary in time of war. It is reasonable to suppose, however, should this bill be passed, that no foreign country would patent or disclose any invention absolutely essential in war. If the War Department is interested in the national defense, it is also interested in fostering chemical and scientific research in this country. Why then is it interested in a bill which will have a tendency to eliminate research in this country and foster it in some foreign country?

The Effect on the Public Welfare

The old bugaboo that German chemists are the finest in the world and no other nationality can successfully compete with them is heard again. One manufacturer believes that within ten years the Germans will be far ahead of the American in chemistry. They most certainly will if we eliminate our research men and pay the Germans to do the work for us.

It is evident to every American chemist that our chemical industry has a marked effect on the public welfare. If the Stanley bill becomes a law, it means that our chemical industry will steadily diminish and the American people will suffer.

D. B. KEYES.

New York, N. Y.

Fullers Earth

To the Editor of Chemical & Metallurgical Engineering

SIR:—The article in your issue just received mentions incidentally that fullers earth absorbs basic dyes. There is a practical application of this property in the manufacture of "lime green," certain qualities of the English earths, generally the cheaper ones, giving superior results to the German "green earth" formerly used as the basis. The colored paste after absorption of the brilliant green tends to dry hard, but this is counteracted by admixture of the cheaper calcium sulphate. This admixture makes the color from all "green earths" I have tried go dull; with a suitable fullers earth it remains bright. The fastness to lime and light of the pigment produced varies with the source of the earth. As the coarseness of the usual product restrains use for paper staining, it would be worth while trying the fines mentioned for these and other applications.

A matter of more general interest is the specific difference the action of methylene blue and the basic triphenyl methane dyes. The pigment with brilliant green is turned a dirty brown permanently by vacuum drying, dried by hot air the color is soluble in alcohol; the methylene blue pigment regains its blue after vacuum drying, the color is insoluble in alcohol. This insolubility in alcohol may be connected with the ring structure, as it is exhibited to a lesser degree by acridine yellow.

Manchester, England. E. F. MORRIS.

Civil Sentiment Toward Chemical Warfare

To the Editor of Chemical & Metallurgical Engineering

SIR:—Evidence is accumulating that civil sentiment in the country with regard to chemical warfare is growing more favorable to the retention of the Chemical Warfare Service as a unit of the army and toward continued research in gas warfare. The accompanying editorial, published in a recent issue of the Chicago *Tribune*, expresses civil opinion more strongly than I have yet heard it in private conversation or seen it in the public print, outside of your own magazine.

Chemical Warfare

One of the Washington agreements outlawed gas and chemical warfare. The United States has ratified it and other agreements. The other nations have not ratified and the American War Department reports that many of the others, including Great Britain, are pressing active investigations of gas weapons.

Great Britain was in favor of prohibition. The British have two fears. One is fear of the use of gas against London and other centers of congestion and production on the island. The other is fear of the submarine against British commerce. Both the gas and the submarine prohibitions worked into the Washington agreements are believed to represent Great Britain's price for agreeing to American proposals.

American civilian sentiment opposes both gas and submarines, and opinion is not based upon reason or prospects, but upon innate abhorrence of war, particularly when it strikes the imagination as cruel and unusual. The *Tribune* believes that the prohibitions which this sentiment indorsed were unwise and detrimental to the United States.

The activity of the other nations, including the British, indicates that in no other country will there be any letup in research and preparedness in chemical warfare. Americans probably will know as little as possible about it, but the others, even promising not to use gas, will be experts in the offensive and defensive of chemical war.

That is our loss and may be our danger. Warfare which depends upon the industries, the laboratories and the science of a nation may be the protection of peaceable, industrial people. It is part of the supremacy of a high civilization over a low civilization.

All explosive shells release lethal gasses. Men in dugouts are killed by fumes, although not reached by the explosive force. Evasions of the stipulated prohibition are easy and it is a reasonable probability if not a certainty that a nation which could save itself by the use of gas would not hesitate to use it.

When men in peace and security attempt to bind men in peril and desperation they frequently fail. War is the business of overcoming an enemy's resistance and the accomplishment of a purpose by force. It is not a game. It is not undertaken in the spirit of sport. People who are fortunate do not have to undertake it at all.

When they do they will not say that they will not use a weapon with which, if they used it, they might save themselves. If a British commander, attacked by thousands of dervishes, could save his command and disperse the enemy by use of a lethal gas, he would be inhuman if he did not do so.

The sentiment against gas reveals one of the taboos of the sentimental mind and does not proceed from its reasoning.

Congress will be well advised to continue the Chemical Warfare Service and to provide adequate appropriation for research. C. W.

New York City.

An Outline of the Uses of Lime

To the Editor of Chemical & Metallurgical Engineering

Sir:—Referring to Mr. Holmes' reply[1] to my criticism of his article,[2] I cannot see the connection between his second statement and the original.

The original read: "There are three kinds of stucco—viz., straight lime and gaged stucco and sorrel (*sic!*) cement. In the first two, lime serves as a bonding agent, plasticizing agent, toughening agent and water-tightening agent. In sorrel cement the action of lime is primarily chemical instead of physical."

The reply states: "The use for lime that we had in mind for the manufacture of sorrel cement was not the addition of lime to the cement, but the use of a dolomitic lime as the base for the cement. . . . The process . . . consists of burning dolomitic lime at a temperature at which the calcium carbonate is not decomposed."

Leaving out an apparent confusion of the terms "lime" and "limestone" in Mr. Holmes' communication, I am unable to see, if the calcium carbonate is not decomposed and hence is inert, how its action can be primarily chemical. Moreover, if the calcium carbonate is not decomposed, this is not a "use of lime"; the calcium carbonate is a mere inert filler, equivalent to sand. It is a use of dolomitic limestone for the magnesia content.

On the other hand, if the original paper is correct in stating the action is primarily chemical, how is this gained by leaving the calcium carbonate undecomposed? DONALD M. LIDDELL.

New York.

Magnesite in 1921

Reports received by the United States Geological Survey, Department of the Interior, from producers of magnesite show that the quantity of crude magnesite sold or treated during the calendar year 1921 was 47,904 short tons, valued at the mines at $510,177. This quantity was less than half that for the year 1920, and smaller than that for any year since 1916. California was the only producing State, and nearly all the product was calcined for use as plastic material. The output of domestic magnesite for use in refractory products was very small.

[1]April 5, 1922.
[2]Feb. 15, 1922.

An Informational Service For a Chemical Manufacturing Concern

By D. B. Keyes
U. S. Industrial Alcohol Co.

How a Special Department Devoted Exclusively to the Accumulation of Technical, Economic and Legal Information Can Serve the Executive, Research and Other Departments Within a Manufacturing Organization in the Chemical Industry—Details of Organization, Operation and Cost

THE growth of the chemical industry in the United States for many years was slow and faltering. It was not until the outbreak of the war that the rapid expansion of this industry required the compilation and accumulation of technical information on an unprecedented scale, as concerns both the vast amount of data to be collected and the rate at which its compilation had to proceed. In many of the larger chemical firms whole departments were devoted exclusively to informational service, and the work was carried out systematically and efficiently in order that no time might be lost in bringing the new American industry up to the standard set by its older foreign rivals.

In the present discussion the writer wishes to bring attention in a practical way to those vital points involved in the organization and maintenance of such an informational department which would be of most interest to the executive head of a chemical manufacturing concern. First, then, let us consider the nature of the demand the informational service must supply.

Who Asks Questions, and What Do They Want to Know?

Nine hundred and ninety-nine men out of a thousand would prefer to ask a question than to reason it out for themselves, or to look it up. If an information department acquires the reputation of answering quickly and correctly all questions asked of it, it will be besieged by every person connected with the company, from the fastidious office boy who wishes to remove egg from his necktie, to the member of the board of directors who would like to know the technical soundness of a new process in which he wishes to invest.

A brief outline is given below of some of the important departments in a chemical concern and the sort of information that each is most likely to desire.

The Research Department:
- Properties of substances:
  - Physical.
  - Chemical.
  - Physiological.
- Processes:
  - Laboratory preparations.
  - Manufacturing processes.
  - Recovery processes.
- Analytical methods:
  - Qualitative.
  - Quantitative.
- Specifications for products.
- Uses of products:
  - Kind of use.
  - Extent of use.
  - Details of consuming processes.
  - Laws governing use.
- Economic data:
  - Prices.
  - Consumption statistics.
  - Production statistics.
  - Imports and exports.
- Recommendations concerning past and future research.
- Recommendations received from customers concerning development of new products.

The Sales and Advertising Departments:
- Properties of products.
- Specifications for products.
- Methods of analysis of products.
- Uses of products.
- General market conditions.
- Technical sales articles.
- Technical talking points for products.
- Characteristics of competing products.
- Recommendations concerning minor difficulties experienced by consumers.

The Patent Department:
- Literature searches.
- Technical aid in drawing up applications.
- Technical aid during any patent litigation.
- Collecting evidence regarding inventorship.
- Collecting data needed in case of interference or infringement.

The General Legal Department:
- Technical aid in damage suits.
- Expert technical witnesses.

The Auditing Department:
- Cost estimates when special knowledge is necessary.

The Traffic Department:
- Properties of products:
  - Physical.
  - Corrosive.
  - Explosive.
  - Physiological.
  - Flammability.
- Kind of shipping container for special products.
- Traffic regulations concerning products and materials.

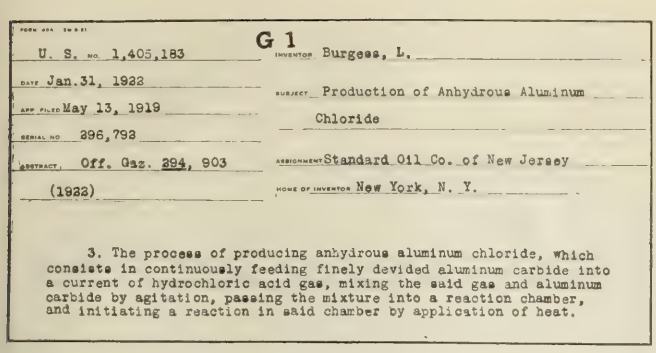
The Purchasing Department:
- Properties of substances purchased.
- Specifications of substances purchased.
- Sources for—
  - Raw materials.
  - Supplies.
  - Equipment.
- Price fluctuations:
  - Past.
  - Future.
- General market conditions.

The Plant Executives:
- Process efficiencies.
- General market conditions.

The Company Executives:
- Control of outside consulting men hired by the company.
- Summaries and criticism of work done by the research department.
- Detailed information regarding issued patents and patent applications owned by the company.
- Recommendations regarding future research and development work.
- Recommendations regarding processes offered to the company by outsiders.
- Recommendations regarding new sales fields for products.

How This Information Can Be Obtained

A great many articles have been written in recent years on the subject of making literature searches. These have been written by competent men, but usually from widely different viewpoints. Probably the best scheme for a particular purpose is the one that is worked out by the searcher himself. The characteristics most desired in the searcher therefore are ability to solve and tenacity to stick with the puzzling technical problems.



G 1

U. S. NO. 1,405,183 INVENTOR Burgess, L.

DATE Jan.31, 1922 SUBJECT Production of Anhydrous Aluminum Chloride

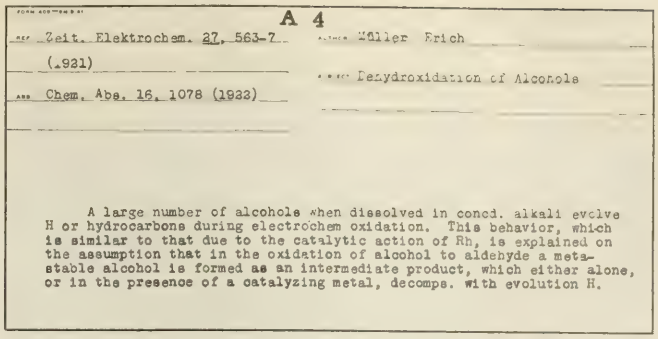
APP. FILED May 13, 1919

SERIAL NO. 296,793

ABSTRACT Off. Gaz. 294, 903 (1922) ASSIGNMENT Standard Oil Co. of New Jersey

HOME OF INVENTOR New York, N. Y.

3. The process of producing anhydrous aluminum chloride, which consists in continuously feeding finely devided aluminum carbide into a current of hydrochloric acid gas, mixing the said gas and aluminum carbide by agitation, passing the mixture into a reaction chamber, and initiating a reaction in said chamber by application of heat.



A 4

REF. Zeit. Elektrochem. 27, 563-7 (1921) AUTHOR Müller Erich

ABS. Chem. Abs. 16, 1078 (1922) TITLE Dehydroxidation of Alcohols

A large number of alcohols when dissolved in concd. alkali evolve H or hydrocarbons during electrochem oxidation. This behavior, which is similar to that due to the catalytic action of Rh, is explained on the assumption that in the oxidation of alcohol to aldehyde a metastable alcohol is formed as an intermediate product, which either alone, or in the presence of a catalyzing metal, decomps. with evolution H.

FIGS. 1 AND 2—TYPICAL AUTHOR CARDS FROM THE INFORMATION DEPARTMENT FILES

It would, perhaps, be futile to outline a definite system for searching the technical literature. Sooner or later even the most brilliantly conceived systems are bound to fail. However, a few general observations may be of interest in this connection.

The number of periodicals to be looked over regularly may be quite variable. Certainly the abstract journals such as the American *Chemical Abstracts*, the abstract sections of the *Journal of the Chemical Society* (London) and the *Journal of the Society of Chemical Industry* and the *Zentralblatt* must be consulted. The leading American chemical publications, including both technical and trade papers, as well as all publications applying directly to the particular field in which the company is operating, must be considered as necessary adjuncts. The U. S. *Official Patent Gazette* is always found valuable and interesting.

In the particular informational department on which this discussion is based, a number of good reference books were obtained, but it was not found desirable to purchase any book that was to be used but rarely and could be consulted at some convenient library.

The information department was thoroughly acquainted with every library in the vicinity and knew approximately what books and periodicals each contained. These libraries were consulted not only for special literature searches but also for interesting current, foreign and domestic publications, whenever these publications were not available at the offices of the department.

Societies which were related to the particular industry often held conventions at which technical problems were discussed and suggestions made or facts stated that would be of value to the company. These conventions were usually attended by at least one member of the information department.

No sources of information should be overlooked or forgotten. On the other hand, the list of sources should be constantly increased and the potential value of each recognized and appreciated. In other words, the scope of the information service must be constantly expanding in order to serve its needs most efficiently.

How Information Should Be Filed

There is vast difference between storing information and filing information. Treasures buried in an unknown spot may be quite safe, but treasures locked in a safe deposit box have many very practical advantages.

It is no easy task to file technical information efficiently. Evidence of this can be seen in any large library. Very little has been done in cataloging except by authors and titles. Perfection cannot be obtained in a subject file, except at an excessive cost. A workable system can be made, however, by holding to a simple outline, such as one which has been evolved after years of development.

The first principle to be adhered to by the informational department was to have an abstract of *all* information on a card that was filed by authors. These cards are more important than any of the others and therefore were the largest in size. Logically they were filed by authors, because each article or piece of information had one distinctive author while at the same time it might have covered many important subjects. No large technical file, classified by subjects, was ever found to be entirely practical.

Several small subject cards were made for each author card; these subject cards were filed separately and used only to locate the author card when the author was unknown.

The Author Card

The author cards were of two kinds, those that cover patents and those that cover articles. These cards were not kept in one file, but were divided up into separate files, each covering some field important to the company. The simplest classification was according to products, but other important subjects could be entered such as chemical apparatus, solvents, engineering materials, etc., depending entirely on the particular industry. It was found best to make the product classifications as general as possible—for example, group references to acids, bases, alcohols, aldehydes, esters and ketones. In the case of some other industry such as the dye industry still other broad classifications may be used.

The details of the author card are best seen by studying the examples given in Figs. 1 and 2. It will be noticed that a file letter and number appear at the top of the card. The letter refers to the particular file in which the author card was placed, and the number refers to the card's position among the other cards by the same author. These cross-references on the ordinary author cards referring to articles, and on the author cards covering patents, have been found to be sufficient for all practical purposes. The file letter and author number were easily put on with a rubber stamp; the remainder of the items, including the abstract, were generally typewritten. If for any reason the front and back of a card were not sufficient for the abstract, a double card was used which folds once, giving the same over-all dimensions. An excellent method sometimes used to save time in making these cards was to paste on the clipping itself. This was especially true in the case of making cards of abstracts appearing in abstract journals. The cost of extra magazine sub-

scriptions was small compared with cost of the stenographic work.

The Subject Card

The subject cards, illustrated in Fig. 3, are much smaller than the author cards and served only as a subject index for the author cards. It was quite possible for one subject card to refer to more than one author card and therefore have more than one set of file letters and numbers.

The making of useful subject cards is an art and not a science. It was found desirable to have one person make all of the subject cards, because any radical change in the system was fatal to the usefulness of the file. A common-sense basis was decided upon at the start and strictly adhered to thereafter. This system is outlined below:

The wording of the subject appearing on the subject card was divided into four groups. *First* was the "Classification Group," which gave the general class under which the subject belongs; usually there was a separate author-card file for the particular classification group. *Second* was the "Title Group," which gave the name of the individual substance, product or chemical, apparatus, etc., to which the information referred. *Third* was the "General Modification Group," which included statements such as "Manufacture of," or "Chemical Properties of," or "Use of." *Fourth* was the "Special Modification Group," which included all other subdivisions or modifications of the subject. This group naturally had a very wide range—for example, "from molasses," "vapor pressures," etc.

Some of the subjects on the subject cards would have appeared, if divided into groups, something like the following:

1	2	3	4
Esters	Ethyl Acetate	Physical Properties of ___	
		Boiling Point	
Acid	Formic	Preparation of ___	from Carbon Dioxide
Apparatus	Filter	Use of ___	to Clarify Cane Juice

The dash after group 3 was used to denote the direct relation of this group to the preceding one.

The "Classification Group" has already been said to have included all the headings that appeared as subjects of the separate author card files, and this group might also have contained other subjects that were not extensive enough at the moment to warrant a separate author card file. Examples of these subjects were: Acids, bases, esters, aldehydes, ketones, apparatus, engineering materials, etc.

The "Title Group" referred to the particular substance or thing; examples were: Formaldehyde, filter, acetone, amyl acetate, ethyl chloride, drier, etc.

When there were modifying words they were placed immediately after the class name—e.g., acetic *anhydride*, pumps *centrifugal*, etc. Although this group was necessarily very large, it was added to at will, but care was taken to prevent using more than one name for the same substance. When there was a choice between two or more names for a substance, the one that was standard in other chemical indexes was selected.

When a subject card was made, care was taken to look over both the title and the subject matter of the author card. Very often an author card was of importance to the company only because it contained information concerning one of the company's products and the name of this product did not appear in the title on the author card.

The "General Modification Group" classified the information that was given on the author card concerning the substance or thing mentioned in group 2.

FORM 40—10M-11-21

SUBJECT Alcohols, Ethyl Alcohol, Chemical

Properties of ---------; Dehydroxidation

AUTHOR Müller, Erich **A 4**

DATE 1921

FIG. 3—A SAMPLE SUBJECT CARD, WHICH IS AN INDEX FOR THE AUTHOR CARDS

This classification is best understood by looking over the following list of common subjects that appear in this group.

Physical Properties.	Properties that can be expressed by some numerical value.
Chemical Properties.	All types of reactions.
Preparation.	Laboratory methods but not commercial methods.
Manufacture.	Commercial and patented processes.
Use.	Any use that would be of commercial value.
Physiological Properties.	Data on toxicity. Any biological reaction.
Economic Data.	All data on trade and production, quantities and values.
Determination.	Quantitative.
Detection.	Qualitative.
Analysis. Occurrence. Recovery.	For impurities.
Purification.	Freeing from impurities.
Separation.	From other substances.
Concentration. Constituents.	Components of a mixture or a solution.
Specifications.	Requirements for various grades or mixtures.

The list of subjects was added to whenever it was deemed expedient, but it was thought best to keep this list as small as possible. In case the subject of this group 3 referred to the general class mentioned in the corresponding group 1, then group 2 was omitted. An illustration is:

1	3	4
Acids	Physical Properties of	Dissociation

The "Special Modification Group" represented a modification of the subject given in group 3. Not much attention was paid to this group, except to see that it was present and that it was short and "meaty." Ex-

amples of complete subjects containing this group, are given below:

Esters, Amyl Acetate, Use of ——,
as a solvent for pyroxylin
4

Aldehydes, formaldehyde, Preparation of ——
from carbon monoxide
4

As this was the last group and the one which covered the widest field of subjects, it was not considered necessary to make any particular classification.

Subject cards were filed alphabetically in the ordinary manner, but as many subdivision cards as possible were used to facilitate the filing and locating of a particular subject.

Both author card and subject card files were kept in duplicate—one complete file at the research laboratory and one in the information department. In the research laboratory the subject cards were always kept in the file in case any author card that may have been taken out and lost could be located in the information department's file and duplicated. Fire insurance was carried on these cards, the amount covering the cost of the copying.

Other Files and Forms

All photostats and manuscripts such as translations, copies of odd journals, etc., were filed by author and had corresponding author and subject cards filed in their respective files. The author cards stated where the manuscript could be found. This manuscript file also contained all reports and any memoranda that were not made by the research staff.

Research or laboratory reports were filed separately and had a separate author- and subject-card system. These reports were also filed by author or by some very simple subject classification. The author card stated where the report might be found.

A patent specification file for all patents not owned by the company was arranged according to author. These, too, had corresponding author and subject cards in the main file. The author card stated where the specification might be found. The specifications of patents assigned to the company were conveniently kept in a note book form, one book for U. S. patents arranged alphabetically by countries. Data on applications filed in the United States by members of the company were kept in a loose-leaf notebook. The following information was included: Name of inventor, title, serial number, date of filing, abstract of subject matter; and later when the patents were issued, the numbers and dates of issue were added. Copies of applications and all legal papers connected with the cases were kept in folders and filed alphabetically by inventors. These folders did not need any corresponding author and subject cards.

Special forms were made up to cover all material required by the patent lawyers in order to make up an application. These forms were filled out by everyone connected with the invention. After the application was filed a special form of an affidavit was filled out by the inventor. This affidavit gave the data necessary in case of an infringement or an interference. Both of these papers were filed in the folders mentioned above.

The manuscript, report and patent specification files were kept in duplicate, one copy in the research department and one in the information department. It was found convenient in certain cases to have a third or fourth copy in other departments.

The Organization

An adequate organization for the average large chemical manufacturing concern would consist of a chief, two technical assistants and three stenographers.

The chief may be a consulting chemist or chemical engineer, who devotes only a part of his time to the information department, the rest of his time being used for consulting work on problems arising within the company. This man must be thoroughly familiar with all of the company's problems and he should be able to foresee the difficulties, both technical and economic, that may arise in their consideration. In brief, he should be a capable chemist, engineer and business man.

The two assistants should be well-trained technical men, who are able to look at a problem from the economic viewpoint. Long experience is not essential. One should be well qualified to read technical French, German, Italian and Spanish. One should handle the routine work, but should be able to prepare an intelligent abstract of a technical article. Both should soon acquire knowledge of the whereabouts of all available sources of information. Naturally this knowledge increases steadily with time. One of the assistants should familiarize himself with the gathering of statistics.

Even the stenographers should comprehend the fundamental principles of chemistry. They must be able to take several hours of dictation covering some technical or scientific subject. Six to eight months is usually necessary to train the average stenographer to be efficient in such a position. Quite often a stenographer desires a special form of shorthand to cover the particular technical terms that occur many times in the work. In case the laboratory is not located in the same building as the information department, it may be desirable to have one of the stenographers stationed in the laboratory library to handle the routine of that department, such as the writing and filing of reports.

The Informational Service in Operation

The current cards covering abstracts of interesting articles were sent daily to the director of the research department. Under ordinary conditions these amounted to about 200 a month and were taken from 60 to 100 publications issued during the same period. The subject cards for these author cards were filed at the laboratory and some of the author cards were sent by the director to various research men. The information department always filed their copies promptly and they were therefore immediately available to all who are interested in them.

Special cards covering more important subjects were sent to the research director marked for his special attention. Likewise photostats, reprints, special copies of periodicals and books were routed through the organization. These were always accompanied by author and subject cards for the research department's files.

Special reports and memoranda were usually sent to the person who made the request for the information and occasionally copies were sent to the general manager, the director of research or the sales manager, depending on the subject. Cards covering these reports were filed as stated previously.

There were many other special features that increased the speed and efficiency of the information service. Obviously only a few can be mentioned here.

One assistant spent most of his time in a large outside library where he could be easily reached by phone.

This library was equipped with a photostating service so that photostats of articles up to fifty pages in length could be obtained within 24 hours after the request was made.

The company's purchasing department was posted regarding all available sources for odd books and periodicals, but the actual subscriptions to periodicals were handled through the informational department.

The valuable services rendered by the office of the editor of *Chemical Abstracts* were utilized to good advantage. The Washington representative of the company's patent attorneys was called upon when photostats of foreign patent specifications were desired in a hurry.

The information department had numerous professional friends who were willing at all times to give bits of information and minor opinions in return for similar services.

The chief of the information department was in close touch with all research men employed by the company, in order to be qualified to judge the needs of the research department. Physically, it is easier to talk than it is to write or even to dictate; therefore frequent conferences with the research men were found to be unusually helpful. This was also true of conferences with the other departments.

After a large and exhaustive card file had been made up, difficulty was experienced in educating the men to make use of it. It happened on several occasions, however, that the basic principles and patentable ideas of some "invention" were found fully described on an information card. After this occurred, the "inventor" was usually more inclined to make use of the information file before starting work on his next idea.

The Cost of the Informational Service

A statement of the average yearly cost of an information department is given below:

Salaries	
Chief (half time of a high grade consulting chemical engineer)	$4,000
Two technical assistants ($3,000 each)	6,000
Three stenographers, (average $100 per month)	3,600
Expense of trips (Depending on location of laboratory and information department)	600
Office rent (15,000 sq.ft., including libraries; $3 per sq.ft.)	4,500
Photostats	300
Periodicals	150
Books	250
Incidentals	100
Total	$19,500

It is understood, of course, that the proposed department would be for a relatively large chemical manufacturing organization. The department and its cost would be proportionately smaller for a smaller company.

New York City, N. Y.

French Chemical Industry Improving

The heavy chemical industry of France is making rapid strides of improvement, according to Commercial Attaché D. C. Huntington, who writes from Paris on June 12. He reports that business is much better than a year ago and prices are well maintained. Chemicals for tanning, glassworks and paints, however, still remain inactive. Synthetic products for drugs and perfumes are satisfactory. The important chemical firm, Etablissements Kuhlmann, reported at the annual meeting that its plants now working at 85 per cent of capacity, as compared with an average of 50 per cent for 1921. This company has successfully made two wage reductions.

Legal Notes

By Wellington Gustin

Eibel Patent for Improvement in Fourdrinier Machines Held Invalid and Not Infringed

In a long and well-considered opinion the United States Circuit Court of Appeals reversed the District Court, which had given a decree in favor of the Eibel Process Co. in its suit brought against the Minnesota & Ontario Paper Co. Suit was for infringement of the Eibel patent 845,222. The patent claims to be an "improvement in Fourdrinier machines."

The Fourdrinier has been the best known and most commonly used paper-making machine for generations. It consists, in its first section, of an endless wire sieve, passing over a series of rolls at a constant speed. At the wet or breast roll end of this running wire sieve there is discharged from a flow box through a sluice a stream of paper-making stock, consisting of wood pulp, sometimes with added mineral matter, mingled with from 135 to 200 times its weight in water. The stock has the appearance of diluted milk. The wire mesh over which the stock travels has also a sidewise shaking motion to assist in the proper fitting and interlocking of the fibers. The stock is carried along on this wire about 30 ft., draining off its water as it goes, until it reaches the couch rolls at the farther end of the wire, where it is pressed into the form of a uniformly distributed wet pulp or web strong enough to hold together. It is then carried through a series of pressing and drying rolls and calenders, which constitute the drying end of the machine. About 20 ft. from the breast roll are placed suction boxes in contact with the under surface of the wire operating by means of a partial vacuum to assist in the extraction of excess water remaining in the pulp and to compact the sheet by atmospheric pressure. This is but a meager description of the first part of a large and complicated machine upon which paper stock goes in highly diluted liquid form, is subjected to draining, shaking, meshing, pressing and heating processes, until it emerges as a smooth fabric newsprint.

No Valid Patent on Mere Principle

A Fourdrinier machine costs approximately $100,000, and for economy is run continuously day and night. Speed and quality of paper have ever been the quest of paper makers. This is what the Eibel principle claims. But the court says of course there can be no valid patent on a mere principle. Claims 7 and 8 of the Eibel patent it holds void for lack of invention. Claims 1, 2, 3 and 12, if construed to cover any elevation of the breast roll of the paper-making wire appreciably greater than that shown by the prior art, to gain speed, the court says are void for indefiniteness and as differentiated from the prior art only by a mere change in degree. If construed in accordance with the natural import of the language, as requiring such a pitch of the paper-making wire as will alone, through gravity, without regard to the head in the flow box, bring about speed equality between the stock and the wire, and practically eliminate the drag of the wire, it discloses no useful invention, since no such pitch has even been used or claimed to be useful in practice.

Modern Handling Methods in the Manufacture of Electrical Porcelain

Electrical Porcelain Plant of the Square D Co. — Experience Obtained in Metal Working Applied to the Manufacture of Porcelain — Economies Realized Through the New Methods

By Graham L. Montgomery

THE Square D Co. manufactures electrical safety devices, such as switches, panel boxes, and so on. A large amount of porcelain enters into these devices for purposes of insulation. Originally all this porcelain was purchased from outside manufacturers. This had the advantage of relieving the Square D Co. of the burden and responsibility of running a porcelain plant. On the other hand, it was attended with many disadvantages, such as inadequate supply, delay in deliveries and high costs.

In consequence, shortly after the armistice, the Square D Co. purchased the plant of the Peru Electrical Porcelain Co., in Peru, Ind. This was rather an old plant and perhaps not in the best of condition. But it was fully capable of turning out high-class product. The methods used there were those still generally used in similar plants and did not include any of the more recently developed equipment, such as tunnel kilns and continuous driers.

Application of Methods From Metal-Working

After the purchase of this plant a study was made of the equipment available for porcelain manufacture and of the methods generally used in such manufacture. It was found that the new plant was well up to the standard and the only improvements in methods that could be made would be by using the tunnel kilns or other equipment mentioned above. This equipment is expensive and the plant as then existing did not warrant such an expenditure.

The new owners were men experienced in the methods used in metal-working plants. It was immediately evident to them from their study of porcelain manufacture that there were possibilities of effecting economy and increased output if the methods of material handling with which they were familiar were applied to their new venture. Nothing was discovered along this line in other porcelain plants except in some few cases where conveyors were used for handling the raw clay as it was unloaded from cars.

Where Handling Equipment Was Used

Bringing their past experience of handling methods to bear in a study of the existing routine of manufacture at Peru, the works engineering department from the main plant in Detroit discovered many opportunities for economy and increased output. From the filter presses onward to the shipping room a complete handling system was devised which was inexpensive to install and which necessitated but little change in the existing manufacturing equipment.

For unloading the raw clay from the cars and for handling to and away from the blungers, methods were used which were in the main the same as are in use in many other plants. The handling used throughout the rest of the manufacturing process naturally falls into four main divisions. These are: First, handling the filter press cakes into and out of the drier and to the crusher. Second, handling the clay through crusher, tempering bed, dust mill and screen. Third, handling

KILN BUILDING, SQUARE D CO., PORCELAIN PLANT, PERU, IND.

the dust to the press room and the unfired products of the presses into and out of the drier and to the saggers. Fourth, handling saggers to the kilns, out of the kilns, and to the packing room.

Types of Handling Equipment Used

The types of handling equipment which were found to be best adapted for use in porcelain manufacture were the hand lift truck, the belt conveyor and the gravity conveyor.

The hand lift trucks are used for handling filter cakes, for handling steel cars of dust, for handling the unfired product of the presses into and out of storage. The skids used for these lift trucks are of two types. Those for handling and storing bulky materials are with removable containers which may be locked to the skid and which can be built up to any desired height. Those for handling the product of the presses and the filters have racks attached. These racks consist of two uprights, fastened along the longitudinal center line of the skid with twelve horizontal supports of ¾-in. pipe on each side.

This total equipment consists of eight lift trucks and about 600 skids and racks. The method in which these trucks and the belt and gravity conveyors are used is described below.

Handling Cakes From the Filter Presses

By the usual method, the cakes from the filter press are carried into the drying room by hand, placed on horizontal stationary shelves, and when the drying is completed, carried out again and to the crusher. The new way utilizes the skids, which are provided with racks. With twelve supports on each side of these racks, twenty-four removable shelves or boards can be laid on each rack. The filter cakes are laid on these boards as they come from the press.

As soon as the shelves of a rack are completely filled, that skid is picked up on a lift truck and conveyed into the drier. When the drying is completed, the lift truck takes the skid to the crusher, beside which it is allowed to rest. As the workman operating the crusher desires to feed it, he takes one of the removable boards from the rack and dumps its load of dried filter cakes into the hopper of the crusher. The empty board is replaced on the rack and when the whole load is emptied thus into the crusher the empty rack is replaced by the lift truck in position near the filter press.

From Crusher to Dust Mill

The product of the crusher discharges into the inclined belt conveyor shown in the accompanying photograph. This conveyor consists of a simple belt running in a wooden trough and inclined about 45 degrees. Slats are secured to this belt at close intervals to aid in carrying the crushed clay up the incline. At the top of its run this belt discharges into a swinging metal spout, by means of which the clay can be placed in any one of the several tempering bins as desired.

From the tempering bins the clay is shoveled onto the horizontal flat-belt conveyor which feeds the dust mill. This conveyor, also shown in the photograph, runs in a wooden trough and is provided near its discharge with a toothed wheel which serves to break up any lumps and thus prevent clogging of the dust mill.

In the dust mill the clay is ground to a fine powder. Referring again to the illustration mentioned above, a wooden housing will be seen at the left. This contains the revolving screen, so placed that the steel cans used to hold the screened dust can be wheeled under it by the lift trucks and left standing there. The photograph shows a wooden chute leading from the dust mill into the wooden housing. The centrifugal force developed in the mill throws the dust through this chute into the screen. The screen is tilted, with its lower end at the point where the dust enters. The driest dust, being lightest, is thrown to the high end. In this manner the dust is separated into four general grades corresponding to the four meshes of the screen and roughly in accordance with the degree of moistness. As the screen revolves these grades sift through its meshes into cans waiting below. The rejects roll back and out of the screen at its low end to be put back through the process or discarded, as the case may be.

When a can is filled it is taken by a lift truck to the elevator. The elevator takes the can—on its skid—to the second floor, where the press room is located. Here another lift truck picks it up and places it conveniently for the worker at one of the presses, it being removed at the same time from the skid, which is taken back for another load.

A Special Type of Hand Truck for Dust Cans

Recently a new method of handling the dust cans has been developed. The cans were provided with trunnions, placed near the tops so that they could be easily swung. Two special hand lift trucks were provided, one for each floor, built to engage these trunnions, lift the cans clear of the floor, and then transport them to the desired point. This is an improvement over the skid method, as the can had to be lifted by hand on and off of the skids, which took some little time and labor—now eliminated.

Handling From the Presses Through the Driers to the Sagger Loading Dock

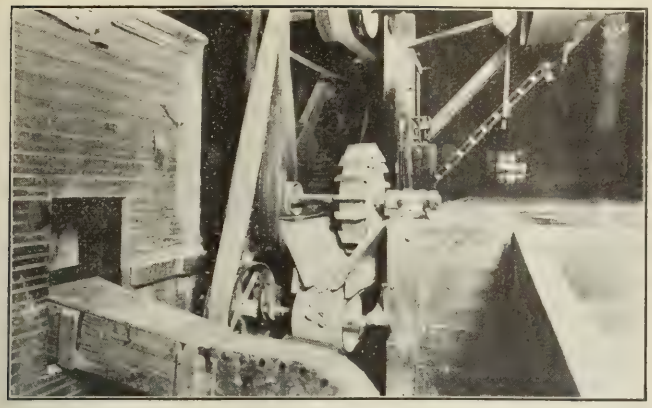
As the unfired pieces leave the presses the press operator places them on a tray which rests on the table at the left side of his machine. Reference to the accompanying photograph will show the arrangement of dust cans, presses, trays and rack skids. The trays are made to fit on the horizontal supports of the rack skids as described in a preceding section. When a rack is filled with loaded trays it is taken by lift truck into the drying room, remaining there until sufficiently dry to be safely fired.

When the drying is completed, the lift truck is again pressed into service and the rack of dried pieces is taken to the room where the cleaning and glazing is done. After this is completed the lift truck again picks up the skid and places it on the elevator. It is thus conveyed to the sagger loading dock on the first floor adjacent to the kilns.

In the illustration which shows the press room, it will be noted that some of the racks are on wheeled platforms. This method of handling was formerly used but the lift truck method has proved to be quicker cheaper and more flexible.

Handling System for Saggers

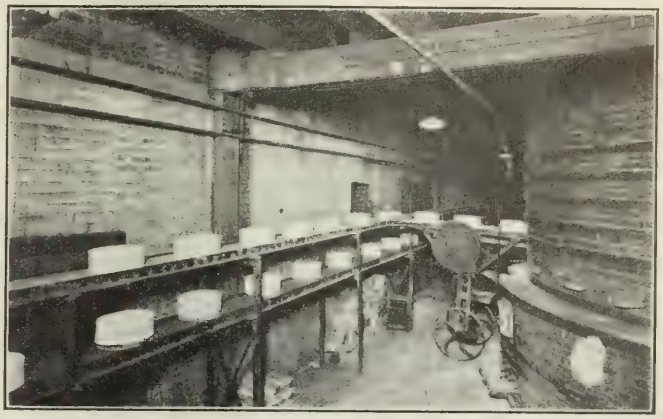
Due to the large variety of shapes and sizes comprised in the product of the plant, there are twelve different types of saggers in use. For this reason it is necessary to have a large number in storage. The size of the storage thus needed has made it necessary for the saggers to be stored some distance away from this sagger loading department.



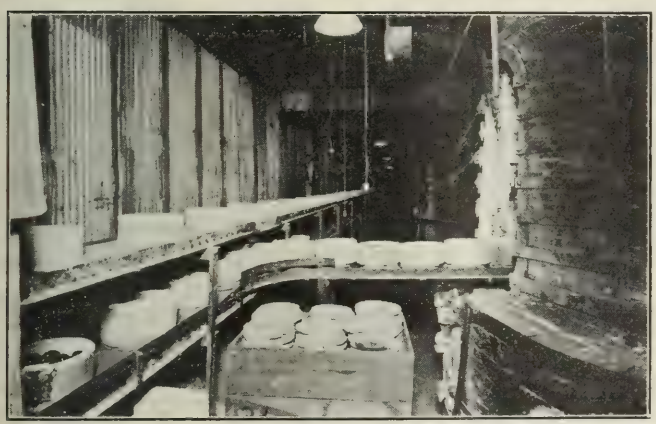
CLAY CONVEYORS, DUST MILL AND SCREEN HOUSE

PRESS ROOM

SAGGER LOADING DOCK



LOADING SAGGERS INTO KILNS BY CONVEYOR



CONVEYOR UNLOADING KILN AFTER FIRING

INSPECTING, CHECKING AND PACKING DEPARTMENT

A plain, flat skid is taken into the sagger storage and the saggers desired are placed on this and taken to the sagger loading dock, where they are placed conveniently for the workers whose duty it is to pack the unfired ware in them. After the firing is completed, the sagger filled with ware is moved to the packing department and the ware taken out. The empty saggers are placed on a flat skid and taken by lift truck back to the sagger storage, where they are unloaded and stacked by hand until again needed.

Loading the Saggers

In the illustration which shows the sagger loading dock will be seen several of the loading benches. These benches are provided with shelves at the top on which are placed trays of the unfired ware. A skid rack of these trays placed close to the bench and a skid loaded with the appropriate style of sagger is placed at the end of the bench. The worker then packs the ware into the saggers, stacking the filled saggers close to the conveyor which leads to the kilns.

The most important part of the conveying system is that part which loads and unloads the kilns. The success of its operation depends entirely upon the manner in which the ware is packed in the saggers. Each piece must be so placed that it cannot knock against the next piece or the sides or bottom of the sagger; and it must be braced in position so that it will keep its place.

The conveyor used for kiln loading is also used for unloading, the top strand carrying ware to the kilns and the bottom strand carrying it away. This conveyor is made up of a two-decked roller conveyor with 16-in. rolls spaced 4 in. apart on the upper deck and 8 in. apart on the lower deck. Running over this roll is a flat canvas belt of heavy construction—14 in. wide.

This use of closely spaced rollers and a flat belt provides a bed on which the loaded saggers ride smoothly and evenly when the belt moves slowly, at about 25 to 30 ft. per minute.

The conveyor is 180 ft. from center to center of pulleys and passes directly by and about 8 ft. away from the loading and unloading doors of the six kilns. At the loading dock, the worker places a wooden pallet on the belt and on this pallet places a loaded sagger. This is repeated rapidly enough so that the spaces between the saggers are about 4 ft., care being taken that these spaces shall not be less. At the speed which this conveyor travels, this gives a delivery of loaded saggers to the kiln equaling about 400 per hour.

How the Saggers Are Conveyed Into the Kilns

The chief difficulty encountered in laying out this system was to devise a workable means for automatically taking the loaded saggers from the main belt onto an auxiliary belt traveling at right angles and taking the saggers into the kiln. It is necessary to make this transfer in such a way that the sagger is not disturbed sufficiently to tip or break the unfired ware.

The method adopted to accomplish the transfer is ingenious but simple. Directly opposite the door of each kiln is a section of the roll conveyor bed of the main belt which is removable. A portable belt conveyor is used as the connecting link between the main belt and the kiln. On the end of this which is toward the main belt two ball-bearing rollers are mounted beneath the frame with their axes of rotation parallel to the line of travel of the portable belt. These rollers are exactly similar to those forming the bed for the main belt.

The removable part of the main belt bed—which corresponds in length to the width of the portable belt frame—is removed. The end of the portable belt carrying the two rollers is then pressed down into this opening and bolted in place. The two rollers serve to guide the main belt around and below the portable belt. When this is completed, the portable belt is running at a level slightly below the general level of the main belt and at right angles. Its other end extends into the kiln—where it delivers onto a short section of roller conveyor which serves as a collecting place for saggers until the kiln-loading crew can dispose of them.

At the corner between the two belts a snub wheel will be noticed. When a sagger comes along the main belt it travels out over the portable belt until it tips through its own weight. The motion of the portable belt pulls it over until it comes against the snub wheel. This serves as a guide and it travels smoothly around the corner and into the kiln.

Unloading the Kilns

For unloading the kilns, a portable gravity conveyor is used. This extends from inside the kiln to the return or bottom strand of the main belt conveyor. The portion next to the main belt curves through 90 degrees and thus delivers in the same direction as the main belt travels. This will be seen in the accompanying photograph.

The method of attaching the portable gravity to the main belt is very ingenious. The last roller is removable. This is removed and slipped under the belt, and then put back and bolted in place with the belt over it. When the frame of the gravity is bolted to the main belt this serves to press the belt against the under side of the second roller on the gravity and revolves it in a reverse direction. As a consequence, the loaded saggers, as the pallets which they travel on hit this roll, are slowed up and come easily onto the main belt.

After passing this point, the loaded saggers travel on the main belt to a point just short of the sagger loading dock. Here the belt makes a vertical dip and the saggers slide off onto a gravity roller conveyor which extends through the inspection, sorting and packing room.

Inspecting and Packing

As the saggers pass along on this gravity conveyor the inspectors sort them and throw out the damaged pieces. The proportion of waste is carefully counted. The saggers then pass on to the packing department, in which location the conveyor is horizontal and they slow up enough for the packers to remove the good ware and pack it. The accompanying photograph clearly shows how this department is arranged. Pallets, saggers and cartons of finished ware are all taken on skids and lift trucks to their various destinations.

This system has accomplished three advantages as follows: 1. It has reduced the manufacturing cost for the product. 2. It has reduced the labor force necessary. 3. It has materially increased the output. All the above has been achieved with an expenditure of less than $10,000 on handling equipment.

Some Economies Realized

Formerly in loading a kiln ten men were required for 20 hours—a total of 200 man-hours. With the conveyors two men are required in the kiln and three men to load saggers at the dock for a total of 7 to 8 hours, or 40 man-hours. This is a clear saving of 80 per cent in this, the most costly labor operation in the plant.

Formerly in unloading a kiln the saggers were carried out by hand, their contents dumped into a tote box and then this carried to the inspecting and packing department. This method took five men working 20 hours, or 100 man-hours. The new method takes six men 8 hours, or 48 man-hours. This is a clear saving of 50 per cent of the labor cost on this operation. In addition, far more breakage occurred in the old method of handling than now occurs throughout the process.

The management stated to the writer that through the use of the conveyor which loads and unloads the kilns a net saving in labor and burden amounting to $125 per day is realized. As the interest charges on the total handling system are not over $50 per month and the operating, maintenance and depreciation charges are very low, the saving effected is really amazing.

A study of the savings resulting from the use of the skids and racks with the lift trucks has not as yet been made; but it is evident to the management that they obtained many advantages through this equipment. One of the outstanding advantages realized is a reduction—in the proportion of 1 to 20—in the time a man has to be in the hot atmosphere of the drying rooms and also in the time which the drying room doors have to be open with consequent loss of heat.

The writer wishes to acknowledge his debt to the management of the Square D Co. both in Peru and in Detroit and to the Dow Co., of Louisville, Ky., which made most of the conveyors described, for their kindness in making available the data of this article.

Heat Losses From Bare and Covered Wrought-Iron Pipe*

At Temperatures up to 800 Deg. F.

By R. H. Heilman†

MANUFACTURERS of pipe coverings often are required to guarantee that the application of a specified heat-insulating covering will effect a certain percentage saving of the heat which would be lost entirely from a bare pipe. Since the bare-pipe loss is the 100 per cent value against which the losses from the covered pipe must be compared, it is essential that the loss from the bare pipe shall be known accurately.

Many investigators have studied the heat losses from bare pipes. Perhaps the most noteworthy of those experimentalists was the French physicist Péclet. Owing, however, to the fact that Péclet's experiments were conducted at very low temperatures, while subsequent investigators confined themselves mostly to one pipe size only, the Mellon Institute deemed it advisable to carry on the research to much higher temperatures and on 1-in., 3-in. and 10-in. pipe.

The 1-in. pipe was selected for test at the higher temperatures, as the relatively small amount of heat loss from a 1-in. pipe could not greatly affect the room temperature. This pipe was run up to a temperature of 800 deg. F. The average room temperature throughout this test was 81 deg. F., and the temperature did not vary more than 1.8 deg. F. during its progress.

The locations of the curves for the 3-in. and the 10-in. pipes were obtained by experiment at the lower temperatures, as indicated by the solid lines in Fig. 1. The values for the higher temperatures are the result of extending the curves parallel to the curve obtained for the 1-in. pipe. This procedure was necessary because of the fact that the larger pipes could not be raised to the higher temperatures without raising considerably the temperature of the room.

In Table I the loss in dollars and cents and in pounds of coal per 100 lineal feet of horizontal bare iron is tabulated for temperature up to 664 deg. F. The loss varies from $1.32 for 100 lineal feet of ½-in. pipe at 180 deg. F. to $297.50 for 100 lineal feet of 18-in. pipe at 664 deg. F.

In order to calculate the loss of heat from an insulated pipe or boiler, it is necessary to know the total temperature drop from the pipe to the surrounding air; and to enable one to make accurate calculations, it is required that the component temperature drops be known.

The total temperature drop from the steam inside a pipe to the outer air can be considered as made up of:

a. Drop from steam to the outer surface of the pipe.
b. Drop from outside surface of the pipe to inside surface of the insulation.
c. Drop from the inside surface of the insulation to the outside surface of the insulation.
d. Drop from outside surface of the insulation to the surrounding air.

The temperature drop from the steam to the outer surface of the pipe depends upon the resistance to heat flow offered by the film at the inner surface and the resistance offered by the iron wall of the pipe. No attempt was made to measure this temperature drop in the present investigation, as it was considered to be so small as to be negligible.

TABLE I—LOSSES FROM HORIZONTAL BARE IRON STEAM PIPES[1]

From 100 linear feet of pipe per month of 30 days with steam in pipes 24 hours per day. Coal at $4 per ton of 2,000 lb.

Gage Press.	Hot Water			10 Lbs.			80 Lbs.			120 Lbs.			160 Lbs.			200 Lbs.			200 Lbs. and 100° F. Superheat.			275 Lbs. and 250° F. Superheat.		
Temp.	180° F			239.4° F.			324.0° F.			350.0° F			370.7° F.			387.9° F.			487.9° F.			664.3° F.		
Pipe Size	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.	Dollars Loss	Pounds Coal	B.t.u. per lineal ft. per °F. diff. per hr.
½"	1.32	52.6	.605	2.24	897	.670	3.92	1566	.779	4.51	1805	.815	5.25	2010	.846	5.53	2210	.875	8.60	3440	1.040	16.15	6460	1.375
1"	1.91	763	.878	3.26	1305	.973	5.72	2290	1.138	6.25	2601	1.178	7.27	2910	1.242	8.07	3230	1.280	12.56	5026	1.520	30.55	12220	2.600
1½"	2.65	1060	1.220	4.54	1818	1.357	7.98	3190	1.586	9.28	3710	1.676	10.42	4165	1.751	11.36	4550	1.804	17.94	7175	2.170	34.30	13720	2.920
2"	3.24	1297	1.491	5.36	2142	1.600	9.78	3910	1.943	11.37	4549	2.052	12.75	5100	2.145	14.00	5600	2.220	22.10	8825	2.670	42.20	16890	3.590
2½"	3.86	1545	1.778	6.65	2660	1.984	11.66	4660	2.320	13.66	5460	2.464	15.25	6100	2.564	16.70	6690	2.650	26.64	10650	3.220	50.50	20200	4.300
3"	4.56	1824	2.100	8.24	3292	2.460	13.88	5550	2.760	16.14	6450	2.910	18.04	7210	3.030	19.84	7945	3.150	31.60	12640	3.820	58.25	24300	5.170
3½"	5.18	2070	2.380	8.89	3554	2.655	15.82	6325	3.145	18.31	7322	3.305	20.50	8200	3.450	22.60	9040	3.580	35.90	14360	4.345	69.00	27600	5.860
4"	5.78	2305	2.650	9.87	3950	2.950	17.70	7075	3.520	25.50	8200	3.700	22.85	9145	3.842	25.15	10060	3.981	40.10	16040	4.850	72.40	30920	6.580
4½"	6.35	2540	2.920	10.94	4370	3.260	19.48	7790	3.878	22.60	9025	4.075	25.30	10120	4.250	27.75	11100	4.400	44.05	17620	5.326	85.60	34240	7.286
5"	6.95	2780	3.200	11.97	4790	3.575	21.25	8500	4.232	24.62	9850	4.450	27.60	11050	4.650	30.40	12140	4.805	49.35	19740	5.960	94.50	37800	8.050
6"	8.20	3280	3.775	14.21	5680	4.240	25.30	10110	5.024	29.30	11720	5.295	32.80	13120	5.522	36.00	14420	5.715	57.50	23000	6.955	112.50	45000	9.580
7"	9.40	3760	4.325	16.18	6470	4.826	29.10	11640	5.782	33.70	13480	6.090	37.60	15040	6.324	41.60	16650	6.560	66.25	26500	8.010	129.00	51550	10.97
8"	11.00	4398	5.050	18.25	7300	5.450	32.60	13030	6.455	37.65	15050	6.840	42.40	16940	7.125	46.05	18420	7.300	74.75	29900	9.050	146.20	58500	12.44
9"	11.62	4650	5.350	20.35	8130	6.070	36.25	14500	7.210	42.10	16840	7.600	47.22	18900	7.950	51.98	20790	8.230	83.50	33400	10.10	162.60	65050	13.84
10"	12.68	5065	5.925	22.05	8820	6.584	40.20	16100	8.010	46.70	18690	8.440	52.30	20910	8.805	57.75	23100	9.150	97.50	39000	11.18	180.00	72000	15.30
12"	15.00	6000	6.995	26.44	10580	7.890	47.40	18950	9.425	55.40	22120	10.00	61.76	24700	10.40	70.00	28010	11.14	109.30	43700	13.22	213.50	85500	18.18
14"	16.60	6635	7.625	28.90	11560	8.620	52.00	20800	10.34	60.50	24200	10.92	67.50	27000	11.36	74.10	29650	11.76	119.40	47740	14.43	233.00	93300	19.85
16"	18.82	7525	8.650	32.80	13120	9.790	58.76	23500	11.70	68.40	27320	12.34	76.10	30410	12.80	84.25	33700	13.35	135.00	54000	16.34	265.00	106000	22.55
18"	21.00	8400	9.650	36.10	14460	10.80	65.40	26150	13.00	76.50	30570	13.80	85.50	34200	14.38	93.75	37500	14.87	151.20	60500	18.30	297.50	119000	25.30

*Abstracted from *Mechanical Engineering* for July, 1922.

†Industrial Fellow, Mellon Institute.

[1]In this table coal has been figured at $4 per ton of 2,000 lb., 13,000 B.t.u. per lb. of coal; labor, boiler-room expense, etc., taken at $1 per ton, making total value of coal fired at $5 per ton. Boiler efficiency taken at 70 per cent; air temp., 70 deg. F. Experimental data obtained at the Mellon Institute.

The temperature drop from the outer surface of the pipe to the inner surface of the covering for 1-in., 3-in. and 10-in. pipe is shown in Fig. 2. These curves show that the temperature drop increases as the pipe diameter decreases. A test was also made on a 3-in. pipe with an air space of 1.2 in. between the surface of the pipe and the insulation. By comparing this curve with the curve for an air space of 0.1 in., it is observed that the temperature drop for a 1.2-in. air space is only a few degrees more than for an air space of 0.1 in. This is probably due to the fact that for air spaces much greater than 0.2 in. convection currents are increased, thus causing an increase in heat loss. An examination of Fig. 2 shows that the temperature drop for a 0.1-in. air space is approximately equal to that for 0.1 in. of commercial insulation, so that this temperature drop can be neglected in calculations and the pipe covering considered as fitting close to the pipe with the pipe temperature and the temperature at the outer surface of the covering as the temperatures bounding the covering.

The drop in temperature, or the temperature gradient curve through the insulation, depends upon the thickness of the covering and the curvature. In a cylindrical covering the resistance to heat flow diminishes as the outer surface is approached, the temperature drop becomes less, and the gradient curve is bowed downward if the curvature alone is taken into consideration. However, the absolute conductivity decreases as the outer surface is neared, with a consequent bowing up of the gradient curve, and the two tend to counteract each other, so that the temperature gradient curve may be bowed either up or down or be a straight line, depending upon the curvature of the cylinder. The temperature gradient curve for a flat surface should bow up.

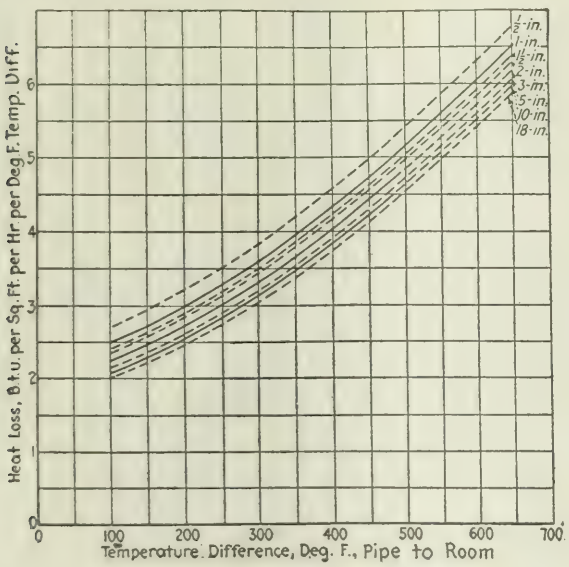


FIG. 1

It is highly desirable that tests should be conducted on commercial steam pipe coverings of different thicknesses and at different temperatures, in order to obtain mean absolute conductivity curves for the different thicknesses.

The temperature drop from the outer surface of the insulation to the surrounding air depends upon the amount of heat emitted by radiation and air contact. This in turn is dependent upon the nature of the surface of the body, the shape of the body, the excess of its temperature over that of objects to which radiation takes place, and the absolute value of the temperature of these bodies. Commercial steam pipe coverings are invariably covered with a canvas jacket. From the above mentioned facts it is obvious that the loss from a canvas surface at a given temperature is independent of what is under the canvas, so that, if the canvas-loss law can be ascertained, this law may be applied to the loss from steam pipe coverings and thus the temperature of the outer surface of the insulation can be determined. In making calculations of heat loss through an insulation, it is absolutely necessary to know the temperatures at the inner and outer surfaces.

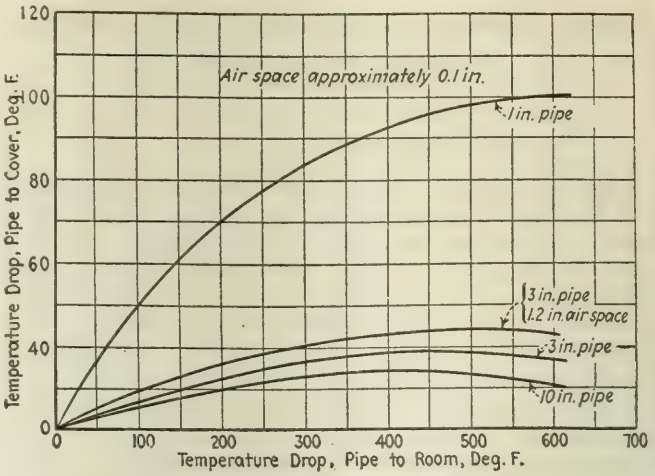

Air space approximately 0.1 in.
1 in. pipe
3 in. pipe
1.2 in. air space
3 in. pipe
10 in. pipe
Temperature Drop, Pipe to Cover, Deg. F.
Temperature Drop, Pipe to Room, Deg. F.

FIG. 2

Péclet made a careful study of the heat emissivity from various surfaces, canvas surfaces included. As mentioned, however, his experiments were conducted at relatively low temperature. McMillan[2] made a study of the heat emissivity from a canvas surface in his study of commercial steam pipe coverings, but confined his experiments to one pipe size only. Nevertheless, McMillan's results in the form of a curve present a readier means of calculating the losses from steam pipe coverings than do Péclet's, whose observations, while taking all the variables into consideration, are in too complicated a form to provide a ready means of calculation.

Since McMillan's canvas-surface-loss curve was obtained from experiments on one pipe size only, this curve can be used in making calculations on coverings of a diameter approximately the diameter of the cover-

[2] *Trans.*, A.S.M.E., vol. 37, p. 928.

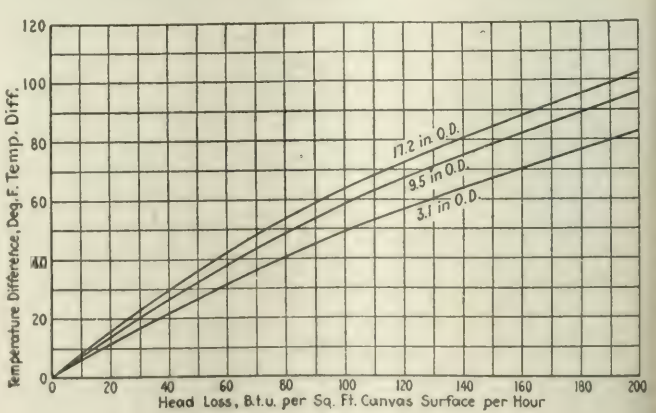


FIG. 3

ings tested. In order to be able to calculate the loss of heat from pipe coverings of any diameter, it has been necessary to obtain the canvas-surface-loss curves for various diameters. Accordingly, coverings were tested on the 1-in., 3-in. and 10-in. pipes used in determining the bare-pipe losses. The average outer diameters of the coverings used were 3.1 in., 9.5 in. and 17.2 in. The results of these tests are shown in Fig. 3.

In order to simplify the calculations necessary to determine the loss of heat through coverings of various diameters, an equation for the three curves shown in Fig. 3 has been derived. In this equation

$$T_d = \frac{272.5\,h}{h + \frac{564}{D^{0.19}}} \qquad (1)$$

T_d = temperature difference between canvas surface and room, deg. F.
h = total B.t.u. loss per hour per square foot of canvas surface.
D = outer surface diameter, inches.

This equation is approximately accurate for diameters up to 2 ft.

Thermocouples were used in determining the canvas temperatures. During this investigation it was found that the couple, when just inserted under the canvas, would invariably read low. This difficulty was overcome by inserting it under the canvas for a distance of several inches, this distance depending upon the size of the couple and the temperature of the covering.

A covering 2 in. thick, having a mean absolute conductivity coefficient of 0.56, is placed on a 4½-in. outside diameter pipe maintained at a temperature of 400 deg. F. The temperature of the surrounding air is 700 deg. F. Determine the heat flow H in B.t.u. per hour per sq.ft. of pipe surface.

The heat flow through a cylinder is given by the following equation:

$$h = \frac{K(T_1 - T_2)}{r_1 \log_e \frac{r_2}{r_1}} \qquad (2)$$

where T_2 is the temperature at the outer surface of the covering. To obtain T_2, knowing only T_1, the pipe temperature, and T_3, the room temperature, it is necessary to change the form of the equation so as to include T_d, thus:

$$h = \frac{K(T_1 - T_3 - T_d)}{r_2 \log_e \frac{r_2}{r_1}} \qquad (3)$$

in which

K = mean absolute conductivity of insulation.
r_1 = radius of inner surface of insulation, inches.
r_2 = radius of outer surface of insulation, inches.
T_d = value given by equation 1.

Substituting in equation 3, there results

$$h = 0.56 \left[\frac{400 - 70 - \frac{272.5\,h}{h + \frac{564}{8.5^{0.19}}}}{4.25 \log_e \frac{4.25}{2.25}} \right]$$

$$= 0.207 \left(330 - \frac{272.5\,h}{h + 375} \right)$$

$$= \frac{-\sqrt{363.1 = 363.1^2 + 4 \times 25{,}600}}{2}$$

$$= 60.4$$

whence $H = 60.4 \times \frac{4.25}{2.25} = 114$ B.t.u. loss per sq.ft. of pipe surface.

The temperature of the outer surface of the covering can be obtained by substituting the value h in the equation $T_d = 272.5h/(h + 375)$, reducing to $T_d = 37.6$. Therefore the temperature of the outer surface of the covering is

$$37.6 + 70 = 107.6 \text{ deg. F.}$$

The utility of these equations will be apparent to anyone who has occasion to calculate heat losses.

Studies on Cast Iron

Conditions obtaining in foundry practice have been vastly improved in the last 30 years, according to Richard Moldenke, in a brief paper before the 1922 meeting of the American Society for Testing Materials. Buying pig iron by its analysis is the rule everywhere and fracture is seldom an issue. The foundry foreman of today has no difficulty in calculating his mixtures chemically, and the composition of the various types of castings are almost standardized. Melting practice has now been placed upon a scientific basis in the foundry, so that there is little excuse for heavy losses from inferior metal.

There still remains, however, a critical study of the principles and practice connected with the rational gating of molds. Furthermore, many points in the following outline need investigation, in order to collect definite data on many still obscure problems relating to foundry practice.

I. Relation between chemical composition and physical properties, such as fusibility, fluidity, set, contraction, chill, hardness, strength, specific gravity, etc.

II. Influence of variations in foundry practice upon chemical composition and physical properties, as in the following summary:

Mixture Characteristics: Pig and scrap proportions, steel additions, charcoal or coke irons, "direct" blast-furnace metal.
Metals' Characteristics: Clean or with sand, rust, "burnt" scrap, shot, borings, salamanders and heavy section pieces.
Melting Characteristics: Rational or poor charging and melting practice in cupola or furnace, normal hot iron or oxidized "lifeless" quick-setting metal. Duplexing in electric furnace for better superheat, deoxidation and desulphurization.
Temperature Characteristics: Pouring temperature and rate of cooling due to mold surface characteristics, whether green or dry sand, metal molds, use of chills, section of castings, refractory quality of mold, gating of molds.
Molecular Treatment: Annealing, seasoning, rumbling, repetition, heating and cooling.

} Effect on {
Grain structure.
Internal shrinkage, porosity.
Blowholes.
Hardness.
Strength.
Internal stress.
Carbon condition.
Changes in other contained elements.

The following bad characteristics in castings are sufficiently important to warrant special mention in separate paragraphs:

III. *Shrinkage* and *Segregation:* As specially affected by composition, oxidized metal through bad melting practice, cold metal, irrational gating methods, insufficient feeding opportunity, low ferrostatic pressure.

IV. *Blowholes:* As specially affected by oxidized ("burnt") metal in charges or through bad melting practice, cold iron, low ferrostatic pressure, wet mold surfaces, wet or insufficiently vented cores.

The Sulphuric-Acid Treatment Of Petroleum Products

Chemistry of the Process—Action of Sulphuric Acid on the Various Hydrocarbons and Other Constituents of Petroleum—Review of Factors Affecting the Successful Application of This Treatment in Petroleum Refining

By Carl J. Von Bibra
Chemical Engineer

MOST of the petroleum products derived from either the ordinary distillation or the cracking processes must be refined before being placed on the market as finished articles of commerce. This refining generally takes the form of a chemical treatment. This is not always the case, however, as other methods depending on a physical action such as filtration are also in common use. Sometimes both chemical and physical methods of refining are employed.

The refining of petroleum products naturally divides itself into two branches. One of these, the refining of light oils such as gasoline and kerosene, has until recently been considered rather a simple process. It is now becoming more complicated, however, because of the greatly increased production of cracked oils. These require, as a rule, more careful and elaborate treatment than do the natural products obtained from the non-cracking distillation processes. The other branch of petroleum refining is that concerned with lubricating oils. This is a difficult matter at best. It has always been costly and tedious and is becoming more so all the time due to the increasing exactness of the trade requirements.

The present paper is to be confined simply to the treatment of petroleum products with sulphuric acid. The neutralization of the acid oil and any subsequent processes are considered proper subjects for separate discussion. This is also true of such matters as the actual dosages used in practice in the acid-treatment of individual oils.

General Theory

All refining processes have as their object the removal of certain impurities in the oil which diminish and sometimes even destroy its commercial value. These impurities are either already present in the crude or else are formed during the distillation process. They are probably limited to organic bodies containing sulphur, oxygen or nitrogen. This would include the various asphaltic or bituminous substances that discolor the distillates, and sulphur alcohols, pyridines, etc., which give them an objectionable odor. The method of refining an oil, or treating it, as the chemical process is generally called, varies very much with the use to which the finished product is to be put. For instance, it would be wasteful to remove from an oil which is to be used exclusively as a gas engine fuel those substances which make an illuminating oil smoke or incrust the wick of a lamp. One of the most commonly used refining processes will now be considered in detail without reference to any particular kind of oil.

The Sulphuric-Acid Treatment Outlined

The use of sulphuric acid in refining petroleum distillates is almost as old as the oil industry itself. This acid was used in the refining of coal oil by Gower as far back as 1792 and was adopted by the petroleum industry about 60 years ago. Despite the many years that have elapsed since then, the chemistry of the sulphuric-acid treatment is still far from being fully understood. What takes place during the process is so complex that it taxes the imagination even to conjecture all the possible type reactions, much less actually to observe or measure them with any degree of accuracy. Much work has been done in the study of this process by many investigators and the results of some of this research are given here.

Very briefly put, the refining of distillates with sulphuric acid is accomplished by mixing the acid with the oil, generally in several doses, by means of air or mechanical agitation. The sludge, consisting largely of reaction products, is drawn off and the oil neutralized with caustic soda or other alkalis. It is finally washed with water to remove the excess of alkali and the alkaline reaction products, and the chemical refining is complete. In actual practice this system must be modified to suit the needs of the particular oil being treated.

At present let us study briefly the various hydrocarbons and other compounds found in petroleum, with particular attention to their behavior toward sulphuric acid, both concentrated and fuming. It may be pointed out that Gurwitsch[1] in his concise and classical volume "Wissenschaftliche Grundlagen der Erdölbearbeitung," has presented the theory of the reactions between sulphuric acid and the various hydrocarbon series in a very logical manner. Therefore his sequence of presentation will, in the main, be followed for this part of the discussion. However, in the light of more recent investigations, it is impossible to concur with him in all of his statements.

Paraffines and Naphthenes

When pure and under ordinary conditions, the paraffines and naphthenes do not react with or dissolve in either concentrated or fuming sulphuric acid. However, several investigators have succeeded in sulphonating naphthenes and normal paraffines with fuming sulphuric acid under special conditions in an experimental way. Both paraffines and naphthenes are quite freely taken up by cold sulphuric acid when they are mixed with other bodies which are themselves reactive with the acid. This is the condition that exists in actual practice, and in this way we account for the fact that an oil can be treated with one dose of acid after another until finally its volume is reduced sometimes as much as 80 per cent. Such is actually the case in the refining of water-white medicinal oil. It has not been established whether this consumption of paraffines and naphthenes is due to chemical reaction or adsorption. It is quite probable, though, that the non-reactive paraffines and naphthenes are mechanically

[1] Gurwitsch's work has recently been made available in English translation under the title of "The Scientific Basis for Petroleum Refining."

taken up—i.e., adsorbed, by the acid sludge. This sludge, a black viscous material, consists of the products formed when the acid reacts with certain constituents of the oil being treated.

Gurwitsch points out that the Imperial Russian Government required that the so-called asphalt content of petroleum products be determined by dissolving the oil in twice its volume of benzine and shaking with 20 per cent by volume of concentrated sulphuric acid. The increase in volume of the acid was taken as the asphalt content of the oil. He found that some residua showed more than 100 per cent of asphalt according to this test. On the other hand, however, after the benzine was distilled off, the acid-treated solution left a much larger percentage of oil as a residue than should have been the case considering the amount of "asphalt" adsorbed by the acid. For instance, a solution of 50 c.c. of residuum in 100 c.c. benzine was treated with 10 c.c. of sulphuric acid. Its volume decreased 28 c.c. The benzine was now distilled off. The oil remaining in the flask amounted to 36 c.c., not 22 c.c. as was expected. This, Gurwitsch feels, can be explained by assuming that the sulphuric acid removed not only certain constituents of the residuum treated but also 14 c.c. of the benzine. He proved this by diluting the acid sludge with water, neutralizing with soda lye and actually distilling off 14 c.c. of benzine. The same results were obtained when refined kerosene, consisting practically entirely of paraffines and naphthenes, was substituted for the benzine. All this certainly seems to point to an adsorption of the non-reactive hydrocarbons in the acid sludge.

Aromatic Hydrocarbons

Cold concentrated sulphuric acid attacks aromatic hydrocarbons only to a very slight extent and since nearly all technical sulphuric-acid treatments are given at atmospheric temperatures, one could scarcely expect to find true sulphonation of aromatics in the distillate taking place to any noticeable degree.

There are appreciable quantities of so-called sulphonic acids found in most sludges from ordinary cold acid treatments. Several authorities agree, however, that these in reality consist mostly of alkyl-sulphuric acids. Davis[2] found, for instance, that when the substances generally taken to be sulphonic acids are fused with caustic soda or potash no phenols are obtained. His particular work was done on bodies obtained from a California oil. Brooks and Humphrey[3] take exception to the views generally held and have pointed out that the higher benzene homologs are very readily sulphonated. Brooks and Bacon[4] have also shown that the fluorescent constituents of petroleum and its distillates are readily sulphonated by concentrated sulphuric acid, the result being the formation of fluorescent, water-soluble sulphonic acids.

The foregoing discussion applies only to concentrated sulphuric acid. If fuming acid is used at ordinary atmospheric temperatures, there is no question that sulphonation of aromatics goes on really vigorously and the sludge will show a yield of sulphonic acids corresponding to the percentage of aromatics in the raw distillate, provided, of course, sufficient acid was used to permit of the complete reaction. This effect is more pronounced when fuming acid is used at elevated temperatures. Edeleanu and Gané,[5] in their investigation of the sulphonation of petroleum distillates, treated various fractions of Bustenari kerosene with 12 per cent fuming sulphuric acid at 80 deg. C. The losses in treating ranged from 6.23 to 10.96, averaging 7.53 per cent. They distilled the sludges with superheated steam and recovered in the neighborhood of 4.6 per cent of aromatics. These included xylene, mesitylene, pseudocumene and many hydrocarbons of unknown constitution such as $C_{11}H_{16}$, $C_{12}H_{18}$, C_9H_{10}, $C_{11}H_{12}$ and $C_{12}H_{14}$. The various sludges contained widely differing percentages of aromatic bodies. In the middle fraction the substances taken up by the acid consisted of 86 per cent of aromatics. In the last fraction (b.p. 258 to 292 deg. C.) they yielded only 10.6 per cent. By converting the sulphonic acids into chlorides and sulphamides Edeleanu and Gané also succeeded in showing that the fuming sulphuric-acid sludge contained disulphonic as well as sulphonic acids. A typical body of this class is m-xylene-disulphonic acid.

Unsaturated Hydrocarbons

It is among the unsaturated bodies that we find the greatest single source of trouble in the chemical treatment of petroleum products. Of all the hydrocarbons found in petroleum distillates the unsaturated ones are undoubtedly the most readily attacked by cold concentrated sulphuric acid. Unsaturated hydrocarbons, either straight-chain or cyclic, are far from being objectionable as fuel. In fact, because of their high carbon content as compared with the saturated paraffines and naphthenes, they are more desirable for this purpose. After all, in one form or another, this is the principal use to which all the light petroleum fractions are put. Even as lubricants the complex unsaturated hydrocarbons are desirable, as their viscosity is greater than that of the saturated bodies of corresponding boiling point.

Now the chemical activity of the unsaturated hydrocarbons is unfortunate in two ways: (1) The ordinary sulphuric-acid treatment, necessary to remove the impurities, also removes a considerable amount of these perfectly good constituents of the distillate. (2) The reaction products of the acid with the unsaturated hydrocarbons remain in solution in the refined distillate. These reaction products are neutral esters of sulphuric acid together with alkyl-sulphuric acids similar to those mentioned in connection with the action of sulphuric acid on aromatics. In cases where it is necessary to redistill the acid-treated and neutralized distillate, these alkyl-sulphuric acids can and very often do cause an endless amount of trouble by breaking up into alcohols and free sulphuric acid. The neutral esters also decompose rapidly at 140 deg. C. or higher temperatures.[6] Decomposition takes place, to a certain extent, even at ordinary temperatures. The liberated sulphuric acid attacks the steel of the still and its dephlegmating and condensing system. The annoyance and cost of frequent partial or complete shut-downs of a still plant because of the decomposition of these reaction products are known to have doomed the commercial operation of an otherwise feasible cracking plant the distillates of which could not be refined commercially without a final redistillation. Several other plants are

[2]Verbal communication; see also Hausmann, *Petroleum* (Berlin), vol. 6, p. 2301.

[3]*J. Am. Chem. Soc.*, vol. 40, No. 5 (1918), p. 848.

[4]*J. Ind. Eng. Chem.*, vol. 6, p. 623 (1914).

[5]*Monit. Roum.*, 1908, p. 493.

[6]See Brooks and Humphrey, *J. Am. Chem. Soc.*, vol. 40 (1918), p. 849.

seriously handicapped on this account at the present time, although they are commercially successful despite it.

The action of sulphuric acid on unsaturated hydrocarbons has been a moot question for many years. Until recently it was generally believed that sulphuric acid, especially fuming, would remove all unsaturated bodies from petroleum. The well-known analytical method of Kramer and Boettcher is based on this assumption. In this method unsaturated hydrocarbons are determined by shaking the oil with an equal volume of concentrated acid. While the conviction has gradually grown that figures obtained in this way are quite unreliable, it remained for Brooks and Humphrey[7] to prove this and to throw much valuable light on the complex chemistry of the unsaturated hydrocarbon-sulphuric acid reactions. These investigators state that the principal results of the action of sulphuric acid on the olefines are polymerization, the formation of secondary and tertiary alcohols and mono- and di-alkyl esters of sulphuric acid. None of the simple or mono-olefines which they studied yielded tars with concentrated sulphuric acids at 15 deg. C. This last statement is a direct contradiction of one of the long-established theories of oil refining. Brooks and Humphrey also found that with increasing molecular weight the tendency is toward polymerization, that the polymers are much more stable toward sulphuric acid than the parent olefines and that the more viscous and heavy polymers are found not in the acid sludge, but, to a large degree, in the oil layer. All the heavier olefines were found to be quite stable. The tars obtained in treating highly cracked oils are taken to be due to the presence of diolefines. Those obtained in the treating of lubricating distillates are also formed from diolefines and perhaps they may also be formed from a number of other substances.

Bituminous Substances

Very little is known about the constitution of those bodies which are responsible for the color in petroleum distillates. It is generally assumed that this color is due to the presence of bitumens. This belief is based on a certain amount of research work which has been done on this question but which so far has been entirely inadequate to establish anything but a number of widely differing theories. Even the nature of the effect which sulphuric acid has on bituminous bodies dissolved in petroleum distillates has been much debated. So, for instance, Schulz[8] explains the matter as being entirely an adsorption phenomenon. Ubbelohde,[9] on the other hand, considers the removal of these substances by sulphuric acid to be due to their precipitation from the oil, the acid serving merely as an agent to throw them out of colloidal solution. Gurwitsch[10] disagrees with both of these authorities and offers a number of excellent reasons for believing the reactions to be exclusively chemical, somewhat in the nature of a polymerization. It is not a polymerization in the ordinary sense of the word, according to this author, because an elementary rearrangement takes place, one result of which is the addition of sulphur to the polymerized molecules.

Despite our present ignorance of the exact chemistry or physics of the case, the fact remains that bituminous substances can be completely removed from petroleum by the action of sulphuric acid.

Organic Acids

Many crudes and their distillates contain organic acids of various sorts. Chief among these are the naphthenic and poly-naphthenic acids and the phenols. Markownikoff[11] found that an excess of concentrated sulphuric acid completely destroys oxygen-containing bodies such as these acids, also that the amounts of acid used technically are not large enough to bring about complete destruction of these substances. In fact both Zaloziecki[12] and Condrea[13] isolated naphthenic acids from acid sludge.

Any phenols present in unrefined distillates are not subject to the action of cold concentrated sulphuric acid any more than other aromatic bodies, with the exception of those homologs of high molecular weight. These, as has been pointed out previously, are likely to be sulphonated.

Sulphur Bodies

There are several objections to the presence of sulphur in petroleum products. The element is found in oil in two forms, as free sulphur and as a constituent of complex substances of several types, either gaseous, liquid or solid. The gaseous and liquid sulphur compounds are generally characterized by an unpleasant if not unbearable odor and by the corrosive action of their decomposition products. Frequently sulphur bodies are responsible for the straw color of light distillates.

It is a difficult matter to discuss the effects, actual and possible, of sulphuric acid on sulphur compounds. This is because there are so many of them and furthermore so little is known of their structure. There is absolutely no relationship between the percentage of sulphur in an oil and the type or intensity of treatment necessary to remove all or at least most of it. It has been necessary to employ special processes in refining some oils which are handicapped by large amounts of sulphur in forms which stubbornly resist removal by sulphuric acid. The well-known Frasch process is a typical example of a chemical treatment designed specially to remove sulphur from oil. Usually, however, sulphuric acid will sufficiently remove those quantities and types of sulphur bodies which occur in the average petroleum. The so-called "doctor treatment,"[14] which has become widely used in late years, serves very well to reduce the sulphur content and improve the color of light distillates. In many refineries it has entirely replaced the sulphuric-acid treatment as applied to gasoline.

Nitrogen Bodies

Practically all petroleums contain some nitrogen. In most oils it occurs in negligible quantities or in the form of compounds which are not objectionable. At times, however, the oil to be refined does contain nitrogen in a form which is very obnoxious. This is specially true of cracked gasolines.[15] Little is definitely known of the constitution of the nitrogen bodies occurring in petroleum and its distillates. Most of them seem

[7] *J. Am. Chem. Soc.*, vol. 19 (1915), p. 823.
Petroleum (Berlin), vol. 5, Nos. 1 and 2.
[8] *Ibid.*, vol. 4, p. 1295.
[9] *Ztschr. f. d. Erdölb.* (1913), p. 186.
[10] *Berl. Ber.*, vol. 16, pp. 1873-1883.
[11] *Chem. Zeit.* (1892), p. 905.
[12] According to Gurwitsch, *loc. cit.*, p. 187.
[13] Sodium plumbite solution.
[14] See Brooks, *J. Frank. Inst.*, vol. 180, p. 653 (1915).

to be pyridine and quinoline bases and are removed by concentrated sulphuric acid. Sometimes, however, it is necessary to use very dilute acid. Other substances, such as metallic oxides, have also been effectively employed to free oil of nitrogen-bearing impurities.[16]

Factors Affecting Acid Treatment

Having considered, without going into detail, the chemistry of the sulphuric acid treatment, the next step leading to an understanding of the process is a review of those influences which may alter the final result.

The Constitution of the Oil

The kind of acid treatment to be used depends almost entirely on the constitution of the distillate. Several general rules may be formulated—viz.:

1. The higher-boiling the fraction the more rigorous the treatment necessary to obtain a certain color or degree of refinement.
2. The quantity of acid required decreases with the narrowness of the fraction.
3. Cracked distillates require more treatment than do the natural distillates.

Let us consider a typical case to show the relationship between the boiling-point range of a distillate and the quantity of acid used in refining it. Two fractions were cut from a California crude. One was a kerosene distillate with a gravity of 38.5 deg. Bé. The other was a lubricating distillate of 22.2 deg. Bé. Both were about equally narrow fractions and were to be refined to a water-white color. The kerosene was given a total of 23 lb. of fuming acid and 4 lb. of 66 deg. Bé. sulphuric acid per barrel. The lubricating distillate, on the other hand, received 335 lb. of fuming and 20 lb. of 66 deg. acid per barrel, and finally was filtered in order to get the water-white color.

Two oils may have almost identical physical constants and yet differ very greatly in their make-up. This is illustrated by two lubricating oils with the following physical properties:

Oil No. 1	Constants	Oil No. 2
476	Saybolt viscosity at 100 deg. F.	462
365	Open-cup flash test	380
425	Open-cup fire test	435
No. 6½	NPA color test	No. 6½
24	Cold test, deg. F.	20
18.0	Baumé gravity, deg.	19.7

Oil No. 1 is a heavy California motor oil which consists of a very large fraction of lubricating distillates reduced to the proper viscosity and flash test. Oil No. 2 is a widely used brand of motor oil, also made in California, and consisting of a quite narrow cut run to specification and treated without further reduction. As shown above, their tests are practically the same. Yet Oil No. 2 requires only an average of 31 lb. of acid per barrel for treatment, while No. 1 requires 47 lb. Neither of the oils is filtered. Both are the product of combined fire and steam distillation in conventional cylinder stills manipulated in practically the same manner.

Cracked motor fuels invariably need treatment to remove objectionably smelling compounds. Also, they usually acquire a dark color quite rapidly when exposed to air. These oxidation products or the bodies from which they are formed must also be removed in order to give the distillate a marketable color or rather lack of color. On the other hand, most motor fuels which are not cracked, such as straight-run gasoline, for instance, can be sold as finished products directly after distillation and without chemical treatment. If a chemical treatment is given it consists of just a small amount of sulphuric acid or perhaps only an agitation with sodium plumbite solution.

Cracked gasolines are hard to refine as compared with the natural product. Fortunately, due to lessened use and an increased supply of crude, it is no longer necessary to make cracked kerosene, at least in the United States.

Lubricating distillates are difficult to treat when in the best of condition. Cracked lubricating oils require a great deal more acid to bring them to a stable color than do those distillates in which cracked products are at a minimum. In fact, it is often absolutely impossible to refine a badly cracked lubricating oil.

Strength of Acid Used in Treatment

While it is true that sulphuric acid in relatively dilute form (not less than 65 per cent H_2SO_4 or 52 deg. Bé.) can be used successfully in the treatment of certain distillates, it has become general practice in the industry to work principally with two concentrations. Sulphuric acid of 66 deg. Bé. (sp.gr. 1.84 or 167 deg. Tw., 93 per cent H_2SO_4) is used in refining most of the world's petroleum. In special cases 98 per cent sulphuric acid (sp.gr. 1.850) is used. This has been found to be better than 66 deg. acid for the refining of certain California distillates, particularly lubricants. In the making of high-grade kerosene or of water-white medicinal oils fuming sulphuric acid is used. This is generally of the 15 per cent SO_3 form (about 103 per cent H_2SO_4), although acid with 20 per cent free SO_3 is sometimes used. There have been developments within recent years of the use of SO_3 gas directly from the acid plant, but this could certainly not be called general practice.

There are two reasons why acids of such high concentrations as those just mentioned are used. In the first place, the quantity required to achieve a certain result in refining increases very rapidly the lower the concentration. Secondly, the more dilute the acid the more troublesome it is to ship and store. In fact, as is well known, sulphuric acid of less than 60 deg. Bé. cannot be shipped commercially in iron tanks.

The relation of acid concentration to results obtained is well illustrated by the following figures. A partly cracked distillate (sp.gr. 0.8245) was treated with acids of various concentrations. In all cases the temperature was 64 deg. F. at the start. The amount of acid used in each treatment was 2.5 per cent by weight.

Tests on Oil After Treatment	Strength of Acid in Per Cent H_2SO_4 — 70	93	96	99	103 (15 Per Cent Fuming)
Saybolt, color, inches	10.5	17	20	25	22
Iodine No., Wijs	16.3	7.2	2.6	1.3	0.65
Doctor test	Sour	Sour	Sweet	Sweet	Sweet

It is clear from the above table that the refining action increases much more rapidly than the concentration of the acid. The only figure which is out of line is the darker color obtained with the fuming acid (103 per cent H_2SO_4) as compared with that given by 99 per cent acid. This is often found to be the case and can be readily explained. Fuming sulphuric acid acts primarily by sulphonating and oxidizing unstable hydrocarbons rather than by polymerizing them. Many of these sulphonation products are soluble in the oil and consequently impart to it a darker color. As these products are more readily soluble in concentrated sul-

[16] In this connection consult Mabery and Hudson, *Am. Chem. J.*, vol. 25, p. 253 (1901); also Brooks and Humphrey, *J. Am. Chem. Soc.*, vol. 40, No. 5, p. 848 (1918).

phuric acid than in oil, the practice has been developed of agitating with a small amount of 66 deg. Bé. acid (93 per cent H_2SO_4) an oil which has been treated with fuming acid. In this way excellent colors can be obtained.

Use of Sludge and Regenerated Acid

Only a part of the acid used in refining is used up in the process. For instance, a sludge from a typical California kerosene treatment with 66 deg. Bé. acid had a Baumé gravity of 46.0 deg. (sp.gr. 1.47) and contained 64 per cent of H_2SO_4 and 24 per cent of hydrocarbons. The sulphuric acid from such sludges is often regenerated and used for various purposes.

Where the fresh acid is given in several doses to the oil being treated and the sludge is drawn off after every agitation, the last one or two drainings frequently consist of fairly pure and concentrated acid. These drainings can be used to advantage in treating the next batch of oil, either as so-called "water acids" to remove any moisture in the oil or as a first dose of "acting acid" to aid in the refining.

Regenerated acid—that is, sludge acid from which water and organic substances have been removed as far as possible—does not usually lend itself well for further use in refining except in the manner indicated above for relatively clean sludge. At the present time considerable work is being done on the subject of acid recovery. Several very clever processes have come into use and the near future will probably see a commercial and generally acceptable method for making a really pure regenerated acid.

Impurities in Sulphuric Acid

Nitrogen trioxide (N_2O_3), nitrogen pentoxide (N_2O_5) and selenium dioxide (SeO_2) have been found to be injurious impurities in sulphuric acid used for oil refining. Schulz,[17] the authority for the foregoing, goes into detail regarding the effects of various concentrations of these impurities. Kharitchkoff[18] also condemns the presence of nitrous and nitric acids and considers 0.05 to 0.07 per cent the maximum permissible. Bacon and Hamor,[19] after also quoting Schulz and Kharitchkoff on the effects of impurities, laconically add that acid-storage tanks in refineries should be subjected to periodical cleaning.

American commercial sulphuric acids are made in many degrees of purity. Analyses of several standard makes of contact acid showed the greatest impurities to be iron sulphates, sometimes also slight amounts of HCl and H_2SO_3. Traces of arsenic, lead and selenium were found in some of these acids. Nitric acid as an impurity is found only in lead-chamber acid. Contact-process acid made from brimstone is generally very pure. Below are typical analyses of acids supplied to southern California refiners by a large manufacturer:

	66 Deg. Bé. Acid	99 Per Cent Acid	15 Per Cent Fuming Acid
Sulphuric acid, per cent	93.30	98.96	103.48
Iron, per cent	0.0056	0.0017	0.0031
Sulphur	Nil	Nil	Nil
Lead	Trace	Trace	Trace
Zinc	Nil	Nil	Nil
Selenium	Nil	Nil	Nil
Arsenic, per cent	Nil	0.00001	Trace
Nitrogen compounds	Nil	Nil	Nil

This same concern makes a commercial acid for the United States Navy so pure that it can be used as an electrolyte when diluted.

[17] *Chem. Zeit.*, vol. 35 (1911), p. 1129.
[18] *Westnik shirow. westsch.*, vol. 6 (1905), p. 119.
[19] *Amer. Petroleum Industry* (1916), p. 583.

Finally one cannot help but feel that while certain difficulties in refining might possibly be laid to inorganic impurities in the acid, there are at least half a dozen other factors in the acid treatment which are more likely to account for these troubles.

Quantity of Acid Used in Treating

The desired results in refining with sulphuric acid cannot be obtained simply by using larger and larger quantities of acid. There is a very definite limit beyond which it is no longer feasible to use additional amounts of acid. This limit is set by the following considerations:

(1) The refining power of the acid is not proportional to the quantity used. In fact, it diminishes very rapidly, as is shown by figures obtained in the treatment of a California lubricating distillate from Coalinga crude:

66 Deg. Bé. Acid Used (Percentage by Weight)	Color of Finished Oil (NPA Scale)
5	5
10	3
15	2
20	1½
50 (including 30 per cent fuming acid)	1

(2) If too much acid is used the distillate is apt to be "burnt." By this the practical refiner means that the treatment has been so rigorous that those delicate and probably aromatic compounds which give a pleasing "outer-tone" or fluorescence to the oil have been destroyed. This applies mostly to lubricating oils, since in refining light distillates one of the principal objects is to remove all trace of color, even of "outer-tone." An acid-burned oil generally has a dirty, brownish or bluish tinge.

(3) The more viscous the oil the more liable it is to the formation of emulsions. These emulsions are usually the result of a heavy acid treatment. An emulsion is a serious problem and when broken almost always yields a darkened oil and a large loss.

Use of the Acid in Doses

It is general practice to apply the acid used in treating in several doses. There are several very good reasons for this. In the first place, most oils are treated at as low a temperature as possible. If sulphuric acid, especially fuming, is mixed with the oil in large quantities the heat of reaction will probably raise the temperature too high. Secondly, most distillates contain a certain amount of free water or at least moisture. If this should be permitted to dilute all the acid, its effectiveness would be materially reduced. Therefore the first dose, or "dump," as it is generally called in practice, is used to remove this water. The succeeding doses can then act on the oil at their original concentration. Thirdly, aside from the question of dilution by water it has been found that a fixed quantity of acid has considerably greater refining power when applied in several small doses rather than in one large one. Since the action of the acid on the oil is partly a solvent action, this behavior is in keeping with the well-known physicochemical principles of solutions.

In speaking of applying the acid in several doses it is assumed, of course, that the sludge is drawn off after each dose has been agitated. Otherwise the final effect would be quite the same as when the acid is given all at once.

Gurwitsch thinks that the good effect of giving the acid in fractional portions is probably due to the fact

hat sulphuric acid often reacts in several stages with he asphaltic and unsaturated compounds of high molecular weight. Even at the beginning or first stage reaction products are precipitated from the oil. In refining certain petroleum products he noticed that even with the addition of small amounts of acid a very weakly acid sludge separated out. Most of this is soluble in benzine. If this sludge is treated with additional quantities of sulphuric acid, it loses its solubility n benzine almost entirely. Now, on the other hand, if he raw (unrefined) product is treated with a single iberal dose of acid, the same insoluble sludge is formed. In cases like this it is very easy to see that the use of acid in several doses must be more effective than a single dose. In the latter case some of the acid performs the entirely useless work of changing still further he reaction products which have already separated rom the oil.

The Effect of Temperature

The temperature at which the acid treatment is carried out is an extremely important matter. A general rule followed by most refiners is to treat at just as low a temperature as possible. This rule is based on the fact that one of the principal objects in refining most petroleum distillates is to make them as nearly colorless as possible, and this can best be done at low temperatures. The lack of color in an oil does not necessarily ndicate a high degree of refinement. However, the rade is prone to judge an oil by its appearance and often blindly assumes that the best looking oil is really he best. This is equally true of light oils such as motor fuels and of lubricating oils.

The only exceptions to this rule of treating at low emperatures are kerosene and sometimes steam-cylinder oil. If a really high-grade kerosene is desired it should be treated hot, as the sulphonating power of the acid increases rapidly with the rise in temperature and aromatic bodies must be removed as completely as possible. The removal of unsaturated hydrocarbons and bituminous substances is also accelerated by the hot reatment. The color of hot-treated oils is generally poor, and this defect is remedied by an after-treatment at relatively low—i.e., atmospheric—temperatures with 66 deg. acid or by filtration through bone black or other decolorizing material. When treating steam-cylinder oils there is an entirely different reason for treating it hot. The object is to reduce sufficiently the viscosity of the oil to make treatment possible. Beyond this any excess heating is carefully avoided. It might be argued hat it is not necessary to treat cylinder oils or other heavy lubricants in their natural condition, the practice usually being to dilute them with a light naphtha sufficiently to reduce the viscosity and then to remove he naphtha after treatment or filtration. This is true, ut not always feasible. There are steam-cylinder oils made which will not stand the distillation after treating necessary to remove the admixed naphtha and such oils must necessarily be treated hot.

Zaloziecki,[20] as a result of his study of the acid treatment of a Galician kerosene, published the table given n Table I.

This table is self-explanatory. Zaloziecki interprets the nsatisfactory color obtained at elevated temperatures n the following manner: Colored oxidation products re freely formed at these temperatures and reactions resulting in the formation of free water are accelerated. The result of the latter is a dilution of the acid, and this in turn causes certain oil-soluble asphaltic substances to pass out of the acid solution into the oil and thus discolor it.

[20] *Chem. Zeit.* (1895), p. 875.

The Effect of Light

Possible effects of light on the results of acid treatments are disregarded in technical procedures. Acid lubricating oils darken rapidly on exposure to direct light, while the same oils darken only very slowly in diffused light or darkness. Zaloziecki found that the acidity was higher and the color darker when a Galician kerosene was treated in diffused light than when it was treated in the dark.

TABLE I—STUDY OF ACID TREATMENT OF A GALICIAN KEROSENE

Temperature, Deg. C.	Acid Sludge, Grams	Unused H_2SO_4	Sulphonic Acids Calculated as H_2SO_4	Acidity of the Kerosene in Terms of H_2SO_4	Polymerization Products	Color in mm. as Compared With an Arbitrary Glass
0	61.6	47.91	1.45	0.86	5.25	193
5	62.0	46.82	1.55	1.42	5.02	166.5
10	62.5	46.53	1.65	1.56	5.13	143.0
15	63.5	45.72	1.93	1.76	5.40	112.5
20	64.3	44.37	2.22	2.45	4.93	89.5
25	64.8	43.52	2.68	2.63	5.62	80.5
30	65.2	41.87	3.72	3.65	5.43	52.0
35	65.8	40.42	4.90	4.15	6.18	Straw
40	66.0	39.03	5.62	4.83	5.78	Straw
45	66.4	38.62	5.76	5.62	5.21	Straw
50	67.0	37.26	4.81	5.91	4.81	Straw

Method of Mixing Acid and Oil

Three methods of mixing chemicals with the oil being treated are used in practice. The one used originally was mechanical and is illustrated by the gear-driven paddles used in grease kettles. Mechanical agitation is at present used only in special cases, mostly when oxidation by air is to be avoided. In most treatments the acid is now mixed with the oil by means of an air blast. In this way rapid, thorough and relatively cheap diffusion of the acid through the oil is obtained. Air agitation, however, has its drawbacks. First, it oxidizes the oil. This is a serious consideration in the case of cracked distillates or oils being treated at elevated temperatures. Second, the air almost always contains considerable water. This dilutes the acid and greatly reduces its efficiency. Third, when light distillates are agitated with air, the evaporation losses are prohibitive. Consequently oils like gasoline are mixed with the acid or other substances by means of a circulating pump. This takes suction near the top of the agitator and pumps the oil in at the bottom.

The Time Factor in Treating

The length of time required to utilize the full refining value of the acid depends on a number of modifying circumstances. Among these the most important are: (1) Method and violence of agitation. (2) Size and shape of the apparatus. (3) Viscosity of the oil. (4) Quantity of acid used and number of dumps in which it is applied to the oil.

When the oil is being treated in separatory funnels in the laboratory, a few minutes violent shaking by hand generally suffices. In agitators of 500-bbl. to 2,000-bbl. capacity light distillates are usually agitated by air for periods varying from 15 minutes to 1 hour. If circulation by pump is used as a method of mixing, the time is increased to as much as 16 hours or more.

The time limit in acid-treating lubricating oils may be defined more closely. It is safe to say that the average large-scale batch varying, say, from 25 to 1,200 bbl. cannot be intimately mixed with acid in less than half an hour. Complete mixing should be attained in 2 hours, at any rate. Needlessly prolonged contact between the acid and the oil is harmful. This is because part of the sludge will dissolve in the oil and thus discolor it. Also, long agitation of acid lubricating oils frequently results in emulsions after the addition of an alkali solution as in the ordinary method of treating. While this is true no matter by what means the oil is agitated, it must be borne in mind that the influence of air is especially bad because of its oxidizing effect.

For a long time the separation of the acid sludge from the oil in which it is suspended was a serious problem in oil refining. Of course, the light oils have such a low viscosity and specific gravity that the heavy viscous sludge settles out almost immediately. Such, however, is far from being the case with lubricating oils, especially the more viscous ones.

Formerly the oil was freed from sludge either by long settling or by centrifuging. The former method injured the oil because of the length of time in which it had to remain in the acid condition. The latter procedure was very expensive and the lead-lined centrifuges used were constantly in need of repair.

During the last 25 years it has become universal practice to "knock down" the sludge from the acid-treated oil. This practical expression really means that the very finely divided sludge particles are gathered together into nodules sufficiently heavy and compact to settle out of the oil. This result is accomplished by sprinkling cold water or caustic-soda solution on the oil while agitating it very gently. Before the sludge is "knocked down" the oil has a color ranging from blue to purple. The oil is more purple when it has been treated with a large amount of acid. After all the sludge is gathered and precipitated the oil takes on a color ranging from green to yellow. The acid treatment is now complete and the oil is ready to be neutralized.

Los Angeles, Calif.

Mechanism of Metallic Oxidation at High Temperatures*

Rapidity of Corrosion in Heated Atmospheres Is Not Determined by Any Property of the Metal but by Some Combination of Physical Properties of the Oxide and Its Ability to Absorb and Diffuse Oxygen

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THE corrosion of metals is one problem of great economic interest upon which much time and thought have been expended over a period of many years. In the effort to avert the destructive action of a hostile environment, attention has naturally been directed almost entirely upon the conditions under which an overwhelming majority of metallic structures are called upon to perform, and the extensive and complicated phenomena attending the corrosive action of atmospheric agencies, acting at the ordinary atmospheric temperatures, have been studied voluminously, although a unanimity of opinion regarding many fundamental facts in the mechanism of corrosion is even now far from being reached.

One somewhat neglected type is the corrosive action of various gases upon metals when exposed to temperatures considerably higher than the atmospheric range, and more especially the attack of atmospheric oxygen upon exposed metallic surfaces. That the problem is a difficult one to contend with is connoted by the practical dominance of industrial electric heating by alloys of one type (nickel-chromium). Proprietary interest may account in part for the paucity of information publicly available in the technical literature upon even the most general factors determining the behavior of metals and alloys exposed to such exacting conditions.

The present brief paper is an account of some conclusions reached as the result of experimental work extending over several years; it is unburdened of much perhaps desirable experimental detail and proof.

High-temperature metallic oxidation may be considered as a phase of metallic corrosion. The scheme outlined below, in which corrosive agent and environment are the principal criteria, is one way of analyzing the several groups of corrosion phenomena.

Erosion:
  Disintegrating or destructive action by *physical* causes
Corrosion:
  Disintegrating or destructive action by *chemical* causes
  Low-temperature corrosion:
    Solid participating phases essentially immobile.
      Gaseous agent.
      Liquid agent.
        Action electrolytic.
        Action non-electrolytic.
  High-temperature corrosion:
    Solid participating phases possess diffusive mobility.
      Liquid agent.
      Gaseous agent.
        Reducing gases.
        Oxidizing gases.
          Water.
          Miscellaneous elemental and combined.

With the exception of the division between high- and low-temperature action, the classification is obvious enough. High and low are only relative terms, with no boundary between them. Similarly, there is no reason for the statement that diffusion is inoperative at certain low temperature; but there is an essential difference due to the fact that when the temperature is raised sufficiently the forces of diffusion not only become active, but active with such rapid amplification as to become dominant forces. The diffusive mobility of the solid constituents of alloys when highly heated is a property recognized by every metallurgist, and some of the fundamental operations of physical metallurgy, such as the heat-treatment and cementation of ferrous alloys, rest upon it as a foundation. The solution and diffusion of gases in solids are appreciated by all who have had occasion to handle hot hydrogen.

*A paper presented before the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers, Rochester, June, 1922.

Noble and Base Metal

Oxidation is a chemical reaction, and a reversible one —that is, in the presence of oxygen at a sufficiently high temperature, a metal may be oxidized, or its oxide decomposed, by suitably adjusting the pressure (concentration) of the oxygen atmosphere. At pressures greater than the equilibrium dissociation pressure of the lowest oxide, oxidation occurs; at lower pressures the oxide decomposes and the metal is unchanged in contact with free oxygen. This dissociation pressure is not a constant, but increases with rising temperature somewhat after the fashion of vapor pressures. Silver and palladium are standard examples in which at atmospheric pressures oxidation occurs at low temperatures and reduction at higher ones.

The first great division in the behavior of the metals may be made on the basis of the order of magnitude of the dissociation pressure of the lowest oxide, serving to separate the noble from the base metals. The former fall within the range of atmospheric pressures and above; the latter are extremely minute—e.g., at 1,000 deg. C. the dissociation pressure of cuprous oxide is estimated[1] to be of the order of ten-millionths of an atmosphere. Included in the few metals which may be classed as non-oxidizing by this distinction are gold, platinum, rhodium, silver, palladium and some chemically similar metals.

Dense Oxide Films Impede Corrosion

The base metals—the oxidizing metals—comprise the remainder of the common metallic elements, and a second division may be made among them based on the physical texture of the oxide which is formed. Here the determining factor is one of relative metallic and oxide density. As the surface of a metallic wire, for example, is being oxidized a cylindrical shell of metal is replaced by a cylindrical shell of oxide, which may or may not take up more space than the former. The characteristic of the formation of subsequent layers of oxide depend upon which of these conditions is fulfilled. If the layer of oxide formed takes up more space than the volume of metal which was oxidized to produce it, the oxide layer forms a tight fitting, solid sheet; if the reverse is the case, there is more space available within the original metallic dimensions than the oxide density requires, and a porous, bricky structure is the result. In the former case, the enveloping oxide layer may impede further oxidation; in the latter, by virtue of its porosity, it does not. The critical density ratio is given in the expression

$$\frac{Wd}{wD}$$

in which

W = molecular weight of oxide formed.
w = formula weight of metal.
D = density of oxide formed.
d = density of metal.

The cellular oxide structure results when this ratio is less than unity; the solid crystalline oxide when it exceeds unity. Table I gives values for this critical ratio computed from data available in current physical tables.

Those metals which fall into the cellular oxide structure group comprise most of the so-called light metals, and the characteristics of oxidation of the group have been confirmed experimentally with magnesium and calcium. Wires of these two metals heated in dry oxygen below their ignition temperatures (about 525 deg. C.) form oxide coatings the thickness of which increases directly proportionally to the time of oxidation—that is, the formation of an oxide film does not interfere with the speed at which subsequent films are formed. After complete oxidation of a calcium wire, the resulting lime wire had the same micrometer diameter as the initial metallic diameter, and from the known densities of calcium and calcium oxide it appears that 45 per cent of the volume of this lime wire was void. A steady stream of oxygen will pass through this porous layer to the oxidizing metallic surface without detectable impedance; expressed differently, the oxygen pressure gradient through an oxide coating of this type is zero.

The remaining large group, which is composed of the majority of the common metals, form compact enamel-like jackets of oxide, being free to expand outward as they form, and all exhibit the common property of suffering a progressive decrease in rate of oxidation at constant temperature, proportional to the thickness of the layer of oxide formed. This leads at once to a parabolic relation between time and quantity of oxidation, the square of the weight of oxide formed per unit of surface being proportional to the time of oxidation. Quantitative verification of this fact has been obtained with copper, iron, nickel, zinc, lead, cadmium and aluminum. At any time the rate of oxidation is inversely proportional to the thickness of the layer of oxide then on the surface. The fact that this rate varies quantitatively with the amount of oxide overlying the metal surface points to an important conclusion: that the speed of the reaction is not determined by any property of the metal at all, but is determined by some combination of physical properties of its oxide. To explain the known differences in the behavior of the metals as regards high-temperature oxidation metallic properties may be forgotten, but a knowledge of the characteristics of their oxides is imperative. It is unfortunately the case, as will appear later in this discussion, that the determinative properties are of a type in which quantitative information at the present time is almost wholly lacking.

TABLE I—CRITICAL DENSITY RATIOS OF METALS AND THEIR OXIDES

Metal	Ratio	Metal	Ratio
Aluminum	1.28	Manganese	2.07
Barium	0.78	Nickel	1.68
Cadmium	1.32	Potassium	0.51
Caesium	0.42	Silicon	2.04
Calcium	0.78	Sodium	0.32
Chromium	3.92	Strontium	0.69
Cobalt	2.10	Thorium	1.36
Copper	1.70	Tin	1.33
Iron	2.06	Tungsten	3.30
Lead	1.31	Zinc	1.59
Lithium	0.60	Zirconium	1.55
Magnesium	0.84		

Solubility of Oxygen in Oxide Layers

The way in which the oxide layer limits the rate of oxidation can only mean that the transmission of oxygen through this layer to the reaction surface, which is the juncture of metal and oxide, is effected against a resistance which is proportional to its thickness. For many reasons it appears that this transmission must be accomplished by the actual solution of oxygen in the metallic oxide, and its diffusion while in the dissolved condition from the outside to the inside sur-

[1] W. Stahl, *Metallurgie*, vol. 4, p. 682 ((1907).

face. The motive force of diffusion is difference in concentration, and speed of diffusion is determined by: (*a*) the concentration gradient of the diffusing substance, (*b*) the diffusional resistivity of the obstructing medium.

In the case of metallic oxidation, the concentration of free oxygen at the reaction surface is maintained at or very near to a value corresponding to the oxide dissociation pressure; at the outer surface it is that of the maximum solubility of oxygen in the oxide, and the difference between the two is the operating force causing a steady stream of free oxygen to pass through.

The critical oxygen pressure which we interpret as bearing a close relation to maximum oxygen solubility may be determined by rate observations in oxygen atmospheres of varying tenuity,[2] and the diffusional resistivity deducted from it and the diffusion rate. In Table II a comparison of the critical constants for three metals is given for a temperature of 900 deg. C.

TABLE II—CRITICAL OXIDATION CONSTANTS FOR THREE PURE METALS

	Electrolytic Copper	Electrolytic Iron	Electrolytic Nickel
Rate of oxidation g./sq.cm./hr.	0.000127	0.00065	0.00000076
Diffusional resistance of oxide (arbitrary units)	2,840	310	50,000
Critical oxygen pressure mm. Hg (maximum solubility)	0.36	0.20	0.04

Nickel at this temperature is 165 times as resistant to oxidation as copper, and this is due both to an oxygen solubility one-tenth as great, and a resistance to diffusion seventeen times greater, of nickel oxide as compared with cuprous oxide.

Rate of Oxidation at Elevated Temperatures

The way in which the rates of oxidation change with temperature, according to our previous analysis, is equivalent to the temperature change in diffusivity of oxygen through oxide, inasmuch as the corresponding change in oxygen solubility appears to be slight. The quadratic rate constant (isothermal) for all of the metals we have examined is related to the temperature of oxidation according to the type equation

$$k = AT^n,$$

a parabolic equation in which

k is the rate constant,

T is the absolute temperature, and

A and n are characteristic constants.

The shape of the curve is determined by the value of n, which is different for the several metals, but always fairly large, usually between 10 and 20. The rate of oxidation thus changes very rapidly with temperature; but the very generality of the equation makes a simple comparison between two metals difficult, except in the very special case, which unfortunately is quite unlikely, when the exponents are equal. Thus the ratio between the isothermal oxidation rates of two metals varies with temperature and may even reverse in relative magnitude.

As to the fidelity with which metallic oxidation follows this simple law, we can only say that in the case of copper, experimentally observed points in the temperature range of 400 to 1,000 deg. C. lie on this curve with surprising closeness, although at temperatures of 600 deg. C. and below there are deviations in the direction of faster rates, which approach the theoretical rates as a lower limit. The cause for this deviation is apparently due to fissuring of the protective oxide coating by the expansive action of the formation of new underlying oxide layers, and the failure of the original oxide surface to accommodate itself to the expansion on account of insufficient plasticity.

Aluminum and cadmium behave in an anomalous manner in that oxidation proceeds according to the parabolic law as is required by their density ratios, until an oxide coating which is truly hardly more than a film is formed, whereupon further oxidation ceases. At a temperature of 600 deg. C. this film forms upon aluminum in about 60 hours, and further exposure up to 900 hours brings about no increase. This critical oxide film weighs about 0.00010 gram per square centimeter, corresponding to a thickness of 0.00002 cm.

[2]For instance, if metallic wires are oxidized in oxygen at various pressures, the rate of oxidation is but slightly influenced by the gas pressure as long as the latter is below a certain value ("critical oxygen pressure"), but is directly dependent at higher gas pressures.

The Romance of Helium

The story of helium, its discovery, development, uses and methods of production is told in a recent Bureau of Mines bulletin by R. B. Moore, chief chemist. In the words of the report, the story of helium is one of the romances of science. It is one of the best examples of a discovery in pure science that has wide commercial application. In 1868, an eclipse of the sun was visible in India. Several scientific men who were in India making observations of the eclipse turned a spectroscope for the first time on the solar chromosphere—that part of the atmosphere of the sun, about 10,000 miles deep, which merges into the corona. A bright yellow line was observed and was thought at first to be due to sodium. Janssen showed, however, that this line was not just the same as either the D_1 or D_2 line of sodium, although it was extremely close to these lines, hence he suggested that the new line have the designation D_3. Frankland and Lockyer decided that D_3 was due to an element in the sun not previously discovered on the earth and suggested for it the name Helium from the Greek word *Helios*, the sun.

For several years nothing more was done in connection with this element. In 1894, Sir William Ramsay, in conjunction with Lord Rayleigh, made his memorable discovery of argon in the atmosphere, which was announced at the British Association meeting in the same year. After this discovery, Ramsay looked for other sources of the element. Through Sir Henry Miers, he learned that W. F. Hillebrand, of the United States Geological Survey, had obtained an inert gas from certain uranium minerals which he had decided was nitrogen. Ramsay, believing that part of it might be argon, obtained from Hillebrand a sample of the mineral, cleveite and after extracting gas from the mineral and purifying it, he ran it into a spectrum tube. The lines obtained were, however, different from those of argon. Among them was the bright yellow line noted by Janssen. Thus was terrestrial helium discovered.

Possessing great lifting power and being non-flammable, helium is recognized as superior to hydrogen for use in dirigibles. Another advantage of the gas for this use is that it diffuses through a fabric at about three-quarters the rate of hydrogen; its non-flammability makes it possible to place the engines in the framework of the dirigible, thus getting a direct drive giving greater control of the craft and much increased speed for any given horse power.

The bulletin also describes manufacturing processes.

Heating Coke Ovens With Blue Water-Gas

Blue Water-Gas Heating Doubles Surplus Gas From Ovens, Eliminates Carbon From Heating Flues and Permits Uniform Oven Operation, Without Change of Oven Burners or Other Parts of Fuel-Gas System

By J. F. O'MALLEY
Superintendent of Gas Manufacture, Empire Gas & Electric Co.

THE Empire Gas & Electric Co., of Geneva, N. Y., recently encountered a serious threefold problem. First, it was necessary to provide additional gas-producing capacity. Second, the plant must be made flexible to the point where coke production could be made to fluctuate as nearly as possible with the demand. Third, the necessity of stocking thousands of tons of coke in excess of requirements with a sluggish coke market showing little prospect of immediate improvement must be avoided. All these results were accomplished through the erection of a blue water-gas plant to supply fuel gas for heating the byproduct coke ovens, in place of using lean oven-gas as had been the former practice. The adoption of this blue-gas for heating has in fact practically doubled the surplus gas-producing capacity of the plant; and, in addition, it gives a greater flexibility of operation than could previously be obtained.

Advantages of Separate Heating Gas Supply

In operating a byproduct coke plant for the production of fuel gas, where several communities depend upon the plant for gas for their daily needs, it is necessary to maintain a sufficient supply to meet these needs and also to anticipate future demands of an ever-increasing gas consumption. It is also necessary under these conditions to maintain a quality of gas which conforms with the required standards. The coke produced must be of first-class quality so that it may find a ready market. This last is particularly germane in a plant where gas is the principal product, as the coke from such a plant must compete with that from plants where coke production is the prime consideration.

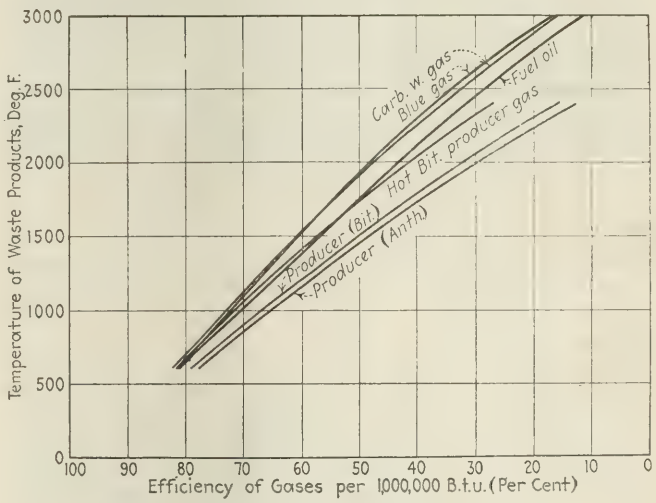
Where lean gas is used for heating the ovens and only the surplus of rich gas is sold, the operation is of necessity a balanced one. Both the lean and the rich gas must come from the coal charged. If the coal charging is interrupted for any reason, the gas production will automatically fall off, which results in a shortage of surplus gas and also of heating gas. As a result it is often a case of "robbing Peter to pay Paul" for a time, while "green" ovens are pushed to build up the gas supply and a poor quality of coke results.

These are the problems that make successful byproduct coke plant operation difficult and at times almost impossible, especially where a plant has gone through many years of service, and repairs and replacements are of frequent occurrence. A blue-gas plant, being an entirely separate gas-making unit using coke as fuel, fits into this situation exactly. And even though other conditions remain the same, if such gas is used to supply the ovens, it liberates an equal amount of oven-gas for sale as fuel.

The advantages of having a separate source of supply for heating gas which can be started and stopped on short notice is evident, for with it heats can be maintained irrespective of oven conditions much better than when the lean gas is used for heating. For such a separately generated gas, blue water-gas is much superior to producer-gas in that it has a higher flame temperature. Producer gas, having a greater percentage of inerts, must necessarily give a flame of lower temperature.

Additional Advantages Obtained

In addition to adding increased production of salable gas to the plant's output, there are other advantages, depending largely on local conditions, which may be realized from such a separate source of heat. It may be used to regulate the coke production more closely to suit market conditions and thus prevent the accumulation of large stocks. This is done by operating only enough ovens to take care of the gas requirements, using all oven-gas for outside demand and heating with



THEORETICAL COMBUSTION EFFICIENCIES OF VARIOUS GASES

blue-gas made from the coke. The coke production can be cut practically in half in this way.

The blue-gas auxiliary also permits the use of coals containing smaller amount of volatile than could be used without its aid. Thus coals especially suited for making foundry coke, may be employed in a plant where gas is the principal product, even though these coals are low in volatile. There are also times when high-volatile coal is difficult to obtain, and here again the low-volatile coal can be used and still sufficient gas be obtained.

Again, by the use of the blue-gas auxiliary, the total coal which must be carbonized for a given output of gas to consumers is greatly lessened. In times of coal shortage, when the only consideration must be to keep the supply of domestic gas at its normal level, this fact allows the storage pile to cover a longer period and may

be of great aid in saving the communities served from serious hardships.

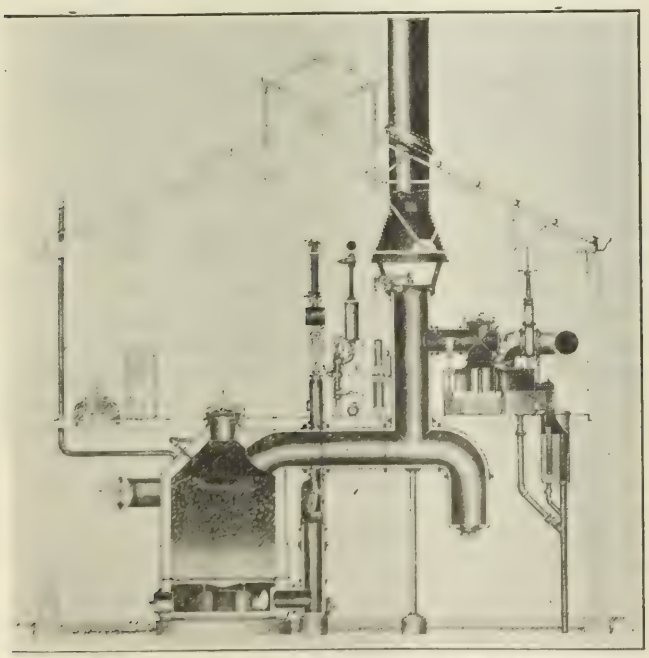
Description of Plant of Empire Gas & Electric Co.

The Empire company's gas plant consists of forty-six byproduct coke ovens of Semet-Solvay design and construction. Thirty of these ovens are four flues high, 15½ in. to 17 in. wide from pusher to coke side, 35 ft. long, and have a capacity of 7 tons each per charge. The sixteen ovens remaining are five flues high, 15½ in. to 17 in. wide, 35 ft. long, and have a capacity of 10 tons each per charge. These ovens are of the usual silica brick construction. Operating at approximately 20 hours average coking time, they carbonize 425 tons of coal per day, giving a total gas yield of over 4,000,000 cu.ft., of which 2,000,000 can be considered as surplus gas.

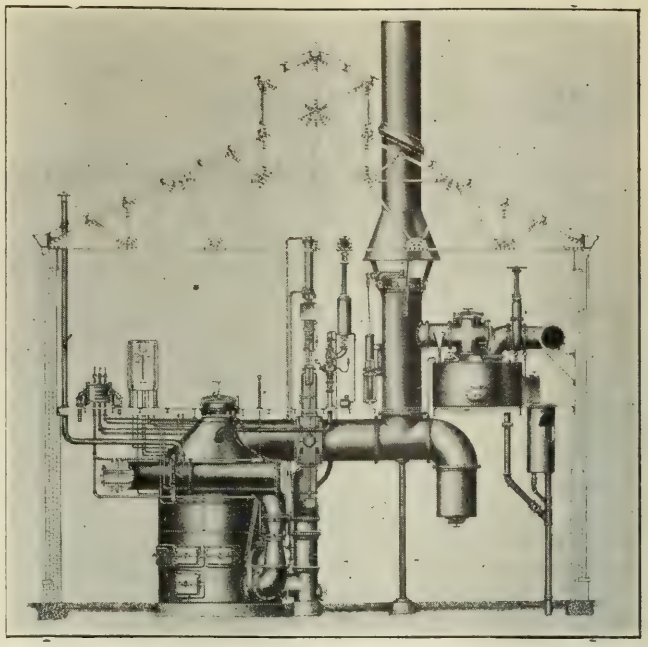
This surplus gas is distributed to nine cities and towns in the Empire territory as follows: Geneva, Auburn, Waterloo, Seneca Falls, Cayuga, Phelps, Newark, Palmyra and Lyons. The largest of these cities are Geneva and Auburn. The farthest point of delivery is Auburn, which is served by 26 miles of high-pressure main from Geneva.

The Auxiliary Blue-Gas Plant

The blue-gas plant was designed and erected by the U.G.I. Contracting Co., of Philadelphia, Pa. It consists of a generator building containing two 9-ft. diameter blue-gas generators and their necessary piping and accessories. These generators, of 7 ft. 2 in. inside diameter, have a grate area of 40.35 sq.ft. each. Their capacity is approximately 1,750,000 cu.ft. of gas each daily. The accessories include U.G.I. automatic control machines for the operation of the set; and two blowers, one motor and one steam turbine driven. There are also two steam-driven pressure pumps used in connection with the control machines. The motors, blowers and pumps are inclosed in a dustproof room on the ground floor. Included in this auxiliary plant is a relief holder of 100,000 cu.ft. capacity and a condenser equipped with sprays and grids—placed after the holder for cooling the gas.



SECTION THROUGH BLUE-GAS GENERATOR AND PIPING



ELEVATION OF BLUE-GAS PLANT

Steam for this blue-gas plant is generated in waste heat boilers and in boilers fired with coke breeze by Coxe stokers.

The handling equipment for feeding coke to the generators comprises a track hopper, a steel apron feeder and a belt conveyor. The belt conveyor has a travel of 200 ft. and is equipped with a 20-in. rubber-covered belt. This conveyor discharges into a storage bin and from there by chute to a charging car on the operating floor of the generator building.

Provision for future extension to this unit has been allowed in the layout. Space in the present building has been reserved for the installation of carburetors, by means of which the blue-gas could be enriched to the required heat and illuminating values for distribution to consumers, should such prove to be desirable.

Operating Mechanism and Methods

The automatic controls add greatly to the efficiency of the plant. When they are set and timed to run in a proper manner, the plant practically operates itself. All of the steam valves, air valves, stack valves, etc., are opened and closed automatically, being timed to the second. Much more efficient results are thus obtained than is generally possible by hand operation. The temperatures throughout the fuel bed are maintained within narrow limits, due to short cycles. The fuel bed is operated at its highest efficiency, producing a uniform quality of gas and a clinker which is easily and quickly removed.

The generator, a cylindrical steel vessel lined with insulating lagging and refractory brick, is provided with self-sealing doors, one at the top through which the fuel is fed, others giving access to the fire at the grate level, and one at the bottom. The air supply for blasting the coke to the proper temperature for gas generation enters the bottom of the generator, where it is controlled by a valve. The blast products, escaping from the top of the fire, pass through outlet connections controlled by special gas and stack valves, thence through the stack to the atmosphere. The installation is not equipped with waste heat boilers, although pro-

vision has been made so these may be installed in the future.

The hot gas outlets, provided with valves, are situated at top and bottom of the generator. When gas is being generated, it is taken off first at the top of the generator and then at the bottom. The operating mechanism which causes the reversal of these gas outlet valves also controls the steam supply and its regulation and the other parts of the accessory equipment, so that reversal for these is exactly synchronized with reversal of the gas.

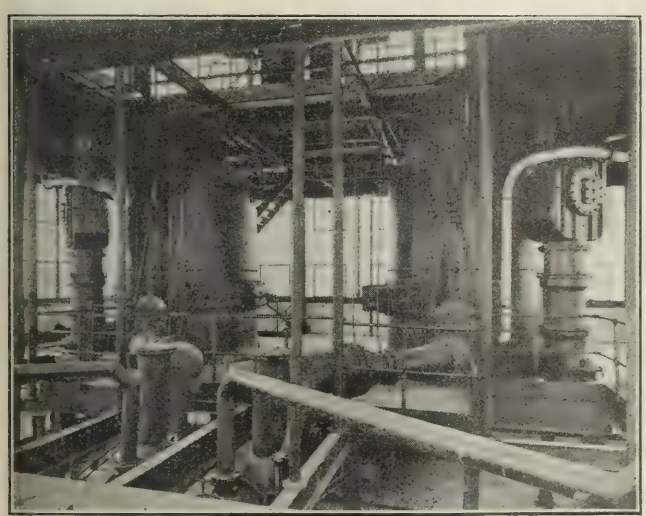
Operating Cycle for the Blue-Gas Plant

The process of making blue-gas consists of heating a bed of coal or coke to a predetermined sufficient degree of incandescence by an air blast through the firebed in the generator, and passing steam through the fuel thus preheated. After the fuel has been made properly incandescent, the steam is blown first up and then down through it until the temperature of the bed has been lowered somewhat. Then the steam is turned off and the fuel bed brought back to incandescence by the air blast.

The period of this cycle and the relative times of its various parts must be changed as required by changes in fuel or other conditions. The cycle found most economical at the Empire Gas & Electric Co. plant occupies 3½ minutes. This is divided into 25 per cent for blow period, 15 per cent for up-run steam, 45 per cent for down-run steam, and 15 per cent for up-run steam, making total of 100 per cent.

Operation of Blue-Gas Plant

The amount of air used varies with the fuel. The conditions are most favorable to gas making when the fuel bed is kept uniform. This plant has obtained good



SECOND FLOOR SHOWING THE TWO GENERATORS AND PIPING

results with an air blast of 10,000 cu.ft. per minute. The usual steam pressures are 90 lb. for up-run steam and 95 lb. for down-run steam.

It is the practice to clean the firebeds once each shift, or three times per 24-hour day. This cleaning occupies about 30 minutes, and can be easily accomplished by the coke handlers from the ovens without interfering with their other duties. The fuel is elevated by the same workers that elevate coal to the ovens. It does not require over 2 hours per day to accomplish the handling of sufficient coke to run the generators.

The product of the blue-gas plant is not at present accurately known, as it was not the former practice to meter the lean-gas used for heating and there is consequently no meter on the oven fuel-gas mains. It is expected, however, to install such a meter at an early date, and at that time the exact operating economy of the blue-gas can be figured.

Comparison of Blue-Gas and Lean Oven-Gas

The following is an average analysis of blue gas:

	Per Cent		Per Cent
Carbon monoxide	43.5	Oxygen	0.6
Hydrogen	47.3	Nitrogen	4.4
Methane	0.7		
Carbon dioxide	3.5	Total	100.0

The above analysis shows 91.5 per cent of combustibles and 8.5 per cent of inerts. Blue-gas of this analysis requires 2.3 volumes of air for complete

OPERATING FLOOR WITH AUTOMATIC CONTROLS AT RIGHT

combustion. This gas has a specific gravity of 0.559, a specific heat of 0.45 and a calculated flame temperature of 3,470 deg. F. Its calorific value is 302 B.t.u. per cu.ft.

A usual sample of the lean oven-gas would have an approximate analysis as follows:

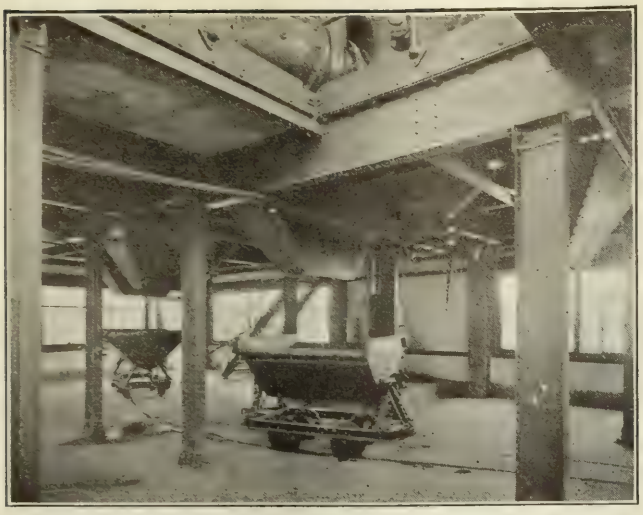
	Per Cent		Per Cent
Carbon dioxide	1.0	Hydrogen	51.9
Illuminants	1.4	Nitrogen	17.4
Oxygen	0.3		
Carbon monoxide	1.5	Total	100.0
Methane	26.5		

This is only a sample analysis of a lean-gas. This gas requires 4.25 volumes of air for complete combustion. Its flame temperature is 4,000 deg. F. Such a gas varies with conditions of carbonization and fluctuations in demand. For this reason it is not feasible to give any constants for lean-gas. The calorific value is found generally to vary between 380 and 450 B.t.u. per cu.ft.

Changing From Lean-Gas to Blue-Gas

One of the interesting points noted in the burning of blue-gas in the oven flues in comparison with lean-gas is that it is a much cleaner fuel. It is also noteworthy that greater operating efficiency is possible because the blue-gas is more constant in quality than the lean-gas.

The adoption of blue-gas as fuel at Empire did not necessitate any changes in burners or equipment on the ovens. The slip blanks which are inserted in the union of the 1¼-in. gas lines which feed the flues are



VIEW UNDER GENERATORS SHOWING CLEAN-OUT AND ASH CAR

disks with round holes varying in size from 8 mm. diameter for upper flues to 14 mm. diameter for lower flues. These serve to govern the amount of gas admitted to the combustion chambers.

It is interesting to note that the openings in these slip blanks were not enlarged or changed any way in changing to blue-gas fuel. The gas pressure in the fuel-gas line to the oven battery was increased by 3 cm. of kerosene, the amount of air admitted to the gas was reduced, and the stack draft reduced proportionately.

After these adjustments had been made no difficulty whatever was experienced and the heats were maintained without any trouble. There is no formation of soot or carbon in the flues when blue-gas is used, such as occurs when heating with lean oven-gas. This is a decided advantage. A slight disadvantage in the use of blue-gas is that sulphur collects in the burner pipes. This can, however, be readily disposed of by steaming out these pipes about twice a month; and is of no importance when the decided advantages obtained by using blue-gas are considered.

The writer wishes to acknowledge the courtesy of the U.G.I. Contracting Co. in supplying some of the photographs used in connection with this paper.

New Use for a Tiering Machine in the Chemical Industry

By Matthew William Potts

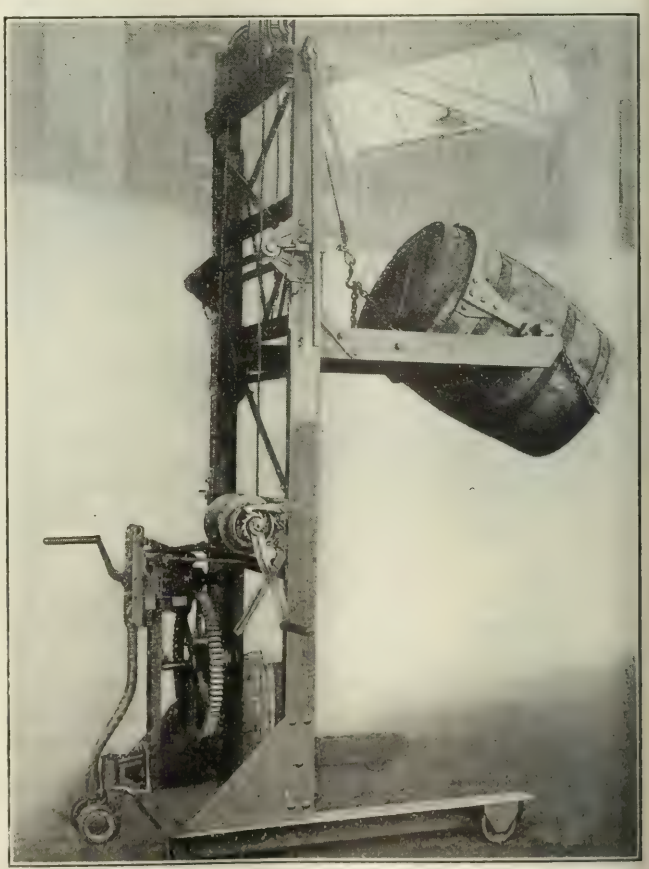
THE photograph herewith illustrates a new use for a tiering machine in the chemical plant. This machine was designed for and is being used by the Agar Provision Co., of Chicago, Ill.

This machine could be used in soap works, perfume and candy factories, packing houses—in fact any place where it is necessary to raise the container before dumping. Many times in passing through a chemical or dye plant, two to four men are seen struggling with a barrel, carboy or drum, trying to raise it so as to dump the contents in to a vat, tank or kettle. If the material being dumped is sticky, the job is made more difficult, as the men have to hold the container while another man scrapes out the contents.

The machine illustrated is portable and can be moved from place to place as easily as a truck. When the pulling or steering handle is in the position shown, the machine is resting on two feet—one at each corner—which grip the floor and hold the machine firmly in place. There is absolutely no danger of the machine slipping or tipping while the load is being dumped. When the steering handle is brought forward, the steering wheels engage the floor and the two feet are lifted about three-quarters of an inch. The machine can then be moved. When the handle is raised to the vertical position again, the machine is automatically locked to the floor and remains there rigidly fixed until the handle is again drawn forward.

Everything about this machine is standard construction with tiering machine manufacture except the tipping device, which is a special design. The tipping device consists of the machine platform arms, the container cradle or cradles and the small winch mounted on the machine uprights, including its cable and sheave.

The operation of the machine is simple and the machine and one man can do the work that with ordinary hand methods would require two or three men at least. When the machine platform is lowered, the steel cradle ring which holds the barrel rests upon the floor. The barrel is placed within the ring, the platform elevated slightly and two short chains are hooked over the chime of the barrel. The platform is then elevated to the height desired, the barrel being held in an upright position suspended within the ring. The cradle rests on two pivot points that are held in brackets or the platform arms. A chain is fastened to the cradle ring and in turn this chain is fastened to a cable which runs over a sheave and to the small winch mounted on the machine uprights. The barrel can be tipped to any angle or completely over and back, always under absolute control of the operator, by turning the hand crank of the small winch.



TIERING MACHINES FOR TIPPING BARRELS

Synopsis of Recent Chemical & Metallurgical Literature

Protection Against Cementation by Direct Application of Coating with a Brush

In the April, 1922, issue of *Revue de Métallurgie* Gailbourg and Ballay present the results of a rather extensive series of experiments upon local case-carburizing.

With the work of Guillet and Bernard as a starting point, they proceed upon the assumption that the best protection against cementation is to be found in a coating which carries copper to a considerable extent. The three methods mentioned for application of copper coatings are the electrolytic, by dropping in solutions of copper salts, and by means of the Schoop spray process. All these processes present some disadvantages in regard to cost, ease of operation, etc.

The authors present a new method of applying a copper coating by one direct application with a brush. At first they experimented with a coating produced by a mixture of resin varnish with copper dust. The results obtained with this coating were not successful and photomicrographs are shown to illustrate this. It is probable that the carbon in the varnish was responsible for part of the cementation.

Sodium silicate was next used as a carrier for the copper dust, equal portions, by weight, of the two being used. The objection to this combination lay in the cost of the copper, so a search was made for some inert material which might serve as a diluent for the copper. Such materials as kaolin, emery dust and iron oxide were used. Emery dust gave the best results. It was thought that possibly aluminum dust might be used in the place of copper, but the experiments wherein this was used indicated that its use was not warranted.

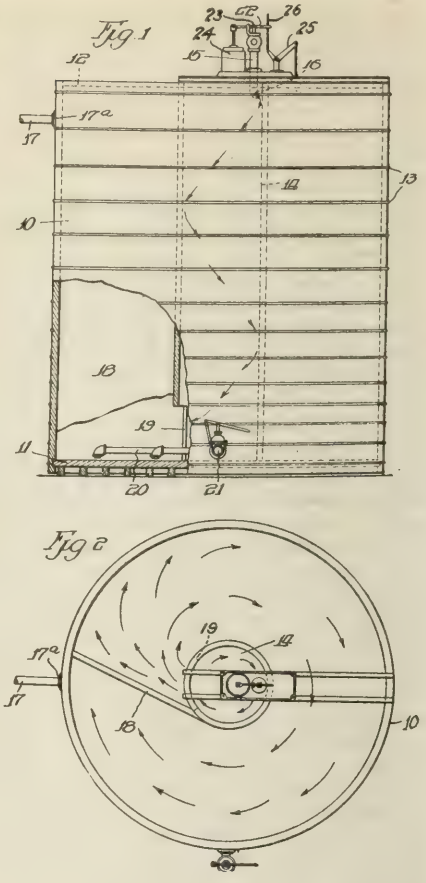
The Mixture Selected

The mixture which the authors finally selected as being the best bears the following proportions:

Copper powder.....2 parts by weight
Emery dust.....1 part by weight
Commercial sodium silicate in sufficient quantity to form a thick paste.

Before applying the coating, the pieces must be freed from all mineral oil, this being accomplished by placing them in an oven at 500 deg. C. A coating of from ½ to ¾ mm. is necessary to prevent cementation. From 15 minutes to 1 hour is required for the coating to dry. This time depends upon the temperature of the piece when the coating is applied.

The latter part of the article is devoted to a discussion of experiments designed to test the efficiency of copper coatings produced by dipping the articles in copper-bearing solutions.



The most successful solution used bears the following proportions:

$CuCl_2.2H_2O$ ..... 1 to 2 g.
HCl .....1c.c.
Butyl alcohol .....100 c.c.

The use of any of these solutions is apparently not unqualifiedly recommended by the authors, for they state in their conclusions that the coatings thus produced do not exhibit any marked superiority over electrolytic coatings.

No Provision for Removal

It is unfortunate that the authors do not describe a means for removal of the coating consisting of copper, emery powder and sodium silicate, as it is in that respect that most of the coatings of a similar nature have failed. The pure copper coatings do not interfere with any subsequent machining operations, but any coating which involves the use of sodium silicate would have to be removed before machining or grinding.

After a consideration of this work, the question arises as to whether or not the presence of copper is absolutely essential in a protective coating of this nature. Experiments carried out at the University of Michigan[1] have seemed to demonstrate that copper is not essential, good protection being secured by the admixture of asbestos and alumina with sodium silicate.

[1]See "Selective Case-Carburizing," by W. P. Wood and O. W. McMullan, *Chem. & Met. Eng.*, vol. 26, p. 1077 (June 7, 1922).

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Settling Tank.—Walter H. Green has designed the settling tank shown in the accompanying drawing for the purpose of causing the flow to pass through the maximum travel while within the tank, thus achieving maximum settling with minimum space requirements. As will be noticed from the drawing, the inlet and outlet are both at the top of the tank, and by means of a series of baffles the fluid from which the solid matter is to settle is caused to make the maximum amount of travel while within the tank which is available if the precipitated matter is to be removed from the bottom of the tank. (1,417,516; Walter H. Green, assignor to International Filter Co., May 30, 1922.)

Fume Control Device.—In heating and treating industrial materials, especially when of a chemical nature, there is liability of the evolution of fumes possessing flammable or explosive properties. The device covered in this patent is for the purpose of governing these fumes at the time and place of their inception by automatic and simple means which will not interfere with the apparatus with which it is employed. The essential feature of this device is a means for disposing of the fumes in a harmless way should ignition or explosion occur. This is accomplished by having the fumes led directly from the place of generation to a chamber having two exits—a normal exit and an emergency exit. When the normal exit is in use, the emergency is closed, being held so by a fusible link. Should this link melt, due to flame or explosion, the normal exit is closed and the fumes are led through the emergency exit to a place where they can do no damage. (1,414,722; Vern K. Boynton, assignor to Perry & Webster, Inc., May 2, 1922.)

Blasting Dynamite.—Blasting dynamite with improved stability and high velocity detonating properties is claimed by Wendell R. Swint in a specification covering the use of smokeless powder and cordite with the usual sodium nitrate and chalk but containing 3 to 15 per cent water.

The smokeless powder and the cordite are ground separately with water, the excess water being removed by centrifuging. The ground smokeless should then contain about 15 per cent water and the cordite 10 per cent water. In this condition they are mixed in the proportion of 28 parts smokeless, 40 parts cordite, 31 parts sodium nitrate and 1 part chalk. (1,411,674; Wendell R. Swint, assignor to E. I. du Pont de Nemours & Co., Apr. 4, 1922.)

Book Reviews

THE MANHOOD OF HUMANITY: THE SCIENCE AND ART OF HUMAN ENGINEERING. By *Alfred Korzybski.* New York: E. P. Dutton & Co., 1921. 208 pp. (Appendices, III.)

EDITOR'S NOTE—The interest displayed among our readers in this book has prompted one of our friends to call our attention to a review of it by Dr. Frankwood E. Williams in *Mental Hygiene.* Dr. Williams is as prominent in his field of endeavor as are the leading chemical and metallurgical engineers in their respective fields. The latter will undoubtedly be deeply interested in the reflections of a physician on the ideas and habits of thought of engineers.

This book has been so much praised—it has been called "epoch making"—that, having finished it and found little of value in it, one wonders if possibly the point of it all has been missed. But on looking through it a second time, it does not seem that the main points have been lost. There are, apparently, three of these, and as they are mentioned in each chapter, not once but several times to the verge of tedium—in fact, the author never seems to get at the real problems of the "science and art of human engineering" because he is so occupied in belaboring his three points—it is impossible to miss them. These points are: (1) Man is not just an animal. (2) Neither is he a combination or union of animal with something supernatural. (3) Man is literally a part of nature and of a different "dimension" than animals. By this latter the author means that man is distinguished by "time-binding qualities"—human beings are "time-binders." (Plants are "chemistry-binders" and animals "space-binders," according to the author.)

The expression "time-binder" is the best contribution the author makes. While there would seem to be nothing new in the conception of "time-binding," the expression itself is a happy one, so rich in imagination that one is surprised to find it in a book on "engineering," praised by engineers and mathematicians, until one remembers that genuine imagination lies rather with the engineer and the mathematician than with the poet and philosopher, as is so commonly supposed.

Count Korzybski is very much in earnest about these three points, and while it does not seem possible that an intelligent person would take serious issue with any one of them, he would seem to feel that the intellectual world is armed to the teeth against them. We have, therefore, not so much a book on the "science and art of human engineering" as a book devoted to proving that man is not just an animal, is not part animal and part supernatural (in fact, is not supernatural at all) and is more than animal because he has a fairly long memory (time-binding quality) and can use it; with a promise that more may be said later, but that not until we have grasped these points will we sufficiently understand human nature to consider undertaking human engineering. One gets the impression, somehow, that the author has been a very busy man in fields quite apart from human engineering—he is a military man, one gathers—but that, as an avocation perhaps, he has let his mind ruminate on some of these problems until he has come to the same conclusion as a good many others—that the greatest study of man is man; only Korzybski stops here while others have pushed from this point and have tried to understand man. It is quite evident that while Count Korzybski has been thinking on these problems he has not been studying them in the sense of ascertaining what data already exist on the subject of human engineering. It is a bit as if an engineer came forward, year 1922, with a book announcing that there is no reason why a heavier-than-air machine should not fly; that it is important that we develop flying machines, as they would have a use both commercial and military; and that he believes he is on the track of principles that will make flying possible—evidently not aware that the Wright brothers flew 18 years ago and that there has been considerable successful experimentation and development of airplanes since.

The general practitioner of medicine, and the layman, frequently complain that the psychiatrist uses a language—a "jargon" they call it when something eludes them—that they cannot understand. They seem to feel that something is being kept from them, that somehow it should all be made a little easier for them. They are not altogether wrong in this, although they forget that every profession, even every occupation or trade, has its own specialized vocabulary; that the reasons for this vocabulary are definite and important and even apparent, if one stops to think, and that one cannot expect to understand technical matters of law, or architecture, or bookkeeping, or farming, or the teaching of English, without first becoming acquainted with some of the special terms commonly used. One can imagine an engineer, for example, frowning at the technical terms in Paton's "Human Behavior"—why does the man hide behind these words? It is interesting to see, therefore, how simply things can be stated for the engineer. Here, for example, is Germany mobilized:

" . . . a state is the governing center of an accumulation of human beings—of time-binding powers—increasing exponential functions of time. These powers, though the same in kind, differ in degree and in respect of individuality. If they are to be united so as to constitute a whole, they must be given a common aim; they must, so to speak, be reduced to a common base; if they be respectively X^m, Y^n, Z^p, and so on, we cannot unite them and compute the whole by adding the exponents; but if we give them a common base—a common aim or purpose—then we can readily represent the magnitudes of the whole constituted by them; if we take X to be their common aim or base, then, if Y equals aX, Z equals bX, and so on, we shall have:

$$X^m Y^n Z^p \ldots = X^m a^n X^n b^p X^p \ldots = (a^n b^p \ldots)\, X^{m+n+p\ldots}$$

"The last expression, where the parenthetical coefficient is the product of individualities, serves to represent the united powers of all in terms of X, the common base, purpose or aim."

In addition to the contribution of the terms "time-binder," Count Korzybski's book will probably be useful in another way. If the book arouses interest in the science and art of human engineering on the part of the president of the International Rotary Club, the vice-president of the Association of Mechanical Engineers, eminent consulting engineers and the professors of mathematics at Columbia and elsewhere (all quoted as praising it), it will be the most useful book on the subject yet printed. And if, their interest stimulated, these business men, engineers and mathematicians wish to continue their studies, they might begin with—a number of books come to mind, but, for example, White's Foundations of Psychiatry.

FRANKWOOD E. WILLIAMS.
The National Committee for for Mental Hygiene.

MANUFACTURING COSTS AND ACCOUNTS. By *A. Hamilton Church,* consulting industrial engineer. First Edition. New York: McGraw-Hill Book Co., Inc. 450 pp. Price $6.

The author has aimed in this book to present a simple view of the general structure of cost accounts and to introduce gradually to the student the underlying principles on which manufacturing accounting of all kinds must rest. The relation of the cost accountant's work to the general accounts is clearly shown and to the general accountant the peculiar value of detail to the cost man has been emphasized.

The book is divided into three parts. Part I presents the general outline of manufacturing accounts; Part II covers cost accounting; Part III shows the factory reports and returns.

The mechanism of accounting is explained in detail with the aid of symbols and diagrams. By these diagrams, quantities and values are shown flowing from the purchase and cash journals to the ledger accounts and from these through the burden and manufacturing journals to the burden and manufacturing accounts, the burden account being later transferred to the manufacturing account. The methods of connecting expenditure incurred in manu-

facturing with individual quantities of product are presented fully. The selection of an appropriate cost system is shown to be governed by three main conditions:

1. The method in which direct labor and expense are applied to the product.
2. The unit quantity of product selected for costing.
3. The degree of detail required in the costing of this unit quantity.

The major portion of the book is devoted to the explanation of the three methods (A, B and C) of charging expense to the product after the amount of burden applicable to each department has been determined by taking into account the amount of equipment, internal expense and the proration of the expense departments on some basis that implies measuring the cost of service as each department has received it.

In Method A the expense is merged and averaged with Direct Labor, and charged to unit quantity of production on a time basis, the material being charged direct to individual orders. This method of costing requires that there be no substantial difference in wage rates between operatives engaged in any one department or performing any one operation and that all product has the same and entire series of operations. Consequently this method of connecting labor and expense with output is limited to homogeneous products.

Method B averages Expense and charges it to Orders in proportion to direct labor or labor hours. Labor and material are charged direct to the orders. Although the most widespread of all methods of costing, it has the disadvantage of being more or less incorrect due to the fact that it is seldom true that all machines used in production are of the same cost, occupy the same space, take the same power or entail the same supervision. If expense is very small compared with labor and material, this approximate method will cause no great harm, but on account of its "simplicity" is unfortunately applied in shops where expense may be many times the direct wages. Piecework, premium or bonus wage systems may be used. For hand industries this method is quite satisfactory.

Method C is the "machine hour rate" in which normal expense is divided into factors which are allocated among different machines on a basis determined by the contribution of each factor to the running of each machine. The total found allocated against each machine divided by the number of working hours in the period for which the calculation has been made gives an hourly machine rate. By this method the cost of idle machines can be ascertained and investigations made to determine cause and apply the correct remedy. This cost of idle machines can be written off to Profit and Loss or applied as a supplementary rate to Production Orders, especially if the industry is in a position to recover this wasted capacity in the selling price of its products. In either case the amount is a barometer of the cost of non-production caused by conditions of trade or more often by poor management. The author, who was among the first to introduce the "machine hour" method of distributing expense, gives detailed methods of determining the correct production factors and hourly rates.

The author has devoted several chapters to purchasing and stores, time and pay, production and standing orders, and the preparation of cost sheets. Sample forms have been profusely used to make the subjects clear to the reader. The chapter on standing orders shows a very complete system for collecting expense in intelligible forms.

Under "Factory Reports and Returns" the author emphasizes the fact that the cost system to be satisfactory must furnish an aid to efficient management and production as well as obtain figures and statistics as to the financial condition of the business. The shop wants its data "red hot," while the higher officials desire information more general in type but with clearer and more systematic grouping and presentation. The reports for foremen, superintendents, executives and proprietors are clearly indicated and their derivation from various parts of the cost system shown.

With the fundamental information contained in this book the student should have no difficulty in applying cost sense to the particular problems that may be met.

WILLIAM B. TODD.

CANE SUGAR. By *Noel Deerr*. Second (Revised and Enlarged) Edition. London: Norman Rodger. New York: D. Van Nostrand Co. 644 pp., 30 plates (12 colored), and 360 illustrations in the text. 1921. Price $10.

A standard reference book! Think for a minute what this means. Then consider the sugar chemist, engineer and plantation manager—nobody realizes better than these men themselves when far away from the city library and in the midst of the sugar-making campaign how much they need an authoritative, complete and up-to-date reference book covering every phase of the sugar industry. Such a book is "Cane Sugar," by Noel Deerr.

When the Sugar Chemists and Technologists tendered Noel Deerr a farewell banquet in New York on Sept. 30, 1920, Dr. C. A. Browne as toastmaster remarked that Mr. Deerr's chemical and technological attainments placed him foremost among the cane sugar experts of the day, and also stated that with his departure America was losing the man who had the greatest bibliographical knowledge of the works and publications on sugar in the libraries of her great cities. Regret was expressed that Mr. Deerr's departure prevented the realization of his plan to compile a much-needed bibliography of the works and references pertaining to the botany, history, agriculture, chemistry and technology of sugar and the sugar cane.

If indeed regret must be expressed that the author's bibliographical work lacks somewhat of being fully complete, the reviewer feels that this loss has been compensated in great degree by the very excellent summations of the literature and the inclusion of the most important references. Each chapter of this book is appended by a list of references to the literature and patents cited which adds greatly to the value of the work as a whole.

In addition to the lists of journal articles and patents to which reference is made in the text, the edition is appended by a very complete bibliography, the various works being arranged for convenience under the following headings: Older Monographs; Works on Travel, Histories, etc.; Encyclopædias and Dictionaries; Works Dealing With History and Commerce; Works Dealing With the Agriculture of the Cane; Books Dealing With Sugar Manufacture; Works on Analysis and Chemical Control; Works Specialized on Steam and Engineering; Books Dealing With the Chemistry of the Sugars; Books Dealing With Pests and Diseases; Works on Filtration; Works on Rum; Bibliographies; Various Unclassified Works.

An interesting historical conspectus traces the progress of the industry from 327 B.C. to the beginning of the Great War in 1914.

The author has arranged the chapters of this textbook into three parts. Part I deals with the agriculture of the sugar cane, Part II with the manufacture of cane sugar and Part III with the analysis of sugar-house products.

In Part I are included chapters on the composition of the sugar cane, description of cane varieties, classification and discussion of soils, cultivation, manuring, diseases and pests, and harvesting.

The second part begins by discussing the extraction of the juice by mills, and traces the process of manufacture to sugar in the bag and disposal of molasses and bagasse. The chapters in this section are entitled Extraction of the Juice by Mills; Diffusion Process; Action of Heat, Alkalis and Acids on Sugar and Cane Juices; Defecation of Cane Juice; Carbonation Processes; Sulphitation; Filtration; Evaporation; Sugar Boiling and Crystallization-in-Motion; Separation of the Crystals; Molasses; and Bagasse as Fuel.

In the third part the author describes the polarimeter, methods for determining cane sugar and reducing sugars, the assay of sugar-house products, and the chemical control of the factory.

An additional chapter is devoted to fermentation, with special reference to the sugar-house and to the fermentation of molasses.

The value of the book as a whole may be attributed to the fact that the subject matter is discussed from both theoretical and practical standpoints, by a man "who has his head up and both feet on the ground." An experience of 25 years is back of it.

Although much of the data is pre-

sented in chronological order tracing technical progress, the various merits and imperfections in types of equipment and advantages and disadvantages of different practices are discussed in such a way that the reader may easily follow the advances in the industry and thereby acquire a sounder and more rational idea of the "reason why" of present practice. At the same time, however, questionable present-day practices which must be further investigated before universal acceptance are dispassionately treated of from the open-minded viewpoint.

As a text and reference book "Cane Sugar" surely calls for no adverse criticism. It is all good. Certain subjects to be sure are treated of more comprehensively elsewhere, but in covering the field so broadly in one volume the author has done well to condense and summarize. To single out minor points for criticism would be superficial in the extreme and would detract none at all from the value of the book to those for whom the author has written it. C. F. WALTON.

AN OUTLINE OF QUALITATIVE ANALYSIS OF INORGANIC SUBSTANCES, INCLUDING THE RARE ELEMENTS. By *Horace G. Byers.* New York: D. Van Nostrand Co. 227 pp. Price, $2.

The book is planned to serve as a guide in courses in which qualitative analysis is presented as a laboratory course to accompany lectures in the general chemistry of the metals. It represents the result of over 20 years' experience in teaching general chemistry and qualitative analysis. Part I "is essentially a syllabus of lectures" upon the procedure and theories of qualitative analysis. In the early pages of this part the purposes, ideals and necessary precautions are set forth in a clear and inviting fashion. It is evident that at the start the author has had in mind the perplexities of the beginner. But one can scarcely help wondering if he has not forgotten the limitations of his students when in discussing the theories of solution he attempts to summarize in brief sentences the divergent views of van't Hoff, Jones, Werner and Kahlenberg, and then harmonize them all in a theory of his own for which he says "he is not able to secure adequate experimental evidence." Would it not be better to select the best of the current theories for the beginner and leave the discussion of the merits and weaknesses of conflicting theories to an advanced class in analytical chemistry or to a graduate seminar? Many teachers will prefer, also, to leave their qualitative students in ignorance of the Lewis-Langmuir theory rather than to be content with the statement that "this theory is not such as may be summarized simply and the student is referred to the original articles. . . . "

Anion analysis precedes the analysis of the metallic ions because in the opinion of the author "there seems to be no logical reason against this order and some very good reasons for it." Not all teachers will agree with him on this point. The methods of identification are "conventional," and the presentation is admirably made. The section on systematic analysis is clear and so well arranged that a student should be quite independent. In a few places he will need help, as for instance when he attempts to get an alloy containing tin into solution with boiling concentrated nitric acid (p. 129), or when he attempts to remove phosphates in the absence of iron (Table VII, p. 150).

The most characteristic portion of the book is Part V, which is devoted to the detection of the rare elements. No attempt is made "to provide a comprehensive treatment of these elements, but rather an outline of the procedures by means of which their presence may be recognized and the means of identification; at least so far as to enable the student to know when he should consult larger texts." The general plan of procedure used in the analysis of the common elements is followed. The presence of rare elements produces certain peculiarities in the preliminary examination, the interpretation of which is given in tabular form. The individual rare elements are grouped according to the usual five metallic groups and characteristic reactions are given for most of the elements. The analysis of each group follows the general scheme, but there are few attempts made to correlate the analysis of the rare elements with that of the more common ones. Frequent references are made to larger works where more detailed information is available.

The appendix contains much useful information for both teacher and student. A more extended table of solubilities would have been welcomed by many. Only a few typographical errors are observable, such as the production of $SnCl_2$ by action of HCl on SnS_2 (Table V, p. 148).

The book shows clearly the wide experience of its author. It will be very useful, especially to the rapidly increasing number of chemists who desire accurate information concerning the qualitative analysis of the less common elements. B. S. HOPKINS.

REVIEW OF PAPERS ON ELECTRODEPOSITION AND ELECTROPLATING. Transactions of the Faraday Society, vol. 16, Part 3, July 1, 1921.

The several papers presented in this book are of much interest and they, along with the discussion, give the opportunity of obtaining a "close-up" of the electroplating industry in England. As a whole the papers are excellent. There is evidence of a great deal of hard, conscientious work by each author. The amount of data given is proof of the desire to give the details that are so essential to a clear conception of the author's opinions.

The discussion is remarkably frank and the reviewer is left very little to do, so thoroughly has each paper been criticized. The papers should be read by every one interested in electrodeposition of metals. While there are points upon which entire agreement will not be possible, it must be admitted that in general they are the best that has so far been published in any one volume. The progress of electroplating seems to have been greater in this country than in England. The commercial application for ornament and protection of metals is done on a larger scale and more study has been given to details.

Dr. F. C. Thompson at the beginning of the discussion very truly states: "I have only one other thing that I should like to say, and that is that in some respects the present meeting is undoubtedly an historical one. In America and on the Continent a great deal more attention appears to have been paid to the problem than has been the case in this country, and the Faraday Society, in bringing together the large number of papers which have been presented at this meeting, has done something which has never before been attempted, to my knowledge, in this country."

We say that such meetings bring all interested in electrodeposition closer together. Let there be more of them. Better still, why not have a joint meeting of the Faraday Society and the American Electrochemical Society and have a session devoted to the electrodeposition of metals?

GEORGE B. HOGABOOM.

DYES CLASSIFIED BY INTERMEDIATES. By *R. Norris Shreve,* in collaboration with *Warren N. Watson* and *A. R. Willis,* Chemists, U. S. Tariff Commission. New York: Chem. Catalog Co., Inc. 8vo, 631 pp. Price, $10.

In the opinion of the reviewer, the authors have rendered a very valuable service to the cause of American dye chemistry in the compilation of this classification, for after all the intermediate is the more important factor in a modern dye plant, since from it not one but many dyes may be manufactured, and nowhere is this more clearly or more compactly exhibited than in the publication under review.

The plan of the work is set forth in the Introduction (pp. 7-15), which includes also a brief description of the system of nomenclature used by *Chemical Abstracts* and its relation to other systems in vogue today.

Part I, Intermediates and Dye Tables (pp. 17-581), constitutes the body of the book, and is composed mainly of an alphabetical list of intermediates. The various names by which these different intermediates are known appear each in their appropriate alphabetical place, but the dye tables and other data are given under but one of these synonyms, all the others being referred to this principal name. In some cases, the *Chemical Abstracts* designation is given the preference, in others

the common trade term is chosen as principal name. After each preferred title appear first its synonyms, then the constitution and molecular formulas of the compound, its molecular weight, a condensed outline of its method of preparation, a citation of the pages in standard reference works where further information can be found, and a tabular statement of dyes produced from it giving Schultz number of the dye, its ordinary trade name and class (structural), statistics of importation and manufacture for the United States, other intermediates employed with it for the preparation of the dyes listed, pertinent notes, and dye application class. Under aniline, for example, appear 104 different dyes, under benzidine 88, under H acid 41, etc. Each dye appears under each of its intermediates.

The list of intermediates and dyes is followed by a Formula Index of the 487 intermediates recorded, the molecular formulas being arranged as in the formula indexes of *Chemical Abstracts*, and each formula being followed by the principal name of the intermediate and a reference to the page whereon it is described. With this Index and the *Chemical Abstracts* name given after each intermediate, reference to the volumes and the index of *Chemical Abstracts* is easy.

In addition, the authors have given a very extensive Glossary of Dye Names (about 5,000), wherein they have endeavored to record the trade names of the better known commercial brands, noting the name of the manufacturer and appending the correct Schultz number wherever possible. This glossary is based largely upon the list given in the index of Norton's "Artificial Dyestuffs Used in the United States."

The book concludes with a Page Index of Schultz Numbers for Dyes, so that knowing the Schultz number the reader can locate at once the page or pages whereon the dye will be found tabulated.

Although in the dyes listed under each intermediate but one of its various names is assigned to each individual dye, there will be no difficulty in locating it through the use of the glossary and Schultz index mentioned. No worker in this field, be he manufacturer, investigator or teacher, can afford to be without this volume, and he should be grateful to those whose labor has made this mine of useful information available in such compact and serviceable form. Were it practicable, in future editions, to add also data showing the uses to which these same intermediates are put in the manufacture of drugs, perfumes, photographic chemicals, explosives, toxic gases, incendiaries, signal flares, synthetic plastics, synthetic tannins, etc., those responsible for framing legislation which will protect adequately the dye industry could see at a glance its widespread and far-reaching ramifications and the vital part it plays in the life of the individual citizen and of the state in our present civilization.

The book is clearly printed upon good paper, with remarkably few typographical errors for so difficult a composition, and makes a most attractive volume in its dark red buckram binding.

MARSTON TAYLOR BOGERT.

THE ELECTRIC FURNACE. By *J. N. Pring*, M.B.E., D.Sc. 485 pages, illustrated. New York: Longmans, Green & Co. Price $10.50.

A really satisfactory text book dealing with the electric furnace is a publication that is much to be desired. The electric furnace has now become a commercial apparatus that is applicable to a great variety of uses, while at the same time it is a most valuable tool in many fields of experimental work. It is not easy, however, to find the man who is qualified to treat the subject as it deserves. It would obviously be impossible to find anyone who had experience with all the electric furnaces that are used or even with a considerable percentage of them; but the author of a text book should at least have had intimate experience with some of the varieties of experimental furnaces and with some representative examples of commercial furnaces used for the different purposes where the electric furnace is the best or the only suitable apparatus. Unless he has this first hand knowledge of the subject, his text book, compiled from the large and highly diversified literature on the subject, is apt to be unsatisfactory to the reader who himself has a practical knowledge of some branch of electrothermics, and actually misleading for the reader who is altogether unfamiliar with electric furnaces.

The task that Mr. Pring has set himself in his book appears to be set forth in this paragraph from his preface:

"The most noteworthy branches of electrochemical and electrometallurgical industry have, within the last decade, been described in a number of publications. Nevertheless, the present rapid progress of these enterprises demands a frequent revision and extension of the literature of this subject as contained in the textbooks. No apology is needed therefore for the attempt, at this stage, to introduce an additional contribution to the general technical discussion of the position and prospects of high-temperature industrial chemistry."

One of the most important uses of the electric furnace is in the production of ferro-alloys, and yet the space devoted to it in this work is only ten pages while eighty pages are devoted to the electric steel furnace. Now, important as is the use of the electric furnace in the manufacture of steel, there appears to be a lack of balance in a text book forming one in a series of "Monographs on Industrial Chemistry" which devotes eight times as much space to that subject as to the production of the numerous ferro-alloys, products of the electric furnace and of the electric furnace alone. No doubt the excuse for this is to be found in the great quantity of advertising matter, exploiting various kinds of electric steel furnaces, with which we are flooded as compared with the shrinking modesty displayed by those interested in selling ferrous and non-ferrous alloys.

As to the revision of the current text books, it is regretable that this has not been more thorough, because the inclusion of obsolete or incorrect information not only crowds out useful matter but is misleading to the uninitiated. For example, it is unfortunate that data, quoted from Borchers, dealing with the permissable current density in carbon electrodes, should appear on page 391, from which it seems that 64 amperes per square inch may be used in a rod 2 in. in diameter, but only 10.7 amperes per square inch in a rod 16 in. in diameter; therefore, "it is usually found preferable to build up the larger electrodes from a bundle of smaller rods."

It is because of such lapses as this and the lack of balance in the space devoted to various uses of the electric furnaces that one is led to the conclusion that the author's practical experience with furnaces is not wide enough to qualify him to write that ideal text book referred to above. In spite of these faults, however, it may be said that Mr. Pring has been successful in making "an additional contribution" to the text books dealing with electric furnaces that will be of use to those interested in the "general technical discussions of the position and prospects of high-temperature industrial chemistry."

After a brief historical sketch the author has an interesting section on laboratory furnaces followed by two good sections on current supply and transformers. In the latter chapter he does not describe the induction regulator, a valuable apparatus where uniform variation in voltage is required. In section 10 the electric smelting of iron ores is treated. In the description of the Swedish work on this problem the relation of it to Dr. Heroult's experiments at Sault Ste. Marie for the Canadian Government is not brought out. It is a pity that the work done with synthetic pig iron during the war is not discussed. In treating of the electric metallurgy of zinc it is a little difficult to understand why space should be devoted to hydrometallurgical methods, as the book professes to treat only of electric furnaces. Section 22, on the design of electrode terminals, is rather weak so far as practice in this country is concerned. The inclusion of a section on waterpower developments and steampower stations is a good idea, and the bibliography which appears as Appendix B is decidedly useful.

F. A. J. FITZGERALD.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Chemical Foundation Plans Fight to Finish Against Return of Patent Rights

General Uncertainty Prevails as to Real Signficance of Move, While Speculations of Political Play and German Propaganda Are Rife

IF THE Alien Property Custodian secures the return of the patents and other rights purchased by the Chemical Foundation, it will be only after the Foundation has exhausted every legal recourse in its effort to retain them. The position of the Foundation is that the President must have been misled. It is believed, however, that the detailed study of the whole transaction, which will have to be made in connection with the court actions which will be taken, will reveal to the satisfaction of the administration as well as to others interested in the establishment of a domestic chemical industry that no organization could have more altruistic and patriotic objectives.

There is no tendency to charge ulterior motives to any of the administration officials involved. It is very generally believed that their action is based on the very plausible case which has been built up by those interested. The opinion is expressed that the Attorney General, smarting under the attacks which have been made on him, rather welcomes any action which may serve as a smoke screen and divert from him some of the objectionable attention which he has been receiving.

Bitter Fight Expected

The fight over the Chemical Foundation purchases promises to be a particularly bitter one. Some of the friends of the Foundation are condemning the administration's action in a most unqualified way and declare that the special representatives of the German chemical industry must be fast workers as they have been in the country for only four weeks. For the most part, however, those particularly interested in the building up of a domestic chemical industry are making no charges of untoward influencing of officials by German interests. They point out that political expediency hardly could have prompted the move since it is certain to be unpopular to restore to former enemy aliens property which will deprive the American people of great benefits. Perhaps the best example of a benefit which the public is receiving is shown in the case of the salvarsan patent. Whereas the price per dose was maintained at $4.50 as long as the patent was in German hands, a more uniform product is now available for $1.50 per dose. The Foundation has applied this policy to all of the patents under its control.

While it has been known for some months that an informal investigation of the Chemical Foundation has been in progress, at no time has the Foundation been called upon for information of any character. It is for this reason that many conclude that the Alien Property Custodian has been informed of one side of the case only.

Attack on Foundation Late

In connection with the demand for the return of the patents held by the Chemical Foundation, it will be recalled that this organization was not formed until after every effort had been made to find a way whereby these patents could be turned over to a governmental agency. Mr. Garvan in testimony before the Ways and Means Committee in 1919 and before the Senate Finance Committee in 1920 expressed willingness to turn the patents over to any governmental agency and urged the Committees to make suggestions as to how that could be done. No suggestion has been forthcoming from either Committee.

Harding Letter Demands Return of Patents

The text of President Harding's letter to Thomas W. Miller, Alien Property Custodian, ordering the return of the patents transferred to the Chemical Foundation under the previous administration follows:

My dear Colonel Miller:

My attention has been called by the Department of Justice to the fact that a corporation known as the Chemical Foundation has brought suit against the Treasurer of the United States and certain licensees of the Federal Trade Commission for an accounting alleged to be due the said Chemical Foundation on royalties due it for the use of certain patents originally seized under the authority of the Alien Property Custodian and sold to the Chemical Foundation by the Custodian during the previous administration. On the face of such an action it became so apparent to me that an inquiry should be made, that I asked for a report by the Department of Justice on the sale of this enemy property to the Chemical Foundation. It appears that the sale was made at so nearly a nominal sum that there is reason to believe that this government has not faithfully observed the trust which was implied in the seizure of this property. The circumstances relating to the entire transaction are of such a character that full investigation becomes a public duty. Moreover, I feel that your office is obligated to maintain the sacred character of the trust to which the Alien Property Custodian is committed by the law.

You are therefore directed to forthwith proceed as follows:

1. Make written demand upon the Chemical Foundation, Inc., in form to be approved by the Attorney General, to immediately return, transfer and assign to the Alien Property Custodian, all patents, trademarks, copyrights, contracts, applications or other properties or rights transferred to it by the Alien Property Custodian as aforesaid, and to account to you for any and all rents, profits, license fees, or other proceeds thereof realized by said Chemical Foundation, Inc., from said properties, or rights or any of them, from the date of transfer thereof to the Chemical Foundation, Inc., to the date of restitution.

2. Take any other action which may be advised or approved by the Attorney General, by suit or otherwise, to fully and in every respect protect the rights or interests of the United States and any other person or corporation interested therein, in and to the properties and rights aforesaid, and any proceeds, income or profits therefrom in the hands of the Chemical Foundation, Inc., or its officers, agents or employees.

In carrying out these instructions you will act upon the advice of the Attorney General.

Very truly yours,

WARREN G. HARDING.

Government Institutes Criminal Proceedings

Criminal proceedings against the Chemical Foundation were begun on Saturday by Attorney General Daugherty and a subpoena was served on Francis P. Garvan, President of the Foundation, calling for immediate production of all of the Foundation's books and papers before a Federal Grand jury in Washington, D. C. The decision to conduct a criminal investigation instead of a civil suit was a complete surprise to Mr. Garvan, who was at a loss to account for this move on the part of the government.

Garvan Charges German Intrigue in Demand on Chemical Foundation

Rescission of Sale of Chemical Patents to Chemical Foundation Is Attributed to the Scheming of German Cartel's Representatives

DEFIANCE to the government's demand for the return of the 4,700 German patents held by the Chemical Foundation, Inc., and a strong insistance that this action is the result of German intrigue are the outstanding notes in the several statements issued by the Foundation's president, Francis P. Garvan. This official, on receipt of the first news of the President's letter declared that "this action was taken without any notice to the American organic chemical industry or to the Chemical Foundation or any of its officers or to, in fact, anyone equipped to speak for this essential American industry in peace and war. It has been begun I am informed after a full hearing by the representatives of the German Cartel, the German Dye Trust and the German Government without any American interest being given an opportunity to be heard in reply."

Mr. Garvan maintained that it was these "powerful friends at court" who had aided in the scheme to regain control of the American organic chemical industry, which had been lost to the Germans during the war. The return of these patents was a necessary step in the German program for the following reasons:

> They know that the upbuilding of German industry to the point already visioned by the industrious and ambitious German mind, is, if not impossible, rendered extremely difficult by American possession of the patents of this basic industry.
>
> They know that unless they can strangle American competition now the American organic chemical industry soon will be too solidly established to be affected by German competition—under any reasonable form of protection.
>
> "They know that if the American organic chemical industry can be wrenched loose from the Chemical Foundation it can be attacked piecemeal and destroyed, the patents, of course, reverting to their former German owners, spies and enemy aliens."

German Lawyers in Washington

The actual workings of this intrigue were discussed in a statement which Mr. Garvan made to the press on July 7, in which he outlined two significant developments.

> 1. Within about three weeks a commission, consisting of three German lawyers, Rudolph Oppenheim, Hans Wagner and Karl Holderman, representing the German Cartel, which in turn consists of all the organic chemical industry of Germany, arrived in this country to perfect plans for the recovery by Germany of their control in America of the organic chemical industry. On Saturday, June 24, a conference was held at the office of O'Gorman, Battle, Vandiver & Levy, of 37 Wall St., at which were present Mr. Vandiver and Mr. Levy, representing Herman A. Metz, the leading German importer and agent of the "I. G.," and several other lawyers representing the German Embassy and other German interests. It was there decided that a direct action by Germany or by the Cartel to upset the sale to the Foundation would be inexpedient, but that the most promising form of procedure would be to attempt to induce the United States Government to bring the action and to offer to the Government all possible German assistance. Accordingly, a committee was appointed consisting of Messrs. Oppenheim and Wagner, Vandiver and Levy to go to Washington and consult with the Department of Justice.
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> 2. On Tuesday, June 7, this committee visited the Attorney General's office and there placed before his assistants the German proposition and offered German assistance. Prior to that time neither the Chemical Foundation nor anyone in any way representing them nor anyone representing any part of the American organic chemical industry had been asked any question in reference to the sale and subsequent to the visit of the German representatives no request or opportunity was given to any American interests to answer the German representatives before the announcement of the intended demand was made.

Other Patents Involved

The demand on the Chemical Foundation naturally raises the question as to whether the case will become a precedent governing other patents sold by the government. In answer to this question, Mr. Garvan declared that the demand would involve: "First, the sale of all wireless patents and plans to the United States government 'for the nominal sum of $140,000.' Germany had obtained the domination in this country through a patent system similar to the chemical patent system and to free the country from that control they were all sold to the Government for what, of course, is an inadequate price if you consider the value to Germany of the control of the wireless news of the world.

"Second, some 5,700 German patents were selected by the Army and Navy as having been taken out by the Germans to control our freedom in waging war. These patents covered gun sights and countless other appliances and devices either used by our army or navy or which might be used in the future. Many of them had been infringed upon by the army and navy in the winning of the war. The Alien Property Custodian turned over to the United States all the German rights and interests as between this Government and German interests to the navy for the nominal sum of $100,000. This transaction will also have to be upset."

Administration's Motives

The President's letter does not specify the purpose to which the patents are to be devoted, assuming, of course, that the proposed proceedings result in forcing the rescission of their sale to the Chemical Foundation. The latter, however, points out that it means the ultimate return to the original German owners since any plan for resale or relicensing by the Government would not be in harmony with our treaty of peace with Germany and Austria.

Charges Met By Counter-Charges

Late Saturday afternoon officials of the Department of Justice voiced a denial of the intimation by Francis P. Garvan that the President's demand for the return of the Chemical Foundation's patents was predicated on information given to the government by lawyers representing the German Cartel. Their conferences in the offices of the Attorney General, it was claimed, were solely in connection with the filing of suits, which had nothing to do with Chemical Foundation matters.

The Government's statement also pointed out that the Department of Justice had decided that the 67 suits instituted by the Chemical Foundation to recover royalties held by the U. S. Treasury might best be handled in the form of one suit in which the government would be the plaintiff instead of the defendant. Another significant statement made by the Department of Justice was that "the return of these patents to the Alien Property Custodian would in no sense benefit their former German owners or interests. The action taken by the Government has been wholly in the interest of the Government itself. The disposition of these patents after their return to the Alien Property Custodian, as well as all alien property held by him must be determined by action of Congress."

Garvan's Refutation

In another long statement issued by the Chemical Foundation, Mr. Garvan replies to the Department of Justice and makes the further charge that its only investigation of the Foundation "was initiated and has been under the direction of Gaston B. Means or Z-13, as he was known during the period when he served Germany under Captain Boy-Ed." He also demanded the "secret" report made to President Harding be made public in order that opportunity might be given to scrutinize the motives behind the government's action.

The refutation of the government's charges are contained in the following paragraphs from Mr. Garvan's statement.

> The naïve explanation of the visits of the representatives of the German Cartel to this country and to the Department of Justice is false. The Germans have had able

lawyers in this country ever since the armistice, and any boy clerk in the office of these attorneys could have attended to the simple filing of these accounting proceedings.

I repeat that the German commission stated that Germany deemed it injudicious for it to attack the title of the Chemical Foundation direct, and that they then urged that these gentlemen in the Attorney General's office persuade the Attorney General and the President to authorize that action and proferred to them all the assistance they could give.

One last falsehood I wish to answer in the anonymous statement issued yesterday. It stated, "It was pointed out that the return of these patents to the Alien Property Custodian would in no sense benefit their former German owners or interests." This statement is also false. No one had ever suggested, so far as I know, that it was the intention of the Government to keep this German property beyond the day when they had satisfied the claims of injured Americans.

The peace treaty with Germany, according to the instructions of the Alien Property Custodian and the Attorney General, ended the Alien Property Custodian's power of sale. They can, therefore, only be held until such time as some arrangement has been made for the securing of American claims, when they must be returned to the German Cartel.

That such action is being contemplated by Congress is evidenced by the fact that Representative Woodruff recently introduced a bill providing for the return to former owners of all German property not exceeding $10,000 in value.

Financial Statement Shows Loss by Foundation

The certified financial statement of the Chemical Foundation submitted in connection with the Shortridge investigation of the dye industry, shows that since its inception in 1919 the Foundation has been operated at a loss of approximately $200,000.

Although the Foundation has received an income of $429,649 it has spent $629,931, of which $264,017 was for "educational literature and pamphlets," $151,268 for office salaries, $84,512 for rent, organization expenses, etc., $43,133 for legal fees in connection with its patents and $26,357 for "general literature and pamphlets."

Over half of the total income, or approximately $245,000, was received from foreign manufacturers importing into the United States products on which the Foundation controlled patents.

It is of interest to know that of the nearly 5,000 patents held by the Chemical Foundation, only 241 have ever paid any royalty. Of these, 31 have paid 67 per cent of the total royalty, 14 have paid 13.8 per cent, 14 have paid 7.2 per cent and 6 have paid 4.2 per cent. In other words, 65 of the 4,802 patents have paid 92.4 per cent of the total income.

Chemical Foundation Activities Cover Wide Range of Utility

In connection with President Harding's demand for the return to the Alien Property Custodian of all patents, trademarks, contracts and other rights by the Chemical Foundation, it is of interest to note the activities in which that organization is engaged.

The primary purpose of the Chemical Foundation is to build up a domestic chemical industry with particular reference to its application to national defense and to the pharmaceutical and medicinal side of the industry. To secure the coal-tar medicinals, it is necessary to have a dye industry, since many medicines could be obtained only at prohibitive expense if they were not developed as byproducts of dye making.

In its efforts to encourage chemical development in the United States, the Chemical Foundation agreed to furnish $25,000 for use this year by the American Chemical Society for the publication of scientific literature. This action was taken when the decrease in receipts of the American Chemical Society made it necessary to reduce the amount of scientific literature it had been publishing.

The Foundation is furnishing $10,000 this year for the National Research Council with which a complete chemical survey has been started. Information is being gathered as to chemical personnel and as to the particular research problems in which the different laboratories are engaging. The survey also includes the compiling of a bibliography of certain chemical subjects and the listing of information with regard to scientific apparatus and chemical supplies.

Another survey being made by the Chemical Foundation has as its objectives the pointing out to individual states the possibilities of developing chemical industries to utilize resources now undeveloped or only partly developed. This survey includes a program for the elimination of waste and the development of chemical byproducts.

Through a co-operative agreement with the Department of Agriculture, the Chemical Foundation is furnishing the necessary funds for work looking to the standardization of biological stains. In encouraging the domestic production of biological dyes, it is felt that an important service is being performed in that the market for these dyes is so limited as to make their commercial production unlikely. Their value to science, however, makes it highly desirable that this country have a source of supply independent of Germany.

With the National Research Council, the Foundation is collecting information as to chemical education. When the survey is complete, it is expected to have in hand full information as to the exact courses of instruction in chemical subjects at all American schools, together with details as to equipment, endowments and the number of students pursuing chemical courses.

The Foundation has an arrangement with the hygienic laboratory of the Public Health Service whereby all salvarsan and other arsenical compounds used for medicinal purposes are tested by the laboratory's chemists before being offered for sale. The Foundation is co-operating with the Fixed Nitrogen Laboratory in research work on the Haber patents, which are among those taken over by the Foundation. The Foundation also has been co-operating with R. C. Tolman, the director of the Fixed Nitrogen Laboratory, in the matter of encouraging Government inventors.

Arrangements recently were completed whereby the Chemical Foundation is to co-operate with the the Bureau of Standards in the setting up of dye standards. The Foundation recently subscribed $1,000 to assist in the preparation of a table of chemical constants, a work being conducted by the National Research Council.

If the Chemical Foundation is allowed to proceed with its program, it is expected to enlarge this type of co-operative work so as to extend help to most of the numerous chemical research laboratories being conducted under government or quasi-government auspices.

Chicago Section, American Ceramic Society, Meets

Spring Meeting in Danville, Ill., Provides Interesting Papers and Inspection Trips

Although rather small in point of attendance, the first meeting of the Chicago section of the American Ceramic Society held outside of Chicago was most successful. About 15 members were present at the dinner at the Plaza Hotel, Danville, Ill., Friday evening, June 23.

Humidity driers were discussed by H. E. Davis of the Northwestern Terra Cotta Co. F. L. Steinhoff, chairman of the section and managing editor of *Brick and Clay Record*, outlined some recent developments in equipment and methods for manufacturing clay products. In an informal talk, E. J. Winkleman, chief engineer of the American Refractories Co., described the Baltimore plant of this company in which certain ideas used in the steel industry have been adapted to the manufacture of magnesite brick. Waste heat boilers utilize heat which is ordinarily lost up the stacks.

In order that the inspection trip through the plants of the Western Brick Co. might be as profitable as possible, Mr. Douthay, general superintendent in charge of production called attention to some of the more important features of the company's operations—stripping by revolving shovel at one plant, the use of hydraulic stripping at another and the mechanical arrangement for pushing cars through the driers.

Norris Blames Muscle Shoals Delay on Fertilizer Trust

Ladd Bill Would Accept Ford Offer—Senator Says It Would Save Farmers $3,000,000 a Year

SENATOR NORRIS, of Nebraska, chairman of the Agricultural Committee of the Senate, who was overridden in his insistence that work in the Muscle Shoals dam should begin July 1, could not resist the temptation on that date to remind the Senate that, as a result of their action, a large number of men who might have been employed, were still without jobs. He addressed his remarks to the people of Alabama, calling attention to the Senate's amendment to the War Department appropriation bill which granted $7,500,000 for the completion of Wilson dam but which included the provision that work should not be started until Oct. 1.

"I hope they will remember," he said, "that those who were giving close attention in the Senate to the Muscle Shoals proposition, and that the Senate, when it passed the appropriation of $7,500,000, would have started that great work to-day, but that because of the great propaganda which influenced the honest and conscientious representatives from the great state of Alabama, and some from the great state of Michigan, where an interested millionaire lives, those men are not working to-day. The Tennessee River is low. The water of the stream is down so that they could do very effective and economical work.

"The effect of the great propaganda that even carried the Senate off its feet was to postpone that great work for a year, and I want the farmers of Alabama, bowed down to the earth with the burdens of the fertilizer trust, to know that through the efforts of their representatives in Congress that great fertilizer trust has been given another year of life to continue to hammer them down to the earth with toil and labor.

Millionaire Senators Helped Delay

"I do not question the motive of any man, either in this body or in the other, because they were carried off their feet, they lost their judgment; but I wish the people of Alabama, the people of Mississippi, the people of Georgia, and of all the South and all the East would look over the roll call when we came to vote on it and see what that roll call means.

I have it in my hand, Mr. President, and while I am not an expert on the financial standing of the various members of this body, as nearly as I am able to determine, I find that the action of the House was confirmed here by a combination of men who were afraid it might be lost if we did not confirm it and by men who did not want anything done, and while it was being done ostensibly from the beginning in the interest of a great millionaire, when it came to the Senate those who were frightened for fear they might lose it were assisted by every millionaire in the Senate, who voted at all, to give this great fertilizer trust another year of life."

In concluding the Senator pointed out the added tax burden imposed on the public by the year's delay in the construction work.

Last Chance for Revised Offers

A final opportunity to offer further modifications to their proposals will be given to all bidders whose offers have been considered by the Senate Agricultural Committee according to Senator Norris' statement after an executive meeting of the committee on Thursday. Letters will be sent to the bidders inviting them to appear at a meeting at his home on July 13.

This course was suggested by several committeemen as a means of finding out whether the bidders have in any way agreed upon modifications.

Ladd Favors Ford Offer

Unconditional acceptance of Henry Ford's offer for the purchase and lease of the Muscle Shoals projects, including the Government's interests in the steam power plants at Gorgas, is provided for in a bill introduced by Senator Ladd of North Dakota. The bill is identical with that introduced in the House by Representative Wright. The bill has the approval of several members of the Senate Agricultural Committee, of which its sponsor is a member.

In introducing the bill Senator Ladd called attention to the expenditures made by American farmers for nitrate importations from Chile and asked if "the farmers should continue to pay more than $3,000,000 annually, when Mr. Ford offers to relieve them of these burdens at Muscle Shoals."

"The average importations of Chilean nitrate for five years, 1911-1915, inclusive," Senator Ladd said, "amounted to 551,714 long tons, with an average value at the Chilean port of $17,511,697, and with an export duty paid to Chile on this tonnage amounting to $6,910,978.92. The cost of ocean freight, insurance, commissions, etc., on this 5-year period of Chilean nitrate importations can be conservatively estimated at $10 a ton, making a total cost at port of approximately $29,939,815.92." Of this tonnage there was consumed as fertilizer by the farmers about 250,000 tons.

"Mr. Ford, in his final offer of May 30, expressly agrees and binds himself throughout the lease period to manufacture nitrogen and other commercial fertilizers, mixed or unmixed, and with or without filler, according to demands, and to produce fixed nitrogen at Muscle Shoals equal to the fixed nitrogen contained in that portion of Chilean nitrate used by the farmers in the 5-year period, 1911-1915."

Marconi Honored by Engineering Societies

Receives John Fritz Medal in Presence of Distinguished Gathering in New York

Senator Guglielmo Marconi received the John Fritz medal on July 6 before a gathering of engineers which filled the auditorium of the Engineering Societies Building in New York. Among the forty distinguished engineers on the platform were Major-General George W. Goethals, Orville Wright, Elihu Thomson and J. Waldo Smith, all of whom have received the same medal.

Senator Marconi received a great ovation as he rose to receive the medal and an even greater acclaim when he concluded his remarks in appreciation of the honor conferred upon him.

"I have long realized that in America, more than anywhere else, the most cordial and generous encouragement is given to an honest endeavor to apply science to useful and practical purposes," said Senator Marconi. "I consider myself fortunate that much of my early work in radio has been carried out in this country, for you realize that wireless communication has become useful, and often necessary, on land and sea, besides tending to increase and simplify the facilities for closer communications between distant people on this earth, thus contributing, I hope, to make good-will take the place of the unrest and mutual suspicion which, unfortunately, seems at present to be a dominating feeling amongst all nations."

Prof. Michael I. Pupin spoke on the progress and prospects for future developments in wireless communication. Prof. C. A. Adams, of Harvard, chairman of the medal committee of the four founder societies, paid a tribute to Marconi's work. James R. Sheffield, for many years Marconi's legal adviser in America, reviewed the life and work of the inventor.

Bureau of Mines Announces Investigation Program

For the fiscal year which began July 1, the Bureau of Mines has at its disposition appropriations totaling $1,580,900. The allotments of that sum for work which includes chemical activities are as follows: Technical work at Pittsburgh experiment station in connection with mine explosions, $53,154; tests of explosives, $50,737; tests of coal mine gases and dusts, $31,655; technical service at Pittsburgh in connection with mineral fuel investigations, $20,210; tests of mineral fuels, $40,890; investigations concerning the preparation and treatment of ores, $32,370; oil shale investigations, $8,920; mining experiments stations, $170,000; study of the chemical technology of oil, $24,040.

Planning for 1923 Meeting of American Chemical Society

Although present interest in American Chemical Society circles centers around the prospects for the September meeting in Pittsburgh it is interesting to note that plans are already forming for the following meeting which will take place in New Haven in April, 1923. The New Haven Section has invited the Connecticut Valley Section to join with them in entertaining the Society.

An executive committee, whose function it is to direct all plans and arrangements, has been chosen by the New Haven Section as follows: Treat B. Johnson, chairman; Blair Saxton, secretary; Arthur J. Hill, C. H. Matthewson, Ralph Langley, J. S. Graveley. Representatives both from outside New Haven in the local section and of the Connecticut Valley Section will be added later.

The meeting of the Society in New Haven will be of special interest, since in connection with this event the new Sterling Chemical Laboratory is to be dedicated by Yale University.

Recent Developments Interest Paper Industry

The Westminster Paper Mill Co., Ltd., has been organized with a capital of $250,000 by Wisconsin capitalists, for the purpose of establishing a mill for the manufacture of tissue paper at New Westminster, B. C. This will be the only paper mill of its kind on the Pacific Coast.

A quantity of pulp wood, about 700,000 ft., is now floating down the Kennebec river for the Pine Tree Pulp Co., a concern established only a few months ago. Ground was broken during the winter for the mill which is located at Gardiner.

The Cushnoe Paper Co. and Kennebec Paper Co., being operated by W. S. Wyman as receiver, are reported as showing a small margin of profit. With a return of normal business conditions, it is expected by Maine paper men that these companies will continue as a factor in Maine's paper production.

There is considerable interest in railroad activities in northeastern Maine. The Great Northern Paper Co. is continuing the building of a logging railroad of standard gauge. Hope is entertained that this eighteen mile road will be completed this season. The Eastern Maine Railroad Co., with charter rights in hand, are considering the question of a railroad from Houlton, in Aroostock County, down the east bank of the Penobscot River to tide water at Bangor where connection will be also made with the Grand Central Railroad. About twenty miles south of Houlton, it is proposed to build a short connecting line to the international boundary near Meductic to connect with the Canadian Pacific Railroad. The proposed road would be about 128 miles in length.

Scientific Photography Now Included in Curriculum

Stockholm University Establishes Complete Laboratory for Technical Photographic Study

Scientific photography is the very latest science added to the subjects studied at the University of Stockholm. Quite recently, Docent Arvid Odencrants, Sweden's leading expert in this line, completed a fully equipped laboratory for scientific photography where the work is now carried on with great intensity and is attracting increasing interest on the part of scientific men and industrial experts in all parts of Sweden.

One of the most important practical aims of the new department is to test and classify the almost innumerable varieties of photographic films, many of them of foreign make, now in the market and to select the best kinds for recommendation to photographers. Films will be graded or classified according to their sensitiveness to light.

The laboratory will also devote itself to the study of photographic apparatus and lighting devices for moving picture purposes. It is closely cooperating with the X-Ray Institute of Stockholm. Important work is also being done in photomicrography, especially in connection with zoology and botany.

Pittsburgh A.C.S. Meeting

Midgley Will Describe Work of General Motors Corporation on Gaseous Detonation

Of outstanding importance in the program of the Pittsburgh meeting of the American Chemical Society will be an address by Thomas Midgley, Jr., of the General Motors Research Corporation on "Chemical Control of Gaseous Detonation with Particular Reference to the Internal Combustion Engine." Mr. Midgley will be assisted by T. A. Boyd. The lecture will include demonstrations of normal combustion and detonation in glass tubes, the suppression of detonation by the addition of certain chemical compounds and demonstrations with an internal combustion engine motor containing quartz windows and apparatus for measuring radiation. The motor will be operated on detonating and non-detonating fuels. Lantern slides will be shown illustrating the periodic variation of anti-knock value among the 16 elements.

"Pittsburgh as a Chemical Manufacturing Center" is the subject of an address to be given by J. H. James, head of the Department of Chemical Engineering, and W. F. Rittman, head of the Department of Commerical Engineering, of Carnegie Institute of Technology. Dr. James will discuss "Pittsburgh's Raw Materials and Markets for Chemical Products." Dr. Rittman will speak on "Pittsburgh's Transportation and Financial Advantages."

By special arrangements, the Committee of the Pittsburgh section of the A.C.S. has obtained dormitory privileges for the councillors at Carnegie Tech. during the Meeting. The Men's Dormitories will be opened to house 350. One of the Women's Dormitories has been offered for the use of the councillor's wives.

Personal

H. B. BRAMLET, First Lieutenant Chemical Warfare Service, was married on June 24 to Miss M. M. DUBOIS. They will be at home after July 15 at Edgewood Arsenal, Md.

C. B. DURGIN has been granted a leave of absence for 6 months from the Bureau of Soils, Washington, to aid in the development work of the Federal Phosphorus Co., Anniston, Ala. Mr. Durgin will be working particularly on the problems of manufacture of high purity phosphoric acid, assisting in the application of the methods for making this material which were developed recently at the Bureau of Soils under the general direction of Dr. W. H. Ross.

WALTER R. HIBBARD has withdrawn from the firm of Burt & Hibbard, Inc., consulting chemists, Bridgeport, Conn., to accept a position in charge of the physical and chemical laboratories of the Winchester Repeating Arms Co., New Haven, Conn.

Prof. H. F. MOORE, of the University of Illinois, addressed the Washington Chapter of the American Society for Steel Treating on June 30, 1922. His topic was "The Fatigue of Metals."

CULLEN W. PARMELEE, professor of ceramic engineering, University of Illinois, has been appointed acting head of the department of ceramic engineering, effective Sept. 1, succeeding E. W. Washburn.

The American Engineering Standards Committee announces the following additions and changes in personnel: F. J. SCHLINK, formerly of the development branch of the engineering department of the Western Electric Co., New York City, has been appointed assistant secretary of the committee. The Electrical Manufacturers Council has appointed A. I. DOREMUS, Crocker-Wheeler Co., New York City, as alternate for A. H. Moore on the main committee of the American Engineering Standards Committee. The Gas Group has appointed W. J. SERRILL, United Gas Improvement Co., Philadelphia, Pa., as alternate for A. H. Hall on the main committee of the A.E.S.C. The U. S. Navy Department has designated Commander HARVEY DELANO, Bureau of Ordnance, Washington, D. C., and Vice-Commander H. F. LEARY to represent the Navy Department on the main committee of the A.E.S.C. The U. S. War Department has appointed Major GLEN F. JENKS, Ordnance Department, U. S. A., Washington, D. C., as alternate to Brigadier General W. S. PIERCE, Ordnance Department, U. S. A., Washington, D. C. on the main committee of the A.E.S.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Coal-Tar Products and Vegetable-Oil Markets During the Second Quarter of 1922

The Trend of Market Developments and Important Price Changes in These Branches of the Chemical Industry

LAST WEEK'S ISSUE contained a review of market conditions for the principal industrial chemicals during the three months ended July 1, 1922. The only significant developments of that period were the general improvements noted in the prices for the more basic commodities and the wide fluctuations in the case of the lesser important and speculative articles. This generalization applies equally well to the coal-tar products market during the second quarter of 1922. Certain of the crudes, such as benzene and phenol showed exceptional strength and favorably affected the market for other crude products. On the other hand, the continued inactivity in the textile centers was reflected by the dormant condition of the intermediate and dye markets. Many of the producers most affected by the slackened demand for staple products have found it profitable to turn their attention to specialties, such as rubber accelerators, photographic chemicals, etc.

Market Developments

Outstanding among the features of this market has been the fact that in the face of unusually large production, benzene prices have been well maintained at comparatively high levels. Most of the producers' business has been in the regular contract requirements of consumers. A few odd lots have appeared in the resale market from time to time and these have brought as high as 40c. per gal. for the 90 per cent test. Quotations were advanced by producers during the interval from 27 to 28c. per gal. for the 90 per cent, and from 29 to 30c. per gal. for the water-white grade.

PRICES OF 35 IMPORTANT COAL-TAR PRODUCTS BY MONTHS, JANUARY-JULY, 1922

Article	Unit	Average Price For Month of— Jan.	Feb.	March	April	May	June	Price on July 1
Benzene, c.p.	Gal.	$0.29	$0.29	$0.29	$0.29	$0.29	$0.30	$0.30
Cresylic acid, 95-97%	Gal.	.60	.45	.45	.48	.48	.50	.51
Dip oil, 25%	Gal.	.31	.27	.24½	.24	.24	.24	.24
Solvent naphtha, water, white	Gal.	.25	.25	.25	.25	.25	.27	.27
Toluene, water white	Gal.	.30	.30	.30	.30	.30	.30	.30
Xylene, pure	Gal.	.40	.40	.40	.40	.40	.40	.40
H acid	Lb.	.97	.90	.85	.85	.85	.85	.85
Phthalic anhydride	Lb.	.37	.37	.35	.36	.35	.35	.35
Salicylic acid, tech.	Lb.	.20	.18	.23	.23½	.25	.25	.25
Alpha naphthylamine	Lb.	.28	.28	.30	.30	.30	.30	.30
Aniline oil	Lb.	.17½	.17	.16½	.16	.15½	.14	.14
Aniline salt	Lb.	.25	.24	.24	.24	.22	.22	.22
Anthracene, 80%	Lb.	.75	.75	.75	.75	.75	.75	.75
Benzaldehyde, U.S.P.	Lb.	1.35	1.30	1.25	1.25	1.25	1.25	1.25
Benzoate of soda, U.S.P.	Lb.	.52	.55	.55	.55	.50	.50	.50
Benzidine, base	Lb.	.85	.85	.85	.85	.85	.85	.85
Benzidine, sulphate	Lb.	.75	.75	.75	.75	.75	.80	.80
Beta naphthol, tech.	Lb.	.31	.29	.28	.27	.25	.23	.23
Dichlorbenzene	Lb.	.06	.06	.06	.06	.06	.06	.06
Dinitrobenzene	Lb.	.21	.21	.23	.23	.22	.22	.20
Diethylaniline	Lb.	.90	.95	1.15	.85	.65	.65	.65
Dimethylaniline	Lb.	.40	.41	.38	.38	.37	.36	.36
Dinitrophenol	Lb.	.38	.35	.33	.33	.33	.33	.33
Diphenylamine	Lb.	.60	.60	.59	.59	.59	.59	.59
Naphthalene, flake	Lb.	.07	.06¾	.06¾	.06½	.06½	.06½	.06½
Naphthalene, ball	Lb.	.08	.07½	.08	.08	.08	.08	.07½
Nitrobenzene	Lb.	.10½	.10	.10	.10	.10	.10	.10
Ortho-nitro-toluene	Lb.	.15	.15	.12	.12	.12	.10	.10
Para-phenylenediamine	Lb.	1.60	1.55	1.50	1.50	1.55	1.55	1.55
Para-amidophenol, base	Lb.	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Para-amidophenol, HCl	Lb.	1.45	1.35	1.30	1.30	1.30	1.30	1.30
Para-dichlorbenzene	Lb.	.16½	.17	.15	.15	.13½	.17	.17
Paranitraniline	Lb.	.77	.77	.75	.75	.75	.73	.73
Phenol, U.S.P.	Lb.	.11¾	.12	.11½	.12½	.14	.14	.14
Resorcinol, tech.	Lb.	1.45	1.30	1.30	1.30	1.30	1.30	1.30
Toluidine, mixed	Lb.	.32	.32	.32	.30	.30	.30	.30

PRICES OF PRINCIPAL VEGETABLE OILS BY MONTHS, JANUARY-JULY, 1922

Castor oil, AA, in bbl.	Lb.	$0.11½	$0.11½	$0.11½	$0.11½	$0.12	$0.12	$0.12
China wood oil, in bbl.	Lb.	.13½	.14½	.14½	.13½	.13¾	.13¾	.13¾
Coconut oil, Ceylon grade in bbl.	Lb.	.09	.08½	.09	.08¾	.08¾	.08½	.08¾
Corn oil, crude, in bbl.	Lb.	.08½	.08¾	.11	.11	.11½	.11¼	.11¼
Cottonseed oil, crude tank cars, f.o.b. mill	Lb.	.07	.08¼	.10	.09¾	.10	.10	.10
Cottonseed oil, summer yellow	Lb.	.09	.09¾	.11¼	.12	.12	.11¾	.11¾
Linseed oil, raw, in bbl., domestic	Gal.	.70	.83	.81	.84	.87	.82	.87
Palm oil, lagos	Lb.	.08	.08	.08	.07¾	.07¼	.07⅛	.07¼
Peanut oil, crude, tank cars, f.o.b. mill	Lb.	.07½	.08¼	.10	.09¾	.10	.10	.09¾
Rapeseed oil, refined, in bbl.	Lb.	.82½	.84	.85	.84	.83	.84	.84
Soya bean oil, in bbl., N. Y.	Lb.	.08¾	.09	.10¼	.10¾	.11½	.12¼	.12¼

Phenol is another product to advance under an increasing demand. Material in the hands of dealers early in the year was gradually absorbed and the receipt of orders from foreign sources for large tonnages caused prices to advance from 12¼c. per lb. in April to 15c. for June. Solvent naphtha, cresylic acid, toluene, cresol and salicylic acid have all shown improvement.

A number of declines were noted among the intermediates. Commodities which showed the effect of the unsatisfactory market for dyestuffs include aniline oil and salt, beta naphthol, diethyl aniline and dinitrobenzene.

The Vegetable Oil Market

Practically all of the vegetable oils are in a stronger position than at the beginning of the current year. Part of this has been brought about by the tendency on the part of the industry to discourage hand-to-mouth buying in favor of contracts for deliveries over a period of three to six months.

An important commodity to show the effects of this regular trading was linseed oil. During the early part of 1922 the market was as low as 74c. per gal. Since February, 1922, prices were on a steady advance with the top mark of 90c. per gal. reached during the latter part of May. The summer months have had a tendency to weaken quotations and prices have since receded to 80c. per gal. During the past two weeks the market has shown a marked revival, with recent prices heard around 87c. per gal. for the domestic raw material in carload lots. Cottonseed oil was another item to show a sharp advance since Jan. 1, 1922. The opening quotation was around 7c. per lb. for the crude material, with a steady advance during February and March. Prices have been firmly maintained during the past few months around 9¾@10c. per lb. Corn oil, peanut oil and soya bean oil have also shown considerable activity during the past few months.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	156.67
Last week	157.52
July, 1921	148
July, 1920	274
April, 1918 (high)	286
April, 1921 (low)	140

Six of the twenty-five commodities on which this index is based changed in price during the week. Three—ammonium sulphate, glycerine and linseed oil—were higher, while caustic potash, caustic soda and cottonseed oil contributed to the decline, which amounted to 0.85.

Wages and Hours of Labor in the Petroleum Industry

Some interesting industrial statistics have recently been brought to light in a study made by the U. S. Bureau of Labor Statistics of wages, hours and earnings in the petroleum industry during 1920. Reports were received from the payrolls of plants estimated to represent 25 per cent of the total number of employees engaged in the drilling and operation of oil wells, 50 per cent of all pipe-line employees and 35 per cent of all oil-refinery employees.

The regular working schedule of 74 per cent of all employees at the oil wells was seven days per week, the remaining 26 per cent being six-day workers. On the pipe lines 34 per cent worked 7 days and 66 per cent 6 days. At the refineries, however, but 23 per cent of the employees were 7-day workers and 77 per cent 6-day workers.

The customary hours of work at the wells and on the pipe lines ranged from 8 to 12 per day and at the refineries from 8 to 13. Forty-five per cent of the employees at wells, 43 per cent on pipe lines, and 65 per cent at refineries worked not more than 8 hours per day; 76 per cent at wells, 77 per cent on pipe lines, and 96 per cent at refineries not more than 9 hours; while 85 per cent at wells and 99 per cent on pipe lines, and 99 per cent at refineries worked not more than 10 hours.

It is of interest to note that of 80 refineries located in 15 states and employing 42,537 males and 274 females, women were found in productive work in only 5 establishments, located in 5 states. They were engaged principally in filling and packing bottles, cartons, etc., and only a few were working at common labor.

A summary of the average full-time hours per week and the average earnings per hour are given in the following table. In connection with the wage rates, it should be emphasized that these are the wages in effect in November, 1920, and that in some of the larger establishments substantial reductions have been reported. In most cases reductions meant that a part or the whole of certain war-time bonuses were discontinued.

Occupation	Average Hours Per Week	Average Earnings Per Hour
Wells:		
Drillers	73.6	$1.140
Drillers' helpers and cleanout helpers	59.7	.683
Firemen	57.7	.651
Laborers, roustabouts and connection men	57.7	.589
Pumpers and engineers	62.5	.582
Tool dressers	78.6	.954
Pipe Lines:		
Engineers and pumpers	57.2	.749
Firemen	55.7	.701
Gaugers, deliverymen and oil receivers	58.9	.775
Laborers, roustabouts, etc.	54.7	.528
Line walkers	62.5	.584
Telegraph operators	56 0	.676
Refineries:		
Engineers and chillermen	55.3	.811
Firemen and assistant engineers	53 6	.756
Pumpmen	53.6	.789
Stillmen	54 2	.905
Stillmen's assistants, chargers and leadersup	53 6	.799
Boilermakers	48.1	.991
Boilermakers' helpers	47 6	.741
Laborers	49 7	.575
Machinists	48 5	.905
Pipefitters	49 4	.855
Pipefitters' helpers	48 8	.685

In addition to the statistical sections of the report (Bulletin 297, dated April, 1922) some interesting information is given regarding duties and division of work in the three principal branches of the petroleum industry.

The New York Market

NEW YORK, July 10, 1922.

The chemical market during the past week has shown the effects of the recent holiday period and trading, in general, has been of a desultory character. About 90 per cent of the trade closed from Saturday until Wednesday morning and business was limited to only a few days of full trading. With the exception of a few commodities, there were no features of outstanding interest. Arsenic, tartaric acid, calcium acetate, copper sulphate and ammonium sulphate showed considerable activity, with quotations in some instances fractionally higher. Prussiates, caustic potash, caustic soda and soda ash have revealed no appreciable changes during the interval and quotations were subject to slight shading on firm business.

GENERAL AND SPECIAL CHEMICALS

Arsenic — Domestic producers are quoting higher prices for nearby goods. Importers have also fallen in line with the advancing tendency and only a few odd lots are heard of at 7½c. per lb. The regular range for prime materials is around 7¾@8c. per lb.

Barium Chloride—Leading factors and importers quote spot material at $95@$100 per ton. Goods afloat are held at $92 per ton with shipments at $86.

Bleaching Powder—Prices in general remain unaltered at $1.60 per 100 lb. f.o.b. works for large drums. Imported material is scarce on the spot market and quoted at $1.70 ex store.

Caustic Potash—Imported 88-92 per cent goods have been offered down to $5.50 per 100 lb. for spot delivery. Recent heavy arrivals are responsible for the competition among sellers and lack of interest from consuming quarters. The general range is around 5½@6c. per lb.

Caustic Soda—The export market has shown no activity whatsoever during the past week. Leading producers offer standard brands at $3.70@$3.75 per 100 lb., f.a.s. The movement in domestic circles has been quite satisfactory to dealers and reports show a notable improvement during the month of June. Goods ex-store are held at $3.75 per 100 lbs.

Copper Sulphate—Spot material is practically extinct. The demand is far greater than the available supply and July allotments seem to be well sold up. Quotations range around 6½@6¾c. per lb.

Glycerine—There was a firmer feeling noted in this market due to the lighter offerings from first-hand sources. Chemically pure was a fraction higher at 15c. per lb. Dynamite glycerine was held around 13½c. per lb.

Nitrite of Soda—Trading was along limited lines with imported material quoted around 8¼c. per lb. Domestic producers were holding 9c. per lb. as the regular carlot quotation.

Permanganate of Potash—Imported U. S. P. Crystals were offered at 14½c. per lb. The demand showed little signs of any future activity.

Prussiate of Potash—Prices for yellow material were lower than the last report. Business has not been very encouraging during the interval and sellers offered spot goods at 32c. per lb. The red material still maintains the high figure around 90c. per lb.

Prussiate of Soda—The demand for this material has been rather weak during the past few days and sellers were offering spot goods at 21¼c. per lb. Shipments were quoted at 20c. per lb.

Soda Ash—Prices have shown no appreciable change and prominent dealers were offering carload lots of single bags at $1.75@$1.80 per lb. on spot, with barrels at $1.95@$2 per 100 lb. Contracts remain unchanged.

Sulphate of Ammonia—There has been a pronounced shortage of this material and the market is in a very strong position. Prices for double bags f.a.s have advanced to $3.45@$3.50 per 100 lb.

COAL-TAR PRODUCTS

There have been no signs of any special interest in the crude and intermediate markets during the past week. Large producers of crudes reported a steady call from the various consuming industries with no particular advance or decline along the list. The intermediate market remained in a very dormant state due to the absence of real interest from domestic buyers. Textile mills, it will be recalled, have been operating on an extremely conservative basis of late.

Benzene—Consumers have shown no desire to ease up on the demand for supplies and the producers report an extremely strong market for future business. The pure material is quoted at 30@35c. per gal. with 90 per cent at 28@31c. per gal. Spot lots are held by second hands at 40c. and higher for the 90 per cent grade.

Beta Naphthol—Sales of technical material were recorded at 23c. per lb. Producers are somewhat higher and quote the market at 24c. Competition remains keen for any passing business with prices subject to shading.

Cresylic Acid—A continued active inquiry has kept the market in a very firm position. Supplies of domestic and foreign goods are rather light on spot, with the 97-99 per cent domestic held at 56@58c. per gal. and 95-97 per cent at 51@53c. Imported high test goods sold up to 65c. per gal.

Paranitraniline — Inquiries have recently been received in satisfactory volume and sales are reported at 75c. per lb. The general range is from 75@80c. per lb.

The St. Louis Market

ST. LOUIS, July 6, 1922.

During the past two weeks activities in the industrial chemical market have been somewhat quiet, but this is only to be expected at this time of the year. We do not believe, however, that this lull will prevail for as long a period as in previous years, as stocks on many items are still being carried on a minimum basis and replacements must be made more frequently. The tone of the market remains quite steady, with a few advances since our last report. Imported chemicals are inactive.

ALKALIS

The *caustic soda* market has been rather quiet since our last report. Small quantity purchases are about nominal with nothing of a carload nature to report. Prices have not fluctuated, flake caustic in single drum lots holding around $4.50 per 100 lb., while solid can be bought at $4. *Soda ash* has done nothing unusual for some time. There has been no tendency toward price fluctuation or an increased or decreased demand. *Bicarbonate of soda* is at present the wild member of the alkali group in so far as it is impossible to say at any time at what price it can or cannot be bought. Replacement goods, however, are somewhat stronger and should have a tendency to stabilize the market. *Sal soda* has recently stiffened a bit and no price cutting has been felt recently. A good volume of business is being done in this item. Prices for barrels are $1.75 per 100 lb., while package goods sell at $2.15 per case.

GENERAL AND SPECIAL CHEMICALS

Producers of heavy mineral acids report a continued improvement in this line, with prices much stronger. *Carbolic acid*, medicinal grade, is moving very well and prices are firm. *Citric acid* manages to keep pace with last year, with spot stocks of domestic material still very scarce. Further advances have been made in *oxalic acid* due to the increased cost of basic material. Last week prices ranged from 14½@16c., the demand being very good with a fairly large expansion over a month ago. *Tartaric acid* is coming to life and some very substantial orders have been placed during the past two weeks, prices remaining at the former levels. *White arsenic, powdered*, is very strong and is now being quoted at 7¾c. f.o.b. New York with a short supply and large demand. *Carbon disulphide*, being a seasonable article, is showing up very well and in all probability will continue to do so, as we are now arriving at a season when it will be used quite extensively in the agricultural districts of the country in destroying boll weevil and other insects infesting crops. *Carbon tetrachloride, technical*, is moving in a routine way. Some time ago the demand for *coppéras* was far in excess of supplies; however, today supplies have been increased and spot stocks are available at $18@$20 per ton in carload lots f.o.b. producers' works. There has been considerable action in the *glycerine* market since our last report. This being a time of contract making, some changes are naturally expected. One producer was offering contracts for six months, with protection against decline, at 14c., basis drums, others as low as 14⅜c. on contracts for a few days only—spot goods at 14½c.—and then suddenly back to 15c. for both contract and spot. At present the price of 15c. seems firm and will undoubtedly be rock bottom for six months to come. There has been no change in the *potash cyanide* situation, stocks still being limited and the demand routine. *Zinc sulphate, technical*, is in very good demand and there are persistent rumors of an advance.

VEGETABLE OILS AND NAVAL STORES

Turpentine has covered a large range of prices recently, the peak being $1.54 per gal. in single barrels, but it has gone downward again and can now be had at $1.30. *Linseed oil* is moving in good volume now, owing to increased activity in the paint industry. Prices have not changed noticeably. *Castor oil* is still being held at 12¾c., with a normal volume of business being transacted.

The Iron and Steel Market

PITTSBURGH, July 7, 1922.

While the actual tonnage of output of pig iron and steel may not be increasing at the moment, on account of weather conditions usual in July and August, the capacity of production units in operation still tends to increase. The number of furnaces in blast increases from week to week. For instance, last week the Republic Iron & Steel Co. blew in a third stack at Youngstown while on July 5 it put in operation its bessemer department, idle since last September.

STEEL INGOT PRODUCTION

Production of steel ingots averaged in May a rate of about 38,250,000 gross tons per annum, and the rate in the past fortnight, counting out time lost by the holiday, which was observed at most plants Monday as well as Tuesday, was probably about 40,000,000 tons, which compares with a rate of about 35,000,000 tons on April 1, when the coal strike started, and a rate of about 20,000,000 tons last December.

Inasmuch as it is unprofitable to blow in a blast furnace for a short period, the continued addition of stacks to the active list is proof that the iron and steel trade feels confidence as to the future not only of its coke supplies but also of its fuel supplies, as it is useless to make pig iron unless there is fuel for power and heating steel. If an actual shortage of coal is looked for, therefore, it appears that it should be sought elsewhere than in the iron and steel industry. There is no circumstantial evidence, furthermore, that any shortage has developed among consumers of steel, as buyers are still pressing steel mills for deliveries.

As to tonnage turnover, the finished steel market is now decidedly quiet, as it almost invariably is in July and August. The dullness gradually stole over the market during June. The steel industry, as to production and consumption, is wound up to run well for the next 2 or 3 months on the basis of engagements already made, and does not require that there be market activity at the present time. The question is solely as to the more distant future. To date there has been no menacing accumulation of steel in the hands of buyers. Production of steel ingots in 1921 was about 19,000,000 tons, while the drastic liquidation of stocks of steel in buyers' hands and of manufactured wares probably represented all of 3,000,000 tons, making 22,000,000 tons a fair guess as the representation of consumption. An increase of only 25 per cent in consumption in the past 6 months over the average of 1921 would require almost 14,000,000 tons of ingots, while production in the 6 months has been 16,000,000 tons. The difference of 2,000,000 tons might represent replenishment of badly depleted stocks and provision of stocks for the filling of actual orders at manufacturing plants consuming steel. The accumulation may be even less than here suggested.

IRON AND STEEL PRICES

The market stands substantially as follows: Bars, shapes and plates, 1.60@1.70c.; hoops and bands, 2.40@2.50c.; standard steel pipe, 71 per cent basing discount; nails, $2.40@$2.50; blue annealed sheets, 2.40@2.50c.; black sheets, 3.15@3.30c.; galvanized sheets, 4.15@4.30c.; automobile sheets, 4.50@4.85c.; tin plate, $4.75. Fabricated wire fence has been reduced about $4 a net ton, the discount on jobbers' carloads being increased from 71½ per cent to 73 per cent. Demand has been relatively light for a long time.

While a few sales of sheet bars were reported recently at $37.50@$38, the common settling price now is $35. The Carnegie adjustment price for third quarter, on regular contracts, is understood to be $33, against $31 for second quarter and $30 for first quarter. Billets and slabs are quotable at $35, by inference from sheet bars, there being no open market transactions of note.

Wire rods, which had been at the practically nominal price of $38, have been advanced to $40, and even at this price producers are indisposed to sell except to regular customers.

Pig iron continues quiet as to actual turnover. In several districts asking prices have advanced slightly in the past week or two. The valley market is unchanged, with prices practically nominal at $25 for bessemer and basic and $24 for foundry, f. o. b. valley furnaces. On the whole the valley market does not seem to be as firm as 30 days ago. Freight from valleys to Pittsburgh came down July 1 from $1.96 to $1.76.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0 38 – $0.40
Acetone	lb.	$0 11 – $0 11½	11½ – .13
Acid, acetic, 28 per cent	100 lbs.	2 25 – 2 50	2 55 – 3 00
Acetic, 56 per cent	100 lbs.	5 00 – 5 25	5 30 – 5.50
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	8 50 – 9 00	50 – 9.75
Boric, crystals	lb.	.11 – 11½	11½ – .12
Boric, powder	lb.	11 – 11½	11½ – .12½
Citric	lb.	..... –	.45 – .46
Hydrochloric	100 lb.	1.10 – 1 20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – 11½	11½ – .12
Lactic, 44 per cent tech	lb.	09½ – 10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – 04½	04½ – .05
Molybdic, c.p.	lb.	3.00 – 3 25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg	lb.	.06 – 06½	.06¾ – .07
Nitric, 42 deg	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.14½ – .14¾	.15 – .15½
Phosphoric, 50 per cent solution	lb.	08 – 08½	.08¾ – 09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9 50 – 10 00	..... – .....
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15 00 – 16 00	..... – .....
Sulphuric, 66 deg., drums	ton	19 00 – 20 00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.29 – .29½
Tartaric acid, imported, powdered	lb.	..... –	.29½ – .30
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.26 – .39
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.26 – .30
Alum, ammonia, lump	lb.	.03¼ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03 – 03¼	.03¼ – .04
Alum, chrome lump	lb.	05¼ – 05½	.06 – 06½
Aluminum sulphate, commercial	100 lb.	1.50 – 1 65	1.70 – 2 25
Aluminum sulphate, iron free	lb.	.02½ – 02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – 07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – 30½	.30½ – .31
Ammonium carbonate, powder	lb.	.07 – .07½	.07½ – .08
Ammonium nitrate	lb.	.06 – 06½	.06¾ – .07½
Amylacetate tech	gal.	..... –	2.00 – 2.25
Arsenic, white, powdered	lb.	.07¼ – 07¾	.08 – .08½
Arsenic, red, powdered	lb.	.12 – 12¼	.12½ – .13
Barium carbonate	lb.	.03 – .04	.04½ – .05
Barium chloride	ton	95.00 – 100 00	105.00 – 110.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate	lb.	.07 – 07½	.07½ – .08
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2.50
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.00 – 2.25	..... – .....
Calcium carbide	lb.	.04½ – 04¾	.05 – .05½
Calcium chloride, fused, lump	ton	24.00 – 24 50	24.75 – 27.00
Calcium chloride, granulated	lb.	.01½ – 01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.80 – .83
Carbon bisulphide	lb.	.06½ – .06¾	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – ....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04¼ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – 05½	.05¾ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2 10
Copperas	ton	20 00 – 22 00	23.00 – 30 00
Copper carbonate, green precipitate	lb.	.19 – 20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6 60	6 65 – 7 00
Cream of tartar	lb.	..... –	.24 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.08½ – .08¾	.08¾ – .09
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00	..... – .....
Fullers earth—imported powdered	net ton	30 00 – 32 00	..... – .....
Fusel oil, ref	gal	..... –	2 25 – 2 65
Fusel oil, crude	gal.	..... –	1 45 – 1 50
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	15 – 15½
Iodine, resublimed	lb.	..... –	4 20 – 4 25
Iron oxide, red	lb.	..... –	12 – 18
Lead acetate	lb.	..... –	09½ – 11½
Lead arsenate, powd	lb.	.13 – 13½	13¼ – 14½
Lead nitrate	lb.	..... –	15 – 20
Litharge	lb.	.07½ – .08	.08 – 09
Magnesium carbonate, technical	lb.	.07 – 07½	.07½ – .08½
Magnesium sulphate, U. S. P.	100 lb.	2 00 – 2 25	2 30 – 2 50
Magnesium sulphate, technical	100 lb.	..... –	1 00 – 1 80
Methanol, 95%	gal	..... –	57 – 58
Methanol, 97%	gal.	..... –	59 – 60
Nickel salt, double	lb.	..... –	11 – 11½
Nickel salt, single	lb.	..... –	.10 – .10½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – 45
Phosphorus, yellow	lb.	..... –	.30 – 35
Potassium bichromate	lb.	.09½ – .10	.10– .10¼
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb.	..... –	.50 – .52
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06¼ – .06¾	.07 – .08
Potassium permanganate	lb.	.14½ – .14¾	.15 – .16
Potassium prussiate, red	lb.	..... –	.90 – .95
Potassium prussiate, yellow	lb.	.32 – .32½	.32¼ – .33
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06¾ – .07	.07¼ – .08
Salammoniac, gray, granular	lb.	.07¼ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	20.00 –25.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.65 – 1.70	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06¼ – .06½	.06¾ – .07
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07 – .07¼	.07½ – .07¾
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ .05¼
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	.. – .....
Sodium cyanide	lb.	.21 – .22	.22½ – .25
Sodium fluoride	lb.	.09½ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.50	3.80 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.70 – 3.75	–3.80 – 4.10
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.85 – 4.00	–4.30 – 4.50
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	–4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03¼	.03½ – .04
Sodium nitrite	lb.	.08¼ – .08¾	.09 – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04¾
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.21½ – .21½	.21½ – 22
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1 25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2 75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1 50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04¼ – .04½	.04½ – 05
Sodium sulphite, crystals	lb.	.03½ – .03¾	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3 10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	..... – .....
Talc—domestic powdered	ton	18 00 –25 00	..... – .....
Tin bichloride	lb.	.09 – .09½	.09½ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.06 – .06½	.06¾ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – 08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.30 — .31
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1 00
Benzaldehyde U.S.P.	lb.	1.25 — 1 30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.50 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99% straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — 22
Dinitroclorbenzene	lb.	.22 — 24
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.59 — .65
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.95 — 1.00
Monochlorbenzene	lb.	.09 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — 06¼
Naphthalene, flake	lb.	.06 — 07
Naphthalene, balls	lb.	.07¼ — 08
Naphthionate of soda	lb.	.58 — 65
Naphthionic acid, crude	lb.	.65 — 70
Nitrobenzene	lb.	.10 — 12
Nitro-naphthalene	lb.	.30 — 35

Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.40 —	2.50
Ortho-dichlor-benzene	lb.	2.15 —	.20
Ortho-nitro-phenol	lb.	.70 —	.75
Ortho-nitro-toluene	lb.	$0.10 —	$0.13
Ortho-toluidine	lb.	.14 —	.18
Para-amidophenol, base	lb.	1.25 —	1.30
Para-amidophenol, HCl	lb.	1.30 —	1.35
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.75 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.90 —	1.00
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.14 —	.15
Pyridine	gal.	1.75 —	2.75
Resorcinol, technical	lb.	1.30 —	1.35
Resorcinol, pure	lb.	1.75 —	1.80
R-salt	lb.	.60 —	.70
Salicylic acid, tech., in bbls	lb.	.25 —	.25½
Salicylic acid, U. S. P	lb.	.26 —	.26½
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.14 —	.18
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Beeswax, pure white	lb.	.38 —	.40
Japan	lb.	.17 —	.17½

All other prices remain same as previous report

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$5.50 —	$5.90
Rosin E-I	280 lb.	6.00 —	6.40
Rosin K-N	280 lb.	6.50 —	7.60
Rosin W. G.-W. W	280 lb.	7.65 —	8.30
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.25 —	1.26
Wood turpentine, steam dist	gal.	.85 —	....
Wood turpentine, dest. dist	gal.	.70 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	10.00
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.36 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.46 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.45 —	3.50

Other quotations same as July 5th report

Crude Rubber

All prices remain quotably unchanged

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.11 —	$0.11½
Castor oil, AA, in bbls	lb.	.12 —	.12½
China wood oil, in bbls	lb.	.13 —	.13½
Coconut oil, Ceylon grade, in bbls	lb.	.08½ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09¼ —	.09½
Corn oil, crude, in bbls	lb.	.11¼ —	.11½
Cottonseed oil, crude (f. o. b. mill)	lb.	.09½ —	.10
Cottonseed oil, summer yellow	lb.	.11½ —	.11⅝
Cottonseed oil, winter yellow	lb.	.12½ —	.12¾
Linseed oil, raw, car lots (domestic)	gal.	.88 —	.89
Linseed oil, raw, tank cars (domestic)	gal.	.84 —	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.93 —	.94
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07¼ —	.07
Palm, Niger	lb.	.06¼ —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10 —	.10¼
Peanut oil, refined, in bbls	lb.	.12½ —	.12¾
Rapeseed oil, refined in bbls	gal.	.84 —	.85
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.12 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.10 —	....

FISH

Light pressed menhaden	gal.	$0.51 —	....
Yellow bleached menhaden	gal.	.53 —	.54
White bleached menhaden	gal.	.55 —	.56
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1, crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700.00	$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	75.00 —	110.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24.00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10 —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	16.00 —	20.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, No. 1 pottery grade	long ton	6.50 —	6.75
Feldspar, No. 2 pottery grade	long ton	5.75 —	5.90
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00 —	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	....
Kieselguhr, f.o.b. N. Y	per ton	50.00 —	55.00
Magnesite, calcined (powdered)	per ton	8.00 —	12.00
Pumice stone, imported	lb.	.03 —	.05
Pumice stone, domestic, lump	lb.	.05 —	.05½
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.81 —	.82
Shellac, orange superfine	lb.	.83 —	.84
Shellac, A. C. garnet	lb.	.68 —	.69
Shellac, T. N	lb.	.79 —	.80
Silica, glass sand, f.o.b. Indiana	per ton	1.50 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00 —	16.00
Silica, building sand, f.o.b. Pa	per ton	2.00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16.00 —	20.00

Refractories

All prices remain same as previous report

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
Ferromanganese, 78-82% Mn, German	gross ton	67.00 —	67.50
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58.00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V	lb.	3.50 —	4.00

Ores and Semi-finished Products

Coke, foundry, f.o.b. ovens	net ton	9.00 —	9.50
Coke, furnace, f.o.b. ovens	net ton	9.00 —	....

Other prices remain quotably unchanged

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent	19.00–20.00
Antimony, wholesale lots, Chinese and Japanese	4.95–5.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	31.375
Lead, New York, spot	5.75
Lead, E. St. Louis, spot	5.50
Zinc, spot, New York	5.75
Zinc, spot, E. St. Louis	5.40

OTHER METALS

Silver (commercial)	oz.	$0.71½
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.10
Platinum	oz.	87.50
Iridium	oz.	170.00@175.00
Palladium	oz.	55.00@60.00
Mercury	75 lb.	54.75@55.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

FORT PAYNE—The Clay Products & Mining Corp., 150 East State St., Trenton, N. J., recently organized with a capital of $1,500,000, is arranging for the immediate development of over 150 acres of clay and kaolin properties, lately acquired in this district, and will install a complete operating and producing plant. R. M. J. Smith is president; and Alfred L. Eccles, secretary.

California

IRVINGTON—The Panama Soap Co. has concluded negotiations with the local Chamber of Commerce for the acquisition of a factory site, and will soon prepare plans for the erection of a new plant, estimated to cost about $60,000, including equipment. The Chamber of Commerce is interested in the project.

OWENSMOUTH—The Standard Oil Co. of California, 200 Bush St., San Francisco, has plans under way for the construction of a local distributing plant, to include a number of 1-story buildings, to cover more than one acre of ground. Work will be commenced at an early date.

SELMA—The Fresno Tire & Rubber Co., Mattei Bldg., Fresno, has awarded a contract to W. L. Miller, Los Angeles, for the erection of its proposed new plant at Selma, to be 3-story, 60x250 ft., and estimated to cost about $125,000, including machinery. It will be equipped for the manufacture of tires and other rubber products. John S. Bates, Rowell Bldg., Fresno, is engineer.

SANTA BARBARA — Considerable special machinery will be installed in the new addition to be erected at the flour milling plant of the Santa Barbara Milling Co., to be 23x90 ft. A. J. Wehrle is general manager.

BAKERSFIELD—The Associated Oil Co. and the Associated Supply Co., affiliated organizations, have plans nearing completion for the erection of a new oil distributing plant at 32nd and Chester Sts., a site recently acquired. It will include oil tanks, storage and pumping facilities, etc., and is estimated to cost about $60,000. Headquarters of the first noted company are in the Sharon Bldg., San Francisco.

Illinois

NORTH CHICAGO—The Chicago Hardware Co. is taking bids on a general contract for the erection of a 1-story addition, 70x100 ft., to be equipped as an enameling plant. It is estimated to cost about $40,000. Shankland & Pingrey, 209 South La Salle St., Chicago, are engineers.

Indiana

HAMMOND—A 1-story foundry, 60x130 ft., will be erected by the Calumet Tank & Mfg. Co., on Industrial Road, estimated to cost about $75,000, including equipment. E. R. Kyler is president and treasurer.

INDIANAPOLIS—The Chapman Price Steel Co., Shelby St., has preliminary plans in progress for the erection of a large addition to its plant, comprising a number of buildings, estimated to cost about $500,000, including equipment. Niles Chapman is president.

GARY — The National Tube Co., Frick Bldg., has completed plans for the erection of the initial units of its proposed new steel mill here, estimated to cost in excess of $1,000,000. R. C. Patterson is company engineer; W. E. Schiller is president.

Kentucky

LOUISVILLE—The Producers Wood Preserving Co., an interest of the Ayer & Lord Tie Co., 39 East Jackson St., Chicago, Ill., has broken ground for the erection of a new creosoting plant, estimated to cost about $200,000, including equipment. The Leonard Construction Co., 37 South Wabash Ave., Chicago, has the general contract. Oscar S. Bond, Marion E. Taylor Bldg., Louisville, is in charge.

Louisiana

HOUMA—The Industrial Committee of the Houma-Terrebonne Association of Commerce, J. H. Thatcher, chairman, is developing plans for the location of an industry at Houma to manufacture synthetic marble from crushed oyster shells. A site for the proposed plant is being selected.

MONROE—The Ouachita Natural Gas & Oil Co., P. O. Box 1199, has preliminary plans in progress for the construction of a new pipe line, with auxiliary equipment, from Swartz to Sterlington, La., for use in connection with its gasoline absorption plant and carbon works, about 9½ miles long, estimated to cost about $60,000.

Maryland

EASTON — The New Brick & Tile Co., Moreland Bldg., will break ground at once for the erection of its proposed new plant on local site for the manufacture of brick and tile products. It will consist of a main 1-story building, and is estimated to cost about $45,000. The company was organized recently under state laws, with a capital of $50,000. O. Fletcher Clark is secretary and treasurer, and Frank Ross, superintendent.

Massachusetts

MALDEN — Wadsworth, Howland & Co., Inc., 139 Federal St., Boston, manufacturer of paints, varnishes, etc., has acquired property adjoining its Malden works on Green St., totaling about 28,600 ft., and another site in the vicinity, aggregating 200,000 ft., and will use the land for expansion. The proposed new buildings are expected to cost in excess of $500,000. The last noted property will be used for the erection of a power plant.

AMHERST—Bids on a general contract have been taken for the erection of a new 3-story and basement chemistry and physics building at the Amherst Agricultural College, to be 94x195 ft. Ritchie, Parson & Taylor, Boston, are architects.

Michigan

MUSKEGON—The Central Paper Co. has tentative plans under consideration for the erection of a 3-story addition to its mill on Richard St., estimated to cost about $200,000, including machinery. E. J. Geddes is secretary.

LANSING—The Capital Glass Co. has completed the erection of a new local plant and will commence operations at once for the manufacture of mirrors and other glass products, primarily for automobile service.

KALAMAZOO—The Kalamazoo Vegetable Parchment Co., manufacturer of parchment papers, has awarded a contract to H. L. Vanderhorst, Grand Rapids National Bank Bldg., Grand Rapids, for the erection of the proposed new addition to its mill, to be 2-story, 2-machine capacity, estimated to cost about $400,000, including machinery. Billingham & Cobb, Press Bldg., Kalamazoo, are architects; J. Kindleberger is president and manager.

Missouri

KANSAS CITY—The Central Paper Box Co., 2935 Belleview Ave., has completed plans and will soon break ground for the erection of a new 2-story and basement plant, 125x150 ft., on Belleview Ave., near 29th St. Hans Von Unwerth, 500 Reliance Bldg., Kansas City, is architect.

New Jersey

TRENTON—The Resolute Pottery Co., 3rd St., manufacturer of sanitary earthenware, has filed plans for the erection of a 1-story plant addition to cost about $10,000.

NEWARK—The Premier Rubber Co., recently organized with a capital of 50,000 shares of stock, no par value, to manufacture a general line of rubber specialties, has acquired the factory at 218-24 New St., at Hoyt St., under a 5-year lease. Possession will be taken at once and equipment installed. It is proposed to have the plant ready for service early in August. The company is headed by John W. Stoddard and W. Howard Demarest, 790 Broad St., Newark.

NEWARK—Fire, June 26, damaged a portion of the plant of L. Mundet & Co., Long Ave., Hillside section, manufacturers of cork products. An official estimate of the loss has not been announced.

New York

NEW YORK—The American Smelting & Refining Co., 120 Broadway, has preliminary plans under way for the erection of a new byproducts coke plant on site selected in the Coahuila district, Mexico, estimated to cost in excess of $5,000,000, including machinery. The proposed plant will consist of a series of buildings, to be equipped for different features of production. William Loeb, Jr., is vice-president in charge.

NEW YORK — The International Carbon Corp., operated under the direction of the Atlas Powder Co., 200 Fifth Ave., and the Columbian Carbon Co., is considering plans for the establishment of a foreign branch plant on site to be selected in France. The company specializes in the production of a decolorizing carbon, known as "Darco," and has succeeded to the business of the Darco Corp., with plant at Marshall, Tex., recently placed in operation. A common stock issue of $1,210,000 is being sold, the proceeds to be used, in part, for the proposed expansion.

New Mexico

RATION—The Ideal Mining & Milling Co. has tentative plans under consideration for the erection of a new flotation plant at its local properties, to have an initial output of about 50 tons a day. A number of improvements are now being made at the works, including the installation of new machinery.

SILVER CITY—The Tonopah-Belmont Co., Tonapah, Nev., has acquired the properties of the Wyman Silver Mining Co., near Silver City, and plans for extensive development and production. Equipment for this purpose will be installed at an early date.

North Carolina

WINSTON-SALEM—The Engineering Division, Department of Public Works, has plans under way for the installation of new filtration equipment at the municipal waterworks. A coagulating basin, six filters, ariator, washing tower, and other equipment will be installed. Bids are expected to be asked early in August.

BALDWIN—The National Soapstone Co., First National Bank Bldg., Roanoke, Va., has awarded a general contract to the Virginia Bridge & Iron Co., Roanoke, for the erection of a new plant at Baldwin, consisting of three buildings, 60x115 ft., 30x45 ft., and 30x45 ft., respectively. A list of equipment for installation has been arranged, and this feature of the work will be arranged at an early date. C. R. Williams is general manager.

Ohio

OAK HARBOR—The Liberty Cut Glass Co. is arranging for extensions in its plant to double, approximately, the present output. Considerable new equipment will be installed. J. H. Fisher is general manager.

WARREN — The Youngstown Steel Co., Realty Trust Bldg., Youngstown, O., has awarded a contract for the clearing of the site at Warren, for the construction of its proposed new steel mill, estimated to cost in excess of $2,500,000. Plans for the plant are in course of preparation. H. Z. Bixler is company engineer in charge.

Oklahoma

ADA—The Oklahoma Portland Cement Co. is making a number of improvements and extensions in its local mills, and is completing the installation of a second kiln in its recently constructed "wet process" plant. The other mill, or "dry process" plant, will be overhauled at once. Work is under way on a new power plant.

MUSKOGEE—The Oklahoma Producing & Refining Co., a subsidiary of the Pure Oil Co., is considering tentative plans for extensions in its local oil refinery. The expansion will be designed to handle the output of the Oklahoma Central Oil Co., recently acquired for a consideration said to be close to $5,000,000, and with production approximating 5,400 bbl. daily.

Pennsylvania

NEW CASTLE—The Elliott-Blair Steel Co. is planning for the erection of an addition to its plant, consisting of a number of buildings, estimated to cost in excess of $200,000, including equipment.

PHILADELPHIA—H. Swoboda & Son, Inc., 1027 North Bodine St., manufacturer of leather products, has foundation work under way for the erection of a 1-story

addition to its plant to cost about $50,000. G. Swoboda is president.

PHILADELPHIA—Fire, June 25, destroyed a portion of the storage and distributing plant of the Pennsylvania Synthetic Gas & Chemical Co., 63rd St., near Chester Ave., with loss approximating about $15,000.

Tennessee

CRAB ORCHARD — The Southern States Lime Corp. is said to be planning for the erection of a new hydration plant to cost about $20,000. N. D. Walker is general manager.

HARRIMAN—The City Council is considering the installation of a new filtration plant at the municipal waterworks. J. C. Laird is city engineer.

Texas

REFUGIO—The Refugio Glass Works, Inc., National Bank of Commerce Bldg., San Antonio, Tex., recently organized with a capital of $75,000, has selected a site at Refugio, near San Antonio, for the erection of a new plant for the manufacture of high pressure glass bottles, glass panels and kindred specialties. Work will be commenced at once, and it is proposed to have the plant ready for operation early in the fall. W. L. Napier is manager.

DALLAS—The Texas Chinaware & Novelty Pottery Co., recently organized with a capital of $50,000, will soon commence the erection of a new plant at Betterson Circle, Oak Cliff district, for the manufacture of whiteware, china tops and other pottery products. The initial works will consist of 3 pottery kilns and 3 kilns for bisque ware. The new company is headed by H. G. Stern, J. D. Robinson and P. A. Angelsburg.

STAMFORD—The Stamford Cotton Oil Co. is reported to be planning for the rebuilding of its local plant, partially destroyed by fire, June 23, with loss estimated at about $40,000, including equipment. J. L. Jones is president, and W. A. Ernest, general manager.

WEST DALLAS—The Clayton Refining Co. has remodeling work under way on the local oil refinery, formerly operated by the Hercules Refining Co. The plant will be increased to develop a daily capacity of about 5,000 bbl. The work is estimated to cost about $45,000.

ELECTRA—D. E. DeCourse, Devol, Okla., and associates, have acquired the local oil refinery of the Beaver Electra Refining Co., for a consideration stated at $95,000. The new owners will organize a company and operate the plant. It is proposed to make a number of improvements and extensions.

West Virginia

BELLE—The Belle Alkali Co. will soon commence the erection by day labor of its proposed 2-story plant addition, 50x100 ft., to be equipped for the manufacture of caustic soda, chlorine, etc., estimated to cost close to $100,000. D. W. Stubblefield is general manager.

Industrial Developments

GLASS—The United States Window Glass Co., Jewella, near Shreveport, La., has placed its new local plant in operation, and will give employment to a working force of about 750 men. The factory was completed recently at a cost of close to $3,000,000.

The Interstate Window Glass Co. has resumed partial operations at its Plant No. 3, following a suspension for more than a year past. Tank fires have been started and it is expected to place the entire plant in full operation by August 1, giving employment to about 200 men. It is said that orders on hand insure continuous production for a considerable period. The company is also arranging for the early resumption of manufacture at its plant at Okmulgee, Okla., and it is expected to through this entire plant in service during July. Tank fires have been lighted.

Manufacturers of glass bottles and containers in the vicinity of Vineland, N. J., report an improved demand for production, and surplus stocks are being depleted rapidly. Opal ware and kindred material containers are in demand considerably in excess of normal.

CERAMIC—The John S. E. Pardee Co., Maple Shade, N. J., manufactuer of brick, is operating under maximum production, with a full working force. The company has just completed the installation of a new brick-making machine to provide an additional output of about 40,000 bricks per hour.

J. E. Thompson, recently appointed receiver for the Guernseyware Co., Cambridge, O., manufacturer of vitrified chinaware products, will continue the plant in operation.

OIL—Gosden & Co., Bigheart and Tulsa, Okla., has advanced production at its refineries from 35,000 to 40,000 bbl. per day.

Following refinancing the Constantine Refining Co., Tulsa, Okla., is planning for the resumption of operations at its plant at Devol, and in the district west of Tulsa. It is expected to develop full capacity at an early date.

IRON AND STEEL—The Reading Iron Co., Reading, Pa., has increased production to the highest point within the past 24 months. All plants at Pottstown, Columbia, Danville and Birdsboro, are now in service, giving employment to a working force about 75 per cent of normal. Operations were recently resumed at the eight furnaces at the Glasgow puddle mill of the company, following a shut down for more than a year past.

The Carnegie Steel Co., Pittsburgh, Pa., is now operating 38 blast furnaces, against a total of 35 on May 5, and 34 early in April, at the commencement of the coal strike. It is planned to add to the list of active stacks at an early date. At its Union mills, the company has increased the operating schedule to 90 per cent of normal, while the Ohio works have 14 open-hearth furnaces in service, with a production basis of 93 per cent of normal.

The Gulf States Steel Co., Gadsden, Ala., is maintaining production at close to normal at its local mills. The wages of mill men have been advanced 10 per cent, effective July 1.

Blast furnace operations in the Mahoning and Shenango Valley districts of Ohio are now at the highest point of any time within the last 18 months. In the first noted section, 18 out of 27 stacks are in service, bringing production to a point of 80 per cent of normal; in the Shenango Valley, 8 out of 20 stacks are on the producing list.

Following a shut down for close to two years past, the Bon Air Coal & Iron Corp., Nashville, Tenn., is arranging to blow in its blast furnace at Allen's Creek around the middle of July. The wood distillation plant of the company at Lyles will be placed in service at the same time, after a similar idle period.

The Wheeling Steel & Iron Co. has advanced production from 45 to 75 per cent of normal at its Benwood, W. Va., plants, adding about 400 men to the working force. The company has placed an additional sheet metal in service at the plant of its Whitaker-Glessner division, Martin's Ferry, O., bringing manufacture up to about 66 per cent of normal.

COKE — The Woodward Iron Co., Birmingham, Ala., is arranging for the operation of 30 more byproduct coke ovens at its plant, bringing the active list up to 200 ovens. The company is operating 4 blast furnaces.

Coke production in the Connellsville, Pa., district is being increased. During the last week in June, 3 plants resumed operations, bringing the number of active plants up to 39. Production in this section has been advanced from 58,663 to 66,850 tons per week.

Arrangements are being made for the early resumption of operations at the coke ovens in the vicinity of Dawson, N. M., which have been closed down for about 2 years past. About 200 ovens are available for immediate lighting.

The H. C. Frick Coke Co., Connellsville, Pa., is increasing operations at its different plants. A total of 50 ovens have been lighted at the Leisenring No. 1 Plant; 40 ovens have been started at the Lomond No. 2 Plant; and 50 ovens have been placed in blast at the Oliphant works.

MISCELLANEOUS — The Lehigh Portland Cement Co., New Castle, Pa., has advanced production to a full capacity basis, with full working force, at its 3 local mills.

The Barrett Co., Philadelphia, Pa., manufacturer of prepared roofing, paper products, etc., has increased the wages of employees at its Elizabeth, N. J., works 10 per cent. About 200 operatives are affected.

The Chino Copper Co., Silver City, N. M., is increasing operations at its properties, and is now giving employment to about 700 men.

The Vanadium Corp., Pittsburgh, Pa., manufacturer of ferro-vanadium, etc., has recently resumed operations at its plant at Bridgeville, Pa.

The Mathieson Alkali Works, Providence, R. I., is running at about 80 per cent of capacity at its plants. Following the recent acquisition of the Commonwealth Co., plans for extensive production are being developed in the line of general chemicals, supplementing the current manufacture of caustic soda, chlorine and bleaching powder.

Capital Increases, Etc.

THE W. H. LOOMIS TALC CORP., Gouverneur, N. Y., has filed notice of increase in capital from $148,000 to $173,000.

THE MORGAN CHEMICAL CORP., Ogdensburg, N. Y., has filed notice of dissolution.

THE ATLANTIC REFINING Co., 3144 Passyunk, Philadelphia, Pa., operating a local oil refinery, with similar plants at Franklin and Pittsburgh, Pa.; and Brunswick, Ga., is disposing of a bond issue of $15,000,000, a portion of the proceeds to be used for general expansion and operation.

THE BRIDGEPORT BRASS FOUNDRY, INC., Bridgeport, Conn., has filed final notice of company dissolution.

The plant and property of the CENTURY-PLAINFIELD TIRE Co., Plainfield, N. J., manufacturer of tires and other rubber products, will be sold by the receiver, Charles R. McNair, 147 Ellison St., Paterson, N. J.

THE TEXIGAN OIL PRODUCTS Co., Saginaw, Mich., has filed notice of increase in capital from $100,000 to 150,000.

THE MINER-EDGAR Co., Blanchard St., Newark, N. J., manufacturer of chemicals and producer of paper clays, has arranged for a bond issue of $1,500,000, a portion of the proceeds to be used for expansion and additions to working capital. Henry M. Miner is president.

HOLTON & Co., Detroit, Mich., a Delaware corporation, have filed notice of change of name to the Century Oil Co., at the same time increasing their capital from $100,000 to $250,000.

THE MUTUAL SERVICE OIL Co., Cleveland, Ohio, has filed notice of increase in capital from $100,000 to $250,000, for proposed expansion.

THE WARREN FOUNDRY & MACHINE Co., Phillipsburg, N. J., has filed notice of change of name to the Warren Foundry & Pipe Co., to devote operations to the manufacture of cast iron pipe, and other foundry products.

THE SAGUENAY PULP & POWER Co., Montreal, Que., is arranging for a bond issue of $6,400,000, a portion of the proceeds to be used for general expansion.

THE PUBLIC SERVICE GAS Co., Newark, N. J., operating artificial gas plants, has been granted permission by the Public Service Commission to issue additional capital stock in an amount of $2,500,000, a portion of the proceeds to be used for extensions and betterments.

William C. Matlack has been appointed temporary receiver for the RARITAN ANILINE WORKS, Raritan, N. J., manufacturer of aniline oils and kindred specialties.

THE AMERICAN LIME & STONE Co., Bellefonte, Pa., operating a local lime manufacturing plant, is disposing of a bond issue of $1,100,000, a portion of the proceeds to be used for plant extensions and betterments. Work is under way on one of the largest single lime-burning plants in this country at Bellefonte. The company is operated by the Charles Warner Co., Wilmington, Del. Charles Warner is president of both organizations.

Charles N. Codding, Elizabeth, N. J., and William H. Dieker, Jersey City, N. J., have been appointed receivers for BYRON HEFFERMAN & Co., manufacturers of camphor substitutes, with plant in the first noted city.

THE AVRI DRUG & CHEMICAL Co., 421 Johnston Ave., Jersey City, N. J., has filed an involuntary petition in bankruptcy.

New Companies

THE BLUE & WHITE SOAP Co., Boston, Mass., has been incorporated with a capital of $50,000, to manufacture soaps. David Harvey is president, and Abraham Superior, 89 Humboldt Ave., Boston, treasurer.

WILLIAM G. MULLER, INC., New York, N. Y., has been incorporated with a capital of $200,000, to manufacture chinaware products. The incorporators are William G. Muller, F. Heinrich and W. G. Bushell, 67 Wall St., New York. The last noted represents the company.

THE OIL PRODUCTS Co. OF BALTIMORE, INC., 302-4 North Holliday St., Baltimore, Md., has been incorporated with a capital of $35,000, to manufacture oils, paints, etc. The incorporators are John G. Platt, Alton L. Kibler and James B. Thompson.

THE KENTUCKY CARBON & CHEMICAL Co., Louisville, Ky., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are Harry Reid, Indianapolis, Ind., Robert G. Gordon and Owsley Brown, Louisville.

THE ASBESTOS FIBRE Co., New York, care of S. V. Elting, 46 Cedar St., represent-

ative, has been incorporated with a capital of $275,000, to manufacture asbestos products. The incorporators are A. Harnick, L. A. Fleischer and G. Levy.

THE ATLANTIC GLASS MFG. CO., care of the Corporation Trust Co. of Delaware, Wilmington, Del., representative, has been incorporated with a capital of $500,000, under state laws, to manufacture glass products.

THE CEROX MINERAL PAINT CO., 2528 West 48th St., Chicago, Ill., has been incorporated with a capital of $75,000, to manufacture paints and kindred products. The incorporators are Louis G. Hughes, J. B. Harris and John R. Nelson.

THE LIGHTNING PRODUCTS CO., 79 Williams St., Orange, N. J., has been incorporated with a capital of $125,000, to manufacture polishes and kindred products. The incorporators are Albert Kellerman, Louis I. and Bernhard Shapiro.

THE DEERFIELD VALLEY PAPER CO., Portland, Me., has been incorporated with a capital of $650,000, to manufacture paper products. E. U. Mann is president; M. D. Mills, treasurer; and Charles D. Booth, Portland, representative.

THE THOMAS OIL CORP., Houston, Tex., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under state laws, with a capital of $100,000, to manufacture petroleum products. The incorporators are S. M. Griffin, O. S. Thomas and B. A. Perryman, all of Houston.

THE NORTH RIVER CHEMICAL CO., New York, N. Y., care of A. J. Levine, 299 Broadway, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are G. W. Frederick, E. Moser and S. A. Junghans.

THE OWENSBORO WALL PLASTER CO., Owensboro, Ky., has been incorporated with a capital of $5,000, to manufacture plaster and kindred products. The incorporators are J. T. Harrison and P. A. Yager, both of Owensboro; W. L. and E. H. Delker, both of Henderson, Ky.

THE EATON, CRANE & PIKE CO., Pittsfield, Mass., operating a local mill for the manufacture of paper products, has filed articles of incorporation under state laws, with capital of $3,500,000, to provide for proposed expansion. Arthur W. Eaton is president; and William H. Eaton, treasurer, both of Pittsfield.

THE EDWARD NEWBY OIL CO., Houston, Tex., care of H. G. Eastburn, Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $1,000,000, to manufacture petroleum products. The incorporators are E. E. Newby, Houston; J. C. Hought and I. H. Schwartz, both of Indianapolis, Ind.

THE SOUTHERN FERTILIZER WORKS, Orlando, Fla., has been incorporated with a capital of $100,000, to manufacture commercial fertilizer products. T. L. Payne is president; J. P. Williams, vice-president; and R. H. F. Dade, secretary, all of Orlando.

THE PENDLETON OIL MILL, INC., Pendleton, S. C., has been incorporated with a capital of $50,000, to manufacture oil products. E. N. Sitton is president; Cema Chreitzberg, vice-president; and B. M. Aull, secretary, all of Pendleton.

THE CHASY LIMESTONE CORP., New York, N. Y., has been incorporated with a capital of $300,000, to manufacture lime and operate limestone properties. The incorporators are H. C. Jeffries, W. H. Higginbotham and W. H. Williams, 32 Nassau St., New York, the last noted represents the company.

THE WOOD COUNTY COTTON OIL CO., Mineola, Tex., has been incorporated with a capital of $56,000, to manufacture cotton oil products. The incorporators are W. W. Perry, R. Bergfield and H. W. Meredith, all of Mineola.

THE COMMERCIAL WALL PAPER MILL, INC., 1416 South Talman Ave., Chicago, Ill., has been incorporated with a capital of $250,000, to manufacture wall papers and other paper products. The incorporators are James E. Hauronic, R. S. Tuthill and Frank P. Page.

THE INTERNATIONAL SUGAR CO., Washington, D. C., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., has been incorporated under Delaware laws, with a capital of $21,000,000, to operate sugar refineries. The incorporators are Howard Allen, Charles E. Wynne and Frank J. Kelley.

THE ALLEY GLASS CO., Shinnston, W. Va., has been incorporated with a capital of $10,000, to manufacture glass products. The incorporators are L. E. Alley, and Paul E. Tetrick.

THE MILTON A. EDGAR CO., Metuchen, N. J., has been incorporated with a capital of $50,000, to operate clay properties. The incorporators are N. G. Edgar, M. A. Rick and Milton A. Edgar, 115 Lake Ave., Metuchen.

THE JOY CHEMICAL CORP., Brooklyn, N. Y., represented by H. A. Eberhardt, 92 William St., New York, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are Earl G. Hart, Jr., H. J. Cluskley and C. B. Brucker.

THE CLINCHFIELD SAND & FELDSPAR CORP., Bristol, Va., has been incorporated with a capital of $600,000, to operate feldspar properties for the production of commercial feldspar. Henry N. Hanna, 296 Water St., Baltimore, Md., is president, and George M. Warren, Bristol, Va., secretary.

THE DYESTUFF & CHEMICAL CO., Wilmington, Del., has been chartered under state laws, with a capital of $25,000, to manufacture chemicals, chemical byproducts, dyestuffs, etc. The incorporators are Walter A. Ryan, H. G. Stevens and George C. Hering, Jr., all of Wilmington. The last noted represents the company.

THE C. E. BECKMAN CO., New Bedford, Mass., has been incorporated with a capital of $100,000, to manufacture oils, paints, etc. Charles E. Beckman, 243 Arnold St., New Bedford, Mass., is president and treasurer.

THE STEVENS PAPER CO., New York, N. Y., has been incorporated with a capital of $50,000, to manufacture paper products. The incorporators are R. L. Stevens, Jr., R. A. Smith, J. S. Beach and G. R. Williams, 165 Broadway, New York. The last noted represents the company

THE CARL FISCHER TIRE & RUBBER CO., 1414 South Michigan Ave., Chicago, Ill., has been chartered under state laws, to manufacture tires and other rubber goods. The incorporators are Carl R. Fischer, Francis A. Winship and John C. Dewolf.

THE COLONIAL CONCRETE PRODUCTS CO., 111 Collins Ave., Baltimore, Md., has been incorporated with a capital of $60,000, to manufacture concrete blocks, and other cement products. The incorporators are George L. Jones and J. R. Carroll.

THE UNITED CHEMICAL & INDUSTRIAL CORP., Baltimore, Md., care of J. Bannister Hall, Jr., Calvert Bldg., has been incorporated with a capital of 30,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts.

THE TRIPLE REFLECTOR CORP., Philadelphia, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., has been incorporated under Delaware laws, with a capital of $100,000, to manufacture glass products.

LORIO SUGARS, INC., Lakeland, Fla., has been incorporated with a capital of $25,000, to operate a local sugar refinery. A. A. Lorio is president; L. F. Lorio, vice-president; and W. A. Lorio, secretary and treasurer, all of Lakeland.

THE RIVERTON MILLS, CORP., Riverton, Va., has been incorporated with a capital of $40,000, to manufacture commercial fertilizer products. B. J. Hillidge is president; and W. J. Dearing is secretary, both of Front Royal, Va.

THE HEINZERLING OIL CORP., Vernon, Tex., has been incorporated with a capital of $30,000, to manufacture petroleum products. The incorporators are J. B. Brady, and W. H. Heinzerling, both of Vernon.

THE STATES RUBBER & SUPPLY CO., 227 West Randolph St., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture rubber specialties. The incorporators are Arthur Cordell and Michael C. Yunker.

THE PETERSON PATENT LEATHER CO., Woburn, Mass., has been incorporated with a capital of $6,000, to manufacture leather products. Brunswick G. Fowler is president; and Alfred W. Peterson, 61 Bow St., Woburn, treasurer.

THE BAKER REFINING & MFG. CO., Jacksonville, Fla., has been incorporated with a capital of $10,000, to manufacture oils. H. Baker, Jr., is president; J. T. Meyers, vice-president; and H. T. Miller, secretary, all of Jacksonville.

THE NON-PUNCTURE TIRE CO., Binghamton, N. Y., care of Mangan & Mangan, Binghamton, has been incorporated with a capital of $50,000, to manufacture tires and other rubber products. The incorporators are G. A. Reynolds, Sr. and Jr.; and F. H. Wilbur.

THE O'BANNON AIRLESS TIRE CORP., New York, N. Y., care of Woodburn Martin, Georgetown, Del., representative, has been incorporated under Delaware laws with a capital of $250,000, to manufacture tires and other rubber products. The incorporators are J. V. Pacher, A. J. Pratting and E. H. Klinglefus, all of New York.

Industrial Notes

THE TITAN IRON & STEEL CO., INC., Newark, N. J., manufacturing mechanically puddled wrought iron, has announced the appointment of W. Woodward Williams as vice-president. Mr. Williams' long experience in the iron and steel industry began immediately upon his graduation from Harvard University in 1905. After 6 years in the mills of the Carnegie Steel Co. at Pittsburgh, Duquesne and Youngstown, Mr. Williams entered the sales department of the Bourne-Fuller Co. of Cleveland and was later appointed manager of its Pittsburgh office. In January, 1914, he became general manager of sales of the A. M. Byers Co., Pittsburgh, and subsequently was made its general manager. In August, 1919, he became general manager of the Reading Iron Co., and afterward was elected vice-president, in charge of sales and operations. In September, 1920, he became associated with the Pittsburgh Gage & Supply Co., jobber of wrought iron merchant pipe in the United States, resigning the vice-presidency on May 31, 1922, to take the vice-presidency of the Titan Iron & Steel Co., Inc.

THE ZELLER MFG. CO. has announced, through Mr. Hugo Zeller, that, contrary to recent trade rumors, there is no connection between the organization and any other company manufacturing lacquer. The Zellers at one time were actively and financially interested in the Egyptian Lacquer Mfg. Co., but since the Zeller Lacquer Mfg. Co. was formed, the Zellers sold out their interest in the Egyptian company so that there is now no connection whatsoever between the two concerns.

THE CHICKASAW REFINING CO., Ardmore, Okla., at a recent meeting of stockholders elected S. A. Apple as president. Other officers elected were: Erret Dunlap and Perry D. Maxwell, vice-presidents; F. A. Schneider, secretary-treasurer; and John Holt, assistant secretary-treasurer.

THE IRON PRODUCTS CORP., New York, and its subsidiaries, the Central Foundry Co., the Central Iron & Coal Co., the Central Radiator Co. and the Molby Boiler Co., announce the opening of a district sales office in the Jefferson County Bank Bldg., at Birmingham, Ala., June 1, 1922. T. C. Hyde will be manager of the new office, under the direction of J. L. Brierton, vice-president and general manager of the Central Iron & Coal Co.

Manufacturers' Catalogs

THE CRESCENT PUMP CO., Detroit, Mich., has issued Bulletin 5, on Crescent "Roto-Piston" dry vacuum pumps. This 12-page booklet illustrates and describes the pumps, tells of the movement, details of foundation, guarantee and a list of the applications for vacuum.

THE THWING INSTRUMENT CO., Philadelphia, Pa., has issued Bulletin 11, which illustrates and describes the company's complete line of indicating and recording radiation pyrometers.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold a summer excursion meeting to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo, Aug. 13-19.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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Senate Rejects Dye Embargo

MUCH to the surprise of all interested in the dye and chemical industries of the United States, the Senate last week voted to eliminate from the tariff bill the item extending the embargo on dyes for a period of one year after the bill becomes law. It is quite evident that in taking this action the Senate was influenced by the Government's proceedings against the Chemical Foundation for the return of the German dye and drug patents sold by the Alien Property Custodian. Friends of the dye embargo were fearful that the Government's action would confuse the embargo issue in the minds of some senators and thus unfavorably affect the safety of that measure.

These fears proved to be only too true, for the vote on the embargo was preceded by violent attacks on the Chemical Foundation and the whole chemical industry. Senators Moses and King led the assault. It would be difficult to listen to Senator Moses and refrain from levity if the issue were not so momentous. He was alliterative but not convincing. He has long been the loyal servant in the Senate of the Amoskeag mills in New Hampshire and has consistently opposed the establishing of a dye industry in this country. As for Senator King, he was so thoroughly discredited in the dye investigation that he carries no weight.

But the fight is not over and the day is not yet lost. Senator Frelinghuysen announced that he would demand another vote on the proposal when the bill is considered in the Senate proper and not as committee of the whole. In the meantime it behooves all friends of the dye industry to see that their senators are under no misapprehension of the necessity for an embargo and are not confused by the proceedings of the Government against the Chemical Foundation.

The Public's Interest in Settling the Coal Strike

AS IN THE CASE of practically all labor troubles, there are three parties involved in the coal strike —the miner, the operator and the coal consumer. The President's proposed plan of orderly settlement is eminently fair in that it looks primarily to the interest of the public. To set up an impartial tribunal to pass on the issues of a controversy in which workers and employers have failed to reach an agreement on their own initiative is assuredly in line with the best thought and sober judgment of the day. To capitulate to the demands of such an all-powerful and unreasoning force as the United Mine Workers would be a sacrifice of principles to which we cannot agree. Equally undesirable would be a surrender to any plan of the mine owner which does not offer a solution of the fundamental economic problems that underlie the coal industry.

The ranks of both miner and operator, if we see the situation rightly, are too close to the battle to get the broad perspective that is really needed. In concentrating their attention on the immediate difficulties and detailed problems arising out of the President's plan, they fail to appreciate the inherent possibility which this sort of settlement promises to their industry.

Before considering the public's interest in the coal strike, however, let us briefly review the operators' and miners' reaction to the plan. At first both seemed to be willing to accept the proposal "in principle," but at the same time were looking madly about in hopes of finding some means that would lead to its ultimate rejection. Finally, the miners took the responsibility of opposing public opinion by refusing to arbitrate. This was the cue for the operators to join with the public in piling high the blame on the other fellow and thoroughly punishing him for obstructing progress.

The operators see in the plan a victory for the unions, because the "uneconomic" wage scale, against which they have fought for almost four months, is now to be extended until August 10, and perhaps until March 1, 1923. In the opinion of *Coal Age* this is "to surrender to the campaign of intimidation, terrorism and massacre that has characterized the union's conduct in this strike." The labor officials' first reaction to the proposal was to question the motives of any possible representation of the public on the President's commission—apparently on the assumption that they will not receive fair treatment in the hands of any disinterested party. Such a stand is so obviously greedy as to be universally deprecated. The miners also appear to be opposed to the setting up of any agency such as the Railroad Labor Board, with power to handle wage rates permanently and to enforce their decisions. Such a plan may not be contemplated by the President, but there are those among the public who are inclined to regard it as a lasting solution for the bickering and bargaining that causes the constantly recurring labor difficulties in the coal industry. Furthermore, the miners insist that the recommendations of the commission apply to operators in all sections of the country, thus reopening the issue in partially unionized fields, where war-time wage scales have already been broken down.

The thing that the public is most interested in is a dependable supply of fuel produced by an efficient and properly functioning coal industry. The public will have none of the purely partisan demands of the operator and miner. As George Otis Smith has aptly said, "The people's coal costs too much because of the mistaken idea that mine owner and mine worker can continue indefinitely to fight over wages and rules. Cheaper coal and larger earnings will come when engineering is emphasized more and bargaining less. In terms of engineering, the coal industry has a bad load factor; translated into human relations, poorly func-

tioning mines mean poorly employed miners. This over-developed industry must suffer deflation; fewer mines can and should furnish the needed coal." In other words, the public wants to see this industry put on a fundamentally sound economic basis. If the President's impartial investigational commission can make recommendations that will ultimately result in the "establishment and maintenance of industrial peace in the coal industry and the elimination of waste due to intermittency and instability," then will the interest of the public have been adequately and honestly served.

One of the Black Arts

"WERE IT NOT to be considered sarcasm, this industry might even be referred to as a 'black art,' first because of the usual secrecy regarding its processes and second, because of absolute dirtiness of the average electrode plant. Carbon works are generally regarded as fortifications through whose gates only the initiated may enter." This is the indictment one of our authors makes of a large and basically important chemical industry. This generalization, we are happy to record, is not universally true even in the electrode industry for we know some manufacturers whose works are always open to the technical public. And curiously enough, these are the plants in which the greatest progress in technology has been made.

Nevertheless one need but search through the very meager literature on electrode manufacture to realize how slow has been the spread of technical information in this industry. For this reason, if for no other, it is with some little pride that we direct our readers' attention to the important series of articles on the technology of the carbon-electrode industry which will be published by this magazine. The first of the series, appearing on pages 109-12 of this issue, is an account of the remarkable development of electrode manufacture. Rarely have we had the pleasure of publishing such an interesting bit of technical history. Were we searching for another explanation of the "black-art" characterization of the electrode industry, we would need go no further than to call attention to its almost magic development.

It is a long cry from 1800 and the little black rods of carbonized wood with which SIR HUMPHRY DAVY struck the first electric arc, to 1921 and the National Carbon's mammoth furnace electrode, 15 ft. long, 20 in. in diameter and weighing over a ton and a half. But 120 years is a comparatively long time when it is realized that in our own country in less than one-fifth of that time our output of electric-furnace electrodes has increased in value from $10,974 (in 1899) to well over $10,000,000 (in 1921). And were we to include electric-furnace products in that comparison the figures would be almost unbelievable!

To the Frenchman, CARRÉ, belongs the credit in 1876 for the first commercial manufacture of carbons. But he was followed closely by several Americans: DAVID THOMPSON of Newark, N. J., was probably the first American producer and it was CHARLES F. BRUSH of Cleveland who molded the first electrodes from petroleum coke and thus laid the real foundation of the industry. Brush, too, devised the calcination process and was the first to use really high pressure in molding and later in the interesting extrusion or "squirting" process of making electrodes. As the electric-furnace developments of SIEMENS, HEROULT, ACHESON and HALL took root in this country and grew so tremendously, the carbon industry was called on to supply an ever increasing volume of its products. With this demand came the need for gigantic electrodes capable of standing up under terrific service in the huge electric furnaces for making carbide, ferro-alloys and steel. And following this progress came the astounding evolution of the industry during the war. On the basis of such a record it is difficult even to hazard a guess as to the limits the industry may reach in the future.

Since the days of CARRÉ and SIEMENS, electrode manufacture has been practically revolutionized by the introduction of modern labor-saving machinery. Much of the progress of the industry is doubtless attributable to the use of large-scale and scientifically controlled equipment. It is believed, therefore, that more than usual interest will attach to the succeeding articles of this series, most of which are intimately concerned with the design and operation of equipment used in the calcining, molding, extrusion and baking processes. In offering these articles to our readers it is with the hope that they will arouse the sort of criticism and comment that will ultimately benefit the carbon industry. Only through the free interchange of information regarding its fundamental technology can this industry dispell the gloom of mysticism and secrecy which has characterized its past.

Are You Guilty of Meticulous Precision?

WE WERE fortunate enough to study quantitative analysis under a professor who invariably did the following thing: If an analysis were reported as 7.0125 per cent and the accuracy of the analysis allowed only two decimal places, the professor marked the result wrong. Many a young and enthusiastic analyst protested vigorously at this summary treatment, but by that same token many a young and enthusiastic analyst learned a lesson which he never forgot and so, too, did the rest of the class. $2 + 2 = 4$ and not 4.0000. But analysts are not alone in falling into this error. Engineers are notorious offenders.

We recall one instance where a celebrated engineer was preparing a set of tables for publication and was using a set of twelve-place logarithms. We asked why he used twelve-place tables and he replied that they were the best he could find, that he had heard there were twenty-place tables but he had been unable to locate them. The interesting thing about this anecdote is that practically all the data which the celebrated engineer was tabulating had an accuracy which was seldom better than 1 per cent and an ordinary 12-in. slide-rule would have been amply accurate for the work.

Again, when a young engineer is about to make a mathematical calculation, say for example the surface of heating coils necessary to obtain certain results, he will almost invariably sit down and calculate it to an accuracy of a tenth or even a hundredth of 1 per cent and this in spite of the fact that the constant factor in the equation (the rate of heat transfer) may not be known within 50 per cent.

Herein lies one excellent reason why many a practical man with good common sense and a wide experience has been able to compete with engineers in many fields. The engineer frequently has technical training only with no balance wheel of common sense that would te

im that a given result, although mathematically correct, is logically absurd.

We have attended conferences and conventions on ngineering education and have heard some studies haracterized as a waste of time for an engineer taking four-year course. Yet we always wonder if that very ourse in some institution may not be the one to give ne student the balance he needs almost more than anyning else in his technical work. Perhaps the professor ho gives that particular course is the one who would est accomplish that much-to-be-desired result. hrough every phase of the chemical field and through lmost every profession we find the need of a sense of alance and proportion, the ability to stand off and ook with perspective at a given problem and say, Here and here are the important things, the rest are iphers beyond the limit of accuracy of the problem." nd so whenever we come in contact with some lack f balance, on the part of technical men in particular, e bless the professor of quantitative analysis who narked us wrong when we said that 2 + 2 = 4.0000.

Turning Accident Into Disaster

TWO WEEKS AGO the City of New York was shocked by an accident in its subway system resulting from the use of pyrene, a carbon tetrachloride re extinguisher, in an attempt to extinguish an electric rc. About 150 men and women were overcome by he resulting fumes and the city's fire and police departments were summoned to the rescue. Some of the assengers were seriously affected and confined to the ospital although most of them soon recovered from heir involuntary "gassing."

The incident is one of special interest to chemists nd technical men because it furnishes another example f the direct relation of chemistry to the public welfare. he resulting investigation has shown what was already ommon technical knowledge, namely, that carbon tetrahloride sprayed on heated surfaces in a small enclosure ives rise to fumes of phosgene and sometimes chlorine nd hydrochloric acid. The unfortunate feature of the ffair was that a slight accident resulting from a short ircuit in a switch box, which need not have had serious onsequences, was turned into a near tragedy by the gnorant use of a fire extinguisher with which subway ars never should have been equipped.

Accidents of this kind always emphasize the great roblem of widely disseminating the knowledge that is eld by specialists and which is available for the public f it knew where to seek it. The U. S. Bureau of Mines, or example, has long since investigated carbon tetrahloride fire extinguishers and has made known in a echnical paper by Fieldner, Katz and Kinney, all of he facts necessary to forestall the use of such devices n subway trains. But how shall the results of such nvestigations, duly recorded in a government publication, be given the wide publicity they deserve? It may e said to the credit of the Transit Commission that ts investigation led it to call upon the Bureau of Mines or advice, but apparently no one thought of seeking t before the accident demanded it. One cannot help eeling that the manufacturers owed a duty to the ublic which would have led them to refuse to sell a ire extinguisher of this kind for use where it could ave such terrible consequences. An order has since een issued to discontinue the use of pyrene in subway ars, but there are still millions of people in the country who may suffer a distressing and even fatal accident if they are not informed on the proper use of carbon tetrachloride in putting out fires. It should not be used in small enclosures. Chemists generally can be of great service in spreading this information.

Science and The Daily Press

SOMETIME ago the Washington *Star* published under the caption "Faith in Science" an editorial that was most encouraging because it indicated a truer appreciation of science on the part of the daily press. It led us to believe that the day is approaching when we can expect to read in our daily newspapers reliable and trustworthy items on scientific progress instead of the scare-head stuff that still seems to meet newspaper standards and ideals. The editorial in question related how once it was "the fashion to class all researchers and inventors with the perpetual motion cranks." But it went on to show the change that is taking place in the public's appreciation of science, as a result of which research and invention are now accorded the dignity they deserve.

This is fine as an editorial expression but it would be finer still if it found practical application in a censorship of the contents of newspapers. The daily press is, and for many years will continue to be, the great medium of publicity through which the public can get a general impression of science and technology. This entails a duty which is far from being performed and a responsibility which has not yet been met. While we have occasional evidence of editorial sanity as indicated in the Washington *Star*, news columns are still filled with alleged scientific stories that are played up by the energetic reporter with a nose for news. In other words, the standards avowed on the editorial page find no expression in the news columns, which, incidentally, is one of the most radical differences between the daily and the technical press.

As yet the newspaper editor makes no discrimination between the announcement of a discovery or invention by an Einstein or a Marconi, and a nondescript screed on the alleged discovery of "life crystals" by Mrs. Maud Dickinson of Brighton, England, hitherto unknown to fame. Columns are devoted to her alleged discoveries because they are shrouded in mystery and because she has been bold enough, or foolish enough, to announce that perhaps she has discovered "the source of all life." Perhaps! Certainly she has discovered a great source of publicity. She talks of "a self-created scarab or beetle of old Egypt" which in some marvelous manner "formed crystals outside and away from the bottle in which it was kept." It staggers the imagination to think what the scarab might accomplish if turned loose instead of being kept in close confinement. It is reported further that "the discovery was made by accident." We can believe it. Why not investigate the accident and find out what really happened instead of leaving our minds confused with vague references suggestive of alchemy, mythology or clairvoyance.

The daily press has a greater responsibility than it realizes in passing out this kind of scientific bunkum to the people. In many respects daily journalism is on a high plane, but its editors have not yet learned to throw such stuff into the waste basket.

Readers' Views and Comments

Effects of Impurities on Electrolytic Zinc

To the Editor of Chemical & Metallurgical Engineering

SIR:—Dr. Scholl's data presented in his paper "Effects of Impurities on Electrolytic Zinc," in *Chemical & Metallurgical Engineering* for March 29, 1922 (vol. 26, p. 595), reasonably confirm the data already published by a number of investigators of this same question.

His photographs, however, appear to me to indicate that his observations were complicated by "doped" solutions—i.e., solutions containing glue or something analogous to it. The striations shown are, I think, invariably due to hydrogen liberated at the cathode and rising through the solution along the cathode surface. Liberation of hydrogen in quantity bespeaks low current efficiency, so, in one way, it is legitimate to refer the striations to the causative impurities.

The various protuberances, "warts," "trees," "sprouts"—whatever you may care to call them—which, as Dr. Scholl's photographs show, become more strongly marked as deposition goes on, can be more readily produced by adding glue-like materials to solution than by any other method I know of. It is my own impression that they are more nearly a characteristic of the "addition agent" and of the quantity of "addition agent" added than they are of specific inorganic solution impurities.

Impurities Accelerate Efficiency Drop

In my own experience, the current efficiency of a zinc cell invariably falls off as deposition goes on (everything else—acidity, temperature, etc.—being kept constant). In pure electrolytes the initial current efficiency is high and the rate of decrease nominal. In impure solutions the initial current efficiency may be fairly high, but the rate of decrease is also high—i.e., I doubt that with certain impurities one does get normally high current efficiencies over a period of several hours and then a sudden inversion when all other factors affecting deposition are rigidly kept constant.

Glue and other glue-like addition agents are oxidized in the cell—i.e., glue concentration changes continuously within a closed cell circuit. I do not understand the action of the glue in spite of much that has been written concerning its action, but I have seen such apparent inversions of current efficiency as Dr. Scholl reports and still it has seemed to me that I could always find some reason for a sudden inversion that did not inhere in the impurity *per se*.

Of the papers concerning the effects of impurities upon zinc deposition that have been published so far, the one that has seemed to me to most nearly correlate observed data is that by Tainton (American Electrochemical Society *Transactions*, 1922). Tainton attributes the effects of impurities to the relative overvoltages for hydrogen of the impurities and of zinc. Zinc, of course, could not be deposited from aqueous solutions were it not that zinc does so strenuously object to having hydrogen deposited at its surface.

I know of but one or two observations that indicate need for something more in the way of explanation than the overvoltage theory, and it may readily be that these can be shown to be incorrect observations.

Iron has about the same overvoltage as cobalt and nickel. The zinc cell is not nearly so sensitive to the presence of iron in solution as it is to the presence of cobalt or nickel.

Solutions containing manganese are particularly sensitive to antimony and only slightly less sensitive to arsenic. If these solutions are treated with permanganates in such manner as to remove all manganese, the arsenic and antimony are usually also eliminated—particularly if ferric salts are precipitated. Solutions so treated yield zinc at maximum current efficiencies, and these solutions are relatively insensitive to the addition of arsenic and antimony. I have electrolyzed such solutions after addition of 17 parts of antimony per million, and, if I remember correctly, Mr. Lee at Trail told me he had added the better part a gram of arsenic per liter (1,000 parts per million) to similarly treated solutions, and yet these solutions yielded zinc at very high current efficiencies.

Unfortunately, one's conclusions from given experimental results are subject to change as an art develops, and I think much of our present perplexity might be set aside by repeating early experiments and interpreting the results in the light of more recently acquired knowledge.

C. A. HANSEN.

General Electric Co.,
Schenectady, N. Y.

New Vogue in German Dyes for Socks

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have just returned from Wonderland. I never appreciated before just how wonderful a country it is. Before leaving these shores of Bungle Land, I had become thoroughly convinced that since *der Wacht* no longer *fest steht und treu* on the Rhine, the dyes of Wonderland constituted the one peerless example of permanency in this world of "relatively" changeable things. Of course, this is so. But the dye chemists of Wonderland have improved on permanency. Of course, to observe all the rules of testimony, witness should be duly sworn and submit his exhibits. The exhibits, however, in this case are my feet, and since *Chemical & Metallurgical Engineering* does not publish multi-colored plates, witness will simply have to depose that having bought a number of otherwise very excellent socks in Germany, his feet are now dyed a beautiful brilliant green.

It is obvious that this is a great improvement in socks and is doubtless fully protected by a Deutsches Reich Patent. Some people would prefer perhaps to have pink toes but this can doubtless be arranged with the master dye-makers of Wonderland. In my case the result, while perhaps not *kolossal*, is at least *tadelos und wunderschoen*. Probably the inventor of this improvement got his idea from the dyed papers with which in former years we used to transfer wonderful dyed patterns to Easter eggs. Nevertheless, it is a great idea and I felt that I should mention it to show how far behind times our dye chemists of Bungle Land really are.

B. T. B.

New York City.

Article V in This Series and the First Article on Accounting—The Calculation of Chemical Efficiency or Yield in Different Types of Chemical Plants—Errors in Plant Accounting Methods

The Business Side of Chemical Manufacturing

By Charles Wadsworth 3d

THERE OUGHT to be a fable about a man who felt so keenly the importance of the subject about which he was going to talk or write that he choked to death trying to enunciate some superlatives which would, in his estimation, be adequate to the situation. If there were such a fable, I should invoke it at this time. The importance of accounting in chemical manufacturing is so great, so vital and so essential to the success of any one unit, that there are not enough superlatives to make the point sufficiently impressive.

Couple with this the fact that technical men in chemical manufacturing industries are almost completely ignorant of accounting and that even the chemical executives and manufacturers do not possess a wide knowledge of the application of accounting principles to manufacturing problems nor any understanding of the interpretation of accounts. All these things contribute in making any one familiar with the benefits which accrue from the application of accurate accounting to manufacturing industries adopt the attitude of an irate pedagogue towards an unusually stupid and recalcitrant pupil.

In these brief articles, we hope only to emphasize the importance of accounting to chemical industries and to point out a few of the weaknesses of existing systems. Turn your attention to the accounting department and to accounting methods whether you are an executive or an analyst. Look at the forms that are used and discover for yourself how accurate the present system is and to what variations it is subject. This article will discuss plant accounting and the last article in the series deals with costs and cost finding systems. When you realize that less than five per cent of the business houses in this country have cost systems, the truth of the often-quoted statement is brought home to you: "It would be better for most business houses in this country to shut up shop and throw dice for a living—their chances of success would be greatly improved."

Chemical Plant Accounting

Are Accurate Production Efficiency Figures Important?

An accurate production efficiency or, as it is more generally called, yield figure, is the pulse of a chemical plant. It would seem to be pretty obvious that an inaccurate yield figure is worse than useless, because it is misleading. It is strange that it should be necessary to point out this rather fundamental truth and yet company after company gives allegiance to a system which cannot produce accurate yield figures. We will take up, a little later on, some of the errors which invalidate yield calculations and estimates.

A true manufacturing yield should and can accomplish three things. It will reveal the chemical efficiency of the process in question. Further, in revealing this efficiency, it will open the way toward improving it. Finally, it will give a reliable line on the work of the manufacturing man. Too often it is impossible now to answer the question, "How well is Jones doing with such and such a unit?" These benefits all have to do with the manufacturing unit itself and do not take up the consideration of the rest of the organization. In addition, true manufacturing yields form a basis of accurate costs and accurate costs are the criteria upon which executive decision must be based. It will be seen then that the cornerstone of intelligent executive action lies in an accurate and workable system of plant accounting.

What Do You Mean—Plant Account?

So far as can be summarized briefly, plant accounts should give consumption of raw materials, production of finished products and the efficiency obtained in the process. Obviously, different kinds of chemical processes require different accounting systems. In the first place, there are to be differentiated small batch processes as distinguished from large scale or continuous processes. It must be apparent that the accounting system for a batch process will in general be simpler than that of a continuous process. With a continuous process there will be no definite point at which you can say, this much product came from that much raw material. There will always be material going in to be consumed and there will be a somewhat indeterminate quantity of material in process. Allowances must duly be made for this condition.

This is only one of a large number of groups into which chemical plants may be divided. Each separate group will need a different accounting system and the number of different systems becomes legion. We shall try to develop some typical examples of methods of recording data and calculating yields, indicating the changes which are necessary when complications arise in the type of process.

There are a good many ways of expressing plant yield or efficiency. The most scientific method of course is to calculate the theoretical yield which should be obtained from a given amount of raw material and divide this into the amount actually obtained. The quotient, with proper decimal point, is the per cent of theoretical or ideal efficiency. This figure is an absolute as well as a comparative figure.

In many firms you will find a peculiar survival in use. Two hundred and fifty per cent yield! How would that appeal to you? Unfortunately, all that it means is that pound for pound you get a quantity of product equal to $2\frac{1}{2}$ times the original weight of one of the raw materials. It is an entirely empirical figure and the actual weight produced per day would be just as good, assuming you consumed a consistent amount of raw material. It does serve as a comparative figure however from one month to the next.

Expressed in lowest terms then we must know how much material goes into a process and how much prod-

uct comes out. These, with the elementary chemical equation, are all that it is necessary to know to calculate yield.

A Few Complications in Yield Calculations

When two or more raw materials are used in manufacturing the same product, there arises some complication as to which shall be used as a basis on which to calculate the yield. For example, sulphuric acid and salt are both used in making hydrochloric acid. The yield based upon the salt used will not be the same as that referred to sulphuric acid. In such a quandary, it is a frequent practice to refer the yield to the most expensive raw material. This in turn is usually the material which is not used in excess, but from which you should get a definite and molecular quantity of product. In some cases the most expensive raw material is used in excess and in such cases it is more usual to calculate on the basis of the material which is used in the proper proportion to produce molecular quantities of the product.

Still another complication arises when two or more products are produced from the same raw material. Our illustration used above still applies, for both sodium sulphate and hydrochloric acid are produced at the same time from sulphuric acid and salt. Now the yields of sodium sulphate based on sulphuric acid or on common salt will differ from each other and also from those yields based on the production of hydrochloric acid. In order to calculate the efficiency of the process, it is usually customary to take the more desirable product and refer it to the raw material used in molecular quantities and not in excess.

Again, in some chemical reactions, one product is made at the expense of another product as in the case of the di-substituted aromatic organic compounds when both ortho and para are formed in varying amounts, depending on conditions. Here, assuming we want paranitrophenol instead of orthonitrophenol, the yield would be expressed in terms of the para product referred to the nitrophenol equivalent of the phenol used.

The case of expressed oils or extraction processes is not infrequently met in chemical processes. It is difficult to obtain a representative sample of the raw material and this is particularly true when the material is of vegetable origin and a certain amount of soluble material is to be extracted or pressed from the crude. If we take a sample of copra, for example, it is a difficult matter to obtain a laboratory figure which will represent accurately its coconut oil content. This is due to a number of things, the greatest of which is the mechanical difficulty of sampling tons of material accurately and putting it into an extraction thimble in the laboratory. Thus we would be able to weigh the copra and to obtain accurate samples and weights of the expressed coconut oil, but we would not know accurately what per cent of the oil was extracted in the process.

Finally, there are processes such as the fractional distillation of petroleum or coal tar, in which an ordinarily expressed yield is not significant since the products are so numerous. Plants such as those for making portland cement in which the finished slag is never weighed nor estimated accurately present another difficulty. In these cases a yield is not significant at all, except over a period of, say six months or better still, a year. Then a rough estimate of the slag pile can be made and the quantity in the slag pile will perhaps represent only a small per cent of the total production, whereas over a shorter period of time the variations in estimating this slag pile would be so great as to vitiate any yield results at all.

Simplest Type of Plant Account

The Small Batch Process

For purposes of illustration we shall take an entirely fictitious process—the formation of glaubers salt from caustic soda and sulphuric acid. Let us assume first that we are to produce 500 lb. a day. This is analagous to hundreds of processes in use now for the production of fine chemicals. In making 500 lb. of glaubers salt, we would use 127 lb. of caustic soda (76 per cent Na_2O) and 163 lb. of oil of vitriol (93 per cent H_2SO_4). In using such small quantities of material, it is customary and safe to trust the daily weights which go into the process. The materials used on this scale are usually expensive and the operating system is so arranged that variations in weight of the raw materials are slight and easily checked. In this type of process it is not infrequently the custom for the purchasing agent to be responsible for stocks of material. They are used in such small quantities that the daily increment is only a small part of any given shipment. The date for replenishing stock can, therefore, be plotted with periodic regularity. The accounting data required from this type of plant are few. They may be recorded with a great many operating data, but we are not at present concerned with these. Below is printed a sample form which might be used in this glaubers salt process.

1. Weight caustic soda (76% Na_2O) used.....
2. Weight oil vitriol (93% H_2SO_4) used.....
3. Theoretical quantity glaubers salt obtained from caustic soda used.....
4. Actual quantity obtained.....
5. Plant Efficiency or Yield $\left(\frac{\text{No. 4}}{\text{No. 3}}\right)$ .....

An analysis of raw materials is necessary in a small plant such as the one we are describing if only to check up the purchasing specifications. No rigid system or form should be necessary for reporting the analysis. There is great danger in small plants of running system into the ground and of having rigidly prescibed procedure for situations that do not happen more often than once a quarter or once a year. If the plant becomes larger and the units increase in number it is necessary to have a rigid system for reporting analysis of raw materials and even for getting samples of these raw materials. It also becomes necessary then for the operating men to take care of the stocks on hand and requisition the purchasing department in time to replenish them. All these things are operating details but have considerable bearing on accounting, due to the fact that plant yield and cost must be calculated on a basis of these operating reports.

From this simplest form of plant account there develops all degrees of complication in methods. We shall discuss in detail next a complicated system used in large batch processes or continuous processes. It will be impossible to take up all the necessary forms and we have therefore printed a fac-simile of the general summary of plant-yield indicating such supple-

mentary forms as are customary. The gaps between these two types can be interpolated with the help of the general principle—"Don't put in a single form that isn't essential. If you can do without it, *do!*"

Effect of Increasing the Size of the Plant Upon Accounting Methods

Instead of making 500 lb. of glaubers salt per day, imagine the plant turning out 50,000 lb. per day, or 25 tons. Obviously the consumption of 12,700 lb. of caustic soda and of 16,300 lb. of sulphuric acid is a very different mechanical problem from 127 lb. and 163 lb. In the first place, although the raw material is invariably weighed or measured in some way as it goes into the process, there will inevitably be inaccuracies in such figures in plants of this magnitude because of the low intelligence of the labor ordinarily employed in operating work. Yield figures cannot be calculated from the process weight and hence we cannot obtain a yield figure from a daily batch unless we check that figure by estimating the stock of materials on hand and calculating from these the consumption during the day. This would be entirely out of the question because of the expense involved and therefore, it is usual to take a given period, say a week or fortnight or even a month, and to calculate the stock of materials on hand at the beginning and at the end of the period. Then the consumption of raw material is equal to the stock on hand at the beginning of the period, plus the receipts of raw material in the plant, minus the stock on hand at the end of the period.

It is obvious, of course, that with a plant of this size a very much larger stock of material must be kept on hand than in the first case. A month's supply would be 381,000 lb. of caustic soda and 489,000 lb. of oil of vitriol. It is a comparatively simple matter to estimate the stock of material on hand with great accuracy when the goods are in packages or containers of fairly standard weight, or when the material is a liquid and stored in tanks. When, however, you are dealing with bulk material in piles or bins the estimate is not nearly so accurate. Errors in estimating stock of bulk material are of two kinds. In the first place, it may be due to an inaccuracy in estimating the cubical content of the pile and in the second place, it may be due to employing a wrong specific weight factor. If two separate measurements on a pile of coal or brimstone check within 1 per cent, the measurers may call it a day. It is just about as close as can be averaged on successive checks. Closer checks are often the brag of various plants and organizations, but they are hardly ever consistently closer. It is a very easy matter indeed to miss a measurement by a few inches and obtain a startlingly different result. Thirty-five per cent variation is not an uncommon experience although when rechecked, one of the measurements will be found to be grossly in error.

The second error arises from the use of inaccurate specific weight factors (the weight of a cubic foot) with which to convert cubical content of piles into weight. Variations in this factor are often due to the fact that material packed in piles is not nearly so densely crowded at the top as at the bottom. Frequently too, raw material from different sources has a different specific weight and due to a somewhat inflexible system, this is overlooked in many factories. Other factors, such as moisture content, frequently affect the packing of the material. The product of our fictitious plant, glaubers salt, is an example of this. It is usually stored in bins as wet crystals without any drying. Actual contents of a given bin vary greatly and only a rough approximation of the stock of materials can be made.

Correction for Stocks in Operation

Whenever the amount of material tied up in manufacturing becomes an appreciable per cent of the production during the given period it must be corrected for. In other words, the stock of material at the beginning of the period may not be the same as the stock of material in operation at the end of the period. Obviously this would have an effect on the consumption of raw material and consequently on the plant yield. This is a nuisance to the plant men and therefore, unless the system is sufficiently rigid and carefully supervised, the results are likely to be quite inaccurate.

The yield records in this type of plant are considerably more involved. The insert gives a log sheet of our fictitious plant for producing 25 tons of glaubers salt per day.

In addition to the form shown, which acts as a summary, it is necessary to have a detailed report on the stock of raw materials and finished product and the quantity of materials in operation. This requires an itemized summary of the material in every piece of equipment together with some chemical analysis or density measurement to translate volume into weight. In some plants this can be combined with the above report.

PRODUCTION OF GLAUBERS SALT

Period ending.....

CONSUMPTION OF RAW MATERIALS

Caustic Soda		Oil of Vitriol	
Stock last report		Stock last report	
Shipments received		Shipments received	
Total (A)		Total (E)	
Stock on hand		Stock on hand	
No. of drums		Tank 1 ..... in.=	lb.
Average weight		Tank 2 ..... in.=	lb.
Total weight (B)		Total (F)	lb.
Consumption (A-B)		Consumption (E—F)	

PRODUCTION

Stock on hand	
Materials in operation	
Sales shipments	
Total (M)	
Stock on hand (beginning of period)	
Materials in operation (beginning of period)	
Total (N)	
P. Production (M-N)	

YIELD

R. Theoretical production from caustic soda consumed	
Yield (Efficiency) P/R	

In taking an inventory in this type of plant the volume, density and chemical analysis of each container must be obtained. Sometimes the analysis can be reduced to a specific gravity determination with proper allowance for temperature. I should have written the last four words in capitals, for there are a great many plants that disregard this completely, curious though it may seem and their actual results are thrown out by as much as 5 to 10 per cent on this account in some instances.

Still another rather foolishly obvious precaution is that the chemical condition of the material in operation should be considered, yet many a time an estimate of material in operation is made as though it were all raw material and not part changed to the product. All these things have their effect on the ultimate yield.

With such variations in the estimates of the stocks

of materials on hand and in operation, both of which affect the consumption and production figures, it must be obvious that a period of no stock on hand would be extremely desirable. The equivalent of this can be obtained by splitting shipments into various bins so that one bin will be entirely cleaned out and another bin containing a definite quantity of material would be all the stock on hand at that time. This procedure is perfectly possible in all plants and should be undertaken at least every fortnight. In this way, constant checks on the stock of raw materials can be made. Scores of companies however, have only one bin or pile to which they add and from which they take at the same time. This continues for years oftentimes and the overages and shortages amount to absurdly high quantities.

The Personal Element in Plant Yield

The Executive Demand for Consistent Yield As a Cause of Inaccurate Yield

When an executive looks over a set of yield figures, he usually compares them with those of the previous month and inquires about those that show marked changes. "What are the reasons?" he asks. This request is transmitted through the usual channels until it finally reaches the operating man in charge of the unit. Usually he is unable to explain the inconsistency and is considerably embarrassed by the searchlight of investigation. Therefore, next time he takes some pains to avoid a repetition of the inquiry. In other words, he usually adjusts his yield so that it will be consistent with the last month's yield. This can be done very easily by subtracting from or adding to the stocks in operation. Then next month or next fortnight, whenever the next calculation is made, he balances up his stock so that over a period of months there will be no great shortage or average so far as his measurements are concerned and his yields will be reasonably consistent. Therefore, executive attention ceases to be focused on that unit.

Too Much Emphasis on High Yields Unwise

Still another phase of the same problem is the desire on the part of operating men to obtain high yields. Praise is usually lavished on high production and yield. There is a great tendency toward dishonest boosting of yields, due to this fact. A great many executives flatter themselves that dishonesty does not exist in their plant and a large majority of them are being awfully well fooled on that point. They will point with pride to the one or two men who are discharged for dishonest practices—they are the men who are caught. Many ingenious methods have been devised to beat the game. Sometimes they will cheat another unit from which a raw material is obtained without its knowing it. Sometimes it is possible to consume more material than is recorded and to run ultimately into a shortage which, in the average plant audit, cannot be pinned on to them, due to a number of possible flaws in the system, such as inaccurate weight delivered to the plant, unreliable inventory measurements, etc. The operating men cannot be blamed too much for this situation. It is a product of their environment and of the system. If executives would remove the tendency toward dishonesty, there would be no dishonesty. This can be done by setting a premium on accuracy of yield rather than on efficiency and high yields.

Executive Sense of Balance Necessary

The effect of dishonesty on plant yield figures is as disastrous. It makes them useless. The first job of a plant executive should be to understand the operating methods so thoroughly that he is certain of the accounting system and knows accurately the possible variables. It is somewhat amusing but more pathetic to see a solemn conference as to why such and such a unit dropped 2 points in yield and to realize that the yield cannot be calculated more accurately than plus or minus 5 points. The trouble is not with an individual executive so much as with the system. The plant executive is asked those questions by his superior who is more and more out of touch with plant methods and he must give the answer which the plant operator gives to him. He can object to the question and point out the fact that it is foolish to worry about so small a variation when you don't know the figure as accurately as that, but generally he does not know this and would not dare say so if he did know it. So in turn, he demands of his subordinate the same unintelligent analysis and therefore, we have a continuation of these absurd conferences, all of them trying to "pass the buck" on a question that had no right to be asked in the first place.

The problem of accurate yield is then twofold. First, a system must be installed upon which reliance can be placed, and second, a personnel must be developed which is in sympathy with the system and which understands it thoroughly. There is not space here to discuss the problem adequately. We have developed some of the underlying principles and pointed out some obvious weaknesses in existing systems. It is vital to emphasize the necessity of intelligent work on this problem. It lies at the root of accurate costs and the whole morale of the organization may be undermined because the system under which it works is lax and permits and even encourages dishonesty.

Use of Rubber in Road Making

Experiments are being carried out by the Colombo municipality in the use of rubber as a road-surface dressing, according to *Commerce Reports* for July 3. The dressing, which is the invention of a Ceylon rubber planter, is now being used on a portion of Darley Road, which is one of the most used thoroughfares in Colombo, Ceylon. This solution was first tried on a road of the Deviturai rubber estate, where it has been in use for the past 13 months. A short stretch was later laid in the municipality of Galle. The present test, however, is the hardest to which the new solution has been put.

The solution is made from pure bark and scrap rubber. The method of laying is similar to that employed with tar and asphalt preparations, it being heated until liquid and then spread on the road with brooms. Fine gravel is then sprinkled over the solution and a steam roller binds the two.

The experiments so far show that this solution is easier to handle than tar. It is a secret formula and the inventor is still working toward its perfection. He hopes to evolve a solution which may not only be used as a binder, but also may be spread to a depth of 1 or 1½ inches so as to be a road surface in itself.

The cost of the liquid-rubber road dressing is 50 to 75 per cent more than that of tar, but it is expected to last two or three times as long.

The Native Sugar Industry of Szechuen Province, Western China

By H. K. Richardson

THE sugar district of Szechuen province, China, is a rather sharply defined area of about three thousand square miles. The most important section of the district parallels the main road from Chengtu to Chungking for a distance of 100 miles between the cities of Chien Chou and Nei Chiang. Fig. 1 shows a sketch map of the territory. The Lu Ho River runs the whole length of this section and serves as a cheap distribution system whereby the sugar products reach about half the population of the province, or 30,000,000 people.

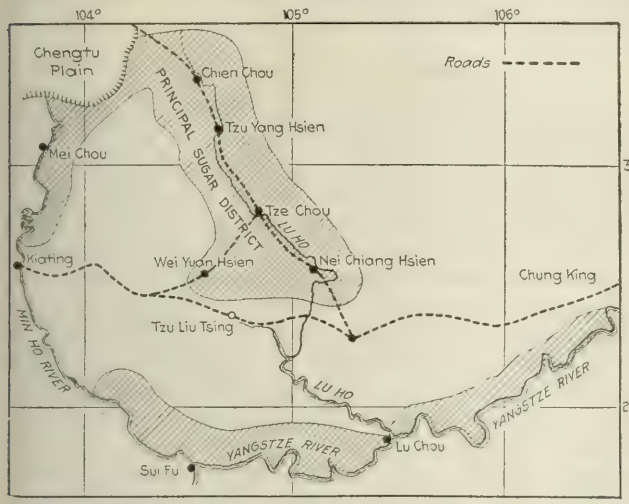

FIG. 1—SUGAR DISTRICT. SZECHUEN PROVINCE, CHINA
Shaded portions represent principal producing sections.

On one trip through this section the writer has seen ten crushing and evaporating houses within a radius of a mile. About half of all the land was given over to the growth of sugar cane. This preponderance of sugar interest holds all over the section.

In *Commerce Reports* for 1915, Consul-General Baker estimated that this section produced about 240,000,000 lb. of sugar per year. From personal observation and Chinese sources the writer feels that about 150,000,000 lb. would be a better figure. Even this is about half the Louisiana crop of 1920-21.

There are two other nearby sections where the growing of cane is a sizable industry. One of these is the river banks of the Yangstze from Sui Fu to Chungking. Hosie in his "Report on Ssuch'uen" speaks of this as a large sugar country. Although the author has seen this cane growing, he has never been in a position to judge of its extent inland. The other section is the banks of the Fu Ho between Kiating and Mei Chou, where the writer has seen wonderful stands of cane ripening in October. Small patches of cane are grown all over the province in favored spots, but these contribute very little to the sugar industry, being used locally for chewing.

Growing of the Cane

There are three kinds of sugar cane grown in Szechuen: *Hong Gan* or red cane, *Lo Han* or large white cane and *Lu Ma Gan*, a small white cane.

The red cane, or *Saccharum officinarum var. rubricaule*, grows to a height of 8 ft., with a heavy stalk 1¼ to 1½ in. in diameter. The joints are 8 to 12 in. long. The stalk alone is 5 ft. long and weighs about 4 lb. This cane is used exclusively for chewing purposes. A single stalk sells for 80 to 90 cash (3 cents) and is cut up by the retailer and sold in small pieces at a few cash each. This takes the place of chewing gum for the Chinese.

FIG. 2—RED SUGAR CANE MARKET

The red variety is grown in quantity outside the regular district. Tze Chang, Pa Chow, Kai Hsien and Ho Chow are famous markets for this variety. The cane is a quick grower. It is planted in February and is ready for use in August, although left standing until frost in December. A supply is stored in pits under cover of the leaves and is used till the new crop arrives. It is said that the red color or the sweetness does not develop until the leaves are stripped from the stalk. A red cane market is shown in Fig. 2.

Wilson, in "A Naturalist in West China," calls all the white cane *Sacchrum officinarum var. sinense*, but the Chinese distinguish two canes as indicated above. The two canes vary only in size, the large being about 1½ in. in diameter, while the smaller is slightly under an inch in diameter. The canes grow 10 to 15 ft. high and are 7 ft. when topped, with twelve to fourteen joints. A load of twenty stalks of the large variety will weigh 80 lb. They sell at the market for 10 cash a catty (1.33 lb.) or about ¼ cent per lb.

These canes are planted in February and harvested in December or January or before frost. The tops alone are used for the planting. They are laid flat in trenches 18 to 24 in. apart. Four to ten sprouts come up from each joint, only three or four of which are permitted to mature. A small stand of this cane is shown in Fig. 3.

FIG. 3—STAND OF SUGAR CANE IN NOVEMBER, NEAR TZECHOW SZE

The land is planted to cane on alternate years only. Wheat, peas and beans are the crops in the intervals. In a few cases the small white cane is used as a perennial, two or three crops being taken from one root.

Raw Sugar Production

Crushing

The crushing of the cane and the evaporating of the juice is always done near the cane fields and away from the cities. The ripened cane is cut by hand and carried to the crushing mills by coolies. The cane is crushed between vertical stone rollers, driven by cows or buffalos. Two limestone rollers are provided with holes around their upper sections, into which oak wedges are driven. These wedges or cogs engage as gears so that the two rolls revolve together but in opposite directions. The rollers have wooden shafts in each end. The lower shafts are provided with iron inserts and rest upon iron ball bearings. The upper shafts project through a large beam supported on stone pillars. The drive roll shaft extends 4 ft. above the beam. To this is tied a bent arm carrying the harness for five draft animals. The driven roll is held against the drive roll by means of a filler block and wedge set in the beam against the upper shaft of the driven roll. The cane is fed through a hollow cast-iron guide shaped to the rolls. About 10,000 catties (13,333 lb.) of cane is crushed per day, two passages through the crusher being the usual practice. Fig. 4 is a photo and Fig. 5 a cross-section of such a mill in the Chien Chou section.

Evaporating

The juice from the rolls runs by gravity to a receiving tank in the evaporator house near the crushing mill. Here a series of iron pans 2 ft. in diameter are set into brick and Chinese cement over a grate and flue. The weak juice is placed into one of the three pans over the grate and dipped up into the pans along the flue as it thickens, thus following direct-current rather than counter-current practice. The last pan in the series is placed to one side of the flue and is called the cold pan. When the juice has reached the right thickness, it is thrown into this cold pan and beaten with an iron paddle until it crystallizes. It is then poured while hot into bamboo basket containers, holding about 40 lb. and permitted to cool. The material resembles maple sugar and is called *Huang t'ang* or yellow sugar by the natives. These baskets are shipped to market in this condition. Where boat carriage is to be used, the sugar is poured into wooden tubs about 3 ft. in diameter. Each batch of sugar makes a layer 2 to 3 in. thick. The different batches are separated by sheets of paper. Fig. 6 shows a set of pans used in a refinery to recover sugar from the sirup made up from dirty sweepings. The arrangement of the pans is shown in Fig. 7.

Nothing but scum is removed in the evaporating process. The imperfectly crystallized raw sugar is an important item of the internal trade of the province. A very large proportion goes into candy. The street vender with his little stove and iron plate is seen all over the province. He breaks up the plinths of *Huang t'ang* and melts them in the hot bowl. The molten sugar is dropped over bamboo sticks on the iron plate forming the Chinese youngster's lolly-pop—it is as popular in China as in this country and consumes a large part of the sugar supply.

Refining the Raw Sugar

A considerable amount of the *Huang t'ang* is submitted to a refining process that gives a whiter sugar called *Beh t'ang* or white sugar. This industry is entirely separate from the process described and is nearly always carried on within the walls or just outside the walls of the large cities. Tze Chou and Nei Chiang are the cities in which most of the refining is carried on.

The raw sugar to be refined is placed in large earthen jars with bamboo sieve bottoms. A layer of clay mud about an inch thick is spread over the sugar and the jar set over a water jar. For about a month the jars are exposed to the air night and day. The moisture absorbed by the clay trickles down through the mass of sugar and leaches out the molasses, leaving a light brown granular sugar. The climate is very humid during the months that the refining is going on, so a considerable amount of water is absorbed. The light brown sugar is stored in bins until the spring months. It is then spread out on bamboo mats to dry and bleach in the sun. This sugar sells at twice the price of the raw material. Unless carefully handled, some of the mud from the top layer gets into the sugar and causes complaint. If too badly contaminated this dirty sugar is dissolved with all the sweepings and evaporated down at the refinery. Fig. 8 is a photo and Fig. 9 a cross-section of the refining jars.

The Chinese in the Tze Chou territory claim that 48 oz. of cane yields 8 oz. of the white sugar, *Beh t'ang*. This 16 per cent extraction yield looks almost too good considering the crude processes used, although the writer did not have means of checking this figure.

The molasses that collects in the lower jar of the set is called *Lou Tzu T'ang*. It is a black liquid and

FIG. 4—STONE CRUSHING ROLLS HOUSED UNDER CONICAL THATCHED ROOF AT CHIENCHOU WORKS

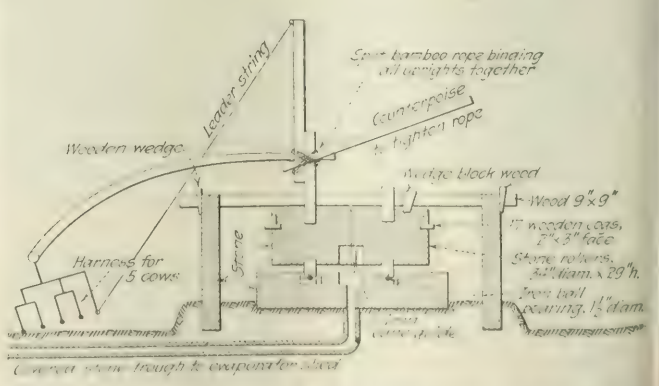

FIG. 5—CROSS-SECTION OF STONE CRUSHING ROLLS AT CHIENCHOU

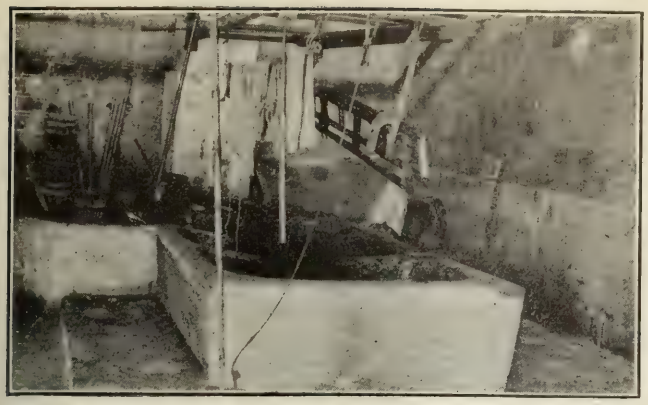

FIG. 6—EVAPORATING PANS IN REFINERY AT TZECHOW SZE, SHOWING TOOLS STORED IN PANS DURING SLACK PERIOD

is carried into nearby villages, where it is used as a sirup for rice cakes, diluted with water and used as a beverage in the fields or boiled up with popped rice—a variety of rice corresponding to our popcorn. This latter material is cut into slabs like our peanut bars and is a very popular confection.

Uses of the White Sugar

White sugar is dissolved up in a minimum of water, placed in jars and the liquid permitted to evaporate naturally. The large crystals formed are called *Bin T'ang* and correspond to our rock candy. Those who wish the best sugar, free from grit, grind this sugar up in a mortar. It is also sold as a sweetmeat.

At the time of the festivals white sugar is melted up at street stalls and cast into molds. In this way hollow idols and animals are made, corresponding to our familiar hollow chocolate Easter bunnies.

In the sugar districts a large amount of the white sugar produced is consumed locally to preserve fruits and make the glacé ginger root so much in demand in this country. The dry preserved ginger root and wet comquots are familiar to all who have eaten in Chinese restaurants in this country, but there is scarcely a fruit or vegetable that is not sugar preserved in the Tze Chow district. Preserved peppers, apples and carrots are among the specialties of this section. A few years ago Tze Chow had eighteen shops that did a yearly business of about $150,000 and consumed about a tenth of the sugar refined in the town.

Barley Sugar and Rice Sugar

The favorite candy of the Chinese adult is a white chewing candy called *Ma T'ang*. This very popular confection is made from a rice sugar which, on account of the method of its manufacture, is sometimes called barley sugar.

The manufacture of this sugar is essentially a home and small-shop industry. It is prepared by steeping 130 catties of dry rice in hot water and mixing the mash with 9 catties of barley sprouts which are produced by the germination of dry barley for 6 to 8 days in warm water. The mash is mixed in a covered tub with a sieve bottom which is placed over a pot of boiling water and steamed for 18 hours. The extracted material trickles down into the pot and is concentrated as the water evaporates. At the end of 18 hours the concentrated sirup weighs 80 to 100 catties. This sirup is boiled down and pulled to form a white candy.

The process is usually carried on "from supper to breakfast" according to the Chinese. This is from 3 p.m. to 9 a.m. During the night only a little attention is needed to keep the fire going. The yield is usually 3 lb. of heavy sirup to 4 lb. of rice. The material is very similar to the Japanese *Me Zu Amee* and is a delightful candy of much milder sweetness than cane sugar candy. On account of the nature of the industry no figures as to its extent can be given.

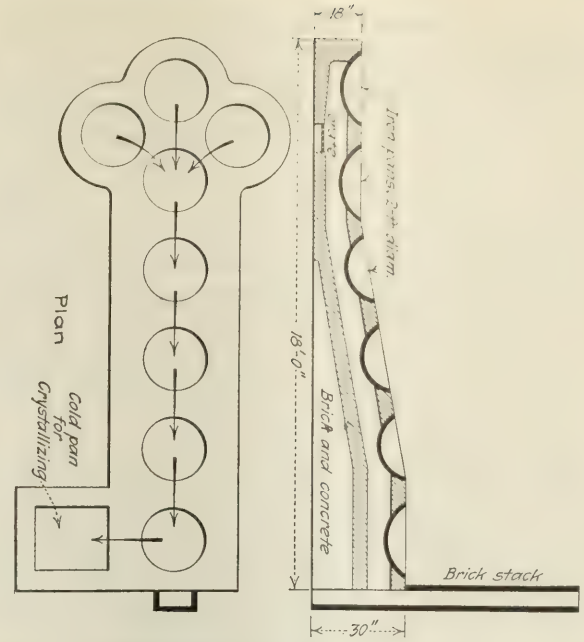

FIG. 7—CROSS-SECTION AND PLAN OF RAW JUICE EVAPORATOR AT CHIEN CHOU

FIG. 8—COMPLETE SUGAR REFINERY
Upper jar contains sugar covered with layer of mud

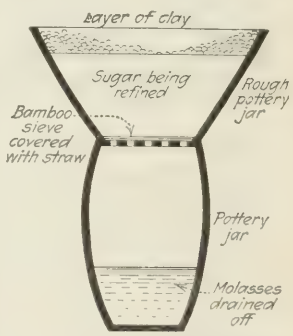

FIG. 9—CROSS-SECTION OF REFINING JARS

Economics of the Industry

The raw cane sugar sells in the district at a little over 3 cents per pound. On the estimated production of 150,000,000 lb. per year, this means a business of $5,000,000.

It is difficult to tell how much sugar is refined. On one of our trips to Tze Chow a Chinese business man said there were twenty-seven refineries in the Hsien (township) that did a business of from 20,000 to 50,000 taels per year. For them all this would mean about $1,000,000 a year business, which at 6 to 7 cents

per pound represents a total of 15,000,000 lb. of sugar refined in this one town. Probably the total refined in the province would be double this amount.

The net extent of the industry can be seen from the table below:

Value of 150,000,000 lb. of raw sugar	(gold)	$5,000,000
Value of 30,000,000 lb. of white sugar		2,000,000
Total		$7,000,000
Value of raw sugar in refined sugar		1,000,000
Net value of the industry		$6,000,000

This may not appear to be a very large industry to an American, but to the Chinese with a 10 cent per day wage, the prevailing rate in west China, it means a considerable industry. Stated in cash, the common coin in circulation among the workmen, the business done per year is 18,000,000,000 cash.

Sugar is the dominant idea in the minds of the 3,000,000 persons that inhabit the district. Nei Chiang and Tze Chow are primarily sugar towns. The carriage of the sugar to distant points requires the employment of a large number of men, for there are no railroads or pack roads in the district, so coolie carriage and boats drawn by trackers must be used.

Modernization of the Industry

Suggestions for the erection of a refining plant of 30 tons of pure white sugar per day for the year received favorable attention from the Chinese. The unsettled conditions brought about by the war have stopped all further plans on the subject. A modern plant of this size on a co-operative basis should be a good investment, for the Chinese like the foreign white sugar and would be willing to pay a premium for it. Loaf sugar sells in the Chinese stores by the piece as a sweetmeat at present.

On the other hand, a modern crushing and grinding plant would probably not be justified at present. The interest on the investment and the high cost of steam power could not compete with the abundant and cheap labor supply. However, technical conditions in the province and especially the district under review are ideal for a very large sugar industry. It will only be a question of time when the Chinese realize that a modern sugar industry in this section would obviate the necessity for their large present importation of sugar from foreign sources.

The Fertilizer Industry and Market in South Africa

In *Commerce Reports* for June 12, 1922, Trade Commissioner Perry J. Stevenson of Johannesburg makes a very interesting résumé of the fertilizer situation in South Africa. The occasion for this is the completion of a very large plant with a capacity of about 100,000 tons of fertilizer per year by the DeBeers Company, the diamond producer. It has been estimated that the present consumption of fertilizer in South Africa is somewhat below the capacity of this plant, but this is due to the fact that South African farmers have not learned the lesson of intensive cultivation and consequently the yield per acre is much lower than in other parts of the world. Furthermore, the soil is becoming more and more impoverished each year.

In South Africa considerable fertilizer is imported from outside. In 1913 63,000 tons was brought in, but this fell during the war to as low as 16,000 in 1918. Some recuperation has been made so that in 1921 nearly 30,000 tons was imported. A large percentage of this was superphosphate, with miscellaneous manure fertilizers, basic slag and bone fertilizer making up the remainder. Great Britain, the Netherlands and Belgium in 1920 were the principal exporters to South Africa.

For the first time since the war German producers have reappeared in South Africa and the German Potash Syndicate has resumed operations through an agency in Cape Town. Superphosphates are being imported and several large shipments have been made. At the present time it is too early to estimate whether local producers can meet German and other competition, but a tariff may be invoked.

Accelerated Weathering of Paints on Wood and Metal Surfaces*

By Harley A. Nelson
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The weathering of exposed surfaces involves variations of a cycle which includes light, temperature changes and moisture. Apparatus in which to artificially reproduce and observe the effects of these singly and combined has been constructed. Special 30-in. quartz mercury arcs furnish the source for ultra-violet (actinic) rays. The rate at which these deteriorate has been estimated with the means at hand. The useful rays appear to be in the region $\lambda = 3000$ Angstrom Units, or near the end of the sun's spectrum. Temperatures equal to summer heat on exposed surfaces—60 deg. C. (140 deg. F.)—are provided by the light. During the winter months advantage has been taken of low outdoor temperatures. Moisture, simulating heavy rainfall, is provided by a revolving spray. The pressure is maintained as high as practicable to promote erosion of decomposition products from the surface. An atomizer provides means for maintaining a saturated atmosphere.

Exposures are made at 28 in. from the light source. The panels are of selected white pine, or standard grade iron, 6 by 12 in., painted according to approved practice. For warm seasons, the cycle most used has been: light 24 hours (temperature 50 to 60 deg. C.), cooling, followed by moisture 24 hours (temperature 5 to 10 deg. C.). During cold weather 24-hour outdoor exposures have been added. Exposures have usually extended for periods of 60 to 90 days, with daily inspections.

Loss of gloss and formation of removable "chalk" follow in the order that these develop under normal outdoor exposure. Saturation of the film accelerates chalking under the ultra-violet light. Freezing saturated films promotes the formation of removable chalk. "Checking," developing gradually into deep cracking and fine scaling, has not been reproduced. Cracking has been reproduced to a limited extent by periodic exposures to low temperatures. Lack of adherence is evidenced by blistering and peeling when the saturated panels are exposed to the heat of the quartz mercury arc (50 to 60 deg. C.).

The relative susceptibilities of paints containing lithopone to light darkening are readily determined. The relative tendencies of tinted or colored paints to fade and discolor under light and moisture, are revealed by exposure.

The test has been applied to paints applied on metal surfaces with encouraging results.

*Summary of a paper presented before the twenty-fifth annual meeting of the American Society for Testing Materials, Atlantic City, June 26 to 30, 1922.

"Report on the Province of Ssuch'uen," British blue book, China 5 (1904), 1909.

The Technology of the Carbon Electrode Industry—I* The History of Its Development

Beginning With Sir Humphry Davy's Experiments in 1800 with the Electric Arc, the Author Presents a Technical Description of the Evolution of the Electrode Industry and Briefly Reviews the Present-Day Applications of the Carbon Electrode in the Chemical and Metallurgical Industries

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IN WRITING the biography of a living man one of the first things to be mentioned is his age, for that gives an idea of the times in which he has lived and the experiences he has passed through. This, in a general way, is also true of an industry, for its age at least hints at the state of perfection to which it has been brought. To say that the manufacture of carbon electrodes on a commercial scale is but half a century old is therefore equivalent to calling attention to its phenomenal development.

It shall be the purpose of the present article to review briefly the technical history of this development, but before attempting this review it is perhaps desirable to direct attention to a condition which is peculiar to the carbon industries. While most industries have a more or less abundant literature, with numerous books, pamphlets and articles, the manufacture of carbon electrodes is a notable exception. Were it not to be considered sarcasm, the industry might even be referred to as a "black art," first because of the secrecy usually surrounding its processes, and second, because of the absolute physical dirtiness of the usual electrode plant. Carbon works have generally been regarded as fortications, through whose gates only the initiated might enter. Most of the manufacturers have been of the opinion that the less said on the subject the better for them. One reason for this, perhaps, is that in Europe the art of manufacturing high-grade electrodes was always regarded as a secret, of which only a few had definite knowledge.

Early Experiments Lacking Commercial Significance

Sir Humphry Davy, in 1800, was probably the first to employ carbon electrodes in connection with the electric arc. His electrodes were made of charcoal, and were simply points or rods cut out of carbonized wood. As a result, they were neither dense nor homogeneous. It can easily be seen that such carbons were rapidly consumed, not especially surprising when we consider the current and voltage he used. He employed the great battery of the Royal Institution, constructed after Wollaston's design, consisting of 2,000 pairs of plates, from which he obtained an arc of approximately 4 in. in length. It is highly probable that if we were to take some of our modern electrodes and subject them to such an arc, they, too, would be quickly consumed, for oxidation of carbon at the temperature reached in the arc is very rapid.

Foucault was one of the first to make use of "deposited carbon," or the coke that condenses on the insides of gas retorts. As early as 1846, however, Staite and Edwards patented a process of making carbon electrodes from pulverized coke and sugar, the mixture first being molded under a high pressure, and later the shaped mass was baked at a white heat. The electrodes were then dipped in a concentrated sugar solution, the assumption being that the sugar would enter the pores and make the mass denser after a second baking. About the same time Leonolt prepared carbons consisting of two parts of retort coke, two parts of wood charcoal and one part of liquid tar. The materials were worked into a paste, well kneaded, molded, pressed, covered with sugar or sirup, and subjected to a high temperature for 30 hours or more. Leonolt also tried, but with indifferent success, to purify carbons by immersing them in different acids before baking.

In 1850 Watson and Slater experimented on a similar basis and 7 years later Lacassagne and Theirs attempted to purify electrodes by immersing them in fused caustic soda or potash, in the hope that they might thus change the silica in the carbons to soluble silicates. After fusing, the electrodes were steeped in hot water and exposed in a porcelain tube to a current of chlorine gas. It was supposed that the various earths not affected by the soda or potash would be converted into volatile or soluble chlorides, thus yielding a purer carbon.

Not long after these experiments, which were of no practical value, Curmer conceived the idea of making carbons of a mixture of lampblack, benzine and turpentine. This mass, after being kneaded, pressed and baked, left a porous coke, since the benzine and turpentine volatilized in a large measure during the baking process. Curmer attempted to increase the density of these electrodes by saturating them with resins and subjecting them to a second baking.

Jacquelain, formerly a chemist at the Ecole Central at Paris, made carbons by using the hydrocarbons obtained in the distillation of coals, turf, etc., and also from the products resulting from the carbonization of these materials in sealed vessels. He obtained fair results, but never worked out a practical method or attempted to engage in the industry commercially.

Gaudin worked on electrodes which he made of lampblack. At that time, however, the price of lampblack was so high that he was obliged to seek some other material. He heated resins, pitch, tars and oils in

*Editor's Note—This is the first of a series of six articles dealing with the technology of the carbon electrode industry. The subsequent articles will discuss raw materials; calcining and calciners; grinding, mixing, molding and extrusion; electric and gas-fired baking and furnaces; and cleaning, machining, testing and shipping.

closed vessels, and obtained sufficiently pure carbon upon their decomposition. The volatile products of these substances were condensed and collected to be used again in mixing. He proceeded by pulverizing the carbon left after the decomposition and mixed it with a certain percentage of lampblack, using the condensed volatile products as binding material. This mixture was well kneaded, and molded with steel molds under the pressure of a powerful hydraulic press. The electrodes, after being baked, were considered to be superior to those in commercial use at the time.

The Beginnings of the Industry

From a commercial point of view, Carré appears to be the first to have had conspicuous success in producing carbons. He may justly be considered the founder of the industry.

The undeveloped state of electric lighting at the time had a great influence upon the work of these early investigators. It will be observed, however, that they were not far out of the way and that present-day practice differs from theirs only in that manufacture is assisted by more perfect mechanical methods.

When Carré studied the problem, the Gramme machine had just appeared and a host of inventors were struggling to construct a good arc lamp. There were demands for a good carbon that was practical in every respect, so that on the whole the time was very favorable to the founder of the arc-lamp carbon industry. It is interesting to read Carré's own account of this work:[1]

> The superiority of artificial carbons for various experiments and the possibility of purifying, with alkalis, acids, aqua regia, etc., the carbonaceous powders that enter into their composition led me to seek some means of producing them economically. By moistening the powders, either with sirups or gums, gelatine, etc., or with fixed oils thickened with resins, I succeeded in forming pastes sufficiently plastic and consistent to be forced into cylindrical rods through a drawplate placed at the bottom of a powerful compression apparatus of about 100 atmospheres. Carbons are now manufactured by this process and I have at various times presented some of them to the Société d'encouragement.[2]
>
> These carbons have three or four times the tenacity and are much more rigid than retort coke; cylinders of 10 mm. diameter and 50 cm. in length may be used without any danger of splintering during a break in the circuit. They may be as easily obtained in the slenderest diameters (2 mm.) as well as in the largest. Their chemical and physical homogeneity gives great steadiness to the arc, their cylindrical form, combined with the uniformity of their composition and structure, causes their cones to continue as perfectly shaped as if they had been turned in a lathe, and therefore there are no occultations of the point of maximum light like those produced by the projecting and comparatively cold corners of retort carbons. They are not liable to the inconvenience of flying into splinters when first lighted, as the others are, in consequence of the great and sudden expansion of the gas contained in their intercellular spaces which sometimes exceed 1 c.c. in capacity.

Carré's carbon mixture, which was patented Jan. 15, 1876, was as follows:

Very pure coke, finely pulverized	15 parts
Calcined lampblack	5 parts
Sirup of sugar	7 to 8 parts

The whole mixture was well pounded together, kneaded and worked into a hard paste. It was afterward pressed through a drawplate by a hydraulic press and the carbons or rods piled into retorts, where they were baked at a high temperature.

The general operations in the manufacture of electrodes have remained practically the same for the last century. Thus Carré has described the crude beginnings of the industrial operations of calcining, grinding, mixing, shaping (either molding or extrusion) and baking. Improvements have been in every one of these, from the original crude coal-fired furnace with its low thermal efficiency and high fuel consumption, to the present highly efficient type of gas-fired continuous variety of multisection ring furnaces. It is a long step from the original calcining ovens, producing poorly shrunk coke to the gas-fired continuous vertical retorts used in the modern electrode plant.

In 1890 O. G. Pritchard[3], an Englishman, published a series of articles upon the manufacture of carbon electrodes. His raw materials and equipment are interesting to look back to, if for no other reason than that today, only 30 years or so later, they would not by any possibility be considered commercially feasible.

His raw material was foliated Ceylon graphite, which he purified by pulverizing to a fine powder and then treated with potassium chlorate and sulphuric acid. The sulphated and oxidized mass was further treated with sodium fluoride to get rid of silica as the volatile tetrafluoride. After calcination the material was ready for the use. Pritchard used purified cane sugar, caramelized, as a binder, explaining that he had failed in attempting to use tar oils, gums, hydrocarbons and beet sugar for the reason that all these substances produced undue porosity after the carbons were baked. He was unable to find a satisfactory measure for correcting this porosity.

Prichard's mixture was pressed through an orifice at the bottom of a vertical hydraulic press at a pressure of approximately 1,800 lb. per sq.in. The carbons were cut into the desired lengths by shears as the stream came out of the press. They were dried in an air-drying room and kilned in a very crude intermittent coal-fired furnace, much like those used at the present time for the small-scale manufacture of red brick.

Early American Developments

In the United States there was a patent granted in 1858 to De Grasses B. Fowler of New York for the process of making carbon plates by mixing ground coke with tar, shaping the mixture under pressure in molds, packing the shaped material in lime and heating it slowly in an airtight box to drive off the volatile matter. As the experimental arc light shown at Yale in 1871 used electrodes cut from retort carbon, it is not very probable that Fowler's patent was commercialized for other than battery plates.

David Thompson of Newark was probably the first American manufacturer. His first plant consisted of a small crusher, a mixing pan, a crude brick oven, some cast-iron molds and a hand-operated grinding and bolting outfit.[4]

Charles F. Brush and Washington H. Lawrence of Cleveland began to experiment on the manufacture of carbon electrodes about 1877. As they had found other materials unsuitable, they investigated the use of petro-

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[1] Carré, *Compt. rend.*, Feb. 19, 1877.

[2] Carré, *Bull. de la Société d'encouragement pour l'Industrie nationale*, 1877. H. Fontaine, "L'Eclairage Electrique," 1877.

[3] O. G. Pritchard, "The Manufacture of Electric Carbons for All Electrical Purposes," The Electrician Publishing Co., London, 1899.

[4] See p. 7 of "The Carbon Electrode," published in 1922 by the National Carbon Co., Inc., New York.

um coke, a source of supply of which they found ithin a mile or so from their workshop where the tandard Oil Co. had for years burned it under the oil ills in an effort to get rid of it. At first they used ie raw coke, pulverizing and molding it to shape in ectrodes about half an inch square and a foot long. s these electrodes had an abnormal shrinkage after aking, Brush invented the process of calcination of the oke prior to its fabrication into an electrode. Brush so invented a hydraulic press to impart greater ensity (due to greater pressure applied during shapng) than was obtainable with the hand press which as first used.

By the year 1878 Brush was manufacturing elecrodes on a commercial scale. It was electrodes such s these that Hall used in 1886 in his experiments hich led to the commercial production of metallic luminum.

The Discovery of Artificial Graphite

The next important event was the discovery of the ommercial manufacture of graphite. In 1893 in a lecure before the Société International des Electriciens, irard and Street[5] of the Société "Le Carbone" deribed a furnace for the conversion of carbon into raphite. The method consisted in causing a series of rcs to play over the surface of the carbon to be conerted. It was stated that an 85 per cent conversion as obtained. It is not known whether this method as ever commercialized.

In 1896 H. Y. Castner[6] patented a process for heating carbon electrodes by means of electricity so that a graphite-like form of carbon was produced." It ight be assumed that this anticipated Acheson's raphite electrode, were it not for the fact that Castner emarks that the resulting electrode "will be found o be of decreased density." The Acheson electrode, fter conversion to graphite, has a higher density than s amorphous raw material. Castner also states "that ie temperature produced is such that the carbon will ive off the more flammable material it contains." ccordingly his patent merely covered the electrical aking of carbon electrodes.

In 1896 E. G. Acheson, then of the Carborundum o., was granted a patent for the manufacture of raphite in an electric furnace. He heated carbon "in ssociation with one or more oxides to a temperature fficiently high to cause a chemical reaction between ie constituents and then continued heating until the ombined carbon separated out in the free state." He oes on in his patent to say: "It is not, however, mited to the use of oxides, as pure metals, their sulhides and other salts may be used; but for various easons the oxides are to be preferred."

Three years after the patent was obtained the Acheon Graphite Co. was incorporated and started buildng a plant at Niagara Falls, which is now the center f the industry. The company proposed that several istinct forms of the product were to be produced. One consists of forms or articles made out of amorhous carbon, with the desired amount of impurity dded, which will afterward be heated in an electric urnace and converted more or less to graphite." Acheson had been doing this work for a year or more revious in the furnaces of the Carborundum Co. He had made about "200,000 carbon electrodes, measuring 15 in. in length, with about 1-in. cross-sectional area, for use in the Castner alkali process, nearly half of them having been shipped to Europe."[7]

To quote again from Acheson, writing in 1899: "It is not the present intention of the company to enter into the manufacture of their product into the finished form for the general market, but rather to encourage those now engaged in making the natural graphite into articles of commerce to become buyers of their material, substituting it for the natural product now used." He states that according to the company's plans, "they will erect machinery for reducing coke to grains of the desired size, an electric furnace through which the prepared grains will pass in a continuous stream, a pulverizer for reducing the grains as they are received from the furnace, and a scalping sieve through which the product from the pulverizer will pass, so that the particles exceeding 1/200 in. in diameter may be removed. The final flour will contain an amount of pure graphite proportional to the percentage in the original coke."

It is interesting that graphite was first shown to be an elementary body and an allotropic form of carbon in the first year of the nineteenth century and in the last year was made to order in great quantities and was rapidly becoming an article of commerce.

Electric Furnace Electrodes

Up to the end of the nineteenth century practically all of the work in the carbon industry had in view the development of a satisfactory electrode for arc lighting. It was only in 1897 that Heroult and Hardmuth in France and Plania and Siemens in Germany started work on the development of suitable carbon electrodes for electric furnace work. They used anthracite coal for the first time as a raw material. Heroult manufactured electrodes in Canada in 1908 and in the United States in 1911.

A great deal of the credit for the development of the modern electric furnace electrode in the United States belongs to the National Carbon Co., which began, in 1906, experimental work to develop a furnace electrode several hundred times larger than the largest arc light carbon of that date.

The last quarter century has seen a most remarkable expansion in carbon electrode manufacture. Jehl[8] in 1899 lamented the fact that the center of the industry was at that time at Charlottenburg and Nürnberg in Germany, while there were so many other locations in the world with much greater natural advantages. He says: "There is no reason why England should not make high-grade carbons, why the United States, with its immense petroleum wells and natural gas spring, should not supply the world with all grades of carbons. Russia and other petroleum countries also have an advantage in starting carbon factories and supplying their own market; in fact, the whole carbon business seems to fraternize with the coal-gas manufacturers and petroleum distillers."

In the United States, in most instances, the industry has been dependent for its existence upon a source of cheap electric power for baking the electrodes, while in Europe the gas-fired furnace has been most generally

[5] *Bull.* des Société des Electriciens, vol. 12, p. 246.
[6] United States Patent 572,472, December, 1896.
[7] E. G. Acheson, "Graphite, Its Formation and Manufacture," *J. Frank. Inst.*, 1899, pp. 475-486.
[8] Francis Jehl, "The Manufacture of Electric Carbons for All Electrical Purposes," The Electrician Publishing Co., London, 1899.

used for baking purposes. In this connection, although not directly connected with electrode manufacture, the names of Mendheim of Munich for his invention of the gas ring and chamber furnace; Escherich, for his gas-ring furnace; and Meiser, for his modification of Mendheim's furnace, first applied to the baking of pottery and then adapted to the baking of electrodes, deserve prominent mention in the history of the electrode industry. The Meiser (more or less adapted to local conditions) modification of Mendheim's furnace is largely used in the United States. It has replaced electric baking to a large extent, even in localities where power is cheap.

Thus it may be seen that the development of the carbon electrode industry has been along four lines: (1) Electric arc lighting; as this industry expanded, carbon development attempted to keep pace with it. (2) Electrolytic manufacture—e.g., alkalis, chlorine, aluminum and magnesium. (3) Electrothermic work—e.g., calcium carbide, silicon carbide, graphite, etc. (4) Electric furnaces—e.g., electric steel; copper, brass and aluminum alloys, ferro-alloys; nitrogen fixation.

Recent Development

One of the most important and useful industrial developments of recent years has been the extension of the use of electric furnaces. This was greatly accelerated by war conditions, war demands and war prices. This growth carried along with it an expansion of the electrode industry due to research and operating investigations. In 1919 there was a shortage of electric furnace carbons. Overwhelming demands swamped the manufacturers, not because of the lack of raw materials. but rather the inadequate manufacturing facilities.

The latest progress has been along the lines of much stricter specifications as to purity, resistivity, hardness and increased density of electrodes. The earlier workers tried to obtain higher densities by saturating the baked articles with binders and baking a second time. In the present day the end is reached by starting with higher density raw materials and calcining them in a manner which will increase this factor. One of the greatest plant problems of today is the maintenance of absolute uniformity of output.

The growth of the manufacture of carbon electrodes in the last 20 years or so has been tremendous. In 1899 the total value of electric furnace carbon output was $10,974,[9] in 1921 the total value of furnace electrodes produced was well over $10,000,000.[10] Electrode production is now the most important branch of the carbon industry; the output of brushes, which formerly was of greater significance only reached the value of $4,000,000 in 1921.[10] The following comments from a recent report of the Tariff Commission summarize the present status of the industry:

> The bulk of the production comes from the aluminum industry, which makes electrodes for its own use; and two carbon manufacturers, making chiefly graphite and amorphous electrodes respectively. Another large company was organized during the war to make amorphous electrodes. There are also a number of smaller concerns producing electrodes.
>
> The bulk of the production is from the states of Pennsylvania and West Virginia and from the Niagara Falls district of New York. The largest plant is probably one in New York.
>
> The entire demand in the United States can be supplied by domestic sources. The production at present probably exceeds the consumption.[10]
>
> The chief foreign producers are Germany, England and France. Carbon products are made in most of the countries of Europe and in Japan.

The essential rôle of the carbon electrode in industry and in modern life has recently been pointed out by Hinckley,[11] who has shown carbon electrodes enter into the manufacture of the following materials:

Electric steel, ferro-alloys, calcium carbide, silicon carbide and related abrasives; aluminum, calcium and magnesium metals; phosphorus and phosphoric acid electrical resistance wire; titanium and zirconium; carbon disulphide; tungsten; fixed nitrogen (cyanamide) sodium; caustic soda and chlorine; and all of the electric furnace alloys. The electrode today is therefore an essential part of our modern existence.

The second of this series of articles will discuss the raw materials for carbon electrode manufacture. It will appear in a subsequent issue of this magazine.

[9] U. S. Census, 1900.

[10] U. S. Tariff Commission, 1921, Tariff Information Survey for Paragraphs 81 and 82 of Tariff Act of 1913.

[11] A. T. Hinckley, "The Development of the Modern Furnace Elec-

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Evaporation of a Liquid Into a Gas

By W. K. Lewis

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A LARGE amount of work has been done on the evaporation of water into air at temperatures below the boiling point. The dynamic equilibrium corresponding to the evaporation of water into air counterbalanced by the flow of heat from the air into the water is the basis of wet-bulb thermometry, the most useful method of determining the humidity of air. In 1886 Desmond Fitzgerald pointed out that the rate of evaporation of water into air is a fraction of the difference in partial pressure between the moisture in equilibrium with the evaporating water and the actual moisture content of the air in contact with it. It is true that Fitzgerald did not assume the rate of evaporation linearly proportional to this difference, but added a small correction term proportional to the square of the difference. Barrows and Babb made a large number of determinations of evaporation from the surface of Maine lakes and while their experimental determinations were subject to a large percentage variation, none the less their results substantiate this proportionality. More recently Willis H. Carrier has shown that the rate of water evaporation is, within experimental error, proportional to partial-pressure difference. The following is an analysis of the mechanism of such evaporation.

Preliminary Assumptions

For purposes of formula derivation assume a long tunnel through which unsaturated air is flowing at constant mass velocity. The walls of this tunnel are non-conductors of heat. Along the bottom of the tunnel is placed a mat or wick permanently wet with water supplied from below as evaporation takes place above. The water is furnished to this wick at every point at a temperature exactly equal to that of the water on the upper surface of the wick at that point. There is no motion of the liquid water parallel to the axis of the tunnel. The mass velocity of the air over the water is constant and sufficiently low so that heat generated by friction may be neglected.

The unsaturated air entering this tunnel will become humidified in passing through it owing to the evapora-

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[*] Abstracted from *Mechanical Engineering*, for July, 1922.

ion of water. In consequence, the temperature of the ir will fall, and if the tunnel be sufficiently long, the ater and air will ultimately come to equilibrium.

Notation

In the formula to be derived, the following notation s used:

A = Area of liquid in contact with gas.
H = Absolute humidity of gas, or parts by weight of vapor per part by weight of vapor free gas.
h = Surface coefficient of conductivity of heat between gas and liquid, or B.t.u. per unit time per unit surface area per unit temperature difference.
k' = Coefficient of diffusion, or parts by weight of vapor diffused per unit time per unit area per unit absolute humidity difference.
k = Coefficient of diffusion, or parts by weight of vapor diffused per unit time per unit area per unit vapor pressure difference.
p = Partial pressure of vapor.
P = Total pressure of vapor and vapor-free gas (i.e., barometer).
θ = Time.
t = Temperature.
r = Latent heat of vaporization.
s = Humid heat, or number of heat units necessary to change the temperature of unit weight of vapor-free gas, *plus the vapor it contains*, 1 degree.
W = Weight of liquid evaporated.

Interaction of Water with Air

Now consider for the moment the conditions at any iven point along the length of this tunnel. At this oint the temperature, absolute humidity and pressure f water vapor in the air will be represented by t, H nd p. Since the apparatus is continuous in its operaion these conditions will remain unchanged at this articular point, but will vary from point to point along ne tunnel. The corresponding quantities representing ne condition of the liquid water in contact with the air t this particular point are t_w, H_w and p_w.

The mechanism of interaction of the water with the ir is as follows: There exists over the water what equivalent to a stationary film of air, which insulates ne water from the main body of the air. Through this ir film heat is diffused from the air into the water and rough the same film there is diffusing, in the opposite irection, the water vapor formed by evaporation on ne surface of the liquid. This evaporation cools the rface of water and, since it is available from no her source, heat must be supplied solely by diffusion om the air. The heat of vaporization must therefore e quantitatively compensated by the heat flow through ne surface film and the rate of evaporation is limited the rate of diffusion of vapor through the same film.

From the foregoing one can immediately write the llowing equations:

$$-\frac{dW}{Ad\theta} = k'(p_w - p) \tag{1}$$

$$\frac{dQ}{Ad\theta} = h(t - t_w) \tag{2}$$

$$dQ = -r_w dW \tag{3}$$

hence

$$p_w - p = \frac{h}{k'r_w}(t - t_w) \tag{4}$$

This last equation is the one normally used for calculating the humidity of air from wet- and dry-bulb thermometer readings. In it, variation in r_w is neglected and the term $h/k'r_w$ is assumed constant. For p in millimeters of mercury and t in deg. C., it equals 0.5. The equation implicitly assumes that the cooling of the air is differential—i.e., so small in the neighborhood of the point in question that the actual changes in temperature and humidity of the air, t and p (or H), are negligible.

Since

$$p = P\frac{\frac{H}{18}}{\frac{H}{18}+\frac{1}{29}} \tag{5}$$

$$t - t_w = \frac{k'r_w}{h}P\left(\frac{\frac{H_w}{18}}{\frac{H_w}{18}+\frac{1}{29}} - \frac{\frac{H}{18}}{\frac{H}{18}+\frac{1}{29}}\right) \tag{6}$$

Where H is small, as is usually the case below 150 deg. F., $\frac{H_w}{18}$ and $\frac{H}{18}$ are negligible compared with $\frac{1}{29}$, and one may write, as a close approximation,

$$t - t_w = \frac{kr_w}{h}(H_w - H) \tag{7}$$

where

$$k = 29k'\frac{P}{18}$$

It is obvious that h and k depend on the thickness of the air film and are therefore functions of the velocity of the air. It is, however, equally obvious that if air velocity be increased sufficiently to double the one, the other will double also. The ratio of h/k therefore remains constant, independent of velocity. This explains why the reading of a wet-bulb thermometer is uninfluenced by the velocity of air passing it, provided the velocity is sufficient so that any heat lost by radiation is negligible in comparison with that picked up by conduction.

The Relation $h/k = s$

Now consider the change in humidity and temperature of the air as it moves along the tunnel. Starting at the same point previously considered, the air will drop in temperature by an amount dt and increase in humidity by an amount dH. The heat given up by cooling must correspond to the heat of vaporization of the water picked up—i.e.,

$$-sdt = r_w dH \tag{8}$$

whence, assuming constancy of s and r_w,

$$H = -\frac{s}{r_w}t + \text{const.} \tag{9}$$

Assuming the tunnel indefinitely long, the air will ultimately become saturated at some temperature t_e, and humidity H_e. Since these conditions present equilibrium between the air and the water, evaporation will cease, and t_e and H_e are therefore the constant, fixed end-points of the process. Inserting these limits,

$$H_e - H = \frac{s}{r_w}(t - t_e).$$

We have now derived two formulas connecting H and t, both applying to this same process of evaporation—i.e.,

$$H_e - H = \frac{s}{r_w}(t - t_e)$$

and

$$H_w - H = \frac{h}{kr_w}(t - t_w)$$

These two expressions must therefore be identical. By the method of undetermined coefficients this can be true only provided the corresponding coefficients are equal, i.e.,

$$\frac{s}{r_w} = \frac{h}{kr_w}, \text{ or } s = \frac{h}{k}$$

and $t_w = t_e$, a constant; and $H_w = H_e$, also constant.

So far the discussion has been limited to water and air. Obviously, however, the same relationships must apply to any liquid and any gas with which its vapor is mixed.

The first of these equations, $h/k = s$, states that the coefficient of heat transfer divided by the coefficient of vapor diffusion through the gas film is constant, and equal to the humid heat of the gas. By means of formula 4 the ratio h/k can be calculated from the observed wet- and dry-bulb temperatures for any vapor-gas mixture of a known gas humidity. The experimental determinations of wet-bulb temperatures for water-air, water-carbon dioxide, toluene-air and chlorbenzene-air, and calculations for h/k given in Table I show that

TABLE I—VALUES OF h/k FOR VARIOUS VAPOR-GAS MIXTURES

	h/k Calculated From Experimental Results	Specific Heat of Gas
Water-air	0.236	0.238
Water-carbon dioxide	0.217	0.220
Toluene-air	0.238	0.238
Chlorbenzene-air	0.248	0.238

this ratio is in all cases substantially equal to the humid heat of the entering gas, which in this case was identical with the specific heat because the gas which was used was vapor free.

We have therefore demonstrated that, granting substantial constancy of s and r_w, and assuming H to be small, the ratio of the coefficient of diffusion of heat to that of any vapor through the gas film on the surface of the liquid is equal to the "humid" heat of the gas. Furthermore, during adiabatic evaporation of a liquid into a gas, the liquid being in dynamic equilibrium with the gas, the temperature of the liquid remains unchanged throughout the process and the end-point of the process is reached when the gas has cooled itself to saturation at a temperature identical with that of an ordinary wet-bulb thermometer.

Importance of the Relationship $h/k = s$

The importance of the relationship $h/k = s$ is very great. The term s, the humid heat, may be readily calculated for any case, regardless of whether the problem is primarily one of heat transfer or of diffusion. Hence if the heat-transfer coefficient h has been experimentally determined for a certain type of apparatus operating under definite conditions, the coefficient of diffusion equals h/s, and the capacity of this same apparatus may be predicted when functioning in diffusion processes—e.g., as a gas scrubber. Conversely, if k and s are known for definite conditions, h equals ks; in other words, one can predict the performance of a given apparatus for heat transfer from data upon the same equipment functioning as a scrubber.

These processes of diffusion of heat and of vapor are at the basis of the performance of all such equipment as humidifiers, dehumidifiers, water coolers, gas scrubbers, air driers, light oil stripping columns, and the like. The above relationships make it possible to study the performance of such equipment on a more rational basis than hitherto and to compare the effectiveness of different types of equipment even when the data on the individual types are obtained under widely varying conditions. The department of chemical engineering, Massachusetts Institute of Technology, expects to publish in the near future a series of articles showing various applications of these relations.

Legal Notes

By Wellington Gustin

Liability for Death of Trespassing Children in Poisoned Pool

By a divided court the decisions of the lower courts have been reversed by the United States Supreme Court in the case of Van Britt and wife against the United Zinc & Chemical Co. (264 Fed., 785.)

The chemical company owned a tract of about 20 acres in the outskirts of the town of Iola, Kan. Formerly it had there a plant for the making of sulphuric acid and zinc spelter. In 1910 it tore the buildings down, but left a basement and cellar, in which in July 1916, water was accumulated, clear in appearance but in fact dangerously poisoned by sulphuric acid and zinc sulphate from the works of the company. The claimants had been traveling and encamped at some distance from the place. A traveled way passed about 100 ft from the accumulated pool. Two children of claimants on July 27, 1916, went bathing in the water, were poisoned and died. Claimants brought suit for the deaths and at the trial the judge instructed the jury that if the water looked clear but in fact was poisonous and thus the children were allured to it, the chemical company was liable. The U. S. Circuit Court of Appeals affirmed a verdict and judgment against the company.

In reversing this judgment the Supreme Court has said that an owner of land owes to trespassers no duty to remove even hidden dangers, though he cannot prepare a trap for trespassers whom he expects to come upon his land. And infants have no greater right to trespass upon other people's land than adults, and landowners owe them no duty to expect them and to prepare for their safety.

Further this court says a land owner owes no duty to children to protect them from hidden dangers on his land, unless he has directly or impliedly invited them to come thereon, so that he is not liable for the death of the children in an abandoned basement, filled with poisoned water, which could not be seen from the highway and thus attract them.

The court's decision rests upon the question whether the poisoned pool of water could be seen from the highway or any place where the children lawfully were and that it was what led them to enter the land. Since there was no evidence to show such attraction the court held the chemical company owed them no duty and therefore reversed the judgment. (42 S. C. Reporter, 299.)

Dissenting Opinion Holds to Humane Doctrine

Chief Justice Taft and Justice Day concurred in a dissenting opinion written by Justice Clark. They pointed out that from 1873 until this decision the Supreme Court of the United States had applied, in

such cases as this at bar, what is termed the "humane" doctrine and deplores this change to the "hard doctrine," or the "Draconian doctrine." The "humane" doctrine was established by a decision of the U. S. Supreme Court in 1873 (Railroad Co. vs. Stout, 21 L. Ed., 745) in a unanimous decision. Since then the Supreme Court of Illinois, on authority of the Stout case, held a city liable for the death of a child drowned in a similar pool of water not poisoned. Justice Clark says:

"Believing as I do that the doctrine of the Stout and McDonald cases, giving weight to and making allowance, as they do, for the instincts and habitual conduct of children of tender years, is a sound doctrine, calculated to make men more reasonably considerate of the safety of the children of their neighbors, than will the harsh rule which makes trespassers of little children which the court is now substituting for it, I cannot share in setting aside the verdict of the jury in this case, approved by the judgments of two courts, upon what is plainly a disputed question of fact and in thereby overruling two decisions which have been accepted as leading authorities for half a century, and I therefore dissent from the judgment and opinion of this court."

Sale of Parts for Unpatented Apparatus Used with Process Patent Not Infringement

The U. S. Circuit Court of Appeals has held that the sale of a single part for use in an unpatented apparatus for carrying out a patented process does not constitute contributory infringement of the process patent, in an action brought by the Electro Bleaching Gas Co. against William G. Miller and others. This holding has been upheld by the United States Supreme Court (42 Sup. Ct. 187).

The Electro company charged the defendants with contributing to the use and practice of the process of antisepticizing water, which rights it claimed under process patent No. 1,142,361, as granted to George Ornstein. The inventor originally applied for a patent on the apparatus as well as the process, but the request for the apparatus was rejected by the examiner of the Patent Office and withdrawn. The application upon which the letters patent were finally granted does not describe the apparatus in any of the claims but only the process of antisepticizing waters, although in the specifications the apparatus to be used is described and also illustrations of three kinds of apparatus which may be used are filed.

Apparatus Sold by Plaintiff for Use With Process

The apparatus by which the patented process is made operative, as shown by the figures accompanying the application, comprised an absorption tower, through which the minor flow of water passes downward to absorb an upwardly moving current of chlorine gas. The chlorine is supplied from a tank of compressed and liquefied chlorine gas from which a pipe leads into the lower part of the tower. The tank is provided with a shut-off valve and the supply pipe with a pressure reducing valve and a regulating valve. Water is supplied to the tower from any suitable source.

The infringement charged is a chlorine gas-pressure regulator, performing the same office and producing the same results as the pressure reducing and regulating valves of plaintiff's apparatus. The company had sold to the city of Chicago, for use in its municipal water plants, a number of complete sets of its apparatus. Later the city purchased from defendants a Miller chlorine gas-pressure regulator to replace the corresponding part in the company's apparatus. The city made this change, according to its assistant city engineer, because defendants' valves enabled the city to obtain a better regulation of gas flow from defendant's valves and a great saving in maintenance costs. The city of Kansas City made a similar change and the city chemist in charge of water purification said the reason was that plaintiff's valve mechanism was insufficient in capacity to get the required quantity of gas into the coke-filled tower.

The U. S. District Judge held that the sales of these valves constituted infringement of plaintiff's process patent, which judgment has been reversed.

It was not claimed that defendants had employed the process of the patent in suit, nor that they had made or sold apparatus for employing that process. Only they sold the pressure regulating valves to replace regulator valves furnished as a part of the apparatus sold by the plaintiff company. Defendant's valves were manufactured and sold by them for general use and were used in some flour mills.

The real question in issue was whether upon this state of facts a person selling a single part for use in an apparatus employed in manufacturing an article protected by a process patent is guilty of contributory infringement.

Distinction Between Process and Apparatus

The application for patent on the apparatus of Ornstein was denied by the Patent Office, and then abandoned by him. The Supreme Court has said: "A machine is a thing. A process is an act or a mode of acting. The one is visible to the eye—an object of perpetual observation. The other is a conception of the mind, seen only by its effects when being executed or performed." (Tilghman vs. Proctor, 102 U. S. 707). Again the Supreme Court, in Cochrane vs. Deener, 94 U. S. 780, said: "A process is a mode of treatment of certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing. . . . The machinery pointed out as suitable to perform the process may or may not be new or patentable; while the process may be altogether new, and produce an entirely new result. The process requires that certain things should be done with certain substances, and in a certain order; but the tools to be used in doing this may be of secondary consequence."

A process and an apparatus by which it is performed may be found in one patent, or they may be made the subject of different patents. And the court here points out that the valves sold by defendants in no wise affected the process, but at most the apparatus which was not protected by the patent.

A similar ruling was made by the Supreme Court in the case of Rumford Chemical Works vs. Hygienic Chemical Co., 30 Sup. Ct. 45. In another case it was of "the opinion that the line should be drawn to include those articles which are either parts of a patented combination or device or which are produced for the sole purpose of being so used and to exclude the staple articles of commerce." 207 U. S. 198.

Therefore the Court held that the defendants were not guilty of contributory infringement as alleged and the District Court was reversed.

Cast Iron as Produced in the Electric Furnace, and Some of Its Problems*

A Basic Electric Furnace Is Useful to Refine Cupola-Melted Iron, Reducing Sulphur and Gases to Any Extent Desired, and Producing Easily Machinable Castings, Very Tough and Strong, and With a Minimum of Defectives From Dirt or Blowholes

By George K. Elliott
Chief Metallurgist, The Lunkenheimer Co., Cincinnati, Ohio

THE first use of the electric furnace for gray cast iron in everyday production, and not in sporadic experimental heats, seems to have been in the iron foundry of the Lunkenheimer Co. at Cincinnati in the summer of 1917. Beginning with "cold charge" heats, the process soon underwent a logical change into the duplexing process, wherein the cupola was utilized for the otherwise costly melting period of the cycle. The first few months the furnace, a Heroult with basic hearth, was confined to melting cold charges of special low-phosphorus iron, desulphurizing, reducing the carbon by dilution with steel, adjusting silicon to suit the size and nature of the castings, and finally casting into parts for which semi-steel originally had been used.

Melting Cold Charges

This product perhaps came as near being the consummate semi-steel as is possible. This relatively expensive process soon developed into the tandem process and now is used only on rare occasions when small heats of special iron are desired. It is the writer's understanding that several foundries are using the cold-charge method regularly where tonnage is too small to justify a cupola and close control of an exceptional grade of iron is required. Under such combination of circumstances there seems to exist a limited economical field for the complete cycle of melting, refining and superheating in the electric furnace.

Several of these "cold charge" furnaces are operating with acid hearth, which means leaving from the cycle the element of refining except in a sense that is mild in comparison with the rigorous basic process. Properly conducted, this acid process consists of melting and superheating under conditions that at least are non-oxidizing as far as furnace atmosphere concerns. The length of stay in the furnace after being melted may become a period of purification, insomuch as an undisturbed exposure to a high temperature in a harmless atmosphere is likely to bring about a flotation on the bath of some of its non-metallic inclusions. Especially will high sulphur aided by manganese automatically reduce in this way to a measurable degree. Irons with 0.15 per cent sulphur have been known to decrease by as much as one-fourth or one-third through manganese sulphide floating to the surface.

The cold-charge process for cast iron probably never will acquire more than a scattered application, and the greatest possibilities seem to lie with the duplexing process. This is because the cupola cannot be relegated to disuse without working economic violence to the commercial foundry. The cupola delivers molten iron, with a minimum of care and labor, too cheaply to be discarded. Any melting scheme for the iron foundry must take into serious consideration the cupola furnace. It needs no substitute, but at times an adjunct is desirable; here is the opportunity for the electric furnace.

Since the duplexing process apportions refining to the electric furnace, the most logical hearth for the electric furnace is the most potently refining one—in other words, the basic hearth. In it lie the best and widest possibilities of the electric furnace for cast iron.

Duplexing in Basic Hearth

Duplexing, as said before, probably was practiced first at the Cincinnati plant, and there also it has been used most continuously, while it was at a plant in Birmingham, Ala., that it developed its greatest tonnage where a pipe foundry frequently passed over 200 tons of iron through the electric furnace in 24 hours.

"What are the conditions in the average iron foundry of today that make feasible the addition of an electric furnace to the equipment? This is a common question. In a sentence we can answer that the influencing factors are, (*a*) the limitations of the cupola, (*b*) the cost of available raw materials, and (*c*) a shifting of the basis of competition in a certain volume of the gray iron castings business from price per pound to quality per piece. Any one of these may carry enough weight to swing the balances in favor of the electric furnace in some cases, while in others—by far the great majority—the united three cannot budge the foundry policy from its present established position. The electric furnace must not be taken up hastily and without a complete survey of its advantages and disadvantages because in one field it may be an unmistakable success while in another it will show only loss.

Advantages of Cupola Melting

In speaking of the limitations of the cupola the writer must not be taken as unfriendly to it or in the least unappreciative of its many sterling virtues. It is without peer as an efficient, inexpensive, universally operated metallurgical servant for the production of molten iron. Probably no other furnace can melt similar metal at a fuel cost of 75c. or lower per ton, which is what the cupola does steadily and with approximate satisfaction on all counts. It lacks only some of the refinements of operation frequently demanded by modern conditions. These occasionally demanded improvements are an ability to reproduce uniformly any desired composition of iron, a positive ability to refine in addi-

*A paper presented at the forty-first general meeting of the American Electrochemical Society held in Baltimore, Md., April 27, 28 and 29, 1922.

ion to melting and an increased power to superheat. To accomplish refining the cupola is helpless, while it has decided restrictions when it comes to superheating.

Just as the inability to refine and superheat are outstanding weaknesses of the cupola, so is the corresponding ability to do them the great advantage of the electric furnace, especially the furnace with basic bottom. Such furnace is the pre-eminent refining furnace for iron and steel. Handling cast iron, it is capable of delivering without too great attention metal superheated to any degree, reduced in sulphur as required, deoxidized and with carbon, silicon and manganese adjusted to the desired standards. Phosphorus alone cannot be altered in cast iron by the electric furnace except by impracticable methods.

The electric furnace is at its best when coupled with a chemical laboratory in an intimate manner. By sampling the molten iron as soon as transferred from the cupola the laboratory can determine as many elements as desired, and the proper additions can be made before the metal is ready to pour, making possible the closest regulation of the composition. Especially is this valuable in regulating silicon and carbon, elements reflected in the machinability of the castings. The rapidly growing tendency in machine shops to introduce standardized rates of machining seems to be taking little or no heed of the fact that there are many kinds of cast iron and that more than one kind may come from one foundry in one cupola during one day.

Maintaining fixed rates of machining and high production cannot be divorced from a parallel preserving the fixed proper grade of iron in the castings. In order to keep uniformly a certain machinability, iron must not vary in composition over too wide a range, especially in silicon and carbon, and at times manganese. Not a few modern factories have installed ultra-modern castings-finishing methods without first co-ordinating in the proper way their metallurgical and mechanical operations. In such cases the results are likely to be either a sad falling down in production from what was so elaborately planned, or a sacrifice of highly desirable physical properties in the product in order to attain and preserve production. Planning production without first establishing the best grade of iron for the product has led to more than one manufacturing débâcle.

Desulphurization

The most striking reaction taking place in the basic electric furnace is desulphurization; also it may become its most valuable. There is no gainsaying that there is a tendency toward higher sulphur in the world's scrap pile. This is not because the foundrymen are no longer afraid of it and are giving it free rein, but rather because it daily is becoming more difficult to hold it within bounds. The universal scrap pile is swollen with the grim harvest of the greatest of wars, and economy demands that it be worked over into usable implements fit for the pursuits of peace. The average of the sulphur is high, perhaps 0.15 per cent, and upon remelting in the cupola almost 0.03 per cent more is picked up with each remelt. The basic-hearth electric furnace seems created almost for this crisis. Elimination of sulphur by its means is one of the readiest of metallurgical operations. Cast iron of 0.18 per cent can be reduced to under 0.07 per cent in about 30 minutes, meaning the changing of relatively bad iron into good. Geographical considerations are strong here, and the foundry located in a region remote from the sources of good pig iron, and therefore having to rely upon the scrap pile of the neighborhood, may be in a logical position to consider seriously the basic-hearth electric furnace.

Illustrating this application of the furnace, there was described in 1920 a small unit on the Pacific coast in which a hand-fed, two-phase arc furnace was utilized for working up otherwise unusable iron scrap.[1] Tensile strengths of 40,000 to 45,000 lb. to the square inch were claimed for the iron.

Sulphur Limits

The introduction of the basic-hearth electric furnace is largely responsible for the prominence that the subject of sulphur in cast iron, especially low sulphur as compared with high, has received in recent years. The time is approaching rapidly when the question of the real effect of various amounts of sulphur in cast iron must be systematically and authoritatively investigated. Something is needed to reconcile the apparently anomalous results with high- and low-sulphur irons that are reported from time to time by different foundrymen and metallurgists. Logical sponsors for such inquiry would seem to be either the American Society for Testing Materials or the American Foundrymen's Association, or a committee of the two organizations.

The conditions in cast iron that will conduce to the precipitation of sulphide, in particles of an optimum size and of an optimum degree of dispersion, so as to assist or at least not hinder the production of mechanical properties of a high order, is a subject about which we know practically nothing. In conducting a research along this line we can suggest a very promising means of attack in the recently announced slip interference theory of the hardening of metals by Jeffries and Archer,[2] which seems capable of a wide application to many of our metallurgical problems, including the one of sulphur in iron. The question of mechanical tests also is involved in the solution of the sulphur problem, and it seems advisable that increased attention be given to tests of a more dynamic nature than the customary transverse and tensile tests, because there is good reason for believing that tests of such nature will differentiate between irons that give nearly identical results under the mentioned static tests.

If an answer to the sulphur problem ever is found, it probably will be many-fold with different limits of sulphur for different kinds of castings. The writer has first-hand knowledge of one class of large castings that invariably are "dirty," to quote the foundryman, at an important machined point whenever sulphur reaches 0.10 per cent or over. Empirically in this one case the answer has been found; generally we can only surmise how far we dare go with sulphur.

To the writer it seems that the sulphur question is involved in the greater one of general refinement, and it is probable that iron high in sulphur also is endowed plenteously with other impurities, some of which may be almost entirely unknown. Examples are oxygen in various combinations, nitrogen as nitride and perhaps others even less familiar. The fact that an iron is desulphurized is evidenced that it has passed through a

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[1] *Electrical World*, 1920, vol. 75, p. 265.

[2] "The Slip Interference Theory of the Hardening of Metals," Zay Jeffries and R. S. Archer, CHEM. & MET. ENG., 1921, vol. 24, p. 1057.

strong refining treatment, and the possibility that some of the benefits attributed to low sulphur in reality may be the result of the removal of one or more other impurities along with it has to be recognized. Desulphurization of iron means one of the most drastic cleansings known to metallurgy, and consequently low sulphur is becoming a hall-mark of refinement.

Refining Reactions

Removal of sulphur requires a reducing slag, and this carries with it additional advantages to the iron. Broadly speaking, there are two inflexible requirements to be complied with before desulphurization can take place—a strongly basic slag and complete deoxidation of slag and bath. Without both there is no elimination of sulphur. The slag is made from an excess of lime, with fluorspar added for fusibility, and coke dust to produce the needed reducing conditions. Deoxidation of bath, since manganese, silicon and carbon all are present, perhaps is a somewhat complex reaction, but for simplicity we can assume the probable rôle of manganese as illustrative:

$$FeO + Mn = MnO + Fe$$

Being not as soluble in molten iron as FeO, the MnO rises to the surface to be taken up by the slag, where it is acted upon by the carbon and reduced back to metallic manganese, the carbon monoxide escaping. After the last of the oxide has been removed from the slag the first step toward desulphurization begins. Immediately around the electrodes where the greatest temperature prevails the carbon and the lime of the slag react, forming calcium carbide. This reaction is assurance that deoxidation is completed. Elimination of sulphur then proceeds by one or probably both of the following reactions (where Fe may act interchangeably with Mn):

$$MnS + CaO + C = Mn + CaS + CO$$

$$3MnS + 2CaO + CaC_2 = 3Mn + 3CaS + 2CO$$

The calcium sulphide formed in either reaction is insoluble in molten iron.

Effect of Oxygen in Cast Iron

Deoxidation we have seen is a necessary concomitant of desulphurization, and cast iron coming from this process should be fairly free from oxides. This introduces one of the moot questions of cast iron. By some reputable authorities it is stoutly maintained that molten cast iron contains too much carbon, silicon and manganese to be able to carry iron oxide at the same time. Others declare it is entirely possible, and that its presence has certain tangible effects. As to the nature of the effects again there is a division of opinion. One group claims they are good, while another takes the opposite view, roundly condemning oxidized or "oxygenated" iron. The writer inclines to the belief that oxygen often persists in cast iron, in spite of the presence of oxidizable elements that should remove it, and also that its presence is undesirable. It seems to him that the persistence of oxygen as iron oxide in molten iron is as reasonably expected as is the well-known persistence of determinable amounts of sulphur and phosphorus in steel heats that have been put through the most rigorous and theoretically impeccable treatments for their removal. It is readily explained by the law of mass action, which enables the iron to hold to the last traces of these impurities.

That the influence of oxygen on the whole is bad is borne out by many experiences with the product of badly acting or carelessly operated cupolas. In these cases the iron without doubt was exposed to oxidizing conditions, and that it was materially affected thereby was shown in the sluggishness of the melt, which in spite of a high temperature prevented its running out castings solid enough to pass a porosity test. It appears probable that oxygen in some of its combinations, especially iron oxide, raises the freezing point of cast iron, bringing about a practical diminution of fluidity. One other point against iron oxide is its reaction with carbon, which is known to produce unsoundness in steel through the resultant gas, and there is reason to hold that this can happen also with cast iron. The time spent in the electric furnace during duplexing gives ample opportunity for this reaction to complete itself.

The oxygen question of cast iron is bound to remain unsettled as far as universal conviction is concerned, until analytical chemistry rises to the occasion. At present there is no generally accepted adequate method for determining all the oxygen in iron or steel. The Ledebur method is practiced here and there, but admittedly has serious limitations, it being claimed that it reaches at best only 75 per cent of the ferrous oxide that may be present,[3] while it misses entirely the oxides of manganese, silicon and titanium. Few contributions to metallurgy could at present be greater than a complete set of accurate practicable methods for determining oxygen and oxides in the various metals and alloys. Let those analytical chemists who feel that dull and futureless is their lot ponder this opportunity for making a well-nigh monumental contribution to practical metallurgy! In the same category we may also include nitrogen and other gaseous elements. The arc electric furnace, particularly the long-arc furnace, with its seeming possibilities for nitrogen fixation, makes pertinent the question of determining nitrogen readily and studying its effects upon iron and steel. There are the Allen method, and one or two others, for determining nitrogen, but they are attended by an uncertainty similar to that of the Ledebur oxygen method.[4]

We are forced to admit that chemical analyses as now made of metals and alloys often are only part analyses, and the elements that are eluding the analyst may be of paramount practical importance.

Advantages of Superheat

In no other furnace can superheating be so effectively done as in the electric furnace. Either the acid or the basic furnace is a good superheater, but the former has some disadvantage in that too high superheat sometimes (depending considerably upon the quality of refractories) has a tendency to raise the silicon unduly. Several times the writer has seen as high as 3.80 per cent silicon in cast iron coming from an acid furnace that went in at barely 2 per cent. In the basic furnace the tendency is toward a slight reduction.

The advantages of superheating can all be summed up in the one word "fluidity." The electric furnace gives fluidity to irons not commonly considered fluid, a conspicuous example of which is low-phosphorus iron. This class of irons generally is preeminently strong, but

[3] Bureau of Standards Scientific Paper 346, by Cain and Pettijohn.

[4] Very recently (Chem. & Met. Eng., 1922, vol. 26, p. 218) there was published an iodide-iodate method by Hurum and Fay, that may be one of the needed long steps forward in the determination of nitrogen in steel; so far no mention has been made of its applicability to cast iron.

nsuited for castings needing fluidity. Superheating in he electric furnace can make many of these irons ligible for the thinnest of sections.

Fluidity is a strong assurance of solid castings hrough freedom from blow-holes, shrink holes, slag nclusions and the like. Superheated metal increases he effectiveness of risers by lengthening the period of uidity, which is their only period of activity as feed-rs, and thereby obviates to a large degree that internal hrinkage that comes from fluid contraction of the ietal. Abetted by superhot metal, the efficiency of the rdinary riser becomes surprising.

Blow-holes seem to be eliminated to a considerable xtent by superheated metal acting through risers. The errostatic pressure of molten iron is nearly one-quarter f a pound per square inch for each inch of head. In ny mold of ordinary dimensions this is not great nough to increase perceptibly the density of the metal tself, but it seems sufficient to prevent the release of issolved gases from the metal and the consequent ormation of blow-holes. In this way the pressure of uid molten metal may be said to increase the actual ensity of the castings themselves by the elimination f blow-holes. This tendency of very fluid iron to pre-ent by pressure the liberation of dissolved gases per-aps is somewhat unnecessary in the cases of electric urnace irons that have been through sufficient refining o insure practical degasification.

Carbon Oxides in Solution

In connection with the gases CO and CO_2 held by he metal in solution or otherwise, there was a sig-ificant paper read before the Iron and Steel Institute British) in the autumn of 1920,[5] by Honda and Murakami, in which it was claimed that in pure iron-arbon alloys graphite is formed not as the direct result f the decomposition of cementite at high temperature ccording to the reaction, $Fe_3C = 3Fe + C$, but rather hrough the catalytic action of CO or CO_2. Should this old true with impure alloys such as cast iron, the emoval of these gases in the electric furnace might e expected to have a retarding effect upon the precip-tation of graphite.

The present writer has seen some evidence to trengthen this theory, chief of which is an occasionally pparent capability of electric-furnace cast iron to arry higher silicon without perceptible opening of the rain, excessive graphitization and the consequent oftening and loss of strength, than a similar iron is apable of that has not been refined. In other words, legasification in so far as the elimination of CO and CO_2 is concerned may explain a part of the increased trength and soundness of electric furnace cast iron, on he ground of its ability to discourage a headlong mas-ive precipitation of graphite. It may be that this retard-ng influence modifies the form of the graphite as well s influencing finer and more advantageously dispersed articles. This is far from a settled matter and the nain object in introducing the idea is to stimulate hought and perhaps point out a path for investigators o explore.

To conclude, it may be that the electric furnace never vill acquire the widespread use for cast iron that its nost enthusiastic friends predict and desire, yet the vriter of this paper does not feel that its usefulness to he art of iron founding is to be measured solely by its number of installations. If it accomplishes nothing more than to inspire a new and fruitful interest in the many problems of cast iron, it may well be said to have been a generous benefactor to all branches of the art. Not only does the electric furnace open up new avenues for the production of cast iron but also new lines for thought and experiment, and who is the man to declare that this last is least in importance?

[5]Also see Chem. & Met. Eng., 1922 vol. 26. p. 180

Distribution of Tar Recovery From Byproduct Coke-Oven Gas

By Frederick M. Washburn and George E. Muns

At the byproduct coke plant of the Wisconsin Steel Works, located at South Chicago, Ill., an investigation was made into the quantity and composition of the tar removed at various points along the path of the gas, resulting in the data given below.

The plant consists of two batteries, each of forty-four Wilputte ovens, together with complete direct type byproduct recovery apparatus. The gas is conducted by goosenecks from the top of the oven through a mushroom valve and into the collecting main. At the mushroom valve it meets a spray of flushing liquor, which prevents pitching of the valve seats. The gas is then drawn through the suction mains, where it is again

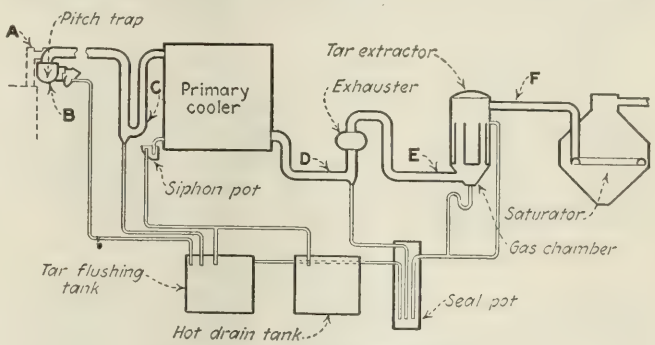

FIG. 1—GAS FLOW CHART

sprayed with flushing liquor, and conducted to the primary coolers, which are of standard indirect type, water-tube design. From this point it passes through Root positive exhausters, which force it through the tar extractor and other apparatus for the recovery of byproducts.

Fig. 1 shows diagrammatically the flow of gas from the ovens through the gas mains and apparatus, and the points at which condensed or extracted tar is drawn off for subsequent separation and storage. Temperature and pressure conditions at the points designated in the figure by the letters *A* to *F* are given in Table I.

TABLE I—TEMPERATURES AND PRESSURES THROUGH SYSTEM

Readings at	Temperature Deg. C.	Pressure	Readings at	Temperature Deg. C.	Pressure
A	346.0	3 mm.	D	26.0	—4.9 in.
B	176.0	3 mm.	E	36.1	63.7 in.
C	79.5	—3.1 in.	F	35.5	55.8 in.

All tests were run under uniform operating conditions, with temperatures and pressures normal, with an average net coking time of 22 hours, 51 minutes, and with a coal mixture of 95 per cent Benham (high-volatile) and 5 per cent Pocahontas (low-volatile) coal. Average tar and gas yields per ton of dry coal charged were taken over a period of 24 days operating at this

coking time, and amounted to 11.39 gal. of tar and 11.365 cu.ft. of gas. All figures in tar gallonage are calculated on a moisture-free basis because of the wide variation in moisture content of different tars separated.

The general plan of the test was actually to measure the tar recovered at the different points for a definite period of time, noting the total volume of gas handled during that time and obtaining a representative sample for analysis of the tar produced. Lack of tank space made the actual running time of the tests shorter than was expected, but good checks were obtained by repeating. In detail, the procedure was as follows:

Test A. Tar Extractors

The hot drain tank was isolated and the tar separated by the P. & A.'s discharged this tank. Measurements were made at the start and finish of each run, and gallonage determined from the tank calibration and measurements. The sample for analysis was taken from the seal pot overflow.

Test B. Gas Chamber (After Exhauster)

The gas chamber was emptied at the start. During the run the condensate was drained into tarred barrels at regular intervals, and at the finish of the run. The gallonage was determined from the weight and specific gravity of the tar. The sample for analysis was taken from the barrels.

Test C. Exhauster Drain (Suction Side)

The exhauster drains were sealed off in 500-gal. cylindrical tubs, which were measured at start and finish of run, and the gallonage determined by calibration and measurements. The samples for analysis were taken from the tubs.

Test D. Primary Coolers

The drains from the primary coolers were discharged into the isolated hot drain tank, which was measured at the start and finish of the run. The gallonage was determined by the tank measurements and calibration. The samples for analysis were taken at the siphon pot.

Test E. Suction and Collecting Mains

This tar occurred in small quantities in comparatively large quantities of liquor and owing to the difficulty of measurement the amount of tar separated here was obtained by the difference between the previous tests and the total production. Separate samples for analysis were taken from the suction and collecting mains. In order to obtain an uncontaminated sample, an all-liquor flush was circulated for 4 hours before the test and during the test.

Moisture determinations were made on all samples except those from the suction and collecting mains. All samples were dehydrated, and specific gravity, free carbon and distillation determinations made on the dehydrated tars. The specific gravity determinations were made with a Westphal balance with the exception of the samples from the suction and collecting mains, which were too viscous for this method, so a tar specific gravity bottle was used. The distillations were made on a 100-c.c. sample in a 200-c.c. side-neck distillation flask connected to a vertical condenser.

The tar obtained from the exhauster drains (test C) probably represents separated tar mechanically carried over from the primary coolers, as from Table III

TABLE II—DISTRIBUTION OF TAR

Test	Location	Duration of Run, Min.	Gas Passed, Thous. Cu.Ft.	Tar Obtained, Gal	Tar per Thous. Cu.Ft. of Gas, Gal.	Percentage of Total Tar Production
A	P. & A. tar extractor	325	2,451.5	179.63	0.0732	7.30
B	Gas chamber	325	2,451.5	49.50	0.0202	2.01
C	Exhauster	325	2,451.5	433.26	0.1767	17.64
D	Primary cooler	120	867.5	354.96	0.4092	40.84
E	Suction main					
F	Collecting main	...	.....	.....	0.3227	32.21

it may be seen that samples C and D are very similar in composition. Sample C is a slightly lighter tar than sample D, which would naturally follow, since sample D is composed of tar separated in all sections of the primary coolers, while sample C probably consists mainly of tar from the last or coldest section. From Table II it may then be seen that over 90 per cent of the tar present in the gas is removed during its passage through the mains and primary coolers. Two per cent of the remaining tar is removed by passage through the exhauster, leaving only a little over 7 per cent to be removed by the tar extractor. The free carbon and residues on samples E and F are extremely high due to coal dust mechanically carried over from the ovens. This coal dust is subsequently removed in a pitch trap. The tar from tests E and F are very heavy and viscous, since they were separated at a high temperature. As the separation temperature is lowered the tars become lighter and more fluid. Due to the increase in pressure and temperature caused by passage through the exhauster, a heavier tar is separated from the gas chamber (test B). Up to this point the separation of tar has been governed mainly by temperature and pres-

TABLE III—ANALYSIS OF TAR

Test	Moisture	Sp. Gr. at 1.5 deg. C. 15.5	Free Carbon	Under 110 Deg. C	110 to 170 Deg.	170 to 235 Deg.	235 to 270 Deg.	270 to 300 Deg.	Residue and Loss
A	4.45	1.135	4.21	1.5	6.0	39.5	9.5	6.5	37.0
B	.47	1.140	3.45	1.0	3.0	30.0	10.5	5.5	50.0
C	6.50	1.121	3.44	1.5	5.5	33.0	10.0	8.0	42.0
D	5.60	1.140	3.48	.5	5.0	35.5	11.0	6.0	42.0
E	....	1.229	11.94	...	...	2.5	4.0	6.0	87.5
F	....	1.202	10.92	...	...	5.0	6.0	7.0	82.0

sure conditions, but in the P. & A. tar extractor the temperature and pressure cease to play such an important part, for the mechanical action of the impingement of the gas on a surface caused the separation. The tar separated from the tar extractor (test A) represents practically the last traces of tar in the gas and is the tar having the greatest percentage of oils and least pitch residue of any of the tars tested.

Carbonization of Peat

Carbonization and gasification of peat are very fully discussed in a report of the Commission of Inquiry into the Resources and Industries of Ireland. This document which is available from the offices of the Commission 87 Grafton Street, Dublin, for 2s. 9d., discusses very fully the resources of that country and the methods of development which have been tried. However, it is not by any means limited to the technology which has been utilized there, but gives a very complete analysis of the work done in all parts of the world.

In view of the comprehensive nature of this report it is not possible to do it justice in a brief review. Anyone interested in the subject of peat utilization will find it very desirable to secure a copy of the full document.

Concentrating Dilute Nitric Acid Solutions*

A Study of Rate of Concentration — Application of Results to Fractionation — Determination of Composition of Vapor Above Boiling Solution of Known Composition

By Clifford D. Carpenter and Joseph Babor

THE PROBLEM of concentrating dilute solutions of nitric acid may be conveniently divided into two stages, preconcentrating and superconcentrating, *i.e.*, bringing the acid up to 50 or 60 per cent by simple fractionation and making acids of higher concentration which requires some special process.

This report will deal only with the problem of preconcentrating. Work is in progress on the problem of superconcentrating and the results will be reported at a later time. For our own convenience in describing our work and discussing the application of the results, we will divide the report into two parts. The first will give our results and discuss them in relation to concentrating the dilute acid by simple distillation and by fractionation.

Part I

Analytical Methods Used

In a recent article[1] we described a method by which we were able to distil a solution in such a manner as to prevent all errors introduced by fractionation and therefore study the rate of change in the concentration of the boiling solution while removing a vapor which was continuously in equilibrium with the boiling solution. While making more extended experiments we found ourselves in trouble on duplicating our results. We found our method of standardizing the base (succinic acid) was not easily duplicated so we tried the thallate and benzoic acid methods which checked each other but did not check the value given by the succinic acid method. We then secured from the Bureau of Standards a sample of benzoic acid with which the base used in these experiments was standardized. We have made a much more extended study of the problem using the experimental procedure described in our first article.

The Tables I to VI give the results obtained and Fig. 1 gives these results expressed graphically. The upper curve of Fig. 2 is a composite expression for the rate of change in the concentration of 1,000 grams of a 5 per cent acid from 5 to 68 per cent. The points

TABLE I—RATE OF CONCENTRATING OF NITRIC ACID FROM 3.342 TO 39.966 PER CENT.
Barometer 762.15 mm.

Weight of Residue, Grams	Weight of Total Distillate, Grams	Weight of HNO_3 Distilled, Grams	Total Per Cent Distilled	Strength of Residue, Per Cent
712.516	0.0	0.0	0.0	3.342
631.23	81.29	0.0275	11.41	3.768
554.10	158.42	0.0576	22.23	4.287
474.20	238.31	0.0907	33.45	5.002
391.90	320.62	0.1379	45.00	6.041
317.36	395.16	0.1953	55.46	7.442
245.29	467.23	0.2813	65.58	9.594
178.03	534.49	0.4240	75.02	13.101
131.69	580.83	0.6906	81.52	17.560
77.14	635.38	1.6730	89.18	28.700
50.72	661.79	3.5215	92.88	39.970

TABLE II—RATE OF CONCENTRATING NITRIC ACID FROM 11.727 TO 65.131 PER CENT
Barometer 0.756 mm.

Weight of Residue, Grams	Weight of Total Distillate, Grams	Weight of HNO_3 Distilled, Grams	Total Per Cent Distilled	Strength of Residue, Per Cent
545.802	0.0	0.0	0.0	11.727
493.66	52.14	0.211	9.55	12.92
444.26	101.54	0.439	18.60	14.31
386.69	159.11	0.764	29.15	16.35
327.09	218.71	1.236	40.07	19.19
266.19	279.60	2.050	51.23	23.28
211.25	334.55	3.441	61.30	28.67
164.97	380.83	5.803	69.77	35.28
117.114	428.69	11.298	78.54	45.01
64.315	481.49	26.424	88.22	58.44
33.48	512.32	42.169	93.87	65.13

TABLE III—RATE OF CONCENTRATING OF NITRIC ACID FROM 21.0775 TO 62.43 PER CENT.
Barometer 765 mm.

Weight of Residue, Grams	Weight of Total Distillate, Grams	Weight of HNO_3 Distilled, Grams	Total Per Cent Distilled	Strength of Residue, Per Cent
718.127	0.0	0.0	0.0	21.0775
657.62	60.51	0.93	8.43	23.35
588.10	130.03	2.34	18.11	25.34
514.32	203.81	4.52	28.38	28.56
443.15	274.98	7.60	38.29	32.44
357.82	360.31	14.30	50.18	38.30
270.94	447.18	27.33	62.27	45.77
187.17	530.96	49.26	73.95	54.55
105.26	612.86	85.65	85.32	62.43

TABLE IV—RATE OF CONCENTRATING NITRIC ACID FROM 34.239 TO 63.440 PER CENT
Barometer 766.7 mm.

Weight of Residue, Grams	Weight of Total Distillate, Grams	Weight of HNO_3 Distilled, Grams	Total Per Cent Distilled	Strength of Residue, Per Cent
728.196	0.0	0.0	0.0	34.239
649.74	78.46	6.357	10.77	37.43
562.85	165.35	16.14	22.71	41.47
476.80	251.39	30.06	34.52	46.03
385.36	342.84	51.73	47.19	51.33
302.76	425.44	79.25	58.43	56.25
216.10	512.10	117.80	70.31	60.96
165.07	563.13	144.83	79.13	63.44

TABLE V—RATE OF CONCENTRATING NITRIC ACID FROM 51.744 TO 66.934 PER CENT
Barometer 755 mm.

Weight of Residue, Grams	Weight of Total Distillate, Grams	Weight of HNO_3 Distilled, Grams	Total Per Cent Distilled	Strength of Residue, Per Cent
618.093	0.0	0.0	0.0	51.74
533.420	84.67	27.73	13.70	54.76
446.44	171.66	61.670	27.77	57.83
364.70	253.39	99.160	41.00	60.50
294.43	323.67	135.560	52.37	62.58
218.45	399.64	178.810	64.66	64.55
157.62	460.47	215.935	74.50	65.91
96.68	521.42	255.110	84.36	66.93

TABLE VI—RATE OF CONCENTRATING NITRIC ACID FROM 59.75 TO 67.16 PER CENT.
Barometer 758.00 mm.

Weight of Residue, Grams	Weight of Total Distillate, Grams	Weight of HNO_3 Distilled, Grams	Total Per Cent Distilled	Strength of Residue, Per Cent
584.87	0.0	0.0	0.0	59.75
537.20	47.67	23.11	8.15	60.75
480.94	103.93	51.61	17.77	61.94
475.86	109.01	54.28	18.64	62.04
417.08	167.79	86.06	28.69	63.16
350.59	234.28	124.22	40.06	64.26
296.38	288.49	156.48	49.33	65.13
244.87	340.00	188.23	58.13	65.86
184.95	399.92	226.52	68.38	66.49
122.32	462.55	267.48	79.08	67.05
89.51	495.36	289.38	84.70	67.16

*A paper presented before the Acid Symposium at the fourteenth semi-annual meeting of the American Institute of Chemical Engineers, Niagara Falls, Canada, June 19 to 22, 1922.

[1] *Chem. & Met. Eng.*, vol. 26, p. 443, March 8, 1922.

TABLE VII—VALUES CALCULATED FROM VALUES IN TABLES I TO VI BY WHICH THE POINTS ON THE COMPOSITE CURVES IN FIG. 2 ARE DEFINED

From Table I			From Table II			From Table III			From Table IV			From Table V			From Table VI		
Strength of Boiling Acid, Per Cent	Weight of Distillate, Grams	Weight of Acid In Distillate, Grams	Strength of Boiling Acid, Per Cent	Weight of Distillate, Grams	Weight of Acid In Distillate, Grams	Strength of Boiling Acid, Per Cent	Weight of Distillate, Grams	Weight of Acid In Distillate, Grams	Strength of Boiling Acid, Per Cent	Weight of Distillate, Grams	Weight of Acid In Distillate, Grams	Strength of Boiling Acid, Per Cent	Weight of Distillate, Grams	Weight of Acid In Distillate, Grams	Strength of Boiling Acid, Per Cent	Weight of Distillate, Grams	Weight of Acid In Distillate, Grams
5.0	0.0	0.0	11.727	580.0	0.58	21.08	770.00	1.78	34.24	867.50	4.70	51.74	932.00	14.70	59.75	956.0	23.70
6.0	173.8	0.11	12.92	620.12	0.75	23.03	789.38	2.08	37.43	881.78	5.86	54.76	941.31	17.75	60.75	959.6	25.44
7.44	331.0	0.23	14.31	658.30	0.93	25.34	811.63	2.53	41.47	897.59	7.64	57.83	950.89	21.48	61.94	963.8	27.58
9.59	482.75	0.41	16.35	702.40	1.18	28.56	835.25	3.22	46.03	913.21	10.17	60.50	959.88	25.61	62.04	964.2	27.78
13.10	625.0	0.76	19.19	748.3	1.54	32.44	858.02	4.21	51.33	930.02	14.11	62.58	967.61	29.61	63.16	968.2	30.17
17.560	722.7	1.28	23.28	795.2	2.16	38.30	885.35	6.36	56.25	944.93	19.12	64.55	975.96	34.38	64.26	973.6	33.05
28.7	837.0	3.35	28.67	837.5	3.23	45.77	913.20	10.53	60.96	960.69	26.13	65.91	982.66	38.45	65.13	977.7	35.47
39.97	892.7	7.20	35.28	873.0	5.05	54.55	940.10	17.55	63.44	972.40	31.06	66.93	988.67	42.76	65.86	981.6	37.86
			45.01	909.8	9.28	62.43	966.10	29.18							66.49	986.1	40.70
			58.44	950.5	20.91										67.05	990.8	43.82
			65.13	974.2	33.03										67.16	993.3	45.47

which define this line are obtained from the results given in the six tables and are given in Table VII. The lower curve in Fig. 2 is a composite expression for the rate, in grams, at which the same acid escapes in the vapor while the concentration of the boiling acid changes from 5 to 68 per cent. If we read the points, in terms of the left-hand ordinate, at which the upper curve intersects the vertical lines representing the composition of the boiling solution we have the amount of distillate. If we read the points, in terms of the right-hand ordinate, at which the same line intersects the lower curve we have the amount of acid which is in the distillate. These points give the results in Table VIII.

An examination of Figs. 1 and 2 shows that very little acid is lost in the distillate until the concentration of the boiling solution reaches 20 per cent (1.6 g. acid to 759 g. distillate). The rate of loss increases slowly until about 30 per cent (2.4 g. acid to 809 g. distillate) when the rate becomes much greater but remains

TABLE VIII—INTERPRETATION OF FIG. 2.

Change in Composition of Boiling Solution from 5 per cent to	Grams of Distillate	Grams Acid In Distillate	Change in Composition of Boiling Solution from 5 per cent to	Grams of Distillate	Grams Acid In Distillate
10 per cent	505.0	0.5	40 per cent	892.5	7.07
15 per cent	670.0	0.95	45 per cent	910.0	9.75
20 per cent	758.0	1.60	50 per cent	926.5	13.25
25 per cent	810.0	2.40	55 per cent	941.3	17.75
30 per cent	845.0	3.55	60 per cent	956.7	24.10
35 per cent	871.5	5.05	65 per cent	977.0	35.20

rather regular until about 55 per cent when it again begins to increase more rapidly. At 63 or 64 per cent there seems to be a striking change and the concentration of the vapor approaches that of the residue very rapidly. It is possible that the peculiar inflexion in the curve between 63 and 64 per cent can be accounted for by assuming the presence of $2(H_2O)HNO_3$. The curve shows that the rate of change is regular enough to permit efficient fractionation up to a 55 or 60 per cent acid.

Galle[2] recently studied the preconcentration of nitric acid by using a flask to which was sealed a fractionating column and as a result of his experiments advises

[2] *Z. Angew. Chem.*, 1921, vol. 34, pp. 168 to 170; 173 to 175.

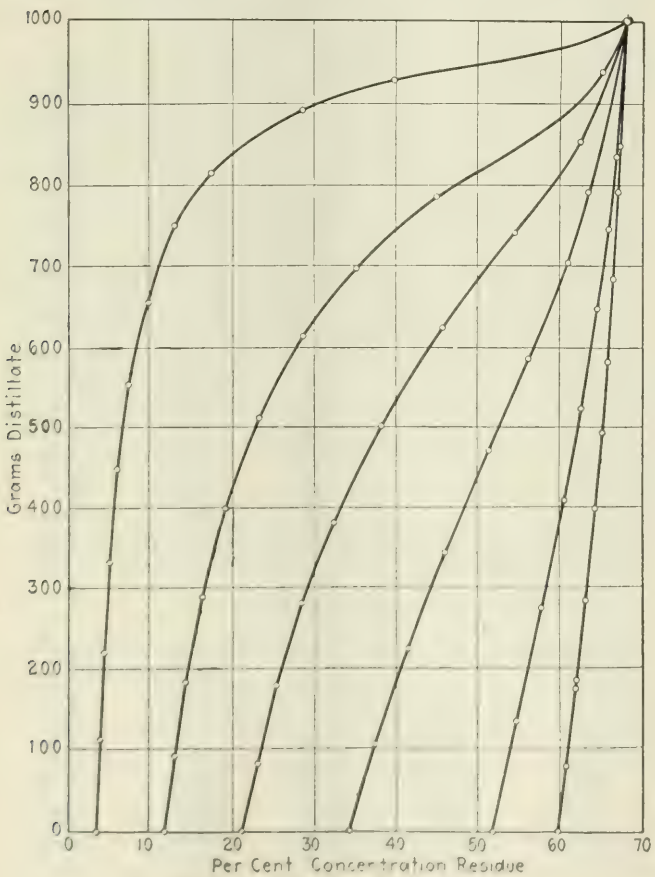

FIG. 1

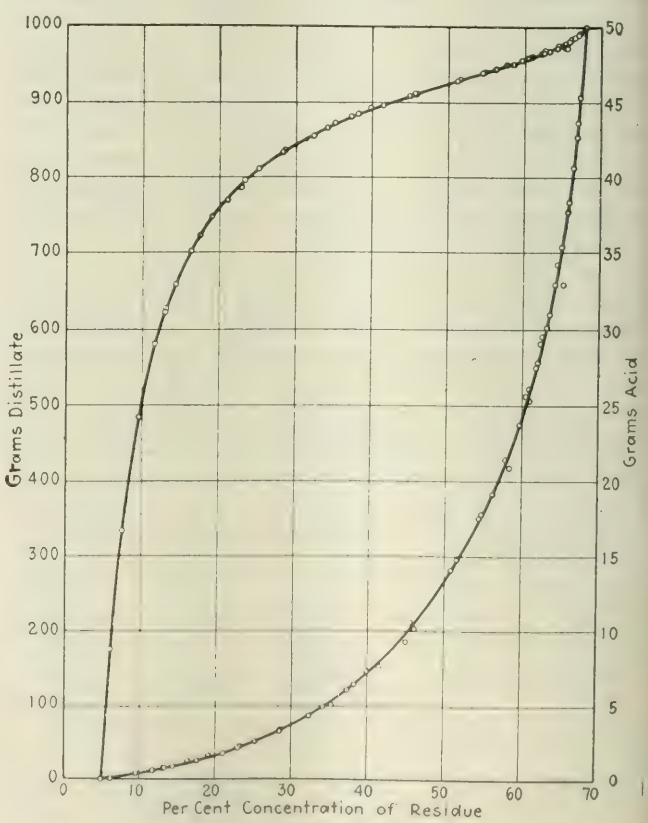

FIG. 2

the fractionation of dilute acid solutions up to 65 per cent before employing methods for superconcentrating the acid. It is evident however that the efficiency of fractionation will be much less above a 55 to 60 per cent composition.

If we wish to obtain a 55 per cent acid from 1,000 g. of a 20 per cent acid by simple distillation, the first residue will be 242.6 g., containing 133.4 g. of the original 200 g. of acid. The first distillate of 757.4 g. will contain the other 66.6 g. of acid and will have a composition of about 8.8 per cent acid. A distillation of the first distillate will produce 78.7 g. of a 55 per cent acid containing 43.3 g. of acid and give a second distillate of 678.7 g. with a composition of about 3.4 per cent. This means by two distillations requiring the vaporization of 1,336 g. of dilute acid that 321.3 g. of 55 per cent acid can be obtained from 1,000 g. of 20 per cent acid, a recovery of about 177 g. or nearly 90 per cent of the 200 g. of acid in the original 20 per cent solution. If a third distillation is made, about 15 g. more of acid may be recovered as 55 per cent acid and about 650 g. of 1 per cent distillate removed. This means that in three fractionations requiring the vaporization of about 1,985 g. of dilute acid that about 92 per cent of the original acid may be recovered as 55 per cent acid.

If it were desired to obtain a 65 per cent acid from the 20 per cent acid, the first distillate removed would be 905 g. containing 138.25 g. of acid while there would remain 95 g. of 65 per cent acid. The second distillation would begin with 905 g. of little more than 15 per cent acid and would require the removal of 840 g. of distillate leaving 65 g. more of 65 per cent acid. Two distillations of a 20 per cent acid will give 160 g. of 65 per cent acid by vaporizing, 1,745 g. of dilute acid. This means a recovery of 104 g. of the original 200 g. of acid. In order to recover 90 per cent of the acid from a 20 per cent solution as 65 per cent acid many fractionations would be required.

From our data it becomes a simple matter to calculate the number of fractionations required to recover nitric acid from dilute solutions at a higher concentration.

Part II

Composition of the Vapor

If we take the curves given in Figs. 1 and 2 and plot them on large co-ordinate paper it will be quite easy to read the amount of distillate and the amount of acid in the distillate while the strength of the acid changes one per cent from any desired concentration to the next higher. Knowing from the data given in Tables I to VI the rate at which the distillate is increasing, a very close estimate can be made for the composition of the vapor of the boiling solution at a concentration represented by the mean composition. Such calculations have been made by reading the values from the curves and the results are given in columns headed C and B in Table IX and have been used to define the curve given in Fig. 4.

Recently Pascal[3] and Berl and Samtleben[4] have carried out experiments in order to determine the composition of vapor above a boiling solution of nitric acid of known concentration. Both used an air bath heated by means of a bunsen burner. They inclosed the flask containing the boiling liquid in the air bath in order to

TABLE IX—COMPARISON OF VALUES GIVEN FOR THE VAPOR COMPOSITION ABOVE BOILING NITRIC ACID SOLUTION.

Strength of Acid	Strength of Vapor — Carpenter and Babor	Strength of Vapor — Berl and Samtleben	Strength of Vapor — Pascal	Strength of Acid	Strength of Vapor — Carpenter and Babor	Strength of Vapor — Berl and Samtleben	Strength of Vapor — Pascal
5.00	0.048	.....	.....	45.00	18.00	.....	.....
10.00	0.200	.....	.....	47.50	22.20	.....	.....
12.50	0.35	.....	.....	47.77	.....	21.71	.....
13.45	.....	0.46	.....	49.80	.....	.....	19.85
15.00	0.55	.....	.....	50.00	26.50	.....	.....
17.50	0.75	.....	.....	52.50	31.10	.....	.....
20.00	1.05	.....	.....	53.96	.....	33.51	.....
20.58	.....	1.26	.....	55.00	35.50	.....	.....
22.50	1.45	.....	.....	56.60	.....	39.37	.....
24.20	.....	.....	2.16	57.50	41.70	.....	.....
25.00	2.20	.....	.....	60.00	47.80	.....	50.02
27.50	3.00	.....	.....	61.47	.....	51.34	.....
30.00	4.10	.....	.....	62.50	54.60	.....	.....
31.75	.....	4.94	.....	62.64	.....	54.46	.....
32.50	5.60	.....	.....	65.00	60.80	.....	.....
33.00	.....	.....	5.90	65.18	.....	60.62	.....
35.00	7.30	.....	.....	67.43	.....	65.97	.....
37.50	9.40	.....	.....	67.10	66.80	.....	.....
37.99	.....	9.20	.....	67.89	.....	67.84	.....
40.00	12.00	.....	.....	68.00	(68.00)	68.00	.....
42.50	14.90	.....	.....	68.40	.....	.....	68.40
43.50	.....	14.86	.....				

prevent condensation in the upper part of the flask and delivery tube. Fig. 3, a, gives a sketch of our apparatus, described in our recent paper,[1] and the ones used by those referred to above. In the case of Pascal, Fig. 3, b, two thermometers are suspended, while Berl and Samtleben, Fig. 3, c, used only one. We have left out the thermometer as it would act as a fractionation column. The only way in which heat can be transmitted to it is by conductance from the boiling liquid and through the vapor. This fractionating effect would be very small in the more dilute solutions but as the concentration increases such an error becomes more serious, especially at the points where the change is most rapid. In our method it would be very serious for any such error becomes cumulative. If, however, it is only desired to know the composition of a vapor above a boiling acid, the error due to fractionation on a thermometer could be made negligible compared with the experimental accuracy possible by taking a small fraction from a large amount of boiling acid. Berl and Samtleben did this and their results are given in the second column in Table IX and are indicated in Fig. 4 by circles to which are attached small arrows. Those falling directly on our curve are indicated by two arrows and those falling to one side by one arrow pointing in the direction indicating the side upon which the point falls. They have made a slight error in their

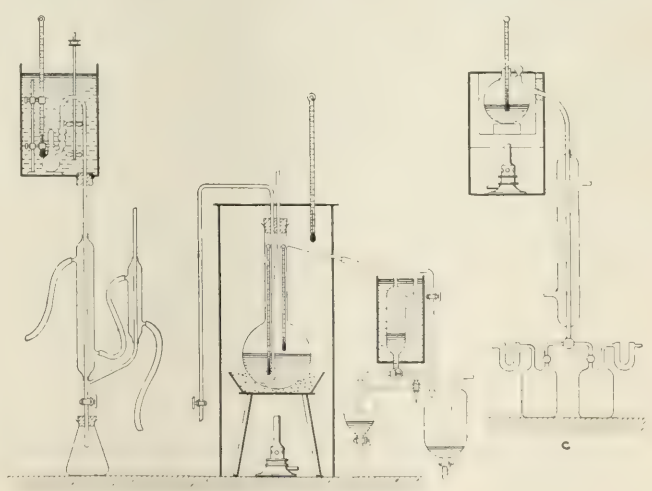

FIG. 3

[3] *Ann. chim.*, 1921. New series, vol. 15, pp. 253 to 290.
[4] *Z. Angew. Chem.*, 1922, vol. 35, p. 201.

estimation of the composition of the vapor, however, for they assume the concentration of the distillate to be the composition of the vapor above a boiling acid which is the mean between the composition of the boiling acid at the beginning and at the end of the change which takes place while the distillate is being collected. It is evident from the shape of the curve in Fig. 2 that this could only be approximately true for the lower concentrations of acids. They have partly corrected the error in this assumption by taking small fractions in the higher concentrations which of course results in a larger experimental error in determining the amount of acid in a small fraction.

Take for example their values obtained for 31.75 per cent (obtained by assuming the concentration of the distillate, 4.94 per cent, while the boiling acid changes from 30.22 per cent to 33.28 per cent to be the composition of the vapor of the mean concentration 31.75 per cent); for 37.99 per cent (residue changing from 37.13 to 38.85 per cent, the distillate of which was 9.20 per cent acid); for 43.50 per cent (residue changing from 42.73 to 44.27 per cent, the distillate of which was 14.86 per cent) and for 47.77 per cent (residue changing from 45.57 to 49.96 per cent, the distillate of which was 21.71 per cent), and note their position in Fig. 4. These values all fall to the right of the curve for in this range the concentration is changing rapidly and the composition of the distillate represents the composition of the vapor for a lower concentration of boiling acid than obtained by taking a mean value. While the values are in close agreement with those given by us, most of the points fall to the right of our curve as would be expected.

Pascal has given the values obtained for five points and are given in column headed P in Table IX and indicated in Fig. 4 by small squares.

Conclusion

1. All values given in our first paper have been redetermined.

2. A brief discussion of the use of our results in considering the problem of fractional distillation has been given.

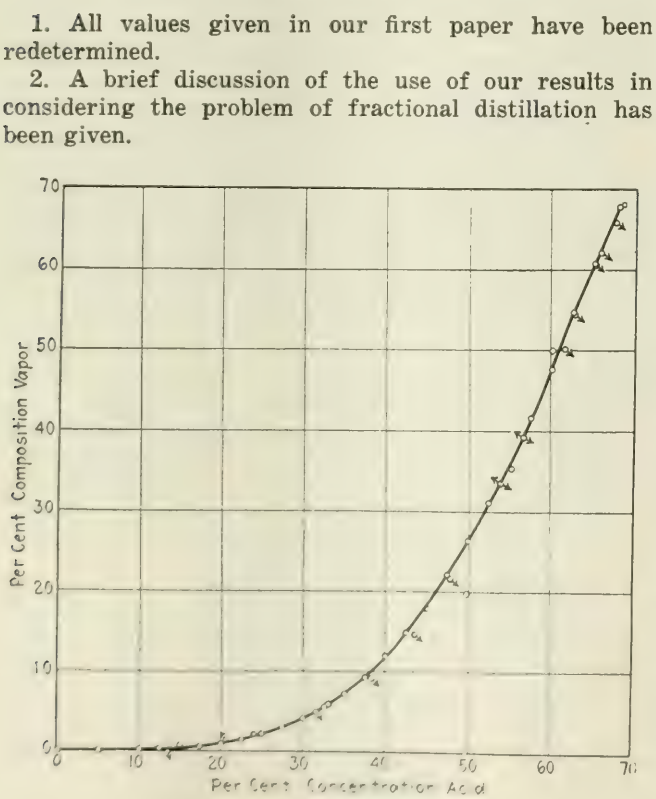

FIG. 4

3. The composition of the vapor above a boiling nitric acid solution from 5 per cent to 68 per cent composition has been determined.

4. A comparison has been made between our results and those obtained by Berl and Samtleben and by Pascal, and errors in their methods have been indicated.

5. When the rate at which the distillate is removed while the change in the concentration of a boiling acid solution is known it becomes a very simple matter to calculate the amount of distillate necessary to be removed by successive distillations in order to recover any desired amount of the acid at a higher concentration.

Italian Oil Activities

An indication of Italian interest in the exploration of the country's oil resources is reported by Consul Leon Dominian from Rome. The Minister of the Department of Agriculture recently made a visit to the oil fields of Ripi and San Giovanni Incarico along the boundary between the Provinces of Rome and Caserta. (Government mining bureaus in Italy are under the administrative jurisdiction of the Department of Agriculture.) According to press reports of the event the Minister assured the managers of the local exploration plants that they could rely on Government help in their work.

It appears that one of the plans of the mining department of the Ministry of Agriculture is to subdivide the Kingdom into zones, in each of which it is proposed to station a Government oil expert. It is also proposed that the State purchase drilling plants specially adapted to deep boring, and that practical instruction in drilling be given to young mechanics prior to their employment by private concerns.

The region visited by the Minister of Agriculture is the seat of several exploration borings, two of which have already yielded oil. The depth at which oil has been found in that region varies between 147 and 240 meters (482 and 787 feet) and the total quantity of oil extracted amounts to 2 tons daily. It is proposed to carry on two sets of operations in the region for the purpose of tapping simultaneously the oil lying at shallow and excessive depths.

Another event which shows that attention is being paid by Italians to their native oil resources was the series of meetings of oil experts in Rome, beginning June 2, to discuss methods of increasing Italian oil production, particularly with reference to deep-seated oil resources. The experts recommended that oil explorations be conducted at great distance from one another in order that better knowledge of the country's possibilities be obtained, and that the Government should make a distinction between assistance to be granted to productive and unexplored regions. It was recommended that subsidies granted to productive zones should be confined only to exploration carried on beyond a depth of 600 meters in order that the deep-seated reserves, which are believed to be large, be tapped. Such subsidies are known as "premiums" in Italy and it is proposed to grant them on the basis of meters in depth.

Final recommendations were that capital intended for exploration work be exempt from all taxation, that no tax be imposed on the sales of native oil and that machinery imported from abroad for exploration work be allowed to enter Italy free of duty.

Petroleum Education

The Industry's Exacting Requirements of the Chemists and Chemical Engineers Are Carefully Analyzed and an Attempt Is Made to Outline Specialized Courses Most Likely to Yield Graduates With Proper Training and Preparation*

By Edwin DeBarr and Fred W. Padgett
University of Oklahoma

THE petroleum industry is one of very broad scope, involving various applications of physics, chemistry, geology, engineering and economics. The sequence of events has been concisely described as follows: The oil well is located by the aid of geology, drilled by the aid of profanity, the oil recovered and transported by the aid of mechanics, refined by the aid of chemistry, and the products are turned over to the shipping clerk. Those experienced in the oil business insist that the above description is mild and inadequate, especially in regard to drilling the well.

The petroleum geological engineer and the geologist are both primarily concerned with the problems of exploration and production. They investigate new areas for possibilities of production and are generally able to indicate whether or not the region is favorable for the accumulation of oil and gas. To the geological profession must go the credit for the discovery of quite a number of entirely new producing areas. Some time in the future, however, most of the exploratory work will have been completed, and the question arises as to whether or not geology will still bear its important relation to the industry. When this time comes, the petroleum geological engineer and the mining engineer will study in much more detail the structure and character of the producing formations and will focus their efforts on the problems of recovering the enormous quantities of oil which remain in the producing formations after they are considered to be exhausted. The results achieved in that field will probably be just as startling as those obtained during the period when new oil pools were being opened with almost monotonous regularity. The subject of valuation of established or prospective producing oil and gas properties is also one which the petroleum geological engineer has studied exhaustively and which often involves consideration of the previous history of adjacent or geologically related producing areas. Valuation has become very much a portion of the everyday work of the petroleum geological engineer and will also constitute an important part of his future work.

The Task for the Chemical Engineer

It is scarcely necessary to mention that applications of civil, electrical and particularly mechanical engineering are of fundamental importance wherever oil is being produced and transported or natural gas distributed, as well as in relation to problems of refinery design and construction. The chemical engineer is intimately concerned with several special phases of production, among which may be mentioned problems of emulsification and petroleum hydrology. Apparently the chemist or chemical engineer is well fitted for a fundamental insight into the character of crude oil emulsions, and therefore possesses a sound basis for undertaking investigations as to the most efficient method to be used in their resolution and the control of processes after being established. Petroleum hydrology is the chemistry of oil-well waters and has very practical significance. The character of oil-well waters differs in different fields, but generally has the same trend in composition among the formations in a single field. These facts may have practical application as indicating, from the analysis of water in the various horizons, when the producing formation is being approached during drilling. Furthermore, after the well is completed, and water happens to appear with the oil in more or less troublesome proportions, analyses or tests of this water may be of value in locating the horizon where the water originates, providing previous analyses or tests have been made at the different horizons where water is present.

The relation of the chemical engineer to petroleum refining is of fundamental importance. In the future, as in the past, the chemist and chemical engineer may be depended upon to make the discoveries which mark important advances in this phase of the industry. Who, it may be asked, if not the chemical engineer or the chemist, is qualified, from the standpoint of training, to make a truly fundamental study of the problems of distillation, refining, "compounding" and the recovery and utilization of byproducts, or intelligently to control processes already established?

Eliminating Waste

Important also is the problem of eliminating, wherever possible, the losses which occur. From the time the crude oil appears above ground until the finished products are obtained by refining, these losses occur, some of which may be wholly or partly eliminated. Important preventable losses often occur from evaporation during production and storage, and during refining from non-recovery of byproducts, inefficiencies in refining processes, leakage, evaporation, fire losses, etc. While the natural-gas phase of the petroleum industry has made commendable strides in recent years in regard to eliminating losses, there are still opportunities for preventing these during its transmission and distribution and while the product is being utilized. In no phase of the oil industry, however, will efficient operation, attention to details and elimination of loss and leakage give more tangible and immediate results than in that of natural-gas gasoline recovery. It is no unusual thing for an inefficient plant to be increased very materially in yield without change of design or the acquisition of new gas wells. At the refinery the oil must be taken as it comes from the pipe line, but in the natural-gas gasoline plant it is possible, and furthermore desirable, in order to obtain the best results, to give consideration to conditions in the field lines

*A paper presented in part at the Birmingham meeting of the American Chemical Society, April, 1922.

and even in the wells themselves, and thus to improve materially the quality and quantity of the gas obtained.

Developing New Industries

We are told that the peak of petroleum production is to be expected within a comparatively short time and that it will then become necessary to supplement the supply of petroleum from oil wells by production obtained artificially by the retorting of pyrobitumens such as lignite, coal and oil shale. Many of the problems that will develop in connection with this new industry will be peculiarly chemical. Before such an industry can be established on a commercial scale in this country, important problems of retorting, refining and recovery of byproducts must be solved. These problems are such as to attract the attention of the research chemist and chemical engineer, to stimulate his interest and will therefore result in productive research. After these problems are solved, the efficient control of the processes established will demand the best efforts of the chemical engineer.

It has been suggested, however, that this new industry in America will be in no sense a byproduct industry, but instead will develop along lines similar to the treatment of low-grade ore. In view of past experience and the fact that conservation can be made to pay its way, it would appear that the coming shale-oil industry will be comparable with the best practice in byproduct technology and that possible developments in refining of shale oil may result in recovery far surpassing in its variations that of the industry as now carried on in Scotland. Handling oil shale as low-grade ore is handled would probably ultimately result in such difficulties as many of the petroleum skimming plants of the mid-continent are now involved.

Petroleum Engineering Curricula

Taking everything into consideration, therefore, it is recognized that the chemist and chemical engineer have a fundamental place in the scheme of things in the bitumen industries, and this position is to become more important as the value of raw materials increases and as the economic necessities demand more efficient operation and attention to byproducts. This condition will no doubt then be reflected in a greater interest of universities in the subject of bitumenology. At the present time petroleum education is confined mainly to those universities the geographical location of which gives them special interest. In this connection may be mentioned the University of Pittsburgh, University of California, University of Oklahoma and the Colorado School of Mines. Dr. Roswell H. Johnson of the University of Pittsburgh was one of the first in this country to establish a course in petroleum engineering.

Problems in Outlining Courses

In establishing a curriculum in petroleum engineering, the following questions arise:

(1) Is it desirable to outline a course so that all the technical phases of the industry, including the principles of chemistry, physics, geology, engineering, economics and several special courses related to the oil industry are studied in a 4-year course; or

(2) (*a*) To outline a course as a whole so that the student completes in 4 years a course in petroleum chemical engineering which specializes in refining and where chemistry is made paramount; or

(*b*) To outline a 4-year course which is designated as petroleum geological engineering and stresses the study of geology; or

(3) To organize a 5- or 6-year course which shall be considered complete from the standpoint of chemistry, physics, geology, engineering and economics, equal attention being directed to both geology and chemistry.

A course according to this latter scheme would be ideal, and in addition to the more complete and better balanced training acquired would present greater opportunity for a thesis based on real research. On the other hand, the difficulty in connection with such a course would be that the bachelor's degree in most educational institutions can be acquired in 4 years, both in arts and sciences, and engineering.

Oklahoma's Course in Petroleum Technology

The writers are unable to understand how a complete course as outlined above, which includes the fundamentals of engineering besides those of chemistry, physics, geology and economics, can be completed in 4 years with equal stress being laid on both chemistry and geology. After all, the fundamentals really are the essentials, and when it is assumed that these have been acquired, it is then quite permissible to give special courses in petroleum technology. In the following paragraphs, courses in chemical petroleum technology are outlined which require as prerequisites university credits in general, qualitative, quantitative and organic chemistry and physics. These courses are open to all students of the university who can satisfy the requirements. Advanced organic chemistry, general physical chemistry and colloid chemistry are considered as important adjuncts to the work from the standpoint of chemistry. Titles of the individual courses in petroleum technology in the Department of Chemistry at the University of Oklahoma are as follows:

Chemistry 132. Petroleum and Natural Gas Technology. Lectures 3 hours a week during one semester.

Chemistry 137. Analysis of Petroleum and Petroleum Products. Laboratory 9 hours per week throughout one semester.

Chemistry 138. The Technology of Coal, Oil Shale and Asphalt. Lectures 3 hours a week during one semester.

Chemistry 139. The Analysis of Coal, Coal Tar, Oil Shale and Asphalt. Laboratory work 9 hours a week throughout one semester.

Chemistry 140. Lubrication, Lubricants, Liquid Fuels and Hydrocarbon Chemistry. Lectures 3 hours a week during one semester.

Chemistry 142. Gas Analysis. Laboratory 6 hours a week during one semester.

Chemistry 143. Petroleum Refining. Laboratory 6 hours a week during one semester.

Chemistry 144. Special Petroleum Products. Laboratory work 6 hours a week during one semester.

Chemistry 145. Field Work in Petroleum Technology. The testing of natural gas for natural-gas gasoline content, measurement of gas wells, testing of meters in the field and tank gaging and sampling. Equivalent to 6 hours of laboratory work a week during one semester.

Chemistry 146. Petroleum Research. Nine or fifteen hours laboratory a week during one semester.

In addition to the courses outlined above, there is listed a course in bitumenology for which elementary chemistry is the only prerequisite, and it is designed to meet the needs of students other than those majoring in chemistry.

Candidates for the degree of Bachelor of Science in Chemical Engineering at the University of Oklahoma may follow one of three lines of chemical engineering—viz., (1) Metallurgical chemistry, (2) petroleum technology (petroleum chemical engineering), (3) sanitary chemistry. It has been previously mentioned that the general course in petroleum technology (petroleum chemical engineering) includes the special courses in

etroleum technology outlined above, and some work in eology, besides the fundamentals of chemistry and ngineering. In connection with special petroleum ctures, it should be noted that the general course in etroleum technology includes a course in petroleum eology given in the Department of Geology, and a urse in the transportation of crude oil and the transission, measurement and compression of natural gas, the Department of Engineering, School of Mechanical ngineering. A title synopsis of the general course in etroleum technology (petroleum chemical engineering) llows for the sophomore, junior and senior years:

SECOND YEAR

First Semester. Quantitative analysis; Organic Chemistry lectures; General Metallurgy lectures; Calculus; and Physics.

Second Semester. Water analysis; Organic Preparations; Petroleum Technology lectures; Analysis of Petroleum and Petroleum products; Calculus; and Physics.

THIRD YEAR

First Semester. Physical Chemistry lectures; Geology; Applied Mechanics; Graphics; Thermodynamics; Mechanical Engineering laboratory.

Second Semester. Industrial Chemistry lectures; Physical Chemistry Laboratory; Gas analysis; Geology; Strength of Materials; Materials laboratory.

FOURTH YEAR

First Semester. Colloid Chemistry lectures; Petroleum Refining laboratory; Direct current machinery lectures; Economics lectures; Direct Current laboratory; Petroleum Geology; Technical English; Oil and Gas measuring and transmission and compression of natural gas.

Second Semester. Field work in Petroleum Technology; Alternating current lectures; Alternating current laboratory; Contracts; Accounting; Petroleum Research; Electives as follows: Chemistry 140 and 143, or Chemistry 138 and 139.

The special equipment for work in petroleum technology should include standard apparatus for the testing and analysis of the native bituminous substances nd their important products, as well as experimental pparatus for the processing of crude petroleum, aparatus for field work, retorts for low-temperature yrolysis of pyrobitumens, and apparatus for the manuacture of special products. At the University of klahoma the special equipment consists of an experiental refinery of 1-bbl. capacity, a low-temperature etort of about 20 to 25 lb. capacity, complete standard esting equipment and apparatus for field work.

CONCLUSIONS

It may be appropriate to inquire as to what a graduate in Petroleum Chemical Engineering should know, ide from the fundamentals of chemistry, engineering, ysics and economics, which, as most everyone will ree, are absolutely essential. The writers would like m to have a thorough understanding of the characteristics and peculiarities of the native bituminous subances; their physical and chemical properties; how test and differentiate them; how to refine them; and ally how to utilize them in their many applications. addition to this, is is desirable that he should have appreciation of the possibilities of research and to of such a frame of mind that too much is not taken r granted. Furthermore he must realize that there e some things which can be learned only by experice after his studies are completed.

The present paper has been an attempt to discuss the fferent aspects of petroleum education as based on the results of several years experience in an endeavor to establish suitable courses in chemical petroleum technology. In concluding this discussion the writers wish to state that they believe the future of this work to be most encouraging, especially in view of the interest shown in it both by chemists and by the oil companies which employ these men. A plan which has been suggested to the writers is that oil companies could profit by selecting promising men from the freshman or sophomore classes in universities and colleges, directing them to study along lines having a bearing upon the business, giving them summer employment, and then finding places for them in their organizations when they graduate, provided they meet their expectations. In fact this plan is already being followed, to some extent, by certain important oil companies.

Norman, Okla.

A New Electric Crane Truck

The Elwell-Parker Electric Co., of Cleveland, Ohio, has recently placed on the market the electric crane truck shown in the accompanying photograph.

The capacity of this crane truck is just less than that of the smaller industrial steam or gas operated locomotive cranes. It has a lift capacity of 3,000 lb. at a 6-ft. radius and 1,000 lb. at a 12-ft. radius. It can stack loads to a height of 12 ft. when set to lift 3,000 lb. at 6 ft. radius. This work is accomplished without the use of outriggers.

The truck has been specially designed of a heavy construction which will give stability and stand the strains of lifting. The boom and hoist, being independent of the driving motor, may be operated while the truck is in motion. All the standard Elwell-Parker truck features are incorporated in the new design. This truck is claimed to be the largest capacity electric industrial crane truck manufactured.

NEW ELECTRIC CRANE TRUCK

Synopsis of Recent Chemical & Metallurgical Literature

Physico-Chemical Problems Relating to the Soil

The *Transactions* of the Faraday Society, vol. 27, part 2, reports a general discussion held on May 31, 1921. Following the introductory remarks of Prof. A. W. Porter and Sir A. D. Hall, are two papers by E. J. Russell and G. W. Robinson. Then come five papers on "Soil Moisture" by B. A. Keen, Prof. Sven Odén, C. A. Shull, Prof. D. R. Hoagland, and F. E. Haskett; three papers on "Organic Constituents of the Soil," by H. J. Page, S. Odén, and E. J. Salisbury; three papers on "Absorption Phenomena," by E. A. Fisher, E. M. Crowther, and C. G. T. Morison; and three papers on "Colloidal Phenomena," by S. Odén, N. M. Comber, and J. W. Mellor. A General Discussion of Capillarity comes next, with papers by Allan Ferguson, P. E. Dowson, and by F. C. Thompson.

The discussion of all these papers is particularly trenchant and admirable. We are too prone to accept without question the experiments, formulas, and conclusions of others, especially of those who have big reputations. It is only by continually questioning our own work as well as the work of others, all in a friendly and impersonal spirit, that we get a more perfect view of the total truth. It is surprising how new unsuspected factors will appear and modify our views and conclusions.

The papers bring out the three-cornered struggle for water between soil, plant, and atmosphere. If the plant transpires moisture more rapidly than the soil will give it up, the plant wilts. At the wilting coefficient, the soil withholds water from the plant with a force of about 4 atmospheres and there is always some water held by the soil despite the osmotic pull of the plant which usually runs over 7 atmospheres. A wheat crop usually transpires about 1,000 tons of water per acre. But the water moving to the roots must bring with it the necessary plant food, or the plant will not thrive. In none of the various papers is consideration given to the "capillary phenomenon" of Bechhold, about which there has recently been some discussion in *Science* between the reviewer and Dr. Frierson. Soluble salts in plaster of Paris, soil and similar capillary bodies, move toward the surfaces where evaporation occurs, and this seems to account in part for the fact that cultivation (tillage) helps plants in dry weather. For even though some soil water be lost by increased surface evaporation from the soil immediately adjoining the plant, the recent work of H. A. Noyes (*J. Ind. Eng. Chem.*, Feb., 1922) indicates that the plant actually transpires less water when the water is richer in food. The soil near the roots is enriched by the capillary rise of salts due to increased local evaporation, which curiously thus conserves the total soil moisture. Cultivation therefore allows moisture to accumulate in the soil when rain is plentiful. Furthermore, it tends to increase the speed at which water reaches the neighborhood of the roots, and thus wards off wilting.

The work of Bouyoucos on the condition of water in the soil should be of interest to those who think that all attraction of this kind is "chemical," especially since F. W. Parker recently showed (*J. Am. Chem. Soc.*, 1921, p. 1011) that finely divided insoluble substances depress the freezing point of water, benzene and nitrobenzene and concludes that "the force holding water or other liquid films on solid particles and causing a freezing-point depression is adhesion."

When humus exercises a deflocculating action, as in the presence of soda or similar alkali, the effect on the soil is bad, for the colloidal matter washes down and may aid in forming a pan. Lime (usually present) forms "calcium humate" which is insoluble and aids in giving soil the desirable tilth, or fine granular state best suited to plant growth.

The papers show that the prevailing view is that the soil is a mineral framework surrounded by a jelly-like layer. But there is conflict between the "chemical" and "absorption" theories of the breaking up of salts in soils. Dr. W. R. Ormandy in discussing Prof. Odén's view that the "breaking up by adsorption is highly doubtful," reported experiments made with pure china clay (aluminum silicate) chosen to minimize the number of variables. In estimating by electric conductivity the amount of alkali in excess of what the clay would adsorb (about 0.2 per cent), the usual type of curve was obtained when the voltage was under 1.68 volts. Above this the adsorbed alkali was set free, increasing the conductivity; but it is at once readsorbed. Is the caustic soda chemically combined with the clay? "We have found that clay which has adsorbed the maximum amount of caustic soda to leave a neutral solution behind it will not adsorb copper, nickel, or other salts, but that such clay not treated with caustic soda does adsorb metallic salts. Similarly clay which is saturated with caustic soda will adsorb quite a lot of phenolphthalein without, however, becoming in any way colored. If distilled water have clay suspended in it, and the mixture be titrated with caustic soda, alkali will be adsorbed and it will appear as though it were an acid, but if the alkali be estimated electrically, such adsorption will not be found if a voltage of over 1.68 be employed."

It will be interesting to see how these observations of Dr. Ormandy will influence our judgment as to what happens when proteins are brought to the isoelectric point, or their hydrogen ion concentrations are determined. The adsorptive action of soils is so powerful, that as Mr. Veen remarks in his paper, "It is quite an easy matter to remove liquid from soil, of course, but it is another matter to say whether the liquid so removed is a true sample of the soil solution as it exists *in situ*." Considerations like this are interesting in connection with experiments recently reported by Dr. J. Loeb wherein he decanted from swollen gelatine particles the supernatant fluid and then determined separately the hydrogen ion concentration of the gelatine and of the decanted fluid. It is a question as to how acid or alkali are fixed, not only by proteins but also by many other "amphoteric" substances, like clay. E. A. Fisher advocates the use of the term "sorption" as suggested by McBain, "a word which emphasizes our ignorance of the nature of many of these reactions and which does not commit us to any particular theory."

JEROME ALEXANDER.

Book Reviews

A MANUAL OF FLOTATION PROCESSES. By Arthur F. Taggart New York: John Wiley & Sons. 181 pages. Price $3.

The evident intention of the author has been to write a book for purposes of instruction in ore-dressing classes or for other students of flotation. From this standpoint the book is remarkably well written. It is divided into four chapters, consisting of an introduction, a chapter on laboratory testing equipment, a chapter on testing and a chapter on mill data. One other avowed purpose of the book is stated in the preface, "to counteract the further spread of false conceptions concerning flotation concentration, by setting forth some of the essential facts which contradict them." This statement immediately follows a condemnation of Minerals Separation for its policy of opposition to the spread of knowledge of the process and "their unfounded claims that all processes prior to that described in U. S. Patent 835,120 were laboratory curiosities or commercial failures and that those subsequently discovered were merely improvements of that process." Evidently with this in view, a very clear exposition of the different methods of flotation is given the division being made into skin flotation, (bulk) oil flotation and froth flotation. The author further subdivides froth flotation into pulp-body concentration processes and bubble-column processes. He claims that the concentration of flotative mineral particles onto bubble surfaces takes place in the body of the pulp in processes like the old style agitation Minerals Separation process, whereas in pneumatic machines of the Callow type, where a deep column of evanescent bubbles is formed the selection of flotative minerals takes place in the bubble column and the gangue drops out of it. The two chapters on laboratory testing machines and on testing are very well written and should be adapted to class instruction. The chapter on mill data contain

drawings of different types of commercial machines, typical flow sheets, formula for calculations involved in mill control and a few conversion tables. This book should fill the need for a laboratory manual suitable to college classes. A more extensive treatise on flotation is to follow in another volume.

OLIVER C. RALSTON.

WITHIN THE ATOM, a popular view of electrons and quanta. By *John Mills*. 215 pp., 5x7½ in. New York. D. Van Nostrand Co. 1921. Price $2.

As the name indicates, this little book is a Cook's tour through the new physics. Not the physics which we were taught in high school and college—the physics which had to do with matter in the aggregate, chunks of matter which you could weigh, energy waves which you could see, hear or feel, or electrical currents which you could measure—but the physics which has to do with matter (or is it energy?) in the ultimate, a subject which our ancestors might even call metaphysics.

At times the author appears in the pitiable plight of the Senator who is both for and against the bonus. He must talk to an audience which presumably knows no science, yet tell it of the speculations of the most scientific. So he explains the meaning of such terms as "component" and "absolute zero," and on the next page says "Ionizing impacts in a conducting gas usually remove a single electron from such stable structures as the inert atoms." On the horns of such a dilemma Mr. Mills stages about midway in the book a vaudeville stunt wherein Proton, Electron, Voice of Energy, Author and Reader—both scientific and general—crack jokes and jazz things up generally. This was so fatiguing that the remaining chapters were negotiated with difficulty.

On the whole, the book is an excellent illustration of the fact that its reaction on the reader depends a great deal upon his understanding of the subject. Chapters on the periodic table, radioactive disintegrations, X-rays and atomic numbers are clear and excellently written. On the other hand, equally skillful chapters on Isolating a Proton and Quantum of Energy are much harder reading—that is, to the present reviewer. Another whose general stock of information is more physical than chemical would doubtless reach exactly the opposite conclusion. In other words, if you already know something of the matter, the book will be interesting—if you don't, it will be pretty dry.

Well-informed people—be they engineers or just "folks"—will want to know something about the recently acquired information on the constitution of matter. Most of them will have to depend upon such books as this, and there is no reason why they should not start in on Mr. Mills' little book. But please don't let him get you worked over the fact that energy is no longer thought to be transmitted continuously—that is, by infinitesimal amounts. No, it is not so; it is reasonably certain it is discharged, in chunks, quanta, so called. A quantum may be as large as 5×10^{-12} erg; which of course is quite sizable to an active imagination!

E. E. THUM.

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTY. By *J. W. Mellor*, D.Sc. London and New York. Longmans, Green & Co., 1922. $20 net per volume. Volumes I and II.

The reader will find this review a distinctly prejudiced one. Some years ago we studied a book by Dr. J. W. Mellor called "Modern Inorganic Chemistry." In fact, we nearly memorized it. All the facts in inorganic chemistry which were not in that text, hung upon the outline presented in the book much as one hangs crystal balls and ornaments on a Christmas tree. Well, anyway, we passed the examination and that book has thus become associated with successful conquest. We love it and when we turn to review its big brothers we realize that we are inevitably prejudiced in their favor.

It can safely be said upon the evidence of the first two volumes that this monumentally conceived work is based upon the shorter text, "Modern Inorganic Chemistry." It gives the same perspective, the same development of the subject and to a large extent the same order of treatment, although it is of course expanded so that it gives the whole story and not a part of it. In general, the treatment of any subject is historical with the high points of fundamental research all mentioned together with original references thereto. The chronological development of each subject is stressed and numerous references within the last two years are evidence that the work is up to date.

We were amazed and altogether pleased to find that the text is readable. We had rather expected to find it simply a compilation of data, a somewhat elaborated Landolt-Boernstein. It is not that kind of a book at all. It is correctly named "a treatise," for it developes chemical theory according to a definite plan, much as a text book would.

It can hardly be considered a text book except for advanced students who will find it invaluable. As a reference book for studying the development of any subject in inorganic chemistry it is accurate and complete. It will undoubtedly have its greatest use in that capacity although we commend it most heartily to serious students of inorganic chemistry who desire to obtain a comprehensive idea of the subject.

Volume I contains a complete discussion of chemical theory developed systematically and as far as any given point is concerned chronologically. As mentioned above it follows the general plan of "Modern Inorganic Chemistry," and this presentation is excellent. We do not think it would be as good for elementary work as, for example, MacPherson and Henderson, but it is by no stretch of the imagination an elementary text book. Volume I also contains a discussion of hydrogen and oxygen and their properties at a point convenient to the better presentation of the gas laws. Volume II contains the halogens and the alkali metals.

The typography is good. The references to literature are all grouped at the end of each section and there are many points which commend this practice although in some ways it is not so convenient as including them as footnotes. The references are in excellent type, the names of the authors and the source being printed in different type as well as the volume numbers and date and page numbers. This makes it exceedingly easy to pick out references. In the text itself in discussing elements or compounds, the physical properties are printed in heavy type, that is to say, a sentence will begin, "The **density** of calcium chloride." This procedure is excellent and makes it extremely easy to locate the physical property in which one is particularly interested and to obtain data quickly and easily. So also in historical discussions, important words are printed in heavy type. In this respect the book is about as nearly perfect as any with which we have come into contact.

The dedication is interesting—"To the privates in the great army of workers in chemistry. Their names have been forgotten; their work remains." Of course the price of the book is rather prohibitive for the individual "private in the great army of workers in chemistry" and so its distribution will be largely in libraries of corporations, universities and technical societies, but its usefulness is great. Professor Mellor has rendered a great service and rendering that service will be his greatest reward unless it be the largely unvoiced thanks of the privates for whom he writes.

CHARLES WADSWORTH.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. Thirtieth annual edition for 1922. 2,324 pp. New York: S. E. Hendricks Co., Inc. Price, $15.

No more convincing proof of the fact that chemistry is an inseparable part of industry can be found than by a study of some comprehensive trade directory such as this new edition of Hendricks'. The products of the chemical and chemically controlled industries enter into practically every ramification of the manufacturing field. To be acquainted thoroughly with all these products as well as the raw materials from which they are derived is obviously beyond the ken of even the technically trained purchasing agent or sales manager. These are the men, however, for whom this book can render yeoman's service. Manufacturers and producers of chemicals and

cognate materials, chemical apparatus, equipment, machinery, containers—in fact, every requirement of the chemical industries—are adequately covered under a suitable heading and are conveniently cross-indexed under a half dozen others. Next comes the lists of hundreds of jobbers and dealers specializing in the sale of chemicals and chemical supplies. And last, but perhaps of most importance, are the consumers—from the smallest chemical laboratory to the largest industrial plant. Thus the picture of industry is complete, for we have production, distribution and consumption, from the crudest raw material to the most intricately fabricated finished product.

The outstanding improvement in the new edition is the change in the type page to the generally accepted standard size. In its new size the larger page (8½x11¼ in.) naturally carries more printed matter and gives a thinner book, which in turn is easier to handle. According to the publisher's statement in the front of the book the increased size of the page would normally reduce the number of pages from 2,800 to 2,100, but enough new material has been added to bring the total up to more than 2,300 pages. As in earlier volumes, the various sections of the book are prominently set apart by different coloring of the front edges of the pages. The first section (blue) is an index to trade classifications and in it every product listed in the book is indexed and cross-indexed for ready reference. This is followed by the classified trade (red) covering 17,145 different classifications. The third section (white) is an alphabetical list of about 20,000 trade names, private brands, etc., together with the name and address of the manufacturer. From personal experience and without hesitancy the present reviewer is willing to testify to the daily usefulness of this very important section. The volume is completed with an alphabetical list of all firms whose products are listed in the book, together with their addresses and principal business.

S. D. KIRKPATRICK.

Recent Chemical & Metallurgical Patents

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Potash From Silicates—This specification relates to the treatment of silicates, such as potassium-bearing silicates and clays, in order to recover their constituents in commercially available form. The silicate is fused with boron trioxide, or any substance that yields boron trioxide at a high temperature and the resulting melt suspended in water and treated with sulphur dioxide. Bisulphites of the metals present pass into solution, while silica remains undissolved and is filtered. The filtrate is boiled, whereupon sulphur dioxide is evolved, the bisulphites converted to sulphites, and aluminum precipitated as hydroxide. The precipitate is filtered and the filtrate boiled, in the presence of air, to oxidize sulphites to sulphates. At the same time any iron present is precipitated and filtered. The filtrate then contains sulphates of the alkali metals, if present, and boric acid. The constituents are separated by fractional crystallization, and the boric acid used again. (Br. Pat. 177,736. E. Levitt, Montreal. May 24, 1922.)

Bleaching Earths—The activity of bleaching earths comprising aluminum hydrosilicates, such as fullers earth and floridin earth is increased by treating them in the cold with dilute acid, such as hydrochloric or sulphuric acid of 1 per cent strength. The earth is afterwards filtered, washed with water, and dried. Known processes comprising cautious heating to expel hygroscopic water, or boiling for 2 hours with hydrochloric or sulphuric acid of 15 per cent strength to produce for example "Tonsil" or "Franconite" are referred to. (Br. Pat. 176,353. Not yet accepted. Schweizerische Sodafabrik, Zurzach. April 26, 1922.)

Hyposulphites — Hyposulphites are produced by reducing bisulphites by means of an amalgam such as sodium amalgam in the presence of an acid such as sulphurous, sulphuric, or hydrochloric acid. The quantity of acid added is preferably equivalent to the metal dissolved in the mercury. The amalgam may be produced electrolytically and led by a siphon to a closed vessel containing the bisulphite solution, the mercury being returned to the electrolytic cell. (Br. Pat. 176,344. Not yet accepted. Bayer & Co. Leverkusen. April 26, 1922.)

Metaldehyde — The stability under heat of metaldehyde prepared by the catalytic polymerization of acetaldehyde is improved by transforming the residual traces of catalyst into substances devoid of catalytic action or by eliminating any adhering paraldehyde. Thus, if sulphuric or hydrochloric acid has been employed as catalyst, a barium or silver compound respectively may be added; adhering paraldehyde may be removed by washing with acetaldehyde or by gently heating in *vacuo*. (Br. Pat. 176,319. Not yet accepted. Elektrizitätswerk Lonza, Basle. April 26, 1922.)

High Explosives—Crystalline compounds of the mixed crystals and double salts type containing the potassium salt of dinitrodinitrosobenzene and difficulty soluble salts of azoimide, tetrazol derivatives, or mono- or poly-nitrated phenols, for example lead azide, azotetrazol and tetrazylazoimide salts, trinitroresorcinates, and trinitrophloroglucinates, are employed for loading ammunition generally and as a top charge in detonators. (Br. Pat. 177,744. H. Rathsburg, Fürth, Bavaria. May 24, 1922.)

Activated Carbon—Consists in subjecting wood charcoal to a partia vacuum, impregnating with alkali caustic or carbonate, heating to a high temperature such as a bright red hea and extracting the alkali. In an ex ample, 200 parts of wood charcoal ar subjected for half an hour at 20 deg C. to a vacuum of 720 mm. of mercury and then impregnated with a solution of 250 parts of potassium carbonate i 250 parts of water. (Br. Pat. 179,108 W. Carpmael, London. June 21, 1922.)

Formaldehyde—Formaldehyde is ob tained by passing a mixture of ace taldehyde and oxygen, air or othe oxygen-containing gas over a heate catalyst, especially a metal or a meta oxide; suitable catalysts are copper silver, or other metals forming easily reducible oxides, and also oxides o metals forming several oxides, for in stance, vanadic and cerium oxides steam or indifferent gases may be pres ent. According to an example, ai containing acetaldehyde is led over coil of copper wire netting and the into water. Unchanging acetaldehyd is separated by fractional distillatio from the solution of formaldehyde ob tained. (Br. Pat. 178,842. Not ye accepted. Consortium fur Elektro chemische-Industrie Ges., Munich. Jun 21, 1922.)

Borneol and Camphor—Borneol i obtained by treating pinene hydro chloride with a hydroxide, such a calcium hydroxide, or with boilin water.

Camphor is produced from pinen hydrochloride by simultaneous treat ment with an oxidizing agent and "dehydrogenizing" substance. Metall oxides and peroxides, such as iro oxide and lead peroxide, are given a examples of oxidizing agents; bisu phates, such as potassium bisulphat and bicarbonates are mentioned a "dehydrogenizing" substances. Cam phor may also be produced by treatin borneol with a peroxide or the lik (Br. Pat. 178,797. Not yet accepte A. Gawalowski, Brünn, Czecho-Slovak and L. Kutter, Vienna. June 21, 1922

Plastic Composition—A plastic com position for covering walls, floor and other surfaces and for makin moulded articles consists of 33 lb. magnesite rendered caustic, 11 lb. wood-meal, and 5 lb. of limestone me mixed into a stiff paste with a 20 p cent solution of magnesium chlorid 2½ lb. of talc and 2½ lb. of colourin matter may be added to the ingredient An imitation marble is produced rubbing the paste through a 1 c sieve to produce granules, mixing d ferently-coloured granules together a subjecting to pressure. When used f covering floors, tables, etc., the co position is applied to a backing consi ing of a wooden framework interstic of which are filled with a mixture wood-meal, magnesite, and magnesiu chloride solution. (Br. Pat. 178,880. Chesterton, St. Margarets-on-Tham June 21, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Grand Jury Investigates Chemical Foundation

Manufacturers Express Confidence in Administration of Foundation and Point Out Baleful Effect in Administration of Foundation ment of Justice Interprets Government's Action

THE Grand Jury investigation of the Chemical Foundation is under ay. Mr. Garvan and the books of the oundation are in Washington. Im-ortant developments were lacking dur-g the past week. The demand of the resident, the charges of German influ-ıce by Mr. Garvan and the instigation criminal proceedings against the oundation followed each other like many bombshells. Now, apparently, ıe fireworks are over for the present. the meantime, however, the industry a whole, having recovered somewhat om the shock, is beginning to figure ıt the ultimate results of the whole fair.

Formal Refusal by Garvan

As previously announced by Mr. Gar-ın, the Chemical Foundation has no tention of complying with the Presi-nt's demand. In a letter transmitted Alien Property Custodian Miller, Mr. ırvan officially proclaimed this stand. ıe text of the letter follows:

Hon. Thomas W. Miller.

Dear Sir:—This will acknowledge the receipt of your communication dated July 6, 1922, demanding that this company return and deliver to you all patents, trade-marks and copyrights heretofore assigned to this company by the Alien Property Custodian, that the company account to you for all income received by it from such patents, trade-marks and copyrights, and that the company forthwith cease to exercise any dominion over such trade-marks, copyrights and patents.

In reply thereto you are advised that this company is the owner, in its own right, of all the aforesaid patents, trademarks and copyrights and of the income derived therefrom. The company denies that the United States Government, or you, as Alien Property Custodian, or any one other than this company has any right, title or interest in said patents, trade-marks and copyrights. The company, therefore, declines to comply with your demand in any particular whatsoever.

The communication was signed by r. Garvan as president of the Founda-n and William D. Guthrie as counsel. The Foundation president also sent long letter to the Chief Executive ex-aining his position and that of his mpany. The letter, which is dated ly 14, says that "the American pub-, in whose interests this corporation as organized, is entitled to be fully informed as to the circumstances under which this demand was made and the reason why it is unqualifiedly refused."

"The Alien Property Custodian," continues the letter, "stated no authority or reason for his demand for the entire property and assets of this corporation for an accounting of all its past business and for the entire cessation of its activities, except that he was acting by your express direction. I am therefore compelled to imply that he was acting under the letter given out by you and the statement of the Attorney General accompanying it.

"These two papers demonstrate that you, Mr. President, have been grossly misled by the Attorney General, both as to the law and the facts of this case."

Mr. Garvan then quotes at length from a report of A. Mitchell Palmer dated Feb. 22, 1919, in which Mr. Palmer announced the sale of 4,500 patents for $250,000 and announced that the new company would be able "to commence immediately and prosecute with the utmost vigor infringement proceedings whenever the first German attempt shall hereafter be made to import into this country." In the Palmer report he referred to Mr. Garvan, the first president of the Chemical Foundation, saying of him " * * * to whose vision and indefatigable industry I am chiefly indebted in the working out of this plan."

Mr. Garvan's letter to the President continues:

"Note that at the time this was written I was a dollar-a-year man, with no expectation of becoming Alien Property Custodian, and at a time when I thought my own war services were over and I was about to return to New York to resume my law practice."

The letter includes a summary of the finances and activities of the Foundation.

Manufacturers Back Foundation

"Nothing could be more disastrous to the American industry than the return to the former German owners of the patents now owned by the Chemical Foundation; nothing could be of greater aid in restoring to the German chemical cartel the monopoly formerly enjoyed." Such is the statement in a memorandum submitted to the President at a conference at the White House by a delegation of representative manufacturers of dyes, medicines and other synthetic organic chemicals.

The committee which conferred with the President included Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association of the United States; C. N. Turner, Newport Chemical Works, Passaic, N. J.; Alfred S. Burdick, The Abbott Laboratories, Chicago, Ill.; W. T. Cashman, Grasselli Chemical Company, Cleveland, Ohio; Samuel Isermann, Chemical Company of America, New York City; Charles A. Meade, E. I. duPont deNemours & Co., Wilmington, Del.; August Merz, Heller & Merz, Newark, N. J.; James T. Pardee, Dow Chemical Co., Midland, Michigan; Fred E. Signer, Butterworth-Judson Corporation, New York City; Herman Seydel, Seydel Manufacturing Co., Jersey City, N. J.; Franklin P. Summers, Noil Chemical & Color Co., New York; Salmon W. Wilder, Merrimac Chemical Co., Boston, Mass.; Edgar F. Queeny, Monsanto Chemical Works, St. Louis, Mo.; George A. MacIntosh, Butterworth-Judson Corp., New York, and Edward S. Rogers, The Bayer Company, New York City.

The statement points out that prior to the war there was practically no organic chemical industry in the United States; this was almost wholly controlled by the Germans and commodities necessary to the safety of the nation and the health and prosperity of the people were solely in their hands. The Germans took out many thousands of patents in the United States. They never exploited them. The sole purpose in holding these patents was to prevent the American manufacturer from building up an organic chemical industry.

The statement submitted by the manufacturers included a review of the circumstances leading up to the organization of the Chemical Foundation and the sale of the siezed property to it by the Alien Property Custodian. It was pointed out that the main consideration in the transaction was the assurance that these patents were to be held in trust for the benefit of the American people by the Foundation. They are non-exclusive in character and license to operate under them is open to every American citizen.

The American manufacturers who have taken out licenses had implicit faith in the authority of the United States Government to make the sale to the Chemical Foundation. Relying upon this authority and believing that the Government desired to foster and encourage an industry vital to the

needs of the country they have invested over $100,000,000, and this will be entirely lost to them, and the loss to the country irreparable if these patents are restored to the Germans.

The attitude of the organic chemical manufacturers toward the administration of the Chemical Foundation is evidenced by the resolution passed by the Board of Governors of the Synthetic Organic Chemical Manufacturers' Association at the meeting held on July 11, 1922, which "expresses (1) its appreciation of the patriotism and forethought of those representatives of government and industry who conceived this plan; (2) its entire confidence in the administration of the affairs of the Chemical Foundation; (3) and records its appreciation of the personal sacrifices of the Foundation's president, Mr. Francis P. Garvan, who, at the solicitation of the founders of the organic chemical industry in the United States, accepted the presidency of the Foundation at its inception and since that time, without remuneration, has administered disinterestedly its affairs in behalf of the welfare of the people of the United States."

Department of Justice Statement

The Department of Justice has issued a statement relative to the government's purpose in proceeding against the Chemical Foundation. Officials of the department say that representatives of the German cartel, comprising the organic chemical industry of Germany, called at the Department of Justice recently relative to thirty-odd suits to be instituted by them against the government on behalf of their clients, but that they had absolutely nothing to do with any action of the department against the Chemical Foundation. It was pointed out that the Department of Justice had been investigating the transaction between the Alien Property Custodian and the Chemical Foundation for many months prior to the arrival of the German representatives, as Mr. Garvan and his associates well knew, and prior to the action of the Chemical Foundation in precipitating an unexpected situation by bringing sixty-seven suits against the government, involving a very large sum of money.

It is pointed out that the return of these patents to the Alien Property Custodian would in no sense benefit the former German owners or interests. The action taken by the government has been wholly in the interest of the government itself. The disposition of these patents after return to the Alien Property Custodian, as well as all enemy property held by him, must be determined by action of Congress.

Civil Service Openings Announced

The U. S. Civil Service Commission has announced an open examination for a microscopist to fill a vacancy in the Public Health Service in Memphis, Tenn. Applications should be made on form 1312 to the Civil Service Commission

Preliminary Program Announced for Fall Meetin of American Chemical Society

Two Thousand Members Expected at Pittsburgh Convention in September—Strong Technical Sessions Scheduled but Entertainment Features Not Neglected

THE preliminary program for the Pittsburgh meeting of the American Chemical Society, which will be mailed to members the latter part of this week, gives promise of a splendid success. All of the regular divisions of the society and the five sections are planning extensive programs. The central location of Pittsburgh augurs well for the attendance and officers of the society estimate the probable attendance at 2,000. With the Chemical Exposition in New York the following week and the American Electrochemical Society meeting in Montreal after that, the month of September should be an outstanding one in the chemical field.

Bargain Railroad Rates

The peculiar satisfaction that everyone experiences in getting a free ride on a "common carrier" will be the lot of each member who makes the trip to Pittsburgh, in some degree, at least. In view of the expected large attendance the railroads have agreed to sell round trip tickets at one and one-half fare on the certificate plan, the intricacies of which are too well known to be described here. Nevertheless, it will make a much more presentable expense account for members coming from a distance and those who were disappointed in the failure of the required number to register at Birmingham last spring will be pleased to know that this economy is assured.

The official registration at the meeting will begin Monday afternoon, Sept. 4. Pittsburgh's well known hostelry, the William Penn Hotel, will be headquarters for the registration and for the council meeting, which is scheduled for the same evening. The Duquesne Club has thrown open its doors to the councillors, who with their wives will be entertained there at dinner, Monday evening, after which theatre parties have been arranged for the ladies.

General Meetings

The first general meeting will be held at Carnegie Music Hall on Tuesday morning. Prominent local officials will extend greetings and welcome to the visiting members and Edgar F. Smith, president of the Society, will respond—a prospect that will appeal to anyone who has had the pleasure of hearing Dr. Smith on similar occasions. Included in the formal addresses at this session will be two dealing with Pittsburgh as an industrial center. J. H. James will describe the historical and industrial features of the city and W. F. Rittman will discuss the phases of finance and transportation.

The second general meeting, the same afternoon, offers a program that could be equalled only with difficulty as fa as the variety and current interest the topics scheduled are concerne No research conducted in the past ye has stimulated more general intere or appealed more to the practical si of technologists than has the extensiv work of the General Motors Corpor tion on motor fuel and anti-kno compounds. Thomas Midgeley, Jr. a T. A. Boyd, both of whom have be directly connected with these invest gations, are to present a paper "The Chemical Control of Gaseo Detonation with Particular Referen to the Internal Combustion Engine The talk will be illustrated with slid and with the ingenious apparatus us in the experimental work.

E. J. Crane, editor of *Chemic Abstracts*, will present a paper "The Journal Literature of Chemistry

Wilder D. Bancroft is scheduled f a discussion of his novel conception "Structural Colors in Feathers." Tho who have been fortunate enough hear Dr. Bancroft's talk on "Bl Eyes and Blue Feathers," at vario sectional meetings will appreciate opportunity to listen to a further e position of this fascinating topic in t inimitable manner of Cornell's di tinguished exponent of colloidal che istry.

Divisional Meetings

As stated above, the twelve divisio of the Society are arranging extensi programs for Wednesday and Thu day. In addition, the technical sessio will be augmented by the convening five sections, including the new formed section of gas and fuel che istry. All these sessions will be h at Carnegie Institute of Technolo Of special interest to the engineer v be the symposium before the Divis of Industrial and Engineering Che istry on "Automatic Process Contr The chairman, L. W. Parsons, has ranged with various authorities to p sent papers, many of them illustrat bearing on the fundamental and pr tical aspects of the subject.

The Water, Sewage and Sanitat Division will discuss the specificati for lime for water treatment as feature of the meeting. Under chairmanship of David Wesson, Biological and the Agricultural Food Chemistry Divisions will hol joint symposium on the subject "Fatty Foods." In view of the re developments in the study of vitam at Johns Hopkins, this meeting sh prove of timely interest. Papers d ing with the preparation, purificat digestibility and adulteration of var fatty foods are being solicited for symposium.

The Rubber Division is planning an exceptionally live program, as the proximity of Pittsburgh to the center of the rubber industry will facilitate the attendance of representatives of the industry. The Leather Division has scheduled a symposium on gelatine and collagen. An important phase of the dye industry and one which has not previously received a proportionate share of attention, will be discussed by the Dye Division—"The Chemistry of the Application of Dyes." The Division of Physical and Inorganic Chemistry will hold a symposium on "Recent Advances in Applied Colloid Chemistry."

The Petroleum Section hopes to perfect its divisional organization at this meeting as provided by the Council at Birmingham last spring. The feature of the technical sessions will be a discussion of "Lubrication from the Chemist's Viewpoint." As previously announced in these columns, the newly-formed Gas and Fuel Section has arranged a symposium on "Combustion" under the chairmanship of R. T. Haslam, of Massachusetts Institute of Technology. The Cellulose Section has a number of papers on live topics on its projected program including "Co-operative Research Problems in Cellulose Chemistry," "The Nature of Oxycellulose and its Bearing on the Artificial Silk, Viscose and Paper Industries," "Dr. Tingle's Proposed Bromine Number" and "The Absorption of Salts by Cellulose." The Sections of Chemical Education and the History of Chemistry will be watched with more than usual interest in view of recent educational developments.

Social Activities

The usual smoker, with unusual features (as yet obscure in the carboniferous atmosphere of the Smoky City) is planned for Tuesday evening at the commodious Syria Mosque. Being strictly a "stag party" the ladies will be entertained that evening at Carnegie Institute of Technology, where the Drama School has arranged to present a play for their special benefit.

Nor will the fair guests be given opportunity for thumb-twiddling during the divisional meetings for they are to be the guests of the Heinz factory on an inspection trip and at luncheon which will include the majority of the 57 varieties. In the afternoon a musicale at the Century Club has been arranged for their entertainment.

The public meeting, Wednesday evening, at Carnegie Music Hall will be followed by a reception. On Thursday evening, the University of Pittsburgh Faculty Club has arranged for supper and garden party.

Trips

The trips to nearby industrial establishments which are scheduled for Friday and Saturday will include visits to the famous steel mills in the vicinity and numerous other chemical industries which cluster about this city of industrial activity.

All Muscle Shoals Offers Rejected

Committee on Agriculture Turns Down Ford Offer with Others—Minority Reports To Be Submitted

All of the offers for the Muscle Shoals nitrate plants and power site were summarily disposed of by the Senate Committee on Agriculture on June 15, when that body rejected Henry Ford's offer by a vote of 9 to 7. The Alabama Power Co., the Engstrum and the Parsons offer were turned down without the necessity for a roll call. Senator Norris' proposal for the government operation of the plants met a similar fate.

Senator Ladd, who voted for acceptance of the Ford offer, was authorized to draw up the minority report in favor of that proposition while Chairman Norris will write the report urging approval of the government-owned corporation plan. Both reports, it was said, will probably go to the Senate in the coming week, although it is not believed that any action on either of them will be taken at this session of Congress.

Fire in Subway Brings Chemistry Home to Public

Fumes Liberated by Carbon Tetrachloride Extinguishers Overcome Scores of Straphangers in New York

The recent fire in the New York subway, during which one hundred and fifty persons were overcome by the fumes evolved by the volatilization of carbon tetrachloride has given rise to considerable comment on the part of the public and the daily press. As is usual in incidents of this kind, the newspapers carried lurid descriptions of the "acrid fumes of carbon dioxide" and other novel and revolutionary conceptions of elementary chemistry.

Making due allowance for the natural effects of the excitement incident with such an occurrence, it is fairly well established that a number of the victims were actually affected to a certain extent by the gases evolved from the use of carbon tetrachloride fire extinguishers. Fortunately, no one was seriously disabled. The occurrence served to emphasize the danger of the unintelligent use of this very efficacious material. Work by the Bureau of Mines has demonstrated that the decomposition products of carbon tetrachloride consist of phosgene, hydrochloric acid gas and sometimes chlorine. In addition, high concentrations of tetrachloride vapor are formed when the liquid is sprayed on a heated material. Death may be caused by breathing the gases for only a short time. It is obvious that the danger of such an occurrence is considerably greater in a confined space where there is not opportunity for the diffusion of the noxious gases.

A report issued by the Bureau of Mines, written by A. C. Fieldner, S. H. Katz and S. P. Finney, contains the results of the work done by the Bureau on this subject. The following extract is offered as an authoritative statement on a subject which vitally concerns the public welfare.

> Seven to nine per cent of carbon tetrachloride vapor mixed with air will extinguish fires. The heavy vapor tends to settle to the bottom of a room and forms a blanket on the floor.
>
> This blanketing effect on any material wet with carbon tetrachloride excludes air and so aids in extinguishing fires.
>
> Undecomposed carbon tetrachloride vapor, arising from the use of the liquid in fire extinguishers when encountered in a small, confined space will probably produce unconsciousness by its anaesthetic effect. The commercial product usually contains some carbon bisulphide, a residue of the carbon bisulphide used in its manufacture. Waller and Veley have found that the presence of carbon bisulphide vapor with that of carbon tetrachloride greatly increased the toxicity, but comparatively large amounts of the carbon tetrachloride vapor must be breathed before the effects become more dangerous. For this reason the more serious danger in the use of carbon tetrachloride lies in the products formed from it rather than from the vapor itself.
>
> An employee of the Bureau of Mines was overcome while using a carbon-tetrachloride fire extinguisher on an automobile burning in the open air. Two employees of the Navy Department died as the result of breathing fumes from carbon-tetrachloride that had been used when the clothes of one of them caught fire when the men were working in a very small compartment.
>
> Care must therefore be observed in the use of fire extinguishers of the carbon-tetrachloride type in underground fire fighting. Such extinguishers are in common use for putting out fires in and around electrical equipment, for carbon-tetrachloride is a non-conductor of electricity, and, indeed, such extinguishers should be a part of the equipment of all mine locomotives. The operator need not inhale the fumes, as electric locomotives usually are in well-ventilated entries or haulageways.

Steps have been taken to prevent a re-occurrence of such an accident by the removal of this type of extinguisher from subway cars in New York.

Sulphuric Acid Plant Built in India

The Dharamsi Moraji Chemical Co. has built a sulphuric acid plant of 7,500 tons per annum capacity. This is the largest plant of its kind in India. It is reported that the factory will also manufacture superphosphates and the results are being watched with the greatest interest. This factory is one of the first built in the new Ambernath area on the G.I.P. Railway which is being developed by the Bombay Protectorate.

Senate Votes Down Dye Embargo

Bolt of Republicans Kills Finance Committee's Recommendation—Sentiment of Legislators Believed Influenced by Chemical Foundation Trial

TO THE surprise of each party to the dye embargo controversy, the Senate, on July 15, voted down the proposal of the Committee on Finance to continue in force for one year after the passage of the tariff bill the embargo provided in the dye and chemical control act approved May 27, 1921. The vote was 32 for the embargo and 38 against. It is believed that the action of the administration in proceeding against the Chemical Foundation influenced a number of Republican senators to vote against the embargo. An informal poll of the Senate, less than a month ago, showed a margin of 3 votes in favor of the embargo.

While Senator McCumber, the chairman of the Finance Committee, made it very clear before the vote was taken that the embargo and the patent situations are entirely distinct, it is believed that fact was not brought home to certain senators who apparently made an eleventh-hour change in their attitude. The fight is not over. Senator Frelinghuysen gave notice that he will demand another vote on the proposal when the bill is considered in the Senate proper. This vote was taken in committee of the whole.

Herty Optimistic of Final Vote

Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers Association, characterized the action of the Senate as a severe blow to the American industry, but he believes the real test, whether America wishes to preserve its dye industry or turn it back into German hands, will come on the forthcoming vote. Continuing, Dr. Herty said:

"An analysis of the vote, to my keen regret, shows a solid Democratic vote against the embargo, in spite of the unanimous approval of this measure by consumers of dyes throughout the South. On the other hand, the division in the Republican vote, fourteen having voted against the embargo, shows clearly that there has been confusion of thought between two issues, patents and embargo, which logically have no connection in the consideration of this measure, as was so ably pointed out by Senator McCumber. I confidently believe that this confusion of thought will disappear and that when the measure comes before the Senate again it will receive that certain majority support which was so clearly evident before this question of patents arose."

The vote on the embargo paragraph was preceded by vitriolic attacks on the American dye industry by Senator Moses and by Senator King. Senator Moses said that if the embargo remains in the bill "we shall go before the country convicted of surrendering to an iniquitous, imprudent and avaricious monopoly." His attack on the American industry extends through 28 pages of the Congressional Record. Senator King's attack, which was largely a reiteration of his oft repeated charges, continued for nearly three hours.

Senator Shortridge, of California, told the Senate that after the extended and painstaking investigation which he conducted on behalf of the Senate, there was nothing disclosed to indicate that there is anything even approaching a monopoly in the domestic dye industry. In announcing his forthcoming report on the subject, Senator Shortridge addressed himself to Senator King and stated that, in making his conclusions, he would not rely upon rumor, and that he would not draw upon his imagination.

Sentiment in Favor of Embargo

The principal address presenting arguments in favor of the embargo was that of Senator Frelinghuysen, who took the floor at the end of Senator Moses' speech. He prefaced his remarks by stating that his speech had not been prepared for him by some one entirely familiar with these technical questions. The theme of his address is well set forth in the following brief extract:

"My fight for a dye embargo and my insistence upon its continuance is based upon two motives — first, to protect and continue the industry in my state and secondly, because I believe it is absolutely essential for the national defense, as I read the history of the war and what was accomplished by Germany by reason of her advanced position in chemical manufacture. This is a great question for the Senate to decide at this time. The only harm that will come from a dye embargo is to the German industries — the German cartel that furnished Germany with all her chemicals and ammunition during the war. If we make a mistake now and lift this embargo, it may destroy, and probably will destroy, this great industry, which was created during the war by the men of energy and genius who had the courage and the ability quickly to provide our armies with the necessary materials with which to meet the onslaught of Germany.

"There is just one question involved. Inasmuch as the former President of the United States, Mr. Wilson, recommended the embargo, since President Harding has recommended its continuance, and every Cabinet officer and military officer who is familiar with the situation and every man who has studied it makes similar recommendations, the question which we have to decide as to its continuance is whether we are going to stand for America first or for 'Deutschland uber Alles'."

Before the vote was taken, Senato McCumber made the following state ment:

"The only question before the Senat is the question of the embargo upo dyestuffs. On that subject there was disagreement in the committee itsel One thing we do know, that prior t 1914 a foreign nation, a foreign peopl furnished practically all the dyestuff for American manufacturers.

One thing we do know and that i that after we were engaged in the wa we found ourselves entirely cut off, o almost entirely cut off, from the dy products. We found, in addition, tha we had to pay many times the pre-wa value of our dye products. We the came to the conclusion that it wa necessary to develop the dye industr in the United States. The previous ad ministration inaugurated the idea o the use of the licensing system fo the development of the dye industry We followed along that pathway an along the previous idea of the Demo cratic administration and in our emer gency tariff law we provided for a embargo. How long the embargo shoul continue is, after all, a question to b determined by the Senate. We agree that it should be continued for anothe year. We know that as a rule, not withstanding the embargo, the price of dyes have gradually gone down fro the highest peak until now they ar only about 50 per cent of the hig prices of 1917.

It may be with the protection w have given them, the dye people will b able to continue to produce but, Mr President, I think in some instances the will not be enabled to continue the pro duction without the embargo for a brie length of time. That, after all, is th only question before the Senate toda not the trial of the Chemical Founda tion but the determination whether o not we desire to continue the dye in dustry in the United States an whether or not the duties that we in posed are sufficient, and if not su ficient for a space of one year, whethe we had better maintain the prese embargo. To that subject I wish v could direct our attention rather tha to be misled and drawn away fro the real question by a trial of a matt which is not before the Senate."

Society of Industrial Engineers To Meet in New York

The next national convention of t Society of Industrial Engineers will held in New York City, Oct. 18, 19 a 20 at the Hotel McAlpin. In conjur tion with the 3-day convention the will be an exhibition of labor-savi equipment. The business meetings w be held in the ball room of the ho and the exhibition in the Wint Garden.

The official program and the list speakers and their topics will not ready for distribution before the mid of September. The general topic discussion, however, will be "The E nomics of Industry."

Standard Oil Co. Called Monopoly but Proof Against Law

The Federal Trade Commission has sent to Congress a report on conditions in the petroleum trade in Wyoming and Montana. This report summarizes the important facts developed through an inquiry into the conditions of the petroleum trade in those states made pursuant to a complaint of the Montana State Railway Commission regarding gasoline prices.

The margins between the wholesale and retail gasoline prices at numerous points in Montana ranged from 5 to 10 cents per gallon, but these unusually large margins were in all cases obtained only by the smaller retailers. The wholesale and retail prices of the large marketing companies were usually identical at points taking the same freight rates and price changes were made by them at practically the same time. No evidence was found, however, which indicated a conspiracy among these large companies to fix prices.

Although the prices of high-grade crude petroleum were lower in Montana and Wyoming than in any other crude-producing states in the country, the refinery prices of gasoline and kerosene were much higher than at Mid-Continent refineries. The Midwest Refining Co. is owned by the Standard Oil Co. of Indiana and produces more than 90 per cent of the gasoline and kerosene refined in the entire Rocky Mountain territory. The Midwest Refining Co. also charges higher prices for gasoline shipped into Montana and adjoining Rocky Mountain states than for shipments made in states adjacent to the Mid-Continent oil field.

The unsatisfactory situation in Montana and adjacent Rocky Mountain states is evidently due to the fact that the oil trade in this region is practically monopolized by Standard Oil interests. This monopolistic position was perfected in 1920 and 1921, when the Standard Oil Co. of Indiana secured control of the Midwest Refining Co. and acquired a one-half interest in the Sinclair Pipe Line Co. and the Sinclair Crude Oil Purchasing Co. Sinclair interests have recently obtained important leases in the Teapot Dome of the Salt Creek field in Wyoming.

The conditions in other sections of the country are not radically different from those in the Rocky Mountain region. Today the entire country is divided into 11 Standard gasoline marketing territories in which a Standard marketing company is the dominating factor and in which there is no real competition between the various Standard units. This monopolistic situation is possible under the terms of the Standard Oil dissolution decree, by which the different Standard companies are, for legal purposes, supposed to be strangers to each other, but, there is, as is generally known, an interlocking stock ownership in the different organizations which has perpetuated the very monopolistic control which the Court sought to terminate.

The Commission is of the opinion that this situation cannot be effectually remedied by existing laws and that adequate relief can only be secured through additional legislation. It recommends, therefore, that Congress pass a law prohibiting common stock ownership in corporations which have been members of a combination dissolved under the Sherman law.

Electrochemists Organize to Stir Public Interest

On June 29 the local committee which so successfully handled the recent meeting of the American Electrochemical Society in Baltimore met for luncheon at the Hotel Emerson and decided to make the committee a permanent organization with the following objects:

1. To promote good fellowship among its members.
2. To arouse interest among the public at large in things electrochemical.
3. To act as an informal clearing house on electrochemistry with a view to attracting new electrochemical industries where possible to the Baltimore district.

W. H. Boynton, analytical chemist of the Crown Cork and Seal Co., was made permanent chairman. Other members are Ernest B. Miller, operating vice-president of the Davison Chemical Co.; F. M. Boyles, McCormick & Co.; Richard K. Meade, consulting chemical and industrial engineer of Richard K. Meade and Co.; A. E. Marshall, consulting engineer; C. C. Thomas, Williams and Wilkins Co.; W. C. Moore, research chemist of the U. S. Industrial Alcohol Co.; A. L. Browne, chemist; S. T. Powell; W. H. Stone, *Manufacturers' Record;* E. W. Rouse, assistant superintendent, Baltimore Copper Smelting and Rolling Co.; R. G. Gerhardt and R. H. Tillman, manager, new business department, Consolidated Gas, Electric Light and Power Co.

Citro Chemical Co. Wins Case

The Citro Chemical Co. has been upheld by the United States Court of Customs Appeal in its abandonment of a shipment of 168 casks of citrate of lime which had been damaged by sea water while en route from Messina. The law provides that notice of abandonment must be filed within ten days after the entry of merchandise. The invoice and the declaration were filed a month in advance of the arrival of the shipment. Since the declaration contains the perfunctory statement that the merchandise has arrived, it was contended that the chemical company could not have recourse to abandonment. The court holds however, that the actual date of entry must govern and since the notice was filed within ten days after the actual entry of the ship carrying the merchandise, the chemical company's contention must be sustained.

A.C.S. Alcohol Committee Secures Government Support

Martin H. Ittner, chief chemist of Colgate and Co., of New York, chairman of the Industrial Alcohol Committee of the American Chemical Society has announced that Wayne B. Wheeler of the Anti-Saloon League has assured him that the League will not attempt any new restrictions without first consulting the A. C. S. Alcohol Committee.

Dr. Ittner's Statement follows:

The Industrial Alcohol Committee believes in a literal interpretation of the 18th Amendment, also that no authority is conferred thereby to prohibit the manufacture, sale, transportation, importation, or exportation of intoxicating liquors for other than beverage purposes.

The main thing that the Committee on Industrial Alcohol is interested in and a thing that we are vitally interested in, is that there shall be no prohibition of alcohol either pure or in liquors where it is intended to be used for other than beverage purposes, i. e., for industrial and legitimate uses.

We recognize the necessity of laws and regulations to control these matters and we desire to see these laws and regulations as little burdensome as possible while accomplishing their proper purpose. We stand ready to give what aid we have, or can enlist, to the support of the Government in advising them with regard to laws or regulations that would prohibit or unduly restrict the proper use of alcohol.

Mr. Wayne B. Wheeler, counsel for the Anti-Saloon League, has assured me that they would not seek to pass any new laws or have any new restrictive regulations drawn up without first seeking our advice and that of representatives of the industries.

The trouble with the national prohibition act is in its improper enforcement. Title III which provides for the industrial use of alcohol, though equally as important as other portions of the law, has not been given the attention and recognition by enforcement officers that it should have had and to this extent industry has suffered.

The prohibition forces ought to see that every unnecessary restriction imposed on industry reacts through public opinion against them.

The statement also points out the undisputed right of Congress to regulate intoxicating liquors.

Progress in Investigation of Fluorspar Industry

The general investigation of fluorspar mining, milling and utilization problems is progressing rapidly through the field work of R. B. Ladoo, Bureau of Mines. Mr. Ladoo has completed field studies in the West and within a short time will have visited the eastern deposits of this mineral. It is planned to gather very complete information regarding methods of utilization of fluorspar and the specifications and requirements as to quality of this material.

Poison Gas Officially Tabooed by Army

War Department Orders Discontinuance of Manufacture Except for Research and Defense

The War Department's interpretation of the gas treaty adopted by the arms conference provides for the discontinuance of the manufacture of poison gas except in limited amounts for research and development of defense appliances. The definite announcement took the form of a general order signed by General Pershing as Chief of Staff, by direction of Secretary Weeks. The order follows:

> In order that the United States may carry out the provision contained in Article V of the treaty in relation to the use of submarines and noxious gases in warfare, signed, Feb. 6, 1922, and ratified by the United States Senate, March 28, 1922, the following limitations will be observed in connection with the procurement, design research, development and supply to cehmical warfare materials as given in Section III, General Orders No. 54, War Department, 1920.
>
> The investigation, development, procurement, manufacture, or supply of poisonous gases for the present will be limited strictly to the amount necessary for the research and development of gas-defense appliances.
>
> The filling of all projectiles and containers with poisonous gas will be discontinued, except for the limited number needed in perfecting gas-defense appliances.

MODIFICATIONS IN TRAINING

Another modification of existing regulations concerning the training of the army in chemical warfare was provided in another order confirming the use of smoke, incendiary materials and non-toxic gas for training and gas-defense appliances.

This order then directs that there shall be a special service school at which specified officers and non-commissioned officers of the army and the National Guard shall be trained. Provision is made for chemical warfare personnel as instructors in defensive chemical warfare at general service schools and at certain special service schools, and for representation on the staffs of departments, corps areas and divisions.

FUNDS AVAILABLE TO C. W. S.

The War Department appropriation bill which has been passed by Congress and approved by the President authorizes construction work at Edgewood Arsenal to cost $262,000. For administrative expense the Chemical Warfare Service is allowed $17,240 and $600,000 for investigations.

New Potash Fertilizer

A new potash fertilizer has recently been introduced in Sweden under the name "Electrokali." The material is the finely-ground slag from the electric-furnace manufacture of ferro-silicon from feldspar and iron turnings.

Salt Producers Association Restrained from Price Fixing

The Federal Trade Commission has issued an order to cease and desist against The Salt Producers Association, of Detroit, and the following members thereof: Michigan Salt Association, of Saginaw, Mich.; Michigan Salt Works, of Marine City, Mich.; International Salt Co. of New York, Scranton, Pa.; Worcester Salt Co., of New York City; The Colonial Salt Co., of Akron, Ohio; Morton Salt Co., of Chicago, Ill.; Ohio Salt Co., of Wadsworth, Ohio; Diamond Crystal Salt Co. of St. Clair, Mich.; Cutler Magner Co., of Duluth, Minn.; Union Salt Co., of Cleveland, Ohio; Stearnes Salt & Lumber Co., of Ludington, Mich.; Carey Salt Co. and Barton Salt Co., of Hutchinson, Kansas; and Mulkey Salt Co., Inland-Delray Salt Co., D. B. Doremus, all of Detroit, Mich.; Anthony Salt Co., of Anthony, Kansas.

The order prohibits the respondents from entering into any agreement or understanding among themselves to use any list of jobbers, wholesalers or other dealers in salt as a basis for allowance of jobbers' and wholesalers' prices and terms. The respondents are also ordered not to restrict, through concerted agreement, the number of purchasers who shall receive recognition as jobbers or wholesalers and not to refuse to sell, through agreement, to anyone not classified or listed as a jobber or wholesaler by any agency, publisher or person.

The complaint against The Buckley & Douglas Lumber Co., of Manistee, Mich., also a member of The Salt Producers Association, has been dismissed by the Commission upon its own motion.

Experiment with Silica Gel for Oil Refining

The Davison Chemical Co. has started operation of the experimental plant at Curtis Bay, Ind., for the study of silica gel in crude oil refining. The unit has a capacity of 40 barrels per day. The primary purpose of the installation is to study the cost of refining with silica gel. A number of oil companies have agreed to send carload shipments of oil for experiments. The present equipment at the plant provides only for the production of gasoline and kerosene but it is planned to extend the work to lubricating oils as the experiments progress.

Personal

E. F. BRUNDAGE, manager of the Baltimore branch office of the General Chemical Co. and superintendent of the plant, resigned to join the staff of Wing & Evans, Inc., agents for the Solvay Process Co. C. S. BENJAMIN has been appointed superintendent and acting manager at Baltimore, succeeding Mr. Brundage.

H. KENYON BURCH, who designed and built concentrating plants for the Inspiration Consolidated Copper Co., Miami Copper Co., Phelps, Dodge Corporation, and others, has opened offices at 806 Junion Orpheum Building, Los Angeles, Cal., and will design and construct a 5,000-ton concentrating plant for the New Cornelia Copper Co., at Ajo, Ariz.

E. L. DOHENY, chairman of the board of the Mexican Petroleum Co., has left New York for Los Angeles, Cal., where he will remain for a number of weeks.

V. L. HAVENS, editor of *Ingeniería Internacional*, expects to sail August 5, for South America, to attend the International Engineering Congress in Rio de Janeiro in September. He will probably visit also in Uruguay, Argentina and some other South American countries and will be gone for several months.

GEORGE B. HOGABOOM has resigned from the research department of the Scovill Manufacturing Co., Waterbury, Conn., to become a partner in Bennet & Seeley, Inc., Bridgeport, Conn., jobbers in foundry, electro-plating and finishing department supplies and equipment. Mr. Hogaboom expects to assist on electroplating engineering problems.

PAUL D. V. MANNING has severed his connection with the International Coal Products Corporation and has taken a position as chemical engineer with the Bregeat Corp. of America, 2 Rector Street, New York City.

T. B. PRESTON of Ionia, Mich., has been elected president of the Charles F. Noble Oil and Gas Co., Tulsa, Okla., succeeding Charles F. Noble.

H. B. PRIOR has been appointed New York representative for the G. T. Banker Chemical Co., Phillipsburg, N. J., with headquarters at 17 East 42nd Street, New York City.

G. N. SCHRAMM has been appointed on the chemical staff of the Bureau of Standards to assist in the work of the battery and electrochemical section. He will be engaged on various research problems under the general direction of George W. Vinal, chief of this section of the Bureau.

E. G. SIEVERS, who has been in charge of the U. S. Geological Survey statistical and geologic work on natural gas and natural-gas gasoline, has been transferred from the Survey to be an assistant valuation engineer in the Oil and Gas Section of the Bureau of Internal Revenue. Mr. Sievers began work in his new position on July 10.

Obituary

EDWARD R. CALDWELL, president of the Syracuse Rubber Co., Syracuse N. Y., died July 6 at his residence. He was the founder of the Caldwell & Ward Brass Co. and for many years was head of the E. R. Caldwell & Son Brass Co. He was one of the founders of the Syracuse Rubber Co., which manufactures rubber tires.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

The Recent Trend of Wholesale Commodity Prices

Closing Up the Spreads Between the Great Groups of Commodities—Further Advances Predicted by Business Cycle Students

SINCE January there has been an upward swing in general wholesale prices which has done much to correct the maladjustment in the price levels of individual commodities. During 1921 the free interchange of commerce had been considerably restricted by the false relations between the prices for the products of the different industrial groups. The higher prices for agricultural and food products, metals and other basic materials of commerce have greatly improved although not entirely eliminated this unfavorable economic condition.

The newly revised index number of the Federal Bureau of Labor Statistics for all commodities, about which we shall have more to say later, has risen from 138 in January, 1922, to 148 for May. Farm products have shown a similar gain of 10 points and foods, fuel and building materials have all recorded improvement. Bradstreet's monthly index during the past thirteen months has advanced eleven times and decreased only twice and then to a minor extent. Dun's index, too, has steadily risen during the past eleven months. *Chem. & Met.'s* weighted index of chemical prices, which stood at 143.30 on January 1, 1922, averaged 157.48 for the month of June and 154.65 for the past week.

That the upward trend of wholesale commodity prices will continue for several months at least is the conclusion drawn by the Harvard Economic Service from a study of price movements over a number of years. This is confirmed, they believe, by the fact that "fundamental economic conditions are still favorable to continued price advance."

The Harvard Service's curve which is reproduced in Fig. 2, is based on their ten-commodity index, which started its upward movement last September and since April has risen steadily. The Harvard forecast for continued price advance is based on the following data and conclusions:

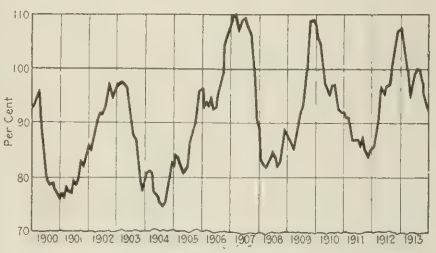

FIG. 2—HARVARD ECONOMIC SERVICE'S TEN-COMMODITY INDEX, 1900-1913

> There have been four major upswings in prices from 1900 to 1913. These movements are shown in the accompanying chart (Fig. 2) where the ten-commodity index is plotted for this period. The first rise begin in January, 1901, and lasted for 21 months, the second commenced in September, 1904, and continued for 30 months; the third started in September, 1908, and terminated 14 months later; and the fourth continued for 14 months beginning in November, 1911. Thus the minimum duration of price advance was 14 months.
>
> The index number of the Bureau of Labor Statistics shows even longer periods of advance. Beginning in June, 1901, the upward movement continued for 20 months; the next advance started in October, 1904, and lasted for 36 months; the third upward movement commenced in August, 1908, and lasted for 19 months; the last advance during the period considered began in May, 1911, and lasted for 29 months. When we consider that the present rise of prices has been under way for only 10 months, according to the ten-commodity index, the evidence from former business cycles points definitely to a continuance of the present upward movement.

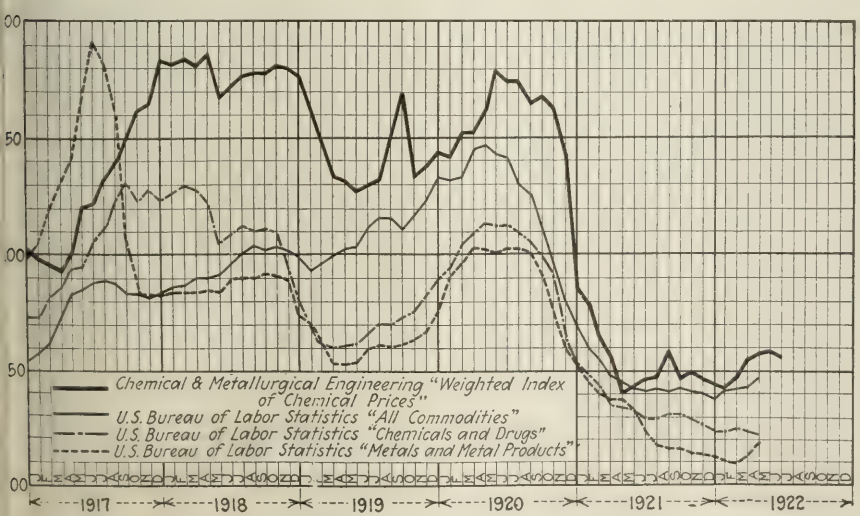

FIG. 1—"CHEM. & MET.'S" INDEX OF CHEMICAL PRICES AND THE U. S. BUREAU OF LABOR STATISTICS' REVISED INDEX NUMBERS, 1917-1922

The Revised Index Numbers

As reported in our issue of July 5 the Bureau of Labor Statistics has recently announced a complete revision of its series of index numbers showing changes in the level of wholesale prices. This revision consists of (1) a regrouping of the commodities and the addition of a considerable number of new articles and (2) the use of the 1919 census data for weighting purposes in place of the 1919 census data formerly employed.

In preceding reports the Bureau confined an article to a particular group regardless of its fitness for inclusion also under other group designations. Under the new plan, articles properly falling under more than one of the classifications adopted are to be included under each classification. In computing the general index number

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	154.65
Last week	156.67
July, 1921	148
July, 1920	274
April, 1918 (high)	286
April, 1921 (low)	140

The decided drop in this week's index number is almost entirely attributable to the lower prices for cottonseed oil. Formaldehyde also declined—to the lowest level since the war—and so did caustic soda. The only increases were for linseed oil and acetic acid.

TABLE I—REVISED INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES, AND BY MONTHS, SINCE JANUARY, 1922.

1913 EQUALS 100

1922	Farm Products	Foods	Cloths and Clothing	Fuel and Lighting	Metals and Metal Product	Building Materials	Chemicals and Drugs	House Furnishing Goods	Miscellaneous	All Commodities — New Index	All Commodities — Old Index
Jan.	122	131	176	195	112	157	124	178	117	138	148
Feb.	131	135	174	191	110	156	123	177	117	141	151
Mar.	130	137	172	191	109	155	125	175	117	142	152
Apr.	129	137	171	194	113	156	124	175	116	143	152
May	132	138	175	216	119	160	122	176	116	148	...

for all commodities, however, such articles will be counted only once, in order to avoid duplication in the final result.

Table I gives the revised index numbers for the several commodity groups from January to June of the current year. For comparison with the new series, the old general index of all commodities is shown in the last column.

Weighting of Chemicals

The former index number for the group "Chemicals and Drugs" was based on the wholesale prices in New York for acetic acid, muriatic acid, nitric acid, sulphuric acid, grain alcohol, wood alcohol, lump alum, anhydrous ammonia, borax, copper sulphate, refined glycerine, opium, quinine, carbonate of soda, caustic soda, nitrate of soda, soda ash and crude sulphur. To show the great number of additions made in connection with the current revision as well as relative weightings given the individual commodities, Table II is appended.

The weighting factors are taken from the 1919 census, supplemented in some instances by information from other government sources and from trade associations. In each case the figures represent, as nearly as can be determined, the quantity of the article sold in the markets in 1919. For commodities represented by more than one series of price quotations, the total quantity marketed has been apportioned among the several markets or grades of the commodity in proportion to their relative importance.

TABLE II. WEIGHTING FACTORS USED BY BUREAU OF LABOR STATISTICS IN CONSTRUCTING ITS INDEX NUMBERS FOR "CHEMICALS AND DRUGS"

Commodity	Unit	Weighting Factor—(000 omitted)
(a) *Chemicals*:		
Acids, New York—		
Acetic, 28 per cent	lb.	53,084
Muriatic, 20 deg.	lb.	294,260
Nitric, 42 deg.	lb.	38,880
Stearic, triple pressed	lb.	16,970
Sulphuric, 66 deg.	lb.	6,592,540
Alcohol, New York—		
Denatured, No. 5, 188 proof	gal.	60,399
Wood, refined, 95 per cent	gal.	6,985
Alum, lump, New York	lb.	654,000
Ammonia, anhydrous, New York	lb.	54,700
Bleaching powder, New York	cwt.	1,771
Borax, crystals and gran., N. Y.	lb.	42,870
Copper sulphate, 99 per cent, crystals, N. Y.	lb.	35,288
Copra, South Sea, sun dried, N. Y.	lb.	98,561
Formaldehyde, New York	lb.	19,664
Oil, vegetable—		
Coconut, crude, Pacific Coast	lb.	244,325
Corn, crude, in barrels, New York	lb.	13,636
Palm kernel, crude, New York	lb.	41,564
Soya bean, crude, in barrels, N. Y.	lb.	88,987
Tariffs of, arsenic, 88-92 per cent, N.Y.	lb.	12,625
Salsoda, New York	cwt.	1,437
Soda ash, 58 per cent, light, N. Y.	cwt.	20,670
Soda, bicarbonate, Amer., f.o.b. wks.	lb.	283,120
Soda, caustic, 76 per cent, solid, N.Y.	lb.	638,980
Soda, silicate of, 40 deg. N. Y.	cwt.	5,736
Sulphur, crude, New York	gross tons	678
Tallow, inedible, packers' pr., Chicago	lb.	263,951
(b) *Fertilizer materials*:		
Acid phosphate, 16 p.c., bulk, N.Y.	tons	3,680
Ammonia, sulphate, dbl. bags, N.Y.	cwt.	5,950
Ground bone, steamed, Chicago	tons	60
Muriate of potash, 80-85 per cent, bags, New York	tons	21
Phosphate rock, 68 per cent, f.o.b. mines	tons	2,272
Soda nitrate, 95 per cent, New York	cwt.	8,978
Tankage, 9 and 20%, crushed, f.o.b. Chicago	tons	297
(c) *Drugs and pharmaceuticals*:		
Acid, citric, domestic, crystals, N.Y.	lb.	3,164
Acid, tartaric, crystals, U. S. P., N. Y.	lb.	5,313
Alcohol, grain, 190 pr., U.S.P., N.Y.	gal.	25,000
Cream of tartar, powdered, N. Y.	lb.	2,855
Epsom salts, U.S.P., in barrels, N.Y.	cwt.	587
Glycerine, refined, New York	lb.	64,343
Opium, natural, U.S.P., New York	lb.	619
Peroxide of hydrogen, 4-oz. bottles, New York	gross	875
Phenol, U. S. P., New York	lb.	64,300
Quinine, sulphate, mfrs' quo., N. Y.	oz.	3,937

The New York Market

New York, July 17, 1922.

Activity in the chemical market during the past week was along very limited lines which, of course, is not unusual at this time of the year. Producers in many items are resuming the old tactics of price cutting in a vain effort to clear out surplus stocks. A few price changes were the only features of the interval. The most important of these was the sharp cut in the price of formaldehyde to the lowest level recorded since the war. The export movement in caustic soda remained very slow and prices for standard goods were again fractionally lower. Leading factors are of the opinion that the present financial uncertainty of Germany, together with the fluctuating foreign exchange, are directly responsible for the decline. The domestic market however, was decidedly active among first hands.

In contrast with these declines was an advance in white arsenic. Insecticide manufacturers have resumed buying and spot supplies have become very scarce with prices advanced to 7¾c. per lb., a new high level for the year. Copper sulphate has remained in an exceptionally tight condition, and it is doubtful if large quantities can be had for earlier than September shipment.

General and Special Chemicals

Acetate of Soda—Prices continue firm on spot goods and the market appears to be in limited supply. Dealers quote 6¼@6½c. per lb. on spot, with material at the works ranging from 5¾@6c. per lb.

Bichromate of Soda—Prices are reported around 6¾@7c. per lb. The general inquiry has remained somewhat dormant, with operations mostly

Caustic Potash—Recent German ar rivals have tended to weaken the mar ket considerably. Offerings of 88@9 per cent are heard at 5½@5¾c. per lb

Caustic Soda—Leading producers re port the export market rather eas with prices around $3.55@$3.60 per 10 lb., f.a.s. July shipment. The domesti market is steady at 3¾c. per lb. fo standard brands of goods. Producer report a regular call for contracts.

Chlorate of Potash—Imported mate rial has been in fair demand durin the past week, with prices firmly main tained at 6½c. per lb. Domestic produc ers quote 8c. per lb., f.o.b. works.

Formaldehyde—Market inactivity i this product are the direct cause o sharp price reductions among large producers. In some quarters as low as 7½c. per lb. was heard. The resale market for spot goods was held around 8c. per lb.

Fusel Oil—Factors in the crude product quote $1.45@$1.50 per gal. The refined grade is held around $2.25@$2.50 per gal.

Epsom Salt—U. S. P. heavy spot stocks of imported material are keep ing second-hand figures down around $1.85@$2.00 per 100 lb. Producers quote prices around 2½c. per lb. De mand is moderate for small lots.

Oxalic Acid—The market among re sale merchants is held in a firm posi tion, with moderate quantities sold a 14¾c. per lb. Producers quote limited amounts at 14½@14¾c. f.o.b. works.

Prussiate of Soda—Imported spo goods were reported lower with quota tions ranging from 20½@21c. per lb Small lot trading was the only feature of the market with the general tone rather unsteady.

Vegetable Oils

Cottonseed Oil—The market was sub jected to severe pressure when th crude material fell off considerably Trading was active at the low figure many buyers taking immediate advan tage of the saving. Crude oil for im mediate shipment from the Southeas was quiet at 8½c. per lb. Septembe shipment sold at 8¾c. per lb buyers tanks, f.o.b. mills. Bleachable oil wa offered at 10c. per lb., buyers' tanks f.o.b. N. Y.

Linseed Oil—The general tone of th market was quite active for this mate rial, advancing from 1 to 2c. per ga During the later part of the week lead ing crushers were asking 89c. per ga with several lots quoted up to 90c. A moderate buying interest was noted fo foreign oil in nearby positions. Sale of July shipment were reported at 82 per gal., c.i.f. N. Y.

Castor Oil—The market remained i a steady position during the week an producers quoted No. 3 grade at 11 per lb. with A. A. in barrels at 12 per lb.

Corn Oil—The market for crude ma terial in barrels was unchanged a 11½@11¾c. per lb. The demand wa

The Chicago Market

CHICAGO, July 13, 1922.

The industrial chemical market showed but little change during the past two weeks except for a slightly firmer tone. Buying continued to be on a hand-to-mouth basis although repeat orders were reported to be more numerous. The railroad strike has had but little effect on the market, as freight is apparently moving as before. Prices are rapidly becoming more stable and with a few exceptions there was but little cutting. Factors in the chemical market were evidently satisfied with the volume of business they were doing and offered no complaints.

General Chemicals

During the past two weeks but little change was to be noted in the general condition of the alkali market. A routine demand existed for *caustic soda* with the solid quoted at $3.85@$3.95 per 100 lb. and the ground at $4.35@$4.50, basis 76 per cent. *Caustic potash* was reported to be moving only in small parcels at 6¼c.@6½c. per lb. for the imported 88 to 92 per cent material. *Soda ash* moved in the regular channels in small or moderate quantities at $2.20@$2.30 per 100 lb. for 58 per cent material in cooperage.

Alums were a trifle easier with spot stocks somewhat heavier. *Ammonia alum* was quoted by importers or their agents at 3¾c.@4¼c. per lb. for the lump and 4¼c.@4¾c. for the powdered. *Potash alum* was unchanged at 4½c.@5c. per lb. for the iron free lump and 5½c.@6c. for the U. S. P. powder. *Sal ammoniac* was quiet and only small lots moved at 7¾c.@8c. per lb. on the white granular. Barium compounds were firm and domestic makers were in a position to deliver ordinary lots at once. *Barium carbonate* was rather quiet with small supplies available at 5c.@5½c. per lb. *Barium chloride* was in better demand and was offered at $95@$110 per ton. *Copper sulphate* continued firm and scarce with only small supplies available at 6½c.@7c. per lb. *Carbon bisulphide* was very active and scarce although today supplies were reported to be larger. Dealers were asking 7c.@7½c. per lb. for small or moderate lots. *Carbon tetrachloride* was rather slow and supplies were heavy. Large drums were available at 10c.@10½c. per lb. *Formaldehyde* was dull with stocks moving very slow at 9c. per lb. for single barrels. *Furfural* lacked quotable change at 35c. per lb. for 1,000 lb. lots or over.

Glycerine was rather easy with refiners quoting c.p. material in drums at 15c. per lb. *Red phosphorus* enjoyed a fair demand and was quoted by second hands at 26c.@30c. per lb. for case lots.

Bichromates were dull and unchanged with weak holders ready to cut prices for any business in sight. *Potassium bichromate* was available at 11c. per lb. in single cask lots and similar quantities of the soda at 8½c.@9c. *Red prussiate of potash* was still very scarce with broken lots quoted at 90c.@$1 per lb. *Yellow prussiate of potash* was easier and supplies were more plentiful at 32c.@35c. per lb. *Potash permanganate* was weaker with supplies of foreign material very plentiful at 15½c.@16c. per lb. for U. S. P. small crystals. *Hyposulphite of soda* moved in a routine way to the consuming trade at $3.85 per cwt. for the pea crystals in barrels. *Zinc chloride* was quoted lower at 6½c.@7c. per lb. for the granular.

Linseed oil was reported by a prominent factor to be moving very well to the consuming trade. The boiled oil was quoted late today at $1.03 per gal. in single drum lots with similar quantities of the raw at $1.01.

Turpentine was reported to be moving slowly and one factor advised his customers to hold off if at all possible as lower prices were expected. Single drum lots were quoted today at $1.31 per gal. but the movement was very light.

The Iron and Steel Market

PITTSBURGH, July 14, 1922.

While the finished steel markets are quieter, as to actual tonnage turnover, the general standing of the market, particularly as to prices, appears to be firmer on account of the fresh menaces to production that have developed in the past week or two. It may be considered objectionable that the strength of the market should be in inverse ratio to the efficiency with which the plants operate, but conditions have to be taken as they are found.

Before the railroad shopmen's strike began July 1 there was congestion at several points where large tonnages of non-union coal were to be moved, and this condition has since been accentuated, presumably chiefly on account of the strike. Large quantities of both West Virginia and Kentucky coal, much of it consigned to byproduct coking plants, have accumulated. Coal has become much scarcer, but the increased scarcity is to be attributed chiefly to railroad conditions, not to the coal strike.

Steel Production

Prospects are that unless there is a great improvement very soon in fuel supplies the production of pig iron and steel will be curtailed from the rate recently prevailing. This rate, moreover, has not been altogether as great as has been estimated recently, it being necessary, in the light of later reports, to revise estimates. The rate of steel ingot production was about 35.500,000 tons a year in April, 36,400,000 tons in May and 36,600,000 tons in June. There had been a sharp increase in production in the first three months of the year but since April 1, when the coal strike started, there has been very little increase.

The Steel Corporation's unfilled obligations increased by 602,769 tons in April, 157,311 tons in May and 381,403 tons in June. Shipments were at about 70 per cent of capacity in April and 75 per cent in both May and June. Thus bookings were much heavier in June than in May. The total of unfilled obligations at the end of June was 5,635,631 tons, but the actual figure sometimes means practically nothing as to operating prospects, the point being whether the tonnage is in contracts or in actual shipping orders. June 30, 1921, the unfilled obligations amounted to 5,117,868 tons, or only a trifle less than at present, but the corporation operated at only 25 per cent in July. Now it is operating at about 75 per cent and its shipping orders would call for a still higher rate. In actual orders the corporation is sold up for about three months.

The Market Situation

Neither sellers nor buyers seem disposed to commit themselves for the last quarter of the year, and thus the market in that respect cannot be regarded as either strong or weak. In the matter of early deliveries there is some demand, with little unsold steel available, and in that respect the market is in sellers' favor. However, in most lines the early deliveries are commanding premiums, bars, shapes and plates for instance being at 1.70c., 1.75c. or 1.80c., according to details of order. This gives the steel market a superficial appearance of great strength, but experience indicates that too much reliance may easily be placed upon such a showing. If the premiums come off, later, the market is made to look weaker and buyers become alarmed, while should plates, shapes and bars advance to 1.80c. as a price for any delivery buyers would in all probability consider the price too high and would start another liquidation of all stocks.

It is rather a complication that just at this time, when coke supplies, previously increasing, are menaced, pig iron should show a softening tendency in some districts. Basic iron at valley furnaces has become quotable at $24, against $25 ruling for more than two months, and southern iron is off a dollar a ton. What will come of this curious situation remains to be seen. Furnaces frankly admit that buyers are showing much less interest in pig iron than it was expected they would be showing by this time. Consumption has evidently been less than was counted upon, in the case both of foundries and of steel works that do not make their pig iron themselves.

The scrap market has been turning softer in the past fortnight in several districts. The theory in the scrap market for two or three months past has been that scarcity of coke makes for higher scrap prices, by both blast furnaces and steel mills using more scrap. Heavy melting steel ruled strong at $17.50, delivered Pittsburgh district, during May and June, but in the past few days round lots have been offered mills at $17 without finding takers.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0.11 – $0 11½	.11¼ – .13
Acid, acetic, 28 per cent	100 lbs.	2.35 – 2 50	2 55 – 3 00
Acetic, 56 per cent	100 lbs.	5 00 – 5.25	5.30 – 5.50
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	8.50 – 9 00	.50 – 9.75
Boric, crystals	lb.	.11 – .11½	.11¾ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	..... –	.45 – .46
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04¼	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)	....	..... –	..... – .....
Nitric, 40 deg	lb.	.06 – .06¼	.06¾ – .07
Nitric, 42 deg	lb.	.06½ – .06¾	.07 – .07¼
Oxalic, crystals	lb.	.14½ – .14¾	.15 – .15½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9 50 – 10 00	..... – .....
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15 00 – 16 00	..... – .....
Sulphuric, 66 deg., drums	ton	19 00 – 20 00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19 00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent(oleum) drums	ton	22 00 – 22 50	23.00 – 24.00
Sulphuric, fuming, 20 per cent(oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.29 – .29½
Tartaric acid, imported, powdered	lb.	..... –	.29½ – .30
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1 00 – 1 10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)	....	..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.28 – .31
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.28 – .31
Alum, ammonia, lump	lb.	.03¼ – .03½	.03½ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03½ – .04
Alum, chrome lump	lb.	.05¼ – .05½	.06 – .06½
Aluminum sulphate, commercial	100 lb.	1.50 – 1 65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02½	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08 – .08½	.08½ – .09
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	..... –	2.00 – 2.25
Arsenic, white, powdered	lb.	.07¾ – .08	.08¼ – .08½
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	61.00 – 63 00	64 00– 68 00
Barium chloride	ton	95.00 –100.00	105.00 –110.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2.50
Blue vitriol (see copper sulphate)	.....	..... –	..... – .....
Borax	lb.	.05¼ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)	.....	..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.00 – 2.25	..... – .....
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22 00 – 23 00	23.50 – 27 00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.80 – .83
Carbon bisulphide	lb.	.06½ – .06¾	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)	.....	..... –	..... – ....
Caustic soda (see sodium hydroxide)	...	..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2 10
Copperas	ton	20 00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6 60	6 65 – 7.00
Cream of tartar	lb.	..... –	.24 – .25
Epsom salt (see magnesium sulphate)	.....	..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.07¼ – .07½	.07¾ – .08
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00	..... – .....
Fullers earth—imported powdered—net	ton	30 00 – 32 00	..... – .....
Fusel oil, ref	gal.	..... –	2 25 – 2 65
Fusel oil, crude	gal.	..... –	1.45 – 1.50
Glauber's salt (see sodium sulphate)	...	..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	15 – 15¼
Iodine, resublimed	lb.	..... –	4 20 – 4 25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate	lb.	..... –	.09½ – .11½
Lead arsenate, powd	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08 – .09
Magnesium carbonate, technical	lb.	.06½ – .07	.07¼ – .08
Magnesium sulphate, U. S. P	100 lb.	2 00 – 2.25	2 30 – 2 50
Magnesium sulphate, technical	100 lb.	..... –	1 00 – 1 80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.10 – .10½
Phogene (see carbonyl chloride)	.....	..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.09½ – .09¾	.10 – .10½
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05½	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb.	..... –	.50 – .52
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06¼ – .06¾	.07 – .08
Potassium permanganate	lb.	.14½ – .14¾	.15 – .16
Potassium prussiate, red	lb.	..... –	.90 – .95
Potassium prussiate, yellow	lb.	.32 – .32½	.32½ – .33
Rochelle salts (see sodium potas. tartrate)	....	..... –	..... – .....
Salammoniac, white, granular	lb.	.06¾ – .07	.07¼ – .08
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	20.00 –25.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.65 – 1.70	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06¼ – .06¾	.06¾ – .07
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.06¾ – .07	.07¼ – .07½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06¼ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.21 – .22	.22½ – .25
Sodium fluoride	lb.	.09½ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.50	3.80 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.85 – 4.00	4.30 – 4.50
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03½	.03¾ – .04
Sodium nitrite	lb.	.08 – .08¼	.08½ – .09
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.20½ – .21	.21¼ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04⅛ – .04¼	.04¼ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	..... – .....
Talc—domestic powdered	ton	18 00 –25.00	..... – .....
Tin bichloride	lb.	.09 – .09¼	.09¾ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran	lb.	.06 – .06¼	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.30 — .31
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.50 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.22 — .24
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25% car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.59 — .65
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.95 — 1.00
Monochlorbenzene	lb.	.09 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06¼ — .07
Naphthalene, balls	lb.	.07¼ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.40 —	2.50
Ortho-dichlor-benzene	lb.	2.15 —	.20
Ortho-nitro-phenol	lb.	.70 —	.75
Ortho-nitro-toluene	lb.	$0.10 —	$0.13
Ortho-toluidine	lb.	.14 —	.18
Para-amidophenol, base	lb.	1.25 —	1.30
Para-amidophenol, HCl	lb.	1.30 —	1.35
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.75 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.90 —	1.00
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.15 —	.15½
Pyridine	gal.	1.75 —	2.75
Resorcinol, technical	lb.	1.30 —	1.35
Resorcinol, pure	lb.	1.75 —	1.80
R-salt	lb.	.60 —	.70
Salicylic acid, tech., in bbls	lb.	.25 —	.25½
Salicylic acid, U. S. P	lb.	.26 —	.26½
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.14 —	.18
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.20 —	$0.21
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.38 —	.42
Candellila, wax	lb.	.40 —	.42
Carnauba, No. 1	lb.	.40 —	.42
Carnauba No. 2, North Country	lb.	.22 —	.23
Carnauba, No. 3, North Country	lb.	.16½ —	.16¾
Japan	lb.	.16½ —	.17
Montan, crude	lb.	.04 —	.04½
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04½ —	....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02¼ —	....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¾ —	.03¼
Paraffine waxes, refined, 125 m.p.	lb.	.03½ —	.03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09½
Stearic acid, double pressed	lb.	.09½ —	.09¾
Stearic acid, triple pressed	lb.	.10½ —	.10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$5.45 —	$5.85
Rosin E-I	280 lb.	5.95 —	6.35
Rosin K-N	280 lb.	6.45 —	7.55
Rosin W. G.-W. W	280 lb.	7.65 —	8.30
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.18 —	1.20
Wood turpentine, steam dist	gal.	.85 —	....
Wood turpentine, dest. dist	gal.	.70 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.36 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.46 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.45 —	3.50
Blood, dried, f.o.b., N. Y	unit	3.50 —	3.60
Bone, 3 and 50, ground, raw	ton	32.00 —	35.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.50 —	2.60
Tankage, high grade, f.o.b. Chicago	unit	3.10 —	3.20
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	3.75
Tennessee, 78-80%	ton	7.00 —	7.50
Potassium muriate, 80%	ton	33.50 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0 18¾ —	.19
Upriver coarse	lb.	.13 —	.13¼
Upriver caucho ball	lb.	.13¼ —	.13½
Plantation—First latex crepe	lb.	.14¼ —	.15
Ribbed smoked sheets	lb.	.14¾ —	.15
Brown crepe, thin, clean	lb.	.13½ —	....
Amber crepe No. 1	lb.	.14 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.11 —	$0.11½
Castor oil, AA, in bbls	lb.	.12 —	.12¼
China wood oil, in bbls	lb.	.12¾ —	.13
Cocoanut oil, Ceylon grade, in bbls	lb.	.08½ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09¼ —	.09½
Corn oil, crude, in bbls	lb.	.11¼ —	.11½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08¾ —	.09
Cottonseed oil, summer yellow	lb.	.11 —	.11¼
Cottonseed oil, winter yellow	lb.	.12 —	.12¼
Linseed oil, raw, car lots (domestic)	gal.	.90 —	.91
Linseed oil, raw, tank cars (domestic)	gal.	.86 —	.87
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.95 —	.96
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07⅛
Palm, Niger	lb.	.06¼ —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09½ —	.09¾
Peanut oil, refined, in bbls	lb.	.12½ —	.12¾
Rapeseed oil, refined in bbls	gal.	.84 —	.85
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y	lb.	.12 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.10 —	....

FISH

Light pressed menhaden	gal.	$0.51 —	....
Yellow bleached menhaden	gal.	.53 —	.54
White bleached menhaden	gal.	.55 —	.56
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All prices remain same as previous report

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00
Chrome brick, f.o.b. Eastern shipping points	net ton	40–42
Chrome cement, 40-50% Cr_2O_3	net ton	24–32
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	28–35
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–23
Magnesite brick, 9-in. straight (f.o b. works)	net ton	56
Magnesite brick, 9-in. arches, wedges and keys	net ton	78
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	30–32
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	33–35
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	27–30
Silicon carbide refractory brick, 9-in	1,000	1100.00

Ferro-Alloys

Quotations remain unchanged.

Ores and Semi-finished Products

Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.28 —	.29

All other prices remain quotably unchanged.

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.875–14.00
Aluminum, 98 to 99 per cent	18.00–19.00
Antimony, wholesale lots, Chinese and Japanese	4.95–5.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	31.20
Lead, New York, spot	5.75
Lead, E. St. Louis, spot	5.45– 5.50
Zinc, spot, New York	5.80– 5.85
Zinc, spot, E. St. Louis	5.475– 5.50

OTHER METALS

Silver (commercial)	oz.	$0.70⅜
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.10
Platinum	oz.	90.00
Iridium	oz.	170.00@175.00
Palladium	oz.	55.00@ 60.00
Mercury	75 lb.	55.00

Structural Material

Prices remain quotably unchanged.

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The plant and business of the San Nox Chemical Co., has been acquired by Charles Siegel and associates from James Johnston and H. H. Smithson, heretofore heads of the company. The company specializes in the manufacture of liquid soaps, polishes, etc. and the new owners plan for immediate extensions and improvements to approximately double the present capacity. New equipment will be installed.

Arizona

SUPERIOR—The Magma Copper Co. has completed plans and will commence the immediate construction of its proposed new smelting plant, estimated to cost in excess of $500,000, including machinery. Contract for the steel framework for the building recently has been awarded.

Arkansas

WESSON—The Edgar Lumber Co. has tentative plans under consideration for the construction of a new creosoting plant.

PENTERS BLUFF—The American Manganese Co. has acquired about 1,200 acres of land in Independence County with manganese and phosphate deposits, and plans for extensive development work. A plant will be installed for immediate production from a portion of the tract.

California

SANTA CLARA—The National Stone Tile Co., San Francisco, is negotiating with the local Chamber of Commerce for a suitable site for the erection of a new plant. Plans will be prepared at an early date.

YUBA CITY—The Shell Oil Co., 343 Sansome Street, San Francisco, will soon commence the erection of a new local distributing plant, with equipment to provide for refined oils, lubricating oils and various byproducts. The plant will cost in excess of $30,000.

Florida

TAMPA—The Riggs Chemical Laboratories are perfecting plans for extensive manufacture at their plant, and facilities will be provided for the production of a line of chemicals and byproducts. Walter B. Riggs and Theodore A. Bailey head the company.

Illinois

WAUKEGAN—The City Council is having plans completed for the construction of a new filtration plant at the municipal waterworks. With pumping station and intake, the proposed plant will cost about $950,000. Hood, Decker & Drury, 303 South State St., Ann Arbor, Mich., are engineers.

PINCKNEYVILLE—The Atlas Powder Co. Delaware Trust Bldg., Wilmington, Del., has plans under way for the erection of a new local plant to consist of a number of 1-story buildings, estimated to cost about $100,000, including equipment. L. K. O'Brien is engineer in charge.

Indiana

ANDERSON—The National Tile Co. will commence the immediate rebuilding of the portion of its plant, destroyed by fire, June 28, with loss estimated at about $40,000.

SCOTTSBURG—The plant of the J. W. P. Tire Co., defunct, with four acres of land, has been acquired by Clay Prosser and associates from the receiver, M. E. Smith. No announcement has as yet been made regarding the plans of the new owners.

Maine

MINOT—The Rogers Fibre Board Co., is planning for the rebuilding of the portion of its plant, including power house, dam-

Maryland

BALTIMORE—The Republic Gasoline Co., 308 Marine Bank Bldg., recently organized, is planning for the establishment of a plant in Kentucky, on site to be selected, for the manufacture of carbon black and affiliated specialties. G. I. Stafford is president, and C. R. Rishel, vice-president.

WILLIAMSPORT—The Conococheague Brick Co. is planning for enlargements in its plant, to include a new building for general manufacture and 3 kilns. The work is estimated to cost about $35,000.

FROSTBURG—The Frostburg Sewer Pipe Co., care of T. C. Carrington, secretary, Frostburg Commercial Club, has acquired a tract of land of about 33 acres, previously held by the Consolidation Coal Co., as a site for the erection of its proposed new plant for the manufacture of vitrified clay sewer pipe. Plans are being drawn for the initial buildings and it is planned to commence erection at an early date. The company was organized recently with a capital of $200,000.

BALTIMORE—The Water Bureau, William A. Megraw, water engineer, City Hall, will soon call for bids for the construction of the proposed new filtration plant at the city water works, to be 1-story, 245x295 ft., estimated to cost close to $1,000,000. William W. Emmert, Union Trust Building, is consulting engineer.

Massachusetts

WOLLASTON—Fire, July 1, destroyed one of the buildings at the plant of the Norfolk Varnish Co., Arlington St., with loss reported at about $10,000. The structure will be rebuilt.

CAMBRIDGE—The Cambridge Rubber Co., 148 Main St., has filed plans for the construction of a new 1-story building at its works.

MALDEN—The Potter Drug & Chemical Corp. has tentative plans under consideration for the enlargement of its local plant, used primarily for the manufacture of soap products. It is proposed to discontinue the present London, Eng., factory, established during the war period and remove the equipment to the Malden plant, where all foreign production will be handled in the future.

SPRINGFIELD—The Springfield Gas Light Co., 35 State St., will construct a new holder and auxiliary plant on Page Blvd., to cost about $240,000. Contract for the holder has been awarded to the Bartlett, Hayward Co., Baltimore, Md.

Michigan

ESSEXVILLE—The Aetna Portland Cement Co., 412 Union Trust Bldg., Detroit, is completing foundation work for a number of buildings at its proposed local plant and will soon commence superstructure work. The plant will cost close to $1,000,000, including machinery.

RIVER ROUGE—The Detroit Sand Lime Brick Co., 1008 Vinton Bldg., Detroit, has commenced excavations for the initial building at its proposed local plant, on site recently acquired. The works are estimated to cost in excess of $75,000.

Missouri

POPLAR BLUFF—The Poplar Bluff Rubber Co. has secured a local building and plans for the immediate installation of equipment for the manufacture of rubber specialties. John H. Patterson is president and manager.

ST. LOUIS—The Mallinkrodt Chemical Works, Inc., 3600 North 2nd St., is reported to be planning for enlargements in its plant. The company recently increased its capital to $5,000,000. Edward M. Mallinkrodt is president.

ST. LOUIS—Machinery to cost about $30,000, will be installed in the proposed new plant to be constructed by the Superior Folding Box Co., 2311 Chestnut St. at Geraldine Ave. and Penrose St. The entire

Nebraska

OMAHA—The Standard Chemical Mfg. Co., 1310 Harney St., has construction under way on a new 2-story plant, 60x114 ft., on Leavenworth St. near 41st St. Charles M. Nye, 737 Peters Trust Bldg., is architect.

New Jersey

NEWARK—The Chemical Treatment Co. has leased property at 264 Jelliff Ave., comprising a 3-story and basement building, aggregating about 13,000 sq.ft., and adjoining property, 105x250 ft., for the establishment of a new plant for the manufacture of special chemical products. It is planned to commence the erection of a new building at an early date on the available vacant land.

PERTH AMBOY—The Novo Laboratories, Inc., manufacturers of chemical specialties, has commenced the construction of a new building at its plant No. 3.

GLOUCESTER CITY—The Armstrong Cork Co., South Camden, manufacturer of cork board and cork insulation products, has acquired the plant of the Ancona Co., Gloucester City, heretofore, used by the Welsbach Co., manufacturer of gas mantels, etc., for a consideration said to be $275,000. Adjoining property at Kings and Essex Sts., has also been purchased. The new acquisition will be used as an extension.

New York

NIAGARA FALLS—The Defiance Paper Co., Walnut Ave., has broken ground for the construction of a 1-story addition, 50x200 ft., at Third and Walnut Sts., estimated to cost approximately $200,000, with machinery.

NEW YORK—The Mexican Petroleum Co., 120 Broadway, has commenced work on extensions and improvements at its oil terminal and distributing plant at Mata Rodonda, Mex., to cost about $300,000.

NEW YORK—The American Glass Bottle Co., 1179 Union Ave., has filed plans for the construction of a 1-story building, 65x79 ft., to cost about $12,000.

NIAGARA FALLS—The Kimberly & Clark Co., manufacturer of paper products, has foundation work under way for a 2-story addition to its local plant on the Niagara Falls Blvd., 60x100 ft. It is purposed to push the structure to completion for earliest possible occupancy.

North Carolina

CANTON—The Champion Fibre Co. is arranging for the early occupancy of its new local plant, now nearing completion, for the manufacture of paper products. The mill will represent an investment of about $1,000,000, and will use three chemical processes for the utilization of paper pulp.

Ohio

COLUMBUS—The Brown Steel Co., 480 Neilston St., manufacturer of steel products, will commence the immediate construction of a 1-story plant addition, 275x305 ft., estimated to cost approximately $150,000, with equipment. Charles W. Brown is general manager.

AKRON—The Anaconda Copper Co., 25 Broadway, New York, N. Y., has purchased property at Betts Corner, Akron, comprising about 9 acres of land for its proposed new plant, for the manufacture of zinc oxides and kindred specialties. Plans for the initial buildings are under way and it is expected to commence construction in September. The plant will be operated by the International Lead Co., a subsidiary organization. It is estimated to cost approximately $1,000.000, with machinery.

BEDFORD—The Mason Tire & Rubber Co., Kent, Ohio, has acquired the plant and property of the Owen Tire & Rubber Co. at Bedford, from Carl E. Friedolin, referee in bankruptcy, for a consideration of about $275,000. The plant is located on a 14-acre tract of land, and consists of a number of buildings. It will be used by the new owner for the manufacture of automobile tires and it is expected to develop an immediate capacity of 1,500 tires per day giving employment to about 200 operatives. The output will be increased in the near future, and the working force enlarged to close to 500 employees. O. M. Mason is president.

YOUNGSTOWN—The Youngstown Steel Co. will soon commence the construction of a new mechanical puddling plant, estimated to cost about $1,500,000. The mill will be operated under a new process and will

develop an output of about 250 tons of iron per day, giving employment to about 200 men. A blast furnace of about 500-ton capacity will be constructed in the near future.

Oklahoma

SAND SPRINGS—A new 1-story foundry building will be constructed by the Tulsa Stove & Foundry Co., Tulsa, Okla., in connection with its proposed local plant, estimated to cost about $175,000.

Pennsylvania

HIGH SPIRE—The Keystone Carbonic Gas Co. has broken ground for the construction of its proposed local plant, 60x140 ft., for the manufacture of carbonic gas and other commercial gas products, estimated to cost close to $250,000. S. S. Bailey, Security Trust Bldg., Harrisburg, Pa., is president.

PITTSBURGH—The Atlantic Refining Co., Chamber of Commerce Bldg., has acquired property in the Lawrenceville district, approximating 7½ acres of land bounded by 56th and 57th Sts. and the Allegheny River, in the vicinity of its present works, for a consideration of $350,000. It will be used for the construction of a new refinery addition.

WAYNESBORO—The Frick Co. will soon take bids on separate contracts for the erection of a 1-story foundry, 300x600 ft., estimated to cost about $200,000, with machinery. A. J. Frick is vice-president.

WILLIAMSPORT—The plant and property of the Nordmont Chemical Co., Nordmont, near Williamsport, devoted to the manufacture of wood alcohol, carcoal, and by-products, has been acquired by new interests, headed by Charles W. Jones, Williamsport. The plant will be continued in operation for a certain time, and later will be dismantled, the machinery to be removed to another location.

MORRISVILLE—The Robertson Art Tile Works has construction under way on a new 1- and 2-story building at its plant, 110x160 ft., to be used for general production and operations.

South Carolina

HAMBURG—The Hankinson Brick Co. is said to be planning for the rebuilding of the portion of its plant, including kilns, destroyed by fire June 30. An official estimate of loss has not been announced.

Texas

STAMFORD—The Williams-Miller Gin Co., Elks City, Okla., operating cotton gineries, is planning for the construction of a new cotton oil mill on property at Stamford, estimated to cost about $150,000.

LLANO—The Honey Creek Minerals Co. has plans under way for the construction of a new refining plant and laboratory at its molybdenite ore properties, estimated to cost about $150,000. The company will also install considerable new machinery in different departments of its works to cost approximately $100,000.

DALLAS—The Taxa Cola Co. of America, recently organized under Delaware laws, with a capital of $2,000,000, has plans under way for the construction of a 2-story plant on local site, for the manufacture of extracts. It is also proposed to construct a number of branch plants in different cities of the state, and sites have been selected at Galveston and Mexia. John H. Wood, Dallas, is secretary and acting treasurer in charge.

Washington

SEATTLE—The Washington Iron Works, Seattle Blvd., and Norman St., will construct a 1-story foundry, 130x140 ft., in connection with a number of plant additions, estimated to cost about $500,000. The foundry will be used for the production of steel and grey iron castings. Gerald Fink is president.

West Virginia

HUNTINGTON—R. E. Morrison, Huntington, is organizing a new company with capital of $50,000, to construct and operate a local plant for the manufacture of soap products. A site is being selected and erection will be commenced at an early date.

Canada

THREE RIVERS, QUE.—The Three Rivers Pulp & Paper Co. is said to have preliminary plans in progress for the construction of a new mill on local site, estimated to cost close to $2,500,000, with machinery

New Companies

THE UNITED STATES PAPER CO., Jersey City, N. J., has been incorporated with a capital of $100,000, to manufacture paper products. The incorporators are Robert P. Gilman, J. Frank Finn, and Frank W. Hastings, Jr., 15 Exchange Place, Jersey City.

THE PENNSYLVANIA POTASSIUM PHOSPHATE CO., Philadelphia, Pa., is being organized by Frank V. McMullin, Harrison B. Price and Edwin Smiley, all of Philadelphia, to manufacture phosphatic and other fertilizer and chemical products. Application for a state charter will be made on July 24. The company is represented by Joseph R. Embery, 1105-6 Real Estate Trust Bldg., Philadelphia.

THE LEAD KOTE PROCESS, INC., New York, care of Slade & Slade, 200 Broadway, representatives, has been incorporated with a capital of $100,000, to manufacture galvanizing products for steel treatment. The incorporators are M. Robinson, I. Levin and L. C. Brady, all of New York; the company will operate a local plant.

THE LOUIS ROSE BRICK CO., Highland Park, Mich., has been incorporated with a capital of $100,000, to manufacture brick and other burned clay products. The incorporators are John P. Scallen, George W. Handloser, and Louis Rose, 169 Eason Ave., Highland Park.

THE HUB PAINT REMOVER CO., Boston, Mass., has been incorporated with a capital of $50,000, to manufacture paint removers and other chemical products. Reuben Hall, 70 State St., Boston, is president and treasurer; Alfred Hall is vice-president.

THE MAURICE CHEMICAL CO., 1545 South Charles St., Baltimore, Md., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture refractory cements, glazing materials, etc. The incorporators are F. Howard Kidd, W. Frank Reed and Joseph R. Hudson.

THE GRISWOLD OIL CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $15,000,000, to manufacture petroleum products.

THE PERTH AMBOY CO., 303-5 Front St., Perth Amboy, N. J., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by Arden D. Cline and Willis H. Landis, Elizabeth, N. J. The last noted represents the company.

THE ORLANDO PERFECT PRODUCTS CO., Jacksonville, Fla., has been incorporated with a capital of $100,000, to manufacture fertilizer products. F. E. Clark is president; A. L. Morgan, vice-president; and E. W. Mitchell, secretary, all of Jacksonville.

THE ELLIOTT PETROLEUM CO., Los Angeles, Calif., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are J. E. Elliott, Floyd C. Merritt and M. E. Davis, all of Los Angeles; and A. M. Goodhue, Long Beach, Cal. The last noted represents the company.

THE MILLARD LEATHER CO., Attleboro, Mass., has been incorporated with a capital of $80,000, to manufacture leather products. Harry S. Millard is president; and Karl B. Brooks, Attleboro, treasurer.

THE MET-ARBOR CO., Norwalk, Conn., has been incorporated with a capital of $50,000, to manufacture soaps, chemicals, etc. The incorporators are William Krusch, Coleburn Block, F. J. G. Hardy and W. T. Krusch, all of Norwalk.

F. BREDT & CO., INC., New York, care of F. S. Rauber, 38 Park Row, representative, has been incorporated with a capital of $50,000 to manufacture chemicals and chemical byproducts. The incorporators are G. C. Orth, H. A. Fanning and L. B. Lebowitz.

THE PENETRATOR CO., INC., Lakewood, N. J., has been incorporated with a nominal capital of $2,000, to manufacture oils, compounds, etc. The incorporators are Max Jerry, M. E. and John A. Meyers, 215 4th St., Lakewood.

THE ELECTROCAST STEEL FOUNDRY CO., 920 West Kinzie St., Chicago, Ill., has been incorporated with a capital of 300 shares of stock, no par value, to manufacture steel castings. The incorporators are Alfred Johnson, Daniel B. Abrahamson and Adolph J. Peterson.

THE HANNIGAN WATER PROOFING & MFG. CO., Milford, Conn., care of Woodburn Martin, Georgetown, Del., representative, has been incorporated under Delaware laws with capital of $50,000, to manufacture waterproofing products and affiliated specThomas Hannigan, and L. U. Berger, all of Milford.

THE LESLIE GROVE OIL CO., Newark, O., has been incorporated with a capital of $50,000, to manufacture oil products. The incorporators are Leslie Grove and Calvin C. Jeffries, both of Newark.

THE PIED PIPERS OF AMERICA, INC., New York, N. Y., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The company is represented by M. A. Vogel, 291 Broadway. The incorporators are D. A. Bach, and W. S. Patjans.

THE CALIFORNIA-MAINE OIL CO., Portland, Me., care of M. F. Foster, Portland, representative, has been incorporated with a capital of $1,000,000, to manufacture petroleum products. R. L. Johnson is president; and A. B. Farnham, treasurer.

THE DOMINION PORTLAND CEMENT CO., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., has been incorporated under Delaware laws, with a capital of $2,000,000, to manufacture portland cement.

THE KLENNIT-CHEMICAL CO., Fort Worth, Tex., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are L. W. Bevans, L. D. Patterson and T. B. Yarborough, all of Fort Worth.

THE ROGERS ASBESTOS CO., Houston, Tex., has been incorporated with a capital of $40,000, to manufacture asbestos products. The incorporators are E. M. Rogers, W. W. Bates and S. H. Rudnick, all of Houston.

EISELE & CO., INC., Nashville, Tenn., care of George M. Jones, Dover, Del., has been incorporated under Delaware laws with a capital of $154,000, to manufacture chemical specialties, chemical byproducts, drugs, etc. The incorporators are A. B. Benedict, William Nelson and C. Logan Eisele, Nashville.

THE AMERICAN ROCK ASPHALT CO., Valliant, Okla., has been incorporated with a capital of $100,000, to manufacture asphalt and affiliated products. The incorporators are H. C. Clark, Valliant; Ralph P. Taylor and T. E. Webber, both of Texanna, Okla.

THE GRASS LAKE MUTUAL OIL CO., Adrian, Mich., has been incorporated with a capital of $10,000, to manufacture refined mineral oils. The incorporators are Arthur F. Messner and Warren K. Raby, both of Grass Lake, Mich.; and Rolland C. Rothfuss, 404 National Bank of Michigan, Adrian. The last noted represents the company.

THE WEST PHILADELPHIA CUT GLASS CO., Philadelphia, Pa., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $100,000, to manufacture glass products.

THE COMMERCIAL ASBESTOS CO., Seattle, Wash., care of the Commonwealth Finance Co., Securities Bldg., Seattle, representative, has been incorporated with a capital of $250,000, to manufacture asbestos products. Charles C. Franklin is the principal incorporator.

THE CARDINAL OIL CORP., Portland, Me., has been incorporated with a capital of $6,500,000, to manufacture petroleum products. R. L. Johnson is president; M. F. Foster, treasurer; and A. B. Farnham, Portland, clerk. The last noted represents the company.

THE CROCKETT COTTON OIL MILL. INC., Crockett, Tex., has been incorporated with a capital of $100,000, to manufacture cotton oil products. The incorporators are J. Legory, G. Q. King and J. S. Shivers, all of Crockett.

THE SUFFOLK LEATHER CO., INC., Boston, Mass., has been incorporated with a capital of $10,000, to manufacture leather products. Hugh J. Shaw is president and I. Stebbins Gilbert, 345 Ashmont St, Dorchester, Mass., treasurer.

THE BEATS-AWL CO., 57 Main St., East Orange, N. J., has filed notice of organization to manufacture chemical specialties, vermin exterminators, etc. Edwin S. Douglas heads the company.

THE UNITED STATES TANNING CO., Philadelphia, Pa., is being organized by A. and Nathan Rathblott, and Carl S. Gross, all of Philadelphia, to manufacture leather products. Application for a state charter will be made on July 24. The company is represented by Sundheim, Folz & Kun, 1516 Real Estate Trust Bldg., Philadelphia.

THE HINCKLEY CORP., Hinckley (Herkimer County), N. Y., care of Dunmore, Ferris & Dewey, Utica, N. Y., representative, has been incorporated with a capital of $20,000, to manufacture sulphite products. The incorporators are T. H. Ferris, F. W. New-

Capital Increases, Etc.

THE EMPIRE STATE PAPER CORP., 216 Seventh Ave., New York, has filed notice of increase in capital from $50,000 to $100,000.

Robert E. Cowden, receiver for the MASTER TIRE & RUBBER CO., Dayton, O., is arranging for the sale of the property and assets of the company, consisting of a main 1-story plant, 70x216 ft., and smaller buildings, with machinery. Bids will be received until July 26.

THE ALBANY MALLEABLE IRON CO., Albany, N. Y., has filed notice of a reduction in capital from $500,000 to $250,000.

THE HUMBLE OIL & REFINING CO., Houston, Tex., operating oil refineries, is disposing of a bond issue of $25,000,000, the proceeds to be used in part for extensions and improvements. W. S. Farish is vice-president.

THE AETNA STEEL PRODUCTS CO., 30 Church St., New York, N. Y., has filed notice of dissolution under state laws.

THE CONNECTICUT HARD RUBBER CO., New Haven, Conn., has filed notice of increase in capital from $10,000 to $50,000.

THE C. H. MILLS OIL CO., Syracuse, N. Y., has filed notice of increase in capital from $200,000 to $1,000,000, for proposed expansion.

THE B. F. GOODRICH CO., Akron, O., manufacturer of automobile tires and other rubber products, is disposing of a bond issue of $20,000,000, a portion of the proceeds to be used for extensions and improvements.

THE ZENITH FURNACE CO., Duluth, Minn., producer of pig iron, coke, etc., is disposing of a bond issue of $1,000,000, a portion of the proceeds to be used for extensions and improvements. W. B. Castle is president.

E. W. Bowen, Delphi, Ind., has been appointed receiver for the INDEPENDENT OIL CO., Delphi and Frankfort, Ind., succeeding Silas Wilson.

A merger of the MARSHALL OIL CO. and the WEST VIRGINIA PETROLEUM CO., Morgantown, W. Va., has been arranged under the first noted name. The consolidated organization will operate with a capital of $1,000,000.

Receivers for the TEXAS STEEL CO., Rusk, Tex., have made application to the District Court for permission to sell the plant and property of the company. The proposed sale will be held on Sept. 15.

The plant of the PLANTERS' COTTON OIL CO., Dallas, Tex., will be sold under foreclosure proceedings. The property represents an investment of close to $300,000.

THE UNITED STATES REFRACTORIES CO., Mount Union, Pa., has perfected arrangements for an increase in capital from $300,000 to $1,400,000.

The plant and property of the LYNCHBURG GLASS CO., Lynchburg, Va., which recently assigned, will be sold at auction for the benefit of creditors.

DWIGHT P. ROBINSON & COMPANY, Engineers and Constructors with main offices in New York City and branch offices in Chicago, Los Angeles, Montreal, Youngstown, Dallas and Rio de Janeiro, Brazil, has recently entered into a contract with the Metropolitan Life Insurance Co. by which life insurance policies are provided without expense to individuals for all members of its organization reporting to the central office under a group insurance plan. This insurance is without cost to the employees and its benefits are in addition to those provided by law under the various State Workmen's Compensation Acts. All employees included in the Plan are insured regardless of their age and condition of health and no medical or physical examination is required. The amount of insurance is increased $100 for each additional year of continuous employment and this plan of regular increase is thus a recognition of length of service.

THE ECONOMY FUSE & MFG. CO. of Chicago, Ill., announces the appointment of Charles H. Bluske as district sales manager of the Los Angeles office at 1304 Maltman Avenue. Mr. Bluske was formerly connected with the Pacific States Electric Co. of Los Angeles, and succeeds George L. Davis. The Pittsburgh Sales Office of the Economy Fuse & Mfg. Company has been moved from 2223 Farmers Bank Building to 1006 Peoples Bank Building at Fourth Ave. and Wood St.

THE U. S. ELECTRO GALVANIZING CO., Inc., announces change of name to U. S. Galvanizing & Plating Equipment Corporation, with main office and factory at 32 Stockton Street, Brooklyn, N. Y.

PAUL O. ABBE, INC., 71-73 Murray Street, New York City, announces the return of Mark L. Alden, who has been having extensive experience in the Chemical Industry for the past ten years. If his health permits him to do so, he will become the chairman of the board of directors of the company.

F. J. RYAN & Co., industrial furnace engineers, Philadelphia, Pa., held its annual meeting at the company's new offices on the 6th floor of the Wesley Building. This is the second increase of facilities of the company within the last year and a half, made necessary by the increasing amount of business. At the election of officers, F. J. Ryan was re-elected president; W. W. Posey (president of Lancaster Iron Works, Lancaster, Pa.) was elected vice-president; A. C. Scully (treasurer of Lancaster Iron Works) was elected treasurer and Miss E. N. Kraske was re-elected as secretary. S. R. Vanderbeck of Philadelphia was re-elected as director. G. F. Beach, who for a number of years had been chief engineer of the Mircs Furnace Departments of the Lancaster Iron Works and who came into a like position with the Ryan Co. after a consolidation of interests of the Mircs Co. and the Ryan Co., was retained in the same position. Additional departments have been decided upon in the line of Producer Gas and Regenerator Furnaces. This work will be under the direction of Karl G. Gustafsson, who has had considerable experience in this line of work in foreign countries, especially Germany and France. Mr. Gustafsson brings with him the results of the necessity of foreign conservation in furnace work.

Industrial Developments

CERAMIC—The Briggs Co., Lansing, Mich., manufacturer of face brick, has adopted a capacity operating schedule at its plant at Grand Ledge, Mich., on a basis of 40,000 to 45,000 bricks per day. Orders on hand insure this rate of production for a number of months to come.

The Robertson Art Tile Works, Morrisville, Pa., is running on a day and night schedule at its plant, with incoming orders in excess of production. Contracts on hand insure maximum output for some time to come.

The Model Brick Co., Houston, Tex., has placed its plant on the Crosby Road in operation, following curtailment for a considerable period. Production will be maintained for an indefinite period on a basis of 20,000 bricks per day.

RUBBER—The Hood Rubber Co., Watertown, Mass., is maintaining capacity production at its local mills, and reports orders ahead for some time to come. The sales for the first five months of the year have registered an increase of $1,200,000 in excess of those for the corresponding period of Jan. 1 to June 1, last year.

Tire production at Akron, Ohio, reached an aggregate of 2,500,000 tires at the different mills during the month of June, or a rate of 85,000 casings per day.

The Goodyear Tire & Rubber Co., Akron, Ohio, has resumed operations at its local mills, following a brief shut down for inventory. The plant will continue on a capacity basis of 26,000 casings a day.

During the month of June, the Firestone Tire & Rubber Co., Akron, Ohio, recorded the highest sales in the history of the organization. It is expected to advance the current output of 25,000 tires a day at an early date. The peak production at the plant is rated at 28,500 tires daily.

OIL—The Rex Refining Co., Sweetwater, Tex., recently reorganized under the direction of A. M. Slade, and associates, Fort Worth, Tex., has resumed operations following a shut down for more than a year past. It is expected to develop maximum production at an early date.

The Vacuum Oil Co., Paulsboro, N. J., has adopted an operating basis of close to normal at its local plant. A regular working force is being employed.

IRON AND STEEL—The Algoma Steel Co., Sault Ste. Marie, Ont., has resumed operations at two of its furnaces, and a third will be placed in service at an early date. The rail mill at the works has been placed in operation, following a period of curtailment and will be run on a capacity basis for an indefinite period.

The Republic Iron & Steel Co., Youngstown, Ohio, has resumed operations at its Bessemer plant, following a shut down for the past 18 months. About 700 men will be employed at the mill. The starting of the mill brings the Bessemer production in the valley to 100 per cent.

The Gulf States Steel Co., Birmingham, Ala., has placed its 20-inch bar mill in operation, following a shut down for about 18 months past.

The Carnegie Steel Co. has blown in the fourth blast furnace at its plant at Ness-

Castle, Pa., placing the works on a fu operating basis, with regular working forc

The Eastern Rolling Mills Co., Baltimor Md., has adopted a capacity operatin schedule at its local plant on a 24-hour p day basis, giving employment to abo 1,200 men.

New Publications

BOOKS

CHEMISCHE UNTERSUCHUNGSMETHODEN FI EISENHÜTTEN UND NEBENBETRIEBE. *Ing. Chemiker Albert Vita.* Second ar revised edition. 197 pp., 34 illustration Published by Julius Springer, Berl (1922), 78 marks (in America, $1.90).

A concise, but nevertheless thorough, con pilation of important analytical metho not only for iron and steel, but for coa gas, coal tar and its products and the mo important non-ferrous metals. It is book of handy size and is well printed ar illustrated.

"Electro Steam Boiler" is the title of pamphlet recently issued by the Electr Furnace Construction Co., Philadelphia, P

Further Investigations of Illinois Fi Clays. By C. W. Parmelee and C. Schroyer. Extracts from Bulletin No. 3 State Geological Survey, Urbana, Ill.

The *Journal of Personnel Research*, t official organ of the Personnel Resear Federation published its first issue in Ma 1922. This *Journal* publishes origin articles by workers in the biological a medical sciences, psychologists, pschiatris engineers and economists who are maki important contributions to the knowled of human beings at work and will ser men who are interested in activities th pertain to personnel in industry, commerc education and government. The magazi is published by Williams & Wilkins C Baltimore, Md.

Scovell, Wellington & Co., accountant engineers, Boston, Mass., have issued small booklet entitled "Selected Profe sional and Business Books" which contai a list of 400 books on accountancy, indu trial engineering and related busine topics. This list has proved useful to the and they think it will be helpful to anyo who is interested in building up a library.

The Hercules Powder Co., Wilmingto Del., has issued a booklet entitled "Dyn mite—The New Aladdin's Lamp." Th article was written by T. W. Bacchus, vic president of the company. It is an inte esting and accurate account of the pa played by dynamite in the industrial d velopment of this country. Copies may obtained free by addressing the Hercul Powder Co., Wilmington, Del.

THE MINING HAND BOOK OF CANAD 1922, covering the metal, mining and oil i dustries of Canada, has recently been pu lished by the Investor's Mining Hand Bo Co., Toronto, Canada. Paper bound copi are $1 and leather bound are $2 per cop

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold summer excursion meeting to Rochest Montreal, Ottawa, Kingston, Toronto, Har ilton, Niagara Falls and Buffalo, Aug. 13-1

AMERICAN CHEMICAL SOCIETY will ho its fall meeting in Pittsburgh, Pa., Sept. to 9.

AMERICAN ELECTROCHEMICAL SOCIETY w hold its fall meeting in Montreal, Sept. 22 and 23. Headquarters will be at t Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold tic City, Oct. 23 to 28.

AMERICAN SOCIETY FOR STEEL TREATI will hold its International Steel Expositi and Convention in the General Moto Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF TH NATIONAL SAFETY COUNCIL will be held Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL I DUSTRIES (EIGHTH) will be held in Ne York Sept. 11-16.

NATIONAL EXPOSITION OF POWER A MECHANICAL ENGINEERING will be held the Grand Central Palace Dec. 7-13, wi the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has d continued meetings for the summer, b will resume them in October.

THE SOCIETY OF INDUSTRIAL ENGINEE will hold its next national convention a exhibitions of labor-saving equipment the Hotel McAlpin, New York, October

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor

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SIDNEY D. KIRKPATRICK
A. E. BUCHANAN, JR.
GRAHAM L. MONTGOMERY
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As They Do It In Scotland

THE GLASGOW meeting of the Society of Chemical Industry, which is reported elsewhere in our columns, indicates that they are keeping chemistry alive in Great Britain. Compared with the meetings of the American Chemical Society its purpose is clearly more social and less devoted to the presentation of papers. Thus, in a meeting which lasted a week, the only papers were the address of the president, the Messel medal address, one on the calibration of storage tanks, one on the viscosity of cellulose in cuprammonium hydroxide, and four papers under the general heading of evaporation and distillation given under the auspices of the chemical engineering group. The fact is, the purpose of the meeting is not for members to read papers to one another; it is rather to see things and to talk informally.

Indeed, at the meetings of the chemical engineering group, which is a very lively section of the society, the authors of the papers do not read them. They are printed in full and distributed. The authors talk about their papers and answer questions which are launched from the floor in great profusion. The chairman is selected with great care as one familiar with the subject under discussion and acquainted with those who have addressed themselves to its problems. There were three members of the American Section of the Society (i.e., the Section in the United States, and not including the five Canadian branches), Messrs. J. V. N. DORR, HENRY WIGGLESWORTH and our consulting editor, ELLWOOD HENDRICK. We gather that from the tales these gentlemen are likely to bring home other cis-Atlantic members will make a point of attending British meetings in the future.

The welcome provided by the City of Glasgow was made an event of such distinction and grace as to be long remembered by those who were present.

Success at $2.50 Per Year

"BECOME an executive! Don't envy the man behind the mahogany desk, get there yourself."

We could go on quoting advertisements in almost any magazine in the United States, the very number of which is evidence of the success of the ventures which they are promoting. Some magazines devote themselves almost exclusively to stories as to how JOHN SMITH, hardware manufacturer, or furniture dealer, or city editor, became a success—or how he thinks he became a success. There is danger in all of this, danger that men will believe success is due to some trick system or catch phrase. The influence of these things upon the community is unbalancing. It leads inevitably to a superficial view of success. It conceals the cardinal fact that success in any field is the result of work and intelligent study.

How many times have you heard a young man say, "I believe that I have executive ability, and I want to become an executive. I don't want to waste my time in a minor capacity." Right here is the real tragedy of this philosophy of success. JOHN SMITH, carpet manufacturer, may like to believe that his success was due to the advice given him by a friend of his young manhood, who said "Never weaken," or some equally inspiring thing. But JOHN SMITH'S success has behind it 30 years of work, of intelligent concentration, of detail, and those things are not emphasized or even mentioned. All this tempts the younger generation to believe that if only someone says to them "Never weaken," then they are fated for certain success at an early age.

What young Americans need, and this applies to young technical men as much as to any other group, is a task master and whip. Perhaps someone can suggest another antidote for the insidious poison that success is to be obtained by cutting magazine advertisement coupons, or by subscribing to a course of reading, or by reading a particular magazine, or by following a given catch phrase. The task master and the whip have produced results in the past. Something must make men realize that intelligent study and hard work are the sure roads to success and make them abandon their gods of clay which produce nothing but swollen vanity and baseless self-confidence.

The Portland Cement Industry And Its Association

TRADE associations have been very much in the limelight recently, partly because the Attorney-General of the United States has suspected them of violating the Sherman act; partly because Mr. HOOVER has done his best to find out from the Attorney-General what a trade association should do and what it should not do; and partly because of the vast and increasing number of trade associations in existence at the present time in the United States. The Portland Cement Association is one of the largest in the country and the methods by which it works as well as the aims toward which it is working are interesting. In this issue we are publishing an account of the association and its work. The article is instructive from another point of view in that it represents all that is now safe for a trade association to undertake. You can be assured that with the federal investigation searchlight turned on trade associations none of them is going to undertake anything that is not perfectly conservative. Particularly is this true of the Cement Association, whose members are under federal indictment at the present time for conspiracy on price fixing.

From the chemical engineering point of view there are other phases of this question of portland cement

which are disquieting. The Portland Cement Association has sponsored and carried out a good piece of work in standardizing the specifications of portland cement. It, however, has not standardized portland cement. Some grades are very much better than others. All of them pass the requirements of the standard specifications, but some of them just barely pass it, and others pass it by a very wide margin. It is therefore inevitable that within a short time there will be a grading of cement. The cement industry does not welcome this, as it will complicate sales and manufacturing, but there is a strong demand for it by many prominent civil engineers. Some of the more progressive cement manufacturers favor it, realizing that their own particular product is far better than the average on the market.

Again, there is another phase of the question which is closely associated with the grading of cement. We have reference to the bettering of portland cement as a product. Very little work is being done on that at the present time. The Portland Cement Association is confining itself to the education of the public in the use of its present product and claims that there is no use in manufacturing a better grade of cement until the public knows how to use the present grade. There is something in this, of course, but no industry can be regarded as healthy which disregards completely the work of improving its product. What is the portland cement industry going to do about it?

Finally, there is a strong disbelief on the part of many that the Cement Association is teaching the public how to make better concrete. Invariably every improvement in concrete making which is announced indicates the desirability of using more cement. After a certain time this becomes monotonous and then suspicious. If there be truth in this belief, then the cement industry would better beware. You can't fool all of the people all of the time. Woe betide the person or the industry that tries it. Who's for the defense?

Chemical Industry Supports the Foundation

DEVELOPMENTS during the past week in the proceedings of the government against the Chemical Foundation were marked by a very noticeable rally on the part of the chemical industry to the support of the Chemical Foundation. The Synthetic Organic Chemical Manufacturers' Association called on the President and expressed confidence in the Foundation and its management and argued against any interference on the part of the government on account of the adverse effect it would have on the development of our organic chemical industry. About the same time the National Association of Finishers of Cotton Fabrics adopted resolutions protesting against any action that might jeopardize the success of the organic chemical industry in this country and aid in re-establishing a German monopoly. Subsequently the American Chemical Society appointed a strong committee and requested an interview with the President, which, at the time of writing, had not been granted. It is to be hoped that the President will find time in the midst of the burdens laid upon him by the railroad and coal strikes to listen to the American Chemical Society's committee. In many respects it would speak more disinterestedly than our chemical trade associations and would add professional weight to the representations that have already been made. This committee comprises men of unquestioned eminence in the profession and integrity as citizens, and they could speak with authority and be heard with respect.

With this evidence of the unstinted support of the industry it may not be out of place to suggest that Mr. GARVAN be less active in speaking in his own behalf. His course thus far is not above criticism, and has added no weight to his cause. His letter to the President was in bad taste. His indulgence in flag-waving and eagle-screaming pyrotechnics accomplished specifically what he, and we, desired to avoid—namely, "to becloud the vital issue." The fireworks have been overplayed. Our distinct preference is to support the cause of the Chemical Foundation and consequently we dislike to see that cause jeopardized by indulgence in discourteous bombast. Let the Attorney-General do the talking and play his politics. Let the Chemical Foundation and the chemical industry acquit themselves in a dignified way under circumstances that are admittedly serious and trying.

Erratic Market In Building Construction

PRESENT times are marked by a deal of preaching on stabilization of markets and study of "the business cycle" and a remarkable disregard, in actual practice, of the principles preached. Those who have studied the great upward and downward swings that business in the United States has exhibited have been urging that men heed the obvious lesson of the business cycle and endeavor to make their expenditures when they can get the most for their money and curtail their expenditures when the dollar will not go so far; but the average man seems to study the indices of business conditions with precisely the opposite ambition. When he sees business is good he wants to "take hold" and *vice versa*.

The great ups and downs in business activity are not necessary. At least, neither those who have studied the matter most carefully nor those who have not studied it at all show any disposition to claim that they are necessary. The business cycle has no friends, yet it continues thriving.

There has been talk of "stabilizing" the coal market, by developing a plan whereby people would realize in summer that they will desire to burn coal next winter. The idea is feasible enough, for coal can be stored. One can carry a stock of greater or less amount, anything above zero. One cannot go short of coal, or consume more than he has. In building construction there is more leeway. One can build ahead of time or he can wait beyond the most desirable time, from the standpoint of convenience, and thus there is really more latitude in building than there is in the consumption of materials that are needed for manufacturing operations.

Despite this obvious fact, one observes that there is a more erratic market in building construction than there is in most commodity markets. We have spells when there is scarcely any construction and other spells, like the present, when building construction is extremely heavy. This is particularly true of dwelling-house construction. The only kind of building that has shown a strong tendency to take advantage of the business cycle is office building. It is the estimate of men well posted that about 85 per cent of all the skyscraper office buildings in the United States have been erected, or more accurately speaking, contracted for in times of business depression.

The present wave of dwelling-house construction

which is felt in nearly all sections of the country, is probably due to a great many men having come to the conclusion at the same time that "now is the time to build." The individual opinion probably was that others were going to build later, hence everyone tried to beat everyone else. Had it been possible to get a house actually built at the cost and within the time that were estimated last autumn or winter the builders might have realized their individual ambitions, but it is one thing to make an estimate and another thing to obtain the expected results. On account of the extreme activity many houses are costing more to build and are slower in construction than was estimated.

During the war it was commonly predicted that afterward there would be a period of several years of active building construction. The casual observer might think that now we have just entered upon the period and expect it to continue for several years at the present pace. The probability, however, is that this particular kind of activity will decrease as rapidly as it increased.

Ido Versus The Great Inertia

IN OUR columns this week we print a letter from one of our readers who has been interested in the Esperanto-Ido controversy. In the universal language idea he sees a great boon to technical men in general and he outlines a very logical program for the introduction of one of these universal languages into engineering work. The interest which has been aroused in this subject rather necessitates our taking a definite position in the matter.

Somewhat reprehensibly perhaps, our attitude toward a universal language has been *laissez faire*. We find ourselves asking the somewhat colloquial question—What's the idea? We find also that a vast majority of our contemporaries ask the same question and adopt the same attitude. That is the most serious drawback to the introduction of a universal language. Most people are not particularly interested in the subject and do not see the benefits that might accrue. The general attitude might be called a cold neutrality, which is unfortunate for any movement. An active opposition is better than neutrality, for it always gets the idea talked about pro and con, and excites an interest in the subject.

The general proposition of studying Ido or Esperanto for two or three months and then being able to read any scientific article in the world is rather tempting, and for the accomplished fact we can feel nothing but enthusiasm. Three or four years of French and German, to say nothing of Italian and Russian, rather makes the two or three months spent on Ido seem like a godsend, but alas, scientific literature at the present time is not printed in Ido and even if we spent two or three months learning it, it wouldn't do us a great deal of good. There's the rub. The tremendous difficulty of getting any publisher to print a column of Ido, let alone a whole magazine, would be well nigh insurmountable.

The plight of the metric system in the United States and Great Britain is an object lesson in this matter. Certainly, if ever there was logic in anything, the metric system should be adopted both in the United States and Great Britain, but it has not been adopted in either place and it will be many a long year before it is adopted as the exclusive system of weights and measures. The stone wall of current practice is a pretty difficult thing to surmount and if the metric system fails, how much more completely impossible would it be to introduce a new language. In Germany it is even impossible to avoid the use of an archaic style of printing. If we can't internationalize type, how can we hope to internationalize language?

There are many delightful pastimes and avocations in which we should like to indulge, but we are pressed with more serious business. Hence we shall forego the novelty of printing a column of Ido each week, and must decline to lend the active support of the magazine to the advancement of the cause of an international language. We fear we are part and parcel of the great inertia.

Raising the Standard of Chemical Engineering Education

THE OLDER half of this generation probably remembers the fly-by-night medical school which gave diplomas for a short course and permitted the recipient to use the title of doctor. This species of school and its products are now happily extinct or practically so. The most potent influence in eliminating them was the attitude of the American Medical Association toward medical education. It gave and continues to give its approval to medical courses which measure up to recognized standards of excellence. It did not give its approval to courses presented by institutions which did not live up to these standards. This naturally created a drift of students toward the better class of medical school, which was reinforced by the fact that the members of state licensing boards were members of the American Medical Association and graduates of reputable and approved institutions. Little by little the fly-by-night medical schools vanished.

A somewhat analogous situation exists in chemical engineering. There are schools in this country that turn out so-called chemical engineers inadequately trained, a menace to the profession because they call themselves chemical engineers. In unanimously adopting a program that calls for the approval of schools in chemical engineering which have recognized merits, the American Institute of Chemical Engineers has made a salutary and progressive move toward remedying an evil. Colleges and universities giving courses in chemical engineering undoubtedly will have due respect for the opinion of the American Institute of Chemical Engineers and will receive with courtesy its suggestion as to changes in curriculum. The approval of the Institute will mean much. But its failure to approve will mean more, because it will seriously militate against the popularity of the school in question. Students are quick to recognize that a course is regarded favorably or unfavorably in the profession and will very quickly flock to an approved school. With the possibility of disapproval imminent, the co-operation on the part of college and university authorities is likely to be prompt and enthusiastic. The Institute had loaded the old family shotgun with real ammunition instead of blank cartridges! It is to be congratulated on its courage and foresight.

There is perhaps one word of caution that should be uttered. In educational work a large part of the value received by the student is due to the personality of the professor, and this must be taken strongly into account in evaluating certain courses in any curriculum of chemical engineering. With due regard for the character of the personnel, as well as the nature of the course, the Institute can hardly go too far.

Readers' Views and Comments

To the Editor of Chemical and Metallurgical Engineering

SIR:—I note the good natured controversy in your columns between the proponents of Esperanto and Ido for an International language.

It appears to me that the supporters are trying to use the arguments of each for its being the best *universal* language and trying to make those arguments stick with regard to a limited field of usefulness. Without going into the merits of either as to a general field of usefulness in commerce, finance, politics, traveling, etc., it seems to me that what the engineer is interested in is a language adaptable to his immediate needs, so that in six weeks in college he may read any technical book or table of statistics. This would ultimately eliminate the necessity of two, three, or four years of French, German, etc.

It is my vague impression that for a universal, all-purpose language, the vocabulary should be so arranged that the root words are proportioned in number to the total number of prospective users speaking any language. That is, to be more clear, if the number of prospective users now speaking English is four hundred million or so, and the number of users speaking Arabic is also four hundred million or so, then the number of basic roots taken from the Arabic should be equal to the number taken from the English and so on. So much for all-purpose language. Now, since the Arabic speaking population can never be expected to shine in science or engineering, it would be useless to go to the Arabic for root words in any language intended for use only by technical men. Similarly with the Chinese, Esquimo, Abyssinian, etc., roots.

Hence it appears to me that any language which has its root words—that is, its vocabulary—pretty well rounded off with respect to the different European languages would be ample for all reasonable technical uses. It would seem that both Esperanto and Ido fall in this class, so we need not look further.

The matter of temporary deficiency of vocabulary is pretty easy to remedy since technical terms are to a quite appreciable extent internationalized anyway, numbers of them being coined each year from the Latin or Greek and adopted unchanged, or only slightly so, throughout the technical world. The general vocabularies of both languages are probably already pretty complete so their adaptability to expression of thought may be considered to be ample.

There remains only the question of the introduction of the particular language chosen. Should this language never come into general public use but remain forever a technical language, there would be only a small loss to each individual as I am told that any of them can be very well learned in a few months. Furthermore, it would be no considerable task to introduce one or the other, and receive its benefits soon. A commercial language could come along later.

I would suggest that the various large technical societies hold a convention, choose and recommend whichever seems best fitted for the use of the members speaking that particular native tongue. The next step would be an international convention of technical bodies and government representatives to thresh out the same question for the technical world as a whole. This recommendation would be final but would still be only recommendation. The third step would be a tryout. Such bodies as the Bureau of Standards, the Smithsonian Institute, the Naval Observatory, and like bodies in other countries would then publish their statistical works in the form of an interlinear translation, that is, the works would be published as at present but with the addition that after the explanation in the native tongue, the same explanation in, say Esperanto, would follow. This would incur very small expense as in such works as the Smithsonian Tables, the numbers are the main thing and the explanations generally occupy only a few lines per page. If British, French, and German organizations followed suit, this would be a very efficient and economical tryout.

Should this be favorable, the fourth step would be more daring. Some magazine, for instance this one, could publish for a couple of years a double issue as is now published by the magazine *Sugar* which has a Spanish edition bound in with the English edition. This would be more expensive as a tryout, but if still successful we are off, and are at once receiving the benefits of the new international technical language. Other magazines, and even book publishers would shortly fall into line. Further, if a success, this very success would stimulate the use of this or another similar language in commerce, and other foreign intercourse.

I hope my ideas will be of interest to you.

Washington, D. C., M. SHERRILL.
States Relation Service,
O. H. E.

Manufacture of Hydrogen Peroxide

To the Editor of Chemical & Metallurgical Engineering

SIR:—More than forty years ago the writer was chemist and manager for Charles Marchand, an ingenious Frenchman who first made H_2O_2 a commercial success. In that capacity I worked out a method for the manufacture of BaO_2, under which many tons of this material were produced. While working in this line the late Professor Joy of Columbia drew my attention to the reaction with CO_2 and I made a number of experiments, producing considerable quantities of hydrogen peroxide at various times without observing that the product was more unstable than that made by Marchand with Thenard's process. But later I went into the experiments much more intensively and completely and was therefore much surprised at the article in your issue of June 14, 1922,[1] re-describing the same process, for this must have been tried by many besides myself.

When I repeated my experiments, now many years ago, the process was carried on in a pressure vessel kept in motion continually and at a pressure of about 100 lb. to the inch. From the first no attempt was made to work the method in unlined vessels and the wrought-iron pressure tank was lined with porcelain.

[1] "Hydrogen Peroxide—A Novel Process for Its Manufacture," by H. A. Doerner, *Chem. & Met. Eng.*, vol. 26, No. 4, pp. 1111-2 June 14, 1922.

bricks of the same quality as used in cylinder mills, but of smaller size. These bricks were cemented together with caustic baryta, which sets into a very hard binder, apparently expanding slightly, like plaster of paris. Many difficulties were encountered and overcome, but there was one not mentioned in that article, which resulted from the production of barium percarbonate and proved more troublesome than all the rest. Under pressure a sort of bi-percarbonate seems to form, probably of the composition BaC_2O_6. This is very unstable, somewhat soluble, at least in the carbonic-acid solution and when removed by H_2SO_4 it is prone to cause a loss of oxygen which should have been held in the peroxide.

The product was never handled commercially, for the high price of CO_2 at that time made it impracticable. Besides, I became convinced that it was one of those things which must be handled on a large scale to be economical and enable the use of comparatively unskilled labor. But the process has undoubted possibilities, and what I did before abandoning the thing convinced me that there were no obstacles that were not easily surmountable. Unfortunately, my notes are not accessible, so that I rely upon memory and cannot go into details, but the process as described in your article is practically a replica, on a rather larger scale, of what was done years ago. H. B. GOETSCHIUS.

Roscoe, Sullivan County, N. Y.

Should Engineers Be Licensed?

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is evident from an editorial in the July 5th issue of *Chemical & Metallurgical Engineering* that the laws passed in several states providing for the licensing of all engineers who wish to engage in the practice of professional engineering do not meet with your approval. You point out several possible faults in the scheme.

The editorial states that, whether he likes it or not, the engineer finds himself restricted or hampered by incompetent legislation. I wish to point out that no qualified engineer is restricted or hampered by the New York law in the performance of any professional work that he could with honesty and from an ethical standpoint hope to perform.

You "gravely question whether any good can come of licensing engineers whose work requires the exercise of initiative, ingenuity, judgment or the creative faculties." Let us consider the question of judgment. The lives of all depend on the judgment of engineers and, under a licensing law properly enforced, the risks which we must run will be lessened, for an engineer will never make more than one mistake in judgment which adversely affects public safety; and his disbarment after failure will be an impressive lesson to others who might commit the same errors of judgment. You would confine the license to only such engineers as are responsible for public works. I say that the chemical engineer responsible for a plant liable to explosions or other dangerous accidents may, by his errors in judgment, jeopardize the public safety fully as much as could a bridge designer responsible for a highway bridge. The license law must apply to all engineers on a basis of full equality.

Your editorial goes on to state that licensing of physicians has not worked miracles with the medical profession. No, nor can licensing work miracles with engineering. Truly, we shall choose our engineers as we do our physicians—for proved ability. But licensing of physicians helps enormously to keep the shysters out of the medical profession and we can expect with confidence that in time the license will do as much for engineering. The license certificate cannot, as you point out, make a good engineer out of a poor one and, in the wildest flights of fancy, no one connected with the passage of licensing laws ever expected that is could. But it does not prevent the totally unqualified man from representing himself to a more or less gullible public in the guise of an expert—an occurrence which is not rare, as those who were stung in the "efficiency" engineer fake of some ten years ago will testify in choice language and with much feeling.

The last objection raised by the editorial is that the license certificate does not differentiate between types of engineering practice. To do so would be really to hamper the engineer. He should have the latitude to perform as large a service as he is able to compass. And it is certainly up to the individual engineer to run no risk of losing his license by trying to do work for which his experience and training do not qualify him. Under the law we have the same safeguards that we formerly had against such malpractice with added protection due to each engineer's anxiety so to conduct himself that his license cannot be revoked.

If you will study the law with care you will find that, at least in so far as the New York law is concerned, the fears evoked in your editorial are all chimeras. Prior to the law's passage, the only real opposition it had came from corporations and their hired engineers who vainly hoped, by maintaining the engineer in a position of public disregard, to continue the then situation—when brains could be hired by the unscrupulous for nothing a week. It would give me cause for great amazement and regret to see *Chem. & Met.* definitely line up in such discredited company.

ONE OF THE "ENERGETIC MINORITY".

New York City.

Electric-Furnace Production of Phosphoric Acid

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your report of the Niagara Falls meeting of the American Institute of Chemical Engineers, there is one matter to which I should like to call your attention.

Referring to the discussion by W. H. Waggaman on the production of phosphoric acid, there is not a clear distinction between the furnace using fuel as a source of heat and the electric furnace. The passage in question is on page 13 of your issue for July 5.

I wish to clarify reference to the mention of a plant "designed by one of the men formerly with the Bureau of Soils." This plant is not in any sense connected with the experimental work of Mr. Waggaman on fuel-fired furnaces and is not in an "investigation stage." On the contrary, it is a full size plant, and regularly producing considerable quantity of phosphoric acid. Further, the reference to the short runs and comparative estimates on the cost of producing phosphoric acid refers to the work of Mr. Waggaman and not the acid work at Anniston.

So far as is known to the writer, the basis of comparison of cost of production of phosphoric acid is the result of Mr. Waggaman's short runs and estimated cost on electric furnaces as published by the writer while connected with the Bureau of Soils.

J. N. CAROTHERS.

Federal Phosphorus Co
Anniston, Ala.

Automatic Equipment and Chemical Control

By Graham L. Montgomery

The Beverage Industry Based on Automatic Equipment for Competitive Purposes and Chemical Control for Purity—Description of the Beech-Nut Packing Co.'s Ginger Ale Plant at Canajoharie, N. Y., an Illustration of the Combination of These Two Important Methods

TO KEEP a continuous, active market for a beverage, the manufacturer must meet three main essential requirements. The price must be such that the product can hold its place in a highly competitive market. The flavor, quality and purity of the beverage must be such as to create a continuous demand among consumers. The beverage must be so made as to be acceptable under all state and federal pure food and health laws.

On the matter of price, the raw materials which enter into the manufacture of beverages are only a slight fraction of the cost of the finished and bottled product. Also, these materials present no particular chance of advantage, as the price fluctuations in the long run will equalize their cost for all manufacturers.

The possibilities of savings lie then in the manufacturing costs. This fact was early recognized by the industry at large and as a consequence, we find that automatic machinery and handling devices are employed by these manufacturers wherever there is any possibility of effective use of this equipment.

The matter of flavor, quality and purity necessary to create and maintain a popular demand is so tightly bound to the matter of purity to comply with the law that these two essentials must be considered as under one head. To accomplish these results it is necessary to establish and maintain a strict chemical and bacteriological check on all stages of the manufacture and bottling of the beverage.

Some Essentials of Beverage Manufacture

Before passing to the specific example of modern beverage manufacturing practice which forms the major portion of this article, there are certain essentials of manufacture which those interested in this industry should bear in mind.

In the first place, all the raw materials used must be pure and of good quality. Water forms the greater part of all non-alcoholic drinks and particular care must be exercised to obtain a pure water of good flavor with the proper degree of hardness. The other materials—those used to make up the flavoring of the beverage—should be absolutely unadulterated, fresh and of good flavor. If these essentials of quality are observed in the selection of the water and other materials it becomes possible to fix on a blend of pleasing flavor and to maintain this constant at all times.

Most of the popular beverages are charged with CO_2 or carbonated. If any bottles of such a beverage reach the consumer in a flat condition, *i.e.*, with the CO_2 discharged, there is much complaint and the sales of that particular beverage are likely to be materially lessened. Hence the successful manufacturer goes to some little trouble and expense to see that the bottles of his beverage are uniformly charged and are sealed tight.

Among items which will not be stressed here but which have a direct influence on the manufacturer's success might be mentioned the control of a supply of bottles and packing-cases. It is evident with but little consideration that any advantages a manufacturer can obtain along this line will be of direct advantage in enabling him to keep costs at a minimum.

The Beech-Nut Packing Company

The Beech-Nut Packing Co., manufacturers of various food products, has been located at Canajoharie, N. Y., for many years. When they contemplated the addition of non-alcohol beverages such as ginger-ale and root-beer to their products, this location was found to be fully as good as could be found elsewhere for the purpose.

As stated above, the largest part of these "soft" drinks consists of water. A few miles north of the town of Canajoharie, in the foothills of the Adirondack Mountains, are located the Sprite springs, yielding a large supply of exceptionally pure water with low mineral content. These springs were acquired and now form the basis of the manufacture of beverages at Canajoharie. The water has sufficient head to flow naturally to the plant site. The watershed of the springs has been fenced and is well guarded against pollution.

Method of Purifying the Water

On first entering the plant the water passes through a meter. Immediately after the meter are four Bowden filters, piped in parallel so that one or two units can be out of use for cleaning or refilling. The water in passing through these filters encounters first a layer of coarse quartz, then a layer of fine quartz, and finally a layer of bone coal. This first filtering serves to remove all coarse suspended matter and the bone coal absorbs any cloudiness or odors which may be in the water.

After passing the Bowden filters, the water goes through one of four International filters. These are arranged in parallel in a similar manner to the first filters. The filtering medium consists of a thick, dense filter paper, protected on the inlet side by a cover of loosely woven cotton cloth which serves to intercept any of the bone coal which might be carried over from the first filter. The International and Bowden filters remove practically all material from the water which can possibly be removed by filtering.

Beyond the filters, the water flows through the sterilizers. These are of the ultra-violet ray type and consist of two concrete tanks, either one of which can take the whole load of the plant. In each tank are two weirs with openings about 4 inches long and $\frac{5}{8}$-in. deep, through which the water flows slowly, passing over the tube containing the arc which produces the ultra-violet ray.

The accompanying photograph of the water purification department shows the Bowden filters on the right, the International filters in the center and the sterilizer on the left.

After passing through the sterilizer, the water flows by gravity to the floor below. There it is divided into three streams, the largest to be carbonated, a second

to form the solvent for mixing the flavoring syrup and the remainder to be used for washing and rinsing bottles.

How the Water Is Carbonated

The bottling process used by the Beech-Nut Company is that known as the low-pressure process. This process depends on the fact that water at a low temperature will absorb and retain a far greater amount of CO_2 than at ordinary temperatures. For this reason the water which is to be carbonated is first passed over a direct expansion cooling coil supplied with a cooling medium from a 75-ton compression refrigerating set. This cools the water to an average temperature of 34 deg. F., a check being maintained on this temperature by means of a Foxboro recording thermometer.

After passing the cooling coil, the water enters the carbonators. These five machines, manufactured by the Liquid Carbonic Co., operate automatically, being governed through liquid level and counterweight so that when the carbonated water in the base of the machine is drawn off below a fixed low level, the machine starts to operate and continues to do so until the carbonated water level reaches a fixed high level. There are five of these machines operating in parallel on the pipe line between the cooling coil and the filling machines on the next floor below.

The operation of the carbonating machines, shown in the accompanying illustration, is as follows. The water is pumped in at the top of the column shown on the forward part of the machine by a geared pump, located at the rear of the machine. As it falls down through this column it is broken up into a fine spray. This spray comes into contact with CO_2 gas coming upward through the column. The CO_2 is introduced at the bottom of the machine where the main casting forms a reservoir for carbonated water. The gas bubbles up through this agitated water maintaining the saturated condition which the water acquired in the column. The CO_2 is received in pressure cylinders at 750 lb. pressure and is fed to the carbonator, through a reducing valve, at a pressure of 75 lb. A Foxboro recording pressure gage is installed on this pipe line.

As it is required in the bottling process taking place on the floor below, the charged water is drawn off from the carbonators through Berkefeld filters, shown on the left of the same illustration which shows these carbonators. After passing through these filters the water tests negative under all bacteriological tests.

The water to be used in syrup making flows as needed from the sterilizers to the copper heating kettles in which it is heated, together with sugar, to form the simple sugar syrup which is the basis of the flavored syrup used in the various beverages.

The water which is to be used to wash and rinse bottles is delivered by a pump situated on the same floor as the carbonators, the third floor. This pump takes the water from the sterilizers on the fourth floor and delivers it to the soaking and rinsing machines on the second floor at the pressure and in the quantity desired.

Manufacture of Flavoring Extract

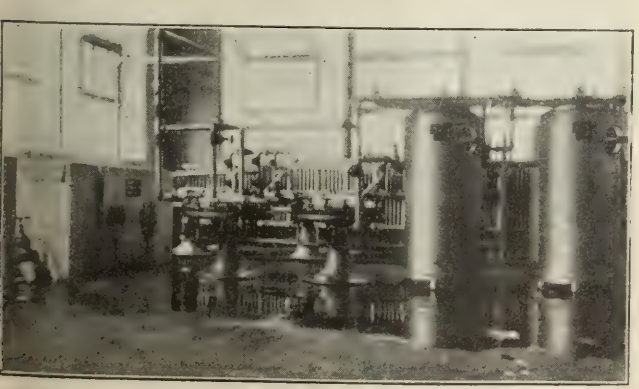
At the Beech-Nut Company's ginger-ale plant, the materials which go to make up the flavoring extract are purchased in as near the raw or original state as possible. It is easier in this way to get pure materials and to control the blend so as to have the flavor exactly the same at all times.

For the purpose of illustrating how the extract is made let us consider that used in flavoring ginger ale. The basis of this flavor is ginger root. Other vegetable products that can be directly extracted are handled in the same way. This root is first pulverized in a Jeffrey pulverizing mill. The pulverized material is then placed in a percolator. The percolators used are of heavily tinned sheet metal and in general design are like a large funnel. These percolators, removably suspended from the room ceiling by hooks, are provided with covers and with valves at their lower or discharge ends. The material to be extracted, about 150 lb. at a time, is placed in a cloth bag and suspended in the percolator. Pure grain alcohol is then allowed to trickle down through the pulverized mass, thus extracting the flavor of the ginger or other material.

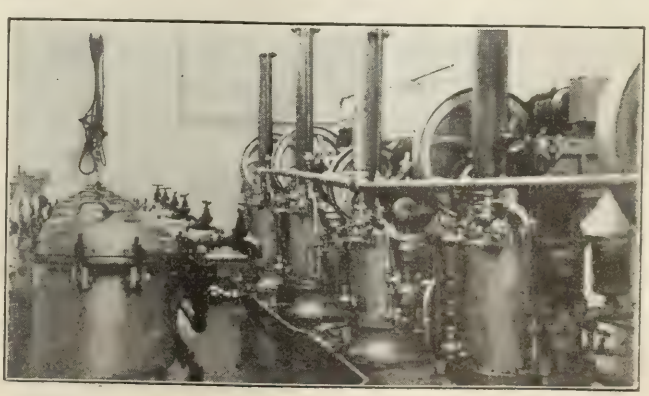
The crude extract which comes from the percolators contains a small amount of tarry material from the ginger roots. To get rid of this, the extract is placed in a Pfaudler glass-lined agitating tank with distilled water and thoroughly washed.

A certain amount of alcohol remains in the woody mass of waste removed from the percolator after the extracting is finished. To recover this, the waste is placed in a small Tolhurst centrifugal extractor. This machine recovers all but a small proportion of the alcohol, which can be purified by distillation and reused.

The essential oils of lime, lemon and orange are used in the flavoring of many soft drinks including ginger-ale. These oils are purchased in the crude state. In this condition they contain terpene and must be refined by extracting the terpene with alcohol. By doing this refining at the plant, it is possible to keep the strength, quality and purity of the refined oil always the same. These factors would not be so easy to control if the oils were purchased in the refined state.



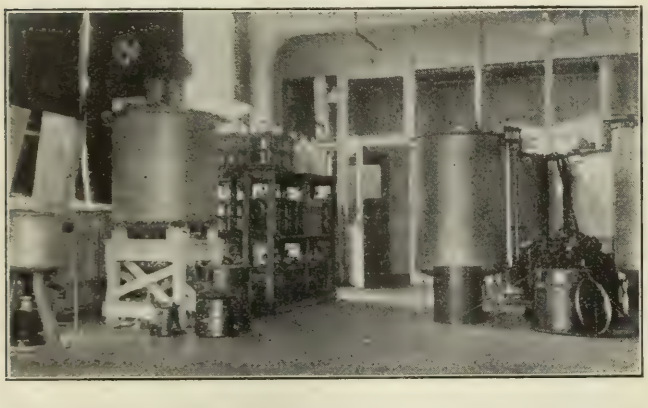
WATER PURIFICATION APPARATUS



CARBONATORS AND BERKEFELD FILTERS

The extract and the essential oil are both carefully filtered through paper. They are then placed in one of the storage tanks in the proper proportion to produce the desired flavor and allowed to age, which improves the blend. Handling of the extracts, of the essential oils and of the blend of the two is accomplished by means of the portable centrifugal pumping set and the copper cans shown in the accompanying photograph.

This photograph shows on the left the Tolhurst centrifugal extractor, next the Pfaudler glass-lined agitating tank; in the center a stack of the bottles used for essential oil containers and on the right, the six storage tanks and the portable pump. The storage tanks are Pfaudler glass-lined tanks with covers lined with block tin. All are provided with gage glasses to show the depth of the liquid contained. The two shown in the rear are of 600 gal. capacity each for the storage



of the blend. In front of these on the left are two of 200 gal. capacity for distilled water. On the right, only partially shown, are two 200 gal. tanks for storage of the pure grain alcohol.

How the Flavoring Syrup Is Compounded

In a previous paragraph, notice was taken of the compounding of the simple sugar syrup of sterilized water and cane sugar in a heating kettle. Then this mixture is pumped to the mixing department on the fourth floor adjacent to the water purification system. In this department are four 350-gal. Pfaudler glass-lined tanks, a small pump and a Sweetland filter. To a measured quantity of this syrup the proper proportions of the blend of citric acid crystals, and of caramel or burnt sugar coloring are added. Here is performed the operation known as polishing the syrup. Two of the tanks are used for unpolished syrup and two for polished or filtered syrup. By means of the pump the syrup is forced from one set of tanks to the other through the filter. This leaves the syrup clear and brilliant and thoroughly mixed.

Syrup Storage Department

To keep the flavoring syrup until used it is necessary to store it in a cool place. For this reason this department is included within the same insulated walls on the third floor which inclose the sterilized water cooling coil and the carbonating or charging department. Within this space is a room maintained at a temperature of 40 deg. F. by cooling coils and containing four 600-gal. Pfaudler glass-lined tanks for syrup storage.

These tanks are provided with gage glasses and have block-tin-lined covers. All the piping through which the syrup or carbonated water must pass is block tin lined. A Foxboro recording thermometer is installed in the storage room to keep a check on the temperature.

Where the Automatic Equipment Is Used

The preparation of the carbonated water and of the syrup has been described above. These two elements are mixed in the proper proportion to form the completed ginger ale in the bottle at the time of filling.

It will be noticed in the descriptions of processes outlined above that most of the material is handled by pumps or by gravity flow in pipes. The bulk materials to be handled—sugar, ginger root, essential oils, etc.—are very small compared to the amount of liquids. The carbonating equipment is automatic. In the other processes there is little possibility of finding better equipment than that described. Only from four to five men are needed throughout this whole series of operations.

But when we come to the work of placing the ginger ale in the bottles, we find a situation in which the use of any hand labor would be extremely costly. For this reason automatic machines were long ago designed and are now generally employed in this work.

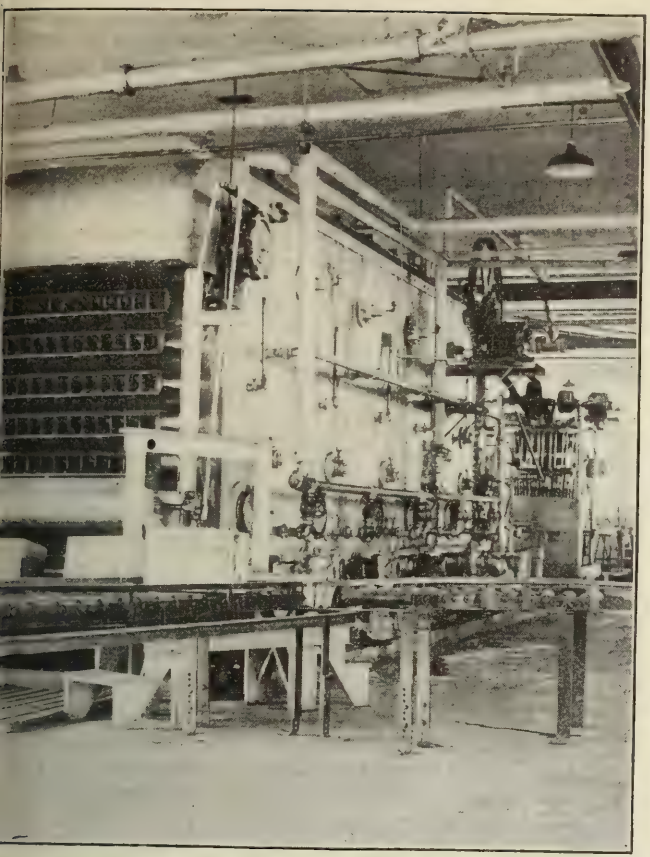
Division Between Manufacturing and Handling of Finished Product

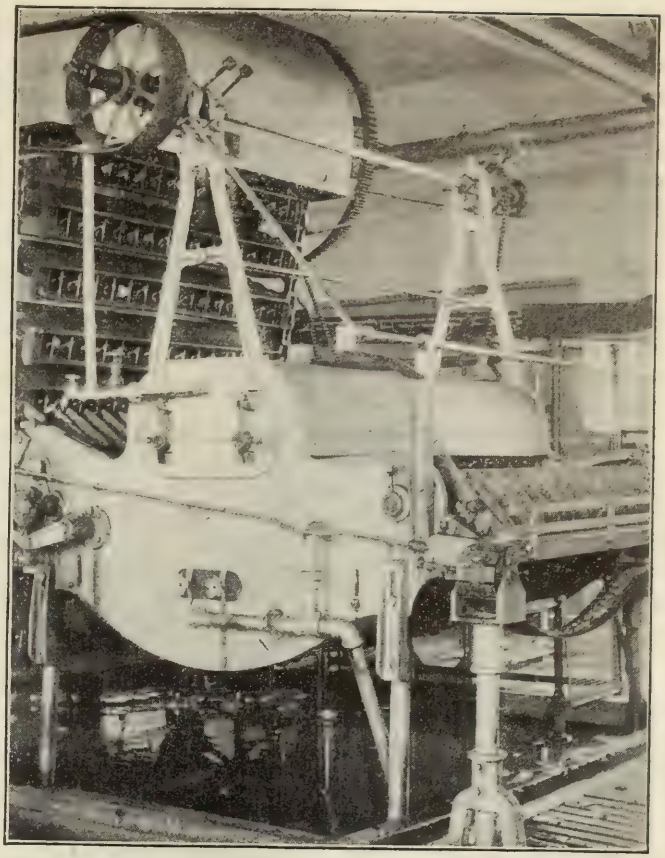
The work of filling the bottles would be classed entirely as handling of finished products except that the mixing of the carbonated water and the syrup takes place in the bottle. For this reason the automatic equipment for handling the bottles and filling and labelling them will be described in this article. The handling equipment used other than that in connection with the automatic machines here described will be the subject of an article entitled "Handling the Finished Products of Industry—IV" to appear in *Chemical & Metallurgical Engineering* for August 2, 1922.

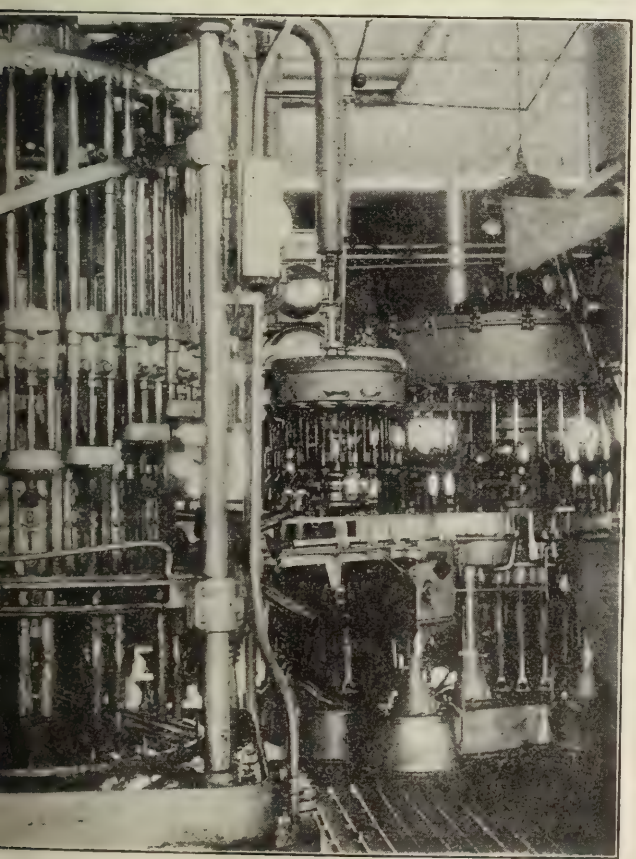
Work Done on Bottles Prior to Filling

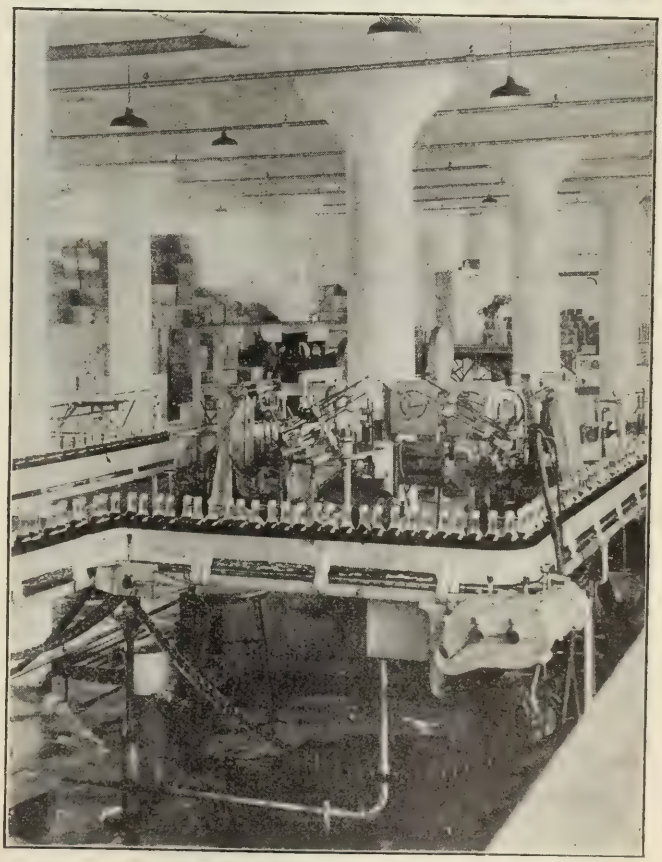
All bottles received at the plant must be thoroughly cleansed before they are filled, whether they are new bottles or bottles returned from dealers. The first operation of this cleansing is performed in the soaker manufactured by Barry-Wehmiller and shown in the accompanying photograph. As can be seen in the picture, the machine consists of five large tanks through which the bottles are carried, 15 abreast, held in the compartments of the chain. The first three tanks are filled with a hot caustic soda solution and the last two are filled with warm sterilized water. The chain makes one upward pass and one downward pass through each tank. Thirty minutes are consumed in passing through the soaker. The soaker and filling equipment are on second floor of the plant, so that water and other liquids are fed by gravity.

The bottles are thoroughly washed in the soaker but any labels which were on returned bottles might still remain on them. So after leaving the soaker the bottles are discharged from the chain compartments, automatically, and go through the brushing machine, also manufactured by Barry-Wehmiller. Channels on a incline receive the bottles as discharged and serve to keep them separate and equally spaced. The bottles slide down these channels under the brushes which rotate on horizontal axes perpendicular to the travel of the bottles. At the same time, the bottles are caused









UPPER LEFT—SOAKER WITH RINSER BEYOND
LOWER LEFT—RINSER AND FILLING HEADS

UPPER RIGHT—BRUSH AT REAR OF SOAKER
LOWER RIGHT—LABELLER AND BOTTLE CHAIN

to rotate on their axes. In this way any labels or other things adhering to the outside of the bottles are brushed off.

After having passed the soaker and brush, it is necessary that the bottles be thoroughly rinsed to remove any possible traces of caustic soda. This rinsing is done with an Arrow Bottlers Co. machine of the rotary type which is shown on the left side of the photograph showing the filling heads.

As the bottles leave the brushing machine they are delivered in an upright position to a single-chain conveyor having flat plates attached on the upper side of its links for the bottles to stand on. This conveyor delivers the bottles directly to the rinser. They enter the top ring of this machine first and as they are carried around they are first partly filled with warm water and then the interior is subjected to a thorough brushing with a high-speed rotating rubber butterfly brush. They are then transferred to the bottom ring of the rinser, being turned at this point so that the neck is down. As they travel around this lower ring the inside is rinsed by a jet of water. The water used by this machine all comes from the sterilizer.

Filling the Bottles

As the bottles leave the rinser they are delivered to a chain conveyor similar to that described above. This conveyor moves them to the first filling machine, called the "syruper," a rotary filling machine manufactured by the Liquid Carbonic Co. As the bottles are taken on this machine and caused to travel around its ring, a regulated amount of the syrup, the compounding of which was described above, is placed in each bottle.

This "syruper" delivers the bottles, over another short single chain conveyor, to the filling machine known as the "filling head," also made by the Liquid Carbonic Co. This machine is similar in construction and operation to the "syruper" except that it is specially designed for use with charged water. As the bottle goes onto the machines' ring, a funnel shaped head is thrust down over the bottle neck. This head makes a gas tight joint around the neck, and the pressure is then built up to 20 lb. before any of the charged water is allowed to enter the bottle. Thus it will be seen that if a bottle is cracked or for some other reason the pressure cannot be built up, no charged water is introduced. The operator picks out these bottles which have only the syrup in them and discards them.

If the bottle will stand the 20-lb. pressure, the valve, on the end of a tube which is projected into the bottle to a point near its bottom, opens and the bottle is gently filled with the cold charged water from the carbonating machines on the floor above. By introducing the charged water in this way it is intimately mixed with the syrup without undue foaming. As both the syrup and the charged water are at a temperature close to the freezing point, there is no undue escape of carbon-dioxide in the short period during which the bottles pass from the "filling head" to the crowning machine.

Crowning, Testing and Labelling Bottles

Transfer from the "filling head" to the crowning machine—a machine made by the O. and J. Manufacturing Co.—is made by means of another single-chain conveyor. This crowning machine crimps the caps on over the lip at the mouth of the bottle.

As the bottles come out of the crowning machine they are placed by hand upright in galvanized wire baskets holding about two dozen bottles each. These baskets are placed on the slat conveyor which conveys them through the test tank. This test tank is a large tank of water maintained at a temperature from 90 to 100 deg. F. It takes 11 minutes for the conveyor to pass through the tank and during this time the bottles are submerged in the warm water.

If there is any possibility of the CO_2 leaking from the bottles and leaving the beverage flat it will show up while the bottle is submerged in the warm water. For, as the bottle warms up, gas escapes into the air space under the crown and the pressure rapidly builds up to as high a point as it would reach under any normal conditions to which the bottle might be exposed. Any bottles which show a leak are removed from the tank by the workman stationed there and thoroughly inspected. If the fault lies in the crowning the bottle is refilled and recapped. If the leakage is due to other causes the bottle is discarded. The percentage of discards is extremely small provided a good strong quality of bottles has been obtained, showing that the automatic machinery is highly efficient.

As the bottles emerge from the testing tank they are removed from the wire baskets and placed on a single-chain conveyor similar to those already described. This carries them to the labelling machine, made by O. & J. Manufacturing Co. Here the labels are affixed and the bottles delivered to another single-chain conveyor. This last conveyor carries them to the inspection department where girl operatives give the final inspection and place them in the wooden shipping cases, 24 bottles to a case.

There are two complete units of this automatic washing, filling, testing and labelling equipment. Each of these units has a capacity of from 1,600 to 1,700 cases of filled bottles per 9-hour day.

Chemical and Bacteriological Control

Throughout the processes described above, a most complete and exhaustive chemical and bacteriological control is maintained over the materials used. The plant is provided with a large laboratory, extensively equipped so that all types of chemical and bacteriological tests can be conducted.

Chemical tests are made on each item of raw materia which goes to make up the product. These tests are made at regular intervals on the water and bulk products and on each container of the small quantity products. As these materials go through the processes regular tests are made after the completion of each step. In this way the quality and flavor of the produc can be uniformly maintained at the point which ha been determined to best meet the popular taste.

Bacteriological tests are made of the water as i enters the plant, after each step of the processes t which the water is subjected, of the various othe liquids used in the manufacture, of the finished produc and of the bottles, both before and after cleaning. Thes enables the company to be sure that the product leavin their plant has a low bacteria count, that the publi health is safeguarded and that the requirements of th various pure food and health laws are fulfilled.

We find then, in the ginger ale plant of the Beech Nut Packing Co., an almost ideal combination of auto matic equipment and chemical control—a combinatio by means of which manufacturing costs are maintaine at the lowest figure and at the same time quality o product is maintained at the highest level.

The Society of Chemical Industry Meets in Glasgow, July 4 to 11, 1922

An Intimate Glimpse of This Live Organization in Action—This Meeting Was a Notable One in Every Way—Abstracts of the Technical Papers Follow the Account of the Meeting

By Ellwood Hendrick

THIS is the fourth time the Society has met in this city since its organization in 1881 and—"Glasgow knows how." It knows how to do many things, not ne least of which is to operate successfully a municipal- y of a million and a half inhabitants—and nearly all of nem Scotch. This latter fact may indicate the reason why. he street railways are municipally owned and a short ide costs a penny, which is two cents, and a long one our pence. The city makes its own gas and works up ne residues. It produces its own electric current at xceedingly low cost. It has no Tammany Society nor ny Republican County Committee nor any Hearst apers. Its policemen and cab-drivers are said to be ostly Irishmen from over Belfast way. Its climate is nly theoretically mild for on the 4th of July a straw at is more of a curiosity on the streets than an vercoat.

Glasgow's Industrial Power

Glasgow is the site of its University and of its echnical College, which is a branch of the University. is headquarters for many chemical industries and ere are important steel works nearby, at the south. he minerals of the district include iron, coal, shale, ays, zinc, lead and its chemical industries are shale l, tar distillation, alkali and acids, cyanides, ferro- anides, bichromates, iodine, explosives (Nobel Works), ls, paints, fertilizers and a great many more. The ction of the Society is a lively one and its members e people of influence.

An Informed and Admirable Lord Provost

At the opening of the meeting in the council room of e beautiful Engineers and Shipbuilders' Institute on ly 4, each registrant received a handbook of the eeting, handsomely bound in Gordon plaid, a guide to lasgow, another guide to Scotland and copies or ab- racts of all the papers to be presented. At 10 o'clock ne Council, about 24 members being present, met for utine business but left the location of the next annual eeting to be determined later. Dr. E. F. Armstrong ad already been chosen president for the next year. t 10:45 the annual general meeting reaffirmed the ac- on of the council and the Lord Provost of Glasgow elivered a speech of welcome.

Now the Lord Provost fulfils the functions of the ayor of the city, and his broad grasp of the meaning chemical industry, the absence of silly pleasantries om his address, and his earnest participation in the rposes and aims of the meeting made your corre- ondent wish for that kind of a mayor in his home wn.

The president, Dr. Ruttan of Montreal, responded racefully in appreciation of the welcome from the city at gave us, among others, Joseph Black, Charles ennant, Kelvin, Sheldon, Ramsay—all of whom were lasgow men. In his presidential address, Dr. Ruttan ve an extensive and complete history of research in ritish possessions since the outbreak of the war and a very thoughtful study of the available methods of developing the resources of the empire. The stimulus of the meeting in Canada and of the International meeting in New York last year was duly recognized, but his problem had to do with carrying on the development and keeping up the general and public interest in research. His conclusion—and he gave many reasons in support of it—was that a series of colonial and imperial institutes of research be organized somewhat on the line of the Mellon Institute at Pittsburgh, would be the best solution. Out of the inter-relations of such establishments in the various British possessions he believed that great good might come. His information as to the present status of the various Research Institutes of Canada, Australia, New Zealand, South Africa, India, and elsewhere shed additional light on his proposal.

President-elect Armstrong, in the discussion which followed, spoke of the hazard of a possible bureaucratic control of research as his only criticism of the plan. In a considerable number of cases in various countries since the war, the efforts made to organize research have taught him to fear the ill-effects of too much of this good thing.

At 1 o'clock an informal luncheon was held at the Grosvenor restaurant in Gordon Street, Glasgow's leading establishment of its kind. Mr. J. H. Young, chairman of the Glasgow section presided, and he and Dr. Ruttan made short but pleasing addresses. There were about 300 present.

At 3 o'clock the party went out on special street cars to a garden party at the house of Mr. David Parry, a leading alkali manufacturer of Glasgow and president of the Society in 1905-06. He has a beautiful estate and here were marquees and settles and awnings, with all the paraphenalia of a garden party, and a band and Scotch pipers, and the famous Glasgow cakes, and dancers who did the highland fling, and there was sunshine and many beautiful Scotch ladies.

The Reception

At 7:30 o'clock (they have daylight saving time, and at this latitude it hardly grows dark until the clock strikes 11) the Hon. Lord Provost and the magistrates of Glasgow received the members of the Society and ladies with them at the great Municipal Buildings. The Lord Provost and the Magistrates in their robes of office, respectively in purple and black and ermine, and with golden chains and medallions, received each guest with ceremony. Then a procession was formed of their eminences and the president, officers, and a few members of the Society, including the representative of the American Section, who took place on the platform of the great hall. Before them were gathered the members of the society and many distinguished persons, invited by the municipality—a large conclave, all in evening dress, including some gentlemen who wore the kilts of their clans. The Lord Provost spoke of the great value to the city which the application of chemistry had proved, how through the efforts of Mr.

Walmsley great savings had been made in their gas products recovery plants. Dr. Ruttan said the right thing and Mr. Young made a plea for the greater glory of chemistry, after which the dancing began.

But some of us are getting along in years and a trifle stiff in the legs, so that for such that did not dance another entertainment was provided. This was in the council chamber where the Glasgow Select Choir, and organization of 18 mixed voices sang, *a capella*, from 8 until 10. This is a famous body of musicians and they have sung in the United States and Canada as well as all over Great Britain. Now after sitting through the concert, the writer of these lines challenges any reader of them to hear the Glasgow Select Choir sing "The Auld Hoose" without getting a bit thick in the throat or wet in the eye, or "Scots wha' hae" without imagining himself a Scotsman and almost feeling as if he could tear up the whole of Mount Vesuvius if he had a mind to. In addition to all this a bountiful collation was served.

Glasgow wants it understood that it believes in and approves of chemistry and chemists. It knows what they are because it has raised them.

Award of the Messel Medal to Prof. Armstrong

Wednesday the 5th was just as lively a day. It began with the first Messel Memorial lecture by Professor Henry E. Armstrong. The late Dr. Rudolph Messel, who many of our readers will remember as president of the Society during the eigth International Congress of Applied Chemistry at New York in 1912, left £20,000 to the society by his will. The Society resolved to give a medal bearing the name and likeness of the donor to the most distinguished chemist of his time in England as the occasion for doing so may arise. Professor Armstrong was the choice this year and his address bore the title, "Rhapsodies Culled from the Thionic Epos." The speaker's delivery was too rapid and mild in voice for the writer to gather more than random notes from it, but we may say that that was the only evidence of mildness which the speaker displayed in his delivery. Professor Armstrong is as peppery as ever and the substance of his discourse was a plea to get back to chemistry, interspersed with frequent flashes of wit and a crack on the head for everyone who did not agree with him. It will probably be published in the form of a booklet and it will make lively reading.

Two technological papers followed on "A Rapid and Accurate Method for the Calibration of Storage Tanks," by Dr. J. W. McDavid and "The Viscosity of Cellulose in Cuprammonium Hydroxide" by Dr. R. A. Joyner, both of the Noble works. They are abstracted below.

An informal luncheon took place again at 1 o'clock and this time the Principal of the University made a short but fitting and very polished address of welcome.

Two excursions followed: to the Provan Chemical Works and the Dalmarnock Power Station.

The Provan Chemical Works is the largest of four units owned and operated by the City of Glasgow for the distillation of tar and ammonia, one being located at each of its gas plants. That is, the crude distillation of tar is done at the other works, whilst the refining is done at Provan. Notes on this plant and the power station will be found elsewhere.

In the evening came the banquet with President Ruttan as Toastmaster and the Lord and Lady Provost of Glasgow and about 300 persons all told. The toast were "The King", "The Queen, the Prince of Wale and members of the Royal Family," given by the chai man. A song followed by a Scotch lass who claime she was lonely, but we doubt if she is likely to suffe much from that complaint. "The Society" was give by the incoming president, Dr. E. F. Armstron F. R. S., and son of the medallist of the morning, t which the chairman replied. "The City of Glasgow was given by Sir William Pope, and it was the mo humorous after-dinner talk we have heard in a mont of Sundays, with a few extra years thrown in to boo The Lord Provost replied and Mr. Ninian McWhanne told a story in Scotch dialect which he said he woul not make "vera broad"; but for purposes of unde standing we need our Scotch dialect narrower. M E. V. Evans, the Treasurer of the Society gave toast to the Glasgow Section and Mr. J. H. Young, th chairman, responded. Professor G. G. Henderson, Hea of the Department of Chemistry at Glasgow Universit tosated the visitors, and the consulting editor of *Che and Met.* replied. Then, with "Auld Lang Syne" th meeting closed.

General Subject Usually Covered in Papers

Thursday began with moving pictures of chemic industries for some and a visit to the harbor f others. A similar informal luncheon at the Grosven followed, with Mr. J. Arthur Reavell in the Chair, a in the afternoon the chemical engineering group he a session at which the following papers were presente "Observations on the Design of Ammoniacal Liqu Stills," by Mr. P. Parrish and "Tar Distillation," Mr. W. A. Walmsley. In the evening Prof. J. Hinchley discussed the general theory of evaporati and Mr. T. H. Gray glycerine distillation. These ve interesting papers are presented in abstracted form the following pages.

The so-called chemical engineering group is an acti association within the body of the Society of Chemic Industry. At these meetings upward of two hundr were present, and the business was handled with co summate skill. They are organized to cover a gener subject, as in the present instance, evaporation a distillation. A chairman is selected who is special familiar with the matter under discussion and aft a paper has been presented he knows his audience w enough to call on the right people. They ask questio with delightful frankness and are not afraid to expre their opinions. There is hardly a dull minute at the sessions.

Technical Program

A Rapid and Accurate Method for the Calculati of Storage Tanks

By J. W. McDavid, D.Sc., F.I.C.

The volume of storage kettles are usually determin either by measuring the vessel and calculating t volume, or by filling the vessel with water and weig ing the water as it is run out of the tank. The fi method is accurate only for symmetrical tanks of co stant vertical cross section. The second method extremely cumbersome. Still another method is to a tank with water and add a weighed quantity of n soluble salts. The resulting solution is analyzed and t volume calculated in this way. This becomes ve laborious if the volume per inch is desired. Anoth

ethod has been worked out by J. M. Weir, N. Taylor d the author, which consisted of the following items own in Fig. 1. A small cylindrical vessel (*A*) 4 ches in diameter and about 2 feet 1½ inches in length open at the top and is held in a vertical position by eans of three legs (*B*), each of which carries a level- g screw (*C*). A plumb line is provided to insure at the apparatus is set vertically. Water is supplied the apparatus through the ¾-inch inlet cock *D* to nich a hose pipe can be attached. *E* is a brass over- w pipe ¾-inch in diameter while *F*, a pipe of similar ze, delivers the water to the tank to be calibrated.

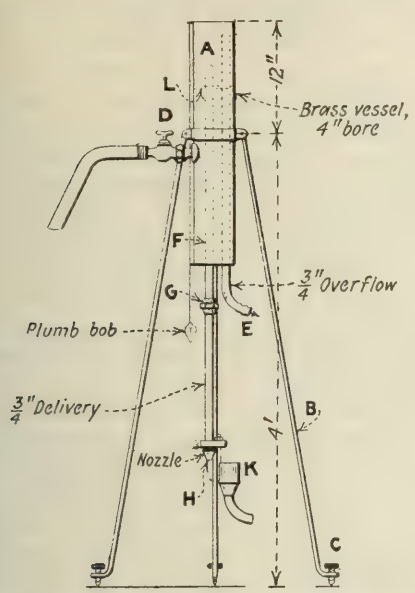


FIG. 1—APPARATUS FOR CALIBRATION OF TANKS

the first instrument this pipe was for convenience ade in two parts connected by means of a screw upling. In later instruments this coupling was nitted. The bottom of the delivery pipe is fitted th a screw thread, so as to take a nozzle *H*. Five zzles of diameter ¼-, ⅜-, ½-, ⅝-, ¾-in. respectively were ovided so that the quantity of water delivered to e tank can be varied. The funnel *K* works on a ivel so that it can be placed underneath a nozzle and divert the water from the tank which is being cal- rated. *L* is a plate perforated with holes ⅛-inch in ameter and serves the double purpose of forming a pport for the pipe *E* and *F*, at the same time reduc- g turbulence in the surface of the water. The com- ete apparatus weighs only 26 lb. and can therefore easily carried about from place to place by one rson.

Method of Using the Apparatus

The method of using the apparatus is as follows: ne instrument is set up in a vertical position over convenient inlet hose over the vessel to be calibrated. ne funnel *K* is placed under the nozzle, and sufficient ater let into the apparatus through the cock *D* until ere is a slight trickle of water escaping over the erflow pipe *E*. In the experiment carried out to libraate the apparatus the quantity of water escaping er the overflow pipe was determined and averaged to 1.5 lb. per minute. As soon as water is leaving e water pipe at the rate mentioned above, the head water in the overflow pipe has reached a constant ure. So long as a level is maintained, the quantity of water delivered through the nozzle with be constant. When this condition has been obtained the funnel *K* is drawn smartly from below the nozzle and the water is allowed to flow into the tank. At the same time a reliable stop watch is started. If it is required merely to find the total volume of tank the time taken to fill it with water is noted. But if it is required to find the volume per inch of depth, then funnel *K* is placed beneath the nozzle after a definite interval of time and the depth of water in the tank measured. By choosing suitable intervals of time, the volume per inch of depth can be calculated.

The apparatus must be calibrated with each of the five nozzles in turn by allowing the water to flow through them into a tared box on a weighing machine. The results obtained in this manner were found to agree well within any possible limit of experimental accuracy and the apparatus has been used with great success in the plant.

The General Problem of Evaporation

By Prof. J. W. Hinchley, A.R.S.M., F.I.C.

A thoughtful paper on this subject, which is divided into two main parts, first evaporation at temperatures below the boiling point and second evaporation at boiling temperatures! Most of Prof. Hinchley's work has been done on evaporation below boiling temperatures and some interesting formulas and curves are presented. This work is also of interest in studying evaporator design, inasmuch as the rate of evaporation from surfaces of various kinds plays an important part in evaporator design. Prof. Hinchley has shown that convex surfaces give a higher rate of evaporation than concave. Considerable work has also been done by Carrier in America and by Dr. Leonard Hill. The effect of velocity of gas stream is also discussed and many practical applications are pointed out as the result of this study. A discussion of vapor pressure and measurement and also of drying immediately precedes the part of the article dealing with boiling point evaporation. This discussion is very interesting and takes up the variation in the rate of heat transmission and in evaporator design. He refers to the work of Badger and others in American universities on the variations of heat-transmission from steam to boiling liquid.

Design of Ammoniacal Liquor Stills

By P. Parrish, A.I.C.

The paper does not deal with the merits or demerits of the batch-fired intermittant stills, or the distillation of ammoniacal liquors. It assumes that substantial technical reasons justify the abandonment of such plants. The present type of continuous columnar still for distillation of gas liquors can be traced to a Frenchman by the name of Savalle, who was responsible for many patents in 1875 aimed at improving the apparatus and processes for the distillation and purification and rectification of alcohol. Savalle's work was undoubtedly directed at the improvement of the Coffey still and it is interesting to note that this alcohol still was substantially taken over into the ammonia industry and used in that work. Mr. Parrish then divides the ammonia stills into three categories, distinguished by a different arrangement of the free still, the lining chamber and the fixed still. He discusses the relative advantages of these arrangements and then enters into

a detailed and very thorough discussion of the construction of stills. Finally the operating details which are necessary in continuous distillation are considered. The whole paper makes very formidable and worthwhile reading.

Tar Distillation

By W. A. Walmsley

This, as well as the last paper, originated in the Provan Chemical Works at Glasgow. Mr. Walmsley divides tar distillation into its constituent parts discussing first the variation in tar which resulted from the use of vertical retorts. The treatment of the various fractions is undertaken in detail and among other things the complete description of the Dorr continuous causticizing plant which is in use there. Some details as to the operation of continuous tar stills are given, tar being distilled over a period of 5 days, in the longer experiments. Final paragraphs deal with the benzol plants and the Kubierschky spraying.

Historical Development of the Distillation of Glycerine

By C. H. Gray

From the earliest mention of glycerine as "the sweet principle of fats", by Scheele, in 1779, through Chevreuel's classic researches about 1820, until Cap's process was introduced in 1840, very little commercial use was made of glycerine. Cap used the liquor from lime saponification of tallow in candle manufacture. After appropriate treatment, the neutralized liquor was carefully evaporated, then passed through bone charcoal, which gave a more or less pure glycerine. Later improvements by Tilghmann and Wilson made considerable difference in the process. Perhaps O'Farrell's improvement, in 1881, is of sufficient importance to mention. He used vacuum pumps for distillation, together with steam at 200 deg. C., using soap lye crude in the still. This lye was, no doubt, substantially soap crude, as we know it today, except for purity. Considerable improvement in design of apparatus was made following 1880, notable improvements by Van Ruymbeke in 1895, and by Scott. Both of them employed extremely high vacuums, as high as 28 in., and many other improvements, such as surface condensers etc.

Double and triple distillation of glycerine did not come about until recently, in order to attain high purity required by the British Pharmacopoeia. Garrigues, in 1905, and Wood, in 1907, bring the subject almost down to the most modern type of plant. Broadly speaking, we may summarize the progress made in glycerine distillation as having gone along the following lines: (1) By actual improvement in design of apparatus from an engineering standpoint. (2) Glycerine of today is practically a pure substance in so far as commercial material may be free today as distinct from earlier times. (3) Efficiency and economical use of energy are the points aimed at by our chemical engineers and designers. It is interesting to note that Lieutenant-Colonel Briggs, B.S.O., in his chapter on glycerine distillation in Young's latest volume "Distillation Principles and Processes" gives the following figures for relative coal efficiencies per ton of glycerine distilled:

Wood	13
Scott	14
Van Ruymbeke	16

As the final development in glycerine distillation, we may briefly consider the idea propounded by Société Francaise de Glycerines. This plant is so designed a to work without the use of steam. Crude glycerine a a temperature of 180 deg. C. passed in an atomize state from one vessel by means of suitable jets t another vessel. Steam coils maintain the temperatu at 180 deg. C.

We have no practical details at this time, but it evident that the idea is very unique, although at time there are some obvious troubles involved. For instanc choking of jets, removal of solids, residues etc.

Dr. Ellwood Hendrick's Address in Reply to the Toast "The Visitors"

My Lord Provost, my Lady Provost, Mr. Presiden Professor Henderson, Ladies and Gentlemen:

From across the great waters I bring you greeting and the assurance of all good will and fraternity. I sha ask you to take this statement for granted and th message as delivered, because in addition to the felic tations of ceremony and the messages from our hearts bring also a problem and seek its solution.

In what follows I shall speak only of conditions i the United States. Whether these obtain in similar c in less measure here or elsewhere in British possession you will know far better than I. The problem has t do with the great gulf that lies between the professio of chemistry and its business. As corporations gro in magnitude, this gulf threatens to become even wide and since Mr. Young touched upon the subject yesterda I venture the belief that you are not total strangers to i

We study long and ardently to attain proficiency i the science and its practice. On the other hand, n study, no proficiency, no competency, and sometime not even character, is demanded of him who woul engage in the business of chemistry. So long as he ca offer or borrow money he is welcome. This is becaus the need of chemical development is so urgent for th welfare of every industrial nation that we do not dar place hindrances in the way of it. The situation pr vides, however, that the business end rules the profe sional end. Business directs the profession in its ow field and the profession must obey. This is not tru of all chemical enterprises by any means but it occu so frequently that ignorance of the science control rules, or directs chemical practice, that I venture th general statement that in the United States the weal ness of chemical industry is not in the works, or equipment, or in labor, or in engineering skill, or the chemists themselves, but that it rests in the boar of directors of chemical establishments.

Corporations have an unfortunate habit of what w call window-dressing, in which men who have achiev success in any walk of life are supposed to assure also in chemical industry, so that a successful bank stockbroker, lumber merchant, mine owner and wh not are invited to join the board in the belief that t public will follow the mistaken idea that astuteness w conquer in spite of ignorance.

In no other great profession than ours does this sit ation exist. Imagine, if you will, a sick man sendi for a physician and on his arrival demanding that punch a time clock, coming and going, be paid acco ing to the time spent in making his diagnosis, and th he devise treatment according to the patient's wh and desire. Or of a client insisting that his counsel at law shall construe the law according to his wish a not as it is found.

The control of chemistry by business has reached uch a pass that I have known a speculator in the ndustry to destroy the entire research organization of great establishment engaged in the most difficult and nvolved scientific processes and to consult an excava- on engineer for enlightenment as to how the works nould be operated.

The future of the industrial nations rests with their hemists. According as they are more or less men f wisdom and understanding, and above all things nen of character, industry will flourish or fade away. Ve cannot ask for all of these standards from the nan who represents the investment of capital alone.

Now the last thing we want to do is to restrict the ights of property, or to destroy initiative. But chemi- al industry is a professional institution and it cannot ourish if it is ignorantly directed. Chemical vision nd understanding are required of it if it is to prosper. nd the looting of corporations by cutting off necessary xpenditures for research and technological develop- nent to use such funds for dividends, or to make a rave showing for the market manipulation of shares, is so heinous an offence against the general welfare that no self-respecting chemist should countenance it or endure participation in it.

Before anyone is admitted to the practice of medicine it is required of him that he take a solemn oath to devote himself to human welfare. A solemn oath of allegiance to the principles of right is required of everyone who would practice at law. At present chemists pass examinations—and look for a job. This does not meet with the great obligations of our profession. So, as a possible means to secure a better status for the profession of chemistry in its own affairs, I venture to suggest that an Oath of Science be drawn and administered to everyone who would engage in chemical practice. He should bind himself on honor to seek diligently the truth by the right co-ordination of all facts which alone leads to it, to abstain from all knavery under any and all conditions, and to address himself to the welfare of humanity, striving throughout his days to seek the light of greater understanding and to bring about a larger, a better, and more abundant life for all mankind.

Calcium Arsenate Manufacture

By Howard W. Ambruster

THE suddenly developed and more or less acute shortage of calcium arsenate available for the battle vith the boll weevil in the South has intensified the nterest in this product.

The market record of this insecticide has been so rratic in the past that despite all indications months go, of an increasingly heavy infestation and conse- uent demand, the manufacturers refused to accumulate ny stocks in anticipation of the season's requirements nd waited until there was an actual movement by sale r contract of the several thousand tons carried over rom 1920 and 1921.

The bulk of these stocks had the status of a distressed nerchandise and were sold in the early months of this eason at a price considerably under the actual cost of roduction during the high level of the inflation period. 'his assisted in completely demoralizing the market as ar as current production was concerned and it was ot until the last few weeks that it was generally real- zed that all old stock would be absorbed and still permit ctive demand for any additional tonnage the existing lants could turn out during the balance of the season.

Indications are now that dusting for boll weevil con- rol will continue well into September, thus compelling he manufacturers to operate their plants to full apacity during the hottest months of the year.

The Same Old Story in Insecticides

It is the old story in the insecticide industry—a feast r a famine year after year; high surplus stocks to arry over and liquidate on a declining arsenic market; r a sales department weeping and gnashing its teeth t the necessity of declining a flood of last moment rders at high prices, an account of earlier commitments t selling prices that preclude any profit.

As an insecticide, however, calcium arsenate is in a ass by itself as it promises a real tonnage development nd as the natural consequence of this season's dramatic imax, plans for additional plant facilities are now nder consideration among all existing manufacturers and many localities in the South are discussing ways and means of building calcium arsenate factories and taking care of their local requirements for next season.

Consideration of additional plant facilities must be based generally on the usual chemical process of utilizing commercial byproduct white arsenic oxidized with nitric acid and combined with lime. The possible production of calcium arsenate direct from an arsenical ore must be considered as having a bearing on the subject but in view of the recent excitement in the South due to the short supply this season, the future development of this new chemical process will hardly prevent others from increasing old plants and building new ones in anticipation of next season's demand for calcium.

The Executive's Dilemma

For the manufacturer who has been in the insecticide business and has any perspective on its many problems, the picture at this time presents many of the aspects of a seven-ring circus. He does not dare concentrate his gaze on only one part of the performance and his vision is confused as he tries to take it all in at once. He knows that it is a slippery hill, but he is bound to try and climb it. For the newcomer in the field the problem may appear much simpler and the hill not slippery at all. All that seems necessary is to raise a little capital, build a plant, buy some lime and arsenic, and when next season's bugs appear there will be a new local hero. But the problem is not so elementary as all that by any means.

There is no question, however, that there is room for a considerable increase in the production of this material and that unlike most of the orchard and truck sprays, calcium arsenate is coming into its own as a tonnage proposition. The existing plants where it is now made, or can be made, have nearly all developed from small units for the production of miscellaneous arsenical and other spray materials such as paris green, london purple, lead arsenate, bordeaux mixtures, etc.

Early Calcium Arsenate Plants

Calcium arsenate was first made in comparatively recent years, along with other similar products as the insecticite manufacturers decided to add it to their line

and few radical changes were introduced from earlier equipment or methods for arsenical compounds. The first of the arsenical sprays to be made on any basis of quantity in this country—paris green—was originally included with the pigment colors and small earthenware units for the oxidation of white arsenic to make the necessary arsenic acid, were added later for the production of lead arsenate.

Recent Developments

In the last few years, two important and somewhat radical improvements have been developed in insecticide manufacture, one in the acid production and the other in reducing the wet batch of lead or carcium arsenate to a commercial dry powder.

The majority of the arsenic acid plants as stated above were of earthenware construction, comparatively small pots in which the commercial white arsenic is oxidized with nitric acid and a part of the nitric fumes recovered in an earthenware tower or series of towers, to be utilized again with subsequent batches of arsenic.

A great deal of hand labor is required for the operation of these plants. The arsenic must be fed by hand in small quantities; such stirring as the batch gets is by hand and the sludge or residue removed by hand after the finished acid is syphoned out of the pot or generator. The breakage item is a heavy one and adds materially to the cost of the acid. The quality of the white arsenic always varies somewhat and thus affects the recovery of the nitric acid by inducing an erratic and explosive reaction which is accentuated by the irregular hand feeding. This results in sudden bursts of gas which the suction from the recovery towers cannot handle.

High Silica Iron Aids Arsenic Acid Process

Preceding and during the war period, the use of high silica iron for large nitrating kettles was developed and large units of this material were adapted for arsenic acid manufacture. This has made it possible to produce the material in very much large batches and to introduce mechanical feeding of the arsenic itself, mechanical stirring of the batch and dropping the finished acid with the sludge or residue from the bottom of the kettle to a shallow tank where the sludge is settled out and the acid pumped to storage or insecticide units. The economy of both labor and nitric recovery are considerable and the production of a nitric-free arsenic acid which can be safely shipped in steel tank cars was first made commercially feasible by this method.

Another radical departure which is applied to advantage in large arsenic acid units is the substitution of the acidproof brick masonry nitric acid recovery tower for the round terra cotta-tile tower construction. The brick tower is hardly to be considered for a small unit but for anything over the production of a few tons of arsenic acid per day, its advantages of stability and efficiency must be given consideration.

In the production of the insecticides themselves, the usual process necessitates the large tubs with mechanical stirring apparatus in which the finished product is combined in a very dilute suspension. The size and material of the tubs and the methods of handling the various raw materials may vary somewhat but the essential features must remain the same.

The New Drum Drier

Beyond these mixing or striking tubs, however, the other definite step forward has been taken in the substitution of a specially designed atmospheric drum drie for the filter presses and hot stoves, oven or tunne driers of the old fashioned pigment plants. We mus go back here to the brick ovens filled with steam pipe of the European color plants and their successors, th modern hot air tray driers in which the filter press cak is baked until the last drop of moisture in the cente of the cake is evaporated. For many products thes modern driers scientifically designed and properly oper ated are still the most efficient units available. Bu for products like lead and calcium arsenate which ar beginning to be handled on a tonnage basis the labo saving affected by means of the atmospheric drum drie is a very large item in proportion to the total labo cost of the material.

Economy of Drum Drier

Instead of pumping the batch first to a filter pres and then handling the cake on trays first in and the out of the drier, the liquor is simply pumped to th drum drier, where it is picked up from a trough o the surfaces of the hot cylinder and the water i evaporated by the time it reaches the scraping knif on the lower downward turn of the drum. The produc comes off in a fine flake which requires very littl grinding as compared with filter press cake dried in tray drier and a power saving also results at the grind ing mill. The question will naturally be raised as t the amount of steam required for the drum drier t evaporate the entire moisture content of the batch whereas in the older method a definite percentage o the water is removed at the filter press. Experienc with the arsenates has demonstrate, however, that th greater efficiency of the effective heat units as applie to a thin film of liquor on the drum rather than as hot blast forced through and around a filter press cak results in no greater coal and steam consumption fo an equal amount of dry production, and in some in stances an actual coal saving is found.

Importance of Improved Methods

The writer was fortunately in a position to observ these various methods of arsenic acid and insecticid production in the same plant, having supervised th actual construction and operation of both the older an the newer types of units and the comparative result were so conclusive that the advantages set forth abov must be accepted as demonstrated facts. The qualit of both the arsenic acid and the finished insecticid was improved, if anything and the material and labo saving constituted a tremendous item in proportion total cost. Chemical manufacturers are frequently loat to throw out existing units before the scrap hea claims them but the controversy regarding these in provements in the production of arsenicals bids fair be settled in the immediate future with the enlarg ment of existing plants and the construction of ne ones for the struggle against the future progeny the 1922 boll weevil. There can be a variable co factor of several cents a pound on a half-pound packa of orchard- or garden-spray and the salesmanship good will of the manufacturer will get or hold the cu tomer. But boll weevil marches in the millions modern warfare and from the chemical manufacture standpoint, this pest must be fought on a carload ba where a difference of a few dollars a ton will deci each producers' part in the contest.

The Technology of the Carbon-Electrode Industry—II
Raw Materials for Electrode Manufacture

The Physical and Chemical Properties of the Carbonaceous Substances and Binding Materials Are Reviewed From the Standpoint of Electrode Requirements—Petroleum Coke and Pitch Are the Principal Raw Materials for the Carbon Industry*

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As a carbon electrode consists almost entirely of elemental carbon, it naturally follows that the best starting point for its manufacture would be a material which contained the largest possible amount of carbon. A raw material would be desired which consisted almost entirely of carbon. This condition is satisfied by those bodies which are known under the general name of carbonaceous substances and, as a matter of fact, practically all carbonaceous matters are, or have been, used in the manufacture of electrodes.

Electrode Requirements

Before attempting a detailed description of the various raw materials, it may be well at this point to devote brief attention to the characteristics and desired qualities of the finished electrodes in order that the raw-materials requirements may be better understood.

In general commercial electrodes consist of elemental carbon, contaminated with more or less ash depending upon the raw material used in making the electrode. The ash is composed of the oxides of silicon, iron, aluminum, calcium and in some cases of copper. The resistivity—i.e., specific electrical resistance—expressed in ohms per inch cube, varies with the ash content; the higher the ash percentage the greater the resistivity, other factors remaining unchanged.

Electrodes for electrothermic work usually have high resistivity. They serve as refractory conductors of the electric current and do not enter into the reactions taking place in the electric furnace or other apparatus in which they are used. The manufacture of calcium carbide is an example of an electrothermic requirement. In this case the raw materials are coke and burnt lime. These are cheap and impure, for the coke contains a large amount of ash. It does no harm, therefore, to use an electrode high in ash in the furnace, for the additional amount resulting from the consumption of the electrode would probably be decomposed by the heat of the furnace itself. Electric steel or electric-furnace alloys are other examples. In these, contamination from the electrode would be drained out of the furnace with the slag or dross and would not get into the product. In most cases of the electrothermic use of carbons, the impurities of the electrode either do not get into the product of the furnace, or if they do, make no appreciable difference in the product. Thus a satisfactory electrode for electrothermic purposes may be high in ash, since its resistivity is either unimportant or else can be sacrificed if, by so doing, a cheaper electrode may be employed.

In electrolytic work, however, the purity and resistivity of the carbons are important considerations. Smaller currents are used at much lower voltages, so that high resistivity means a greater power loss than in electrothermic work. Furthermore, the material of the electrode may enter into the reaction and its impurities be imparted to the product of the electrolysis. An example is the reduction of alumina to aluminum. In this case the impurities of the electrode, if present in too great amounts, cause serious contamination of the aluminum metal. Silicon and iron are particularly undesirable. It is desired that carbons for electrolytic use have a low resistivity and be as free as possible from contamination.

Classification of Raw Materials

Raw materials for carbon-electrode manufacture may be divided into three classes according to the part they play in the process: (1) "Body" materials, which are the carbonaceous matters making up the bulk of the finished electrode. (2) Binders, which serve to hold together the finely ground particles of the body materials, and (3) other miscellaneous substances entering into the manufacturing process.

TABLE I—A COMPARISON OF CARBONACEOUS SUBSTANCES USED AS BODY MATERIALS IN ELECTRODE MANUFACTURE

Material	Moisture, Per Cent	Volatile Matter, Per Cent	Fixed Carbon, Per Cent	Ash, Per Cent	Specific Gravity
Coal:					
Anthracite	2.4–14.0	1.5– 8.5	65.0–85.0	6.0–18.0	1.5
Bituminous	1.8–19.0	6.0–40.0	49.0–79.0	2.8–19.0	1.36
Coke:					
Beehive	0.5– 1.5	0.3– 3.0	80.0–95.0	4.0–21.0	1.9
Byproduct	0.7– 3.0	0.6– 3.3	79.0–92.0	7.0–16.0	1.7
Petroleum coke	0.4– 2.0	4.0–18.0	82.0–97.0	0.5– 2.0	1.8
Retort and gas carbon	0.5– 2.0	4.0–13.0	88.0–97.0	3.0–10.0	...
Graphite, natural	0.5– 2.0	1.0– 7.3	78.0–92.0	7.5–19.7	2.0– 2.5
Pitch coke	0.5– 1.5	4.0–12.0	85.0–97.0	0.3– 2.0	1.6– 1.8
Wood charcoal	1.0–10.0	1.0–10.0	84.0–97.0	1.0– 4.0	...
Lampblack	0.6– 3.0	3.0– 7.0	90.0–96.0	0.6–10.0	...
Butts, amorphous, from electrothermic work	0.2– 2.0	0.0– 0.2	85.0–94.0	6.0–14.0	1.9– 2.2

The composition of the various body materials which are, or have been, used in the production of carbon electrodes is shown in Table I.

The Body Materials

Anthracite and Bituminous Coal

Anthracite coal contains a large amount of fixed carbon as compared with its content of volatile matter. The ash is incombustible mineral matter, consisting mostly of clay, silt or sand, more or less intimately mixed in the body of the coal. Anthracite is used largely for electric-furnace electrodes where purity and low resistivity are not desired. In fact, very little else

*Part I of this series, which reviewed the history of the industry, appeared in *Chem. & Met. Eng.*, vol. 27, No. 3, July 19, 1922.

other than anthracite coal is used in making the large-sized molded electrodes for electric furnaces.

Jean Escard[12] gives the following data in regard to European practice in the purification of anthracite for use in making electrodes for the reduction of aluminum. "Anthracite in general contains more than 2 per cent of ash, of which at least 0.35 per cent is silica. This latter figure is inadmissibly high for the production of aluminum, but when purified such anthracite shows the following ash figure before and after treatment (anthracite is first degassed in one of the standard illuminating gas ovens, the gas being burned under the grate):

Constituents of Ash	Scotch Anthracite — Previous to Treatment, Per Cent	Scotch Anthracite — After Treatment, Per Cent	Welsh Anthracite — Previous to Treatment, Per Cent	Welsh Anthracite — After Treatment, Per Cent
SiO_2	5.00	0.84	0.78	0.20
Iron oxides	1.06	0.25	0.32	0.12
Al_2O_3	2.02	0.25	0.43	0.12
CaO and MgO	1.16	0.20	0.53	0.13
Total	9.24	1.30	2.06	0.57

The chemical treatment referred to by Escard consists of digesting the ground anthracite in a hot concentrated NaOH solution, and following this with a washing with a more dilute solution.

In the United States a much purer raw material can be obtained at a lower price than the cost of the purified anthracite would be, so that this method of purification is not used. In this country petroleum coke is the chief raw material for graphite electrodes which are made by graphitizing in the electric furnace.

Bituminous coal is high in volatile matter, containing a much smaller amount of fixed carbon in proportion to the volatile matter than the anthracite. It also runs high in ash. Since large losses are sustained in driving off the volatile matter in calcination and since the gases generated cannot usually be profitably disposed of by an electrode plant, bituminous coal is seldom used as a raw material. It has the further disadvantage of having a lower specific gravity than anthracite. Some of the first electrodes made for metallurgical work were prepared from a mixture of bituminous and anthracite coal, but the practice has since been abandoned.

Coke prepared from bituminous coal is high in ash content, high in fixed carbon and low in moisture and volatile matter. It is used in Europe for electrodes for electrosmelting, but to a much less extent in the United States. Coke is not employed in making electrolytic carbons.

Petroleum Coke

Petroleum coke, the residue in the distillation of petroleum oil by the intermittent process, is the most important material for electrode making. It is a hard and brittle substance, of shiny, oily appearance, is very high in fixed carbon and low in ash. It is one of the purest forms of carbon available in large quantities. Its ash is probably due to the small amount of fine sand carried along mechanically or in suspension by the crude oil. The coke represents approximately 1 per cent of the original oil and from 8 to 9 per cent of the weight of the final residual tars after all of the other fractions have been distilled.

Sulphur is one of the undesirable constituents of petroleum coke, and is greater in coke from Mexican crude oils than from those obtained from other fields.

[12] *General Electric Review*, Schenectady, N. Y., November-December, 1918.

Not many years ago petroleum coke was merely a byproduct—if not a waste—in the oil industry, and was disposed of by burning it under the stills. In recent years, however, the market price has nearly trebled, and today the petroleum refinery regards it as a valuable commercial material. The quantity of petroleum coke being produced is growing smaller, however, because many oil distillers are changing over from intermittent to continuous or vacuum methods whereby no coke is produced. This change is already causing electrode manufacturers to search the field for new sources for their raw material supplies.

The percentage of volatile matter in petroleum coke depends upon the temperatures reached in distillation. Present practice is to run the stills to as high a temperature as possible without actually damaging the bottoms of the stills. Pyrometric control methods are not used nor is any attempt made to control the percentage of volatile matter in the coke produced.

After the run is finished, the still is allowed to cool for 4 to 6 hours. Workmen then enter through the manhole, their hands, head and feet wrapped in wet cloths, break off the coke with heavy iron bars from the sides and bottom of the still box, and unload it. Because of the excessive heat, the men can remain inside the still for only a short while. The coke is cooled by drenching with a stream of water.

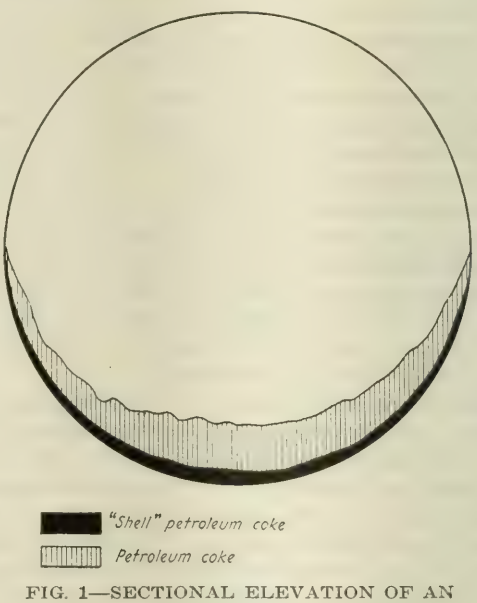


FIG. 1—SECTIONAL ELEVATION OF AN INTERMITTENT-TYPE OIL STILL, SHOWING COKE FORMATION

Petroleum coke is received at the electrode plant in pieces varying in size from as small as 3 in. in diameter to chunks three or four times as large as a man's head. The coke consists of two portions, the main or upper part and beneath it a layer of denser material, called "shell," varying from eggshell thickness in some pieces to 2 to 3 in. This shell is the coke that was in contact with the sides and bottom of the still (see Fig. 1). It is higher in ash and soluble salt than is the coke of the upper portion, probably because the mineral matter of the oil gradually sank to the bottom of the still as the distillation proceeded and the shell, being the first coke made, formed around the mineral matter. Being nearer the source of heat and the bottom of the still, the shell was heated to a higher temperature and lost more of its volatile matter than did the upper portion.

Shell petroleum coke usually contains from 1 to 3 per nt of soluble salts, mostly sodium chloride. When ke containing shell is calcined in silica brick-lined torts, the salts are volatilized and attack the brick-ork by forming low-fusing sodium silicates. In order save the retorts and lengthen their life, the shell is ipped off and separated from the main portion of the ke, to be calcined in special calciners by itself. The l distillers formerly prepared coke in this manner, but recent years have refused to ship anything but chipped coke, as the cost and trouble of chipping was t justified by the price they received for the mate-al.

A short time ago a manufacturer of carbon brushes as in the market for 25 to 30 tons of petroleum coke, d on attempting to obtain this amount from the oil stillers learned that they had none for sale. Their tput in its entirety had been contracted for a year in vance by electrode makers. The contracts of one of e largest electrode plants called for the delivery of proximately 50,000 tons of petroleum coke during the ar. This amount is the result of the distillation of 000,000 tons, or 31,250,000 bbl. of crude oil.

Petroleum coke is used more than any other material making the purest electrolytic carbons. These elec-odes are low in ash and low in resistivity. For the wer grades, where exceptional purity is unnecessary, troleum coke is mixed with anthracite. This enables e manufacturer to turn out a cheaper electrode but of rer composition than if he had used anthracite alone.

Retort and Gas Carbon

Retort carbon, or "glance" coal, is a very dense form carbon, produced by the deposition of carbon in the per part of the retorts in the manufacture of coal s. It exhibits the luster of a metal, is sonorous when ruck and is a good conductor. Ordinarily it is rich in ica, the result of adhering fragments of brickwork d refractory pastes from the retorts. The amount of tort carbon on the market, however, is very small. ree years ago a canvass of several hundred gas-nufacturing plants in the East was made to deter-ne the amount of this material available. Quantities nging from 1 to 25 tons per year were offered—this ing the entire production of the individual gas works at prices from $20 to $30 per ton. For most of the s makers, the price received for the material would t have paid them for their trouble in accumulating from the periodical cleaning of the retorts. The price ked was considerably higher than the market price petroleum coke, a much purer substance.

Because of the difficulty of obtaining large quantities well as its high price, retort carbon is seldom used making electrodes. It finds its greatest use in the nufacture of carbon brushes, where its hardness and e sharp edges of its particles are employed to give a ting grain to the texture of the brush.

Other Body Materials

Graphite. Graphite, of the natural variety, is not ployed in the United States for the manufacture of ctrodes, first, because of its high price ($120 to $180 r ton) and, second, because the artificial product, de directly by graphitizing electrodes in electric fur-ces, as a result of its superior qualities, is given pref-nce in practice.

Pitch Coke. Pitch coke has much the same qualities petroleum coke. It is produced as a result of the destructive distillation of pitch, which comes mostly from coal tar. It is low in ash and high in fixed carbon. At the present time it is not being produced in large quantities. Its production, however, is gradually increasing with the demand. In every place in which petroleum coke is now used it can be replaced by pitch coke. As the supply of petroleum coke grows less, due to the changed methods of oil distillation, its place will probably be filled by pitch coke. What is needed is the production of a pitch coke with a volatile matter so low (0.5 per cent) that it needs no calcination to prepare it for use in electrode making. This has been done, but not as yet on a commercial scale.

Wood Charcoal and Lampblack. These substances were used by some of the earlier investigators. They are low in ash and high in fixed carbon. Their high price, however, and the fact that they are produced in relatively small quantities prevent their utilization in electrode making.

Butts. Butts are the unconsumed or waste portions of finished electrodes. They are usually high in ash. They are used in making electrothermic carbons, and are mixed in low percentages with petroleum coke for electrolytic electrodes. Usually, however, they are given a preliminary purification. As they are portions of electrodes previously baked, they need no calcining operation to prepare them for use.

TABLE II—COMPARISON OF APPROXIMATE PRICES OF CARBONACEOUS MATERIALS, f.o.b. NEW YORK (1922)

Materials	Dollars Per Ton
Coal:	
Anthracite	8.00@ 9.00
Bituminous	3.50@ 4.00
Coke:	
Beehive	5.50@ 6.00
Byproduct	4.50@ 5.50
Petroleum coke	12.00@ 15.00
Retort carbon	25.00@ 30.00
Graphite	120.00@180.00
Pitch coke	Not on open market
Butts	20.00@ 40.00

A rough comparison of prices for the most important carbonaceous materials which are or may be used in electrode manufacture is afforded by Table II.

Binding Materials

Binders for electrode making are divided into three classes; those which at ordinary temperatures are either (1) liquid, (2) semi-solid and (3) solid. The principal binding materials which have been used in the manufacture of carbon electrodes are:

(1) Liquid:
  (*a*) Tars.
    (1) Retort-gas tar.
    (2) Oven-gas tar.
    (3) Water-gas tar.
(2) Semi-solid:
  (*a*) Electrolytic pitch.
(3) Solid:
  (*a*) Coal-tar pitch.

Chemical analyses of these substances are given in Table III.

The binders used are, in general, products of the distillation of coal. They are composed of elemental carbon and hydrocarbons in varying proportions. Their function is to hold together the finely ground particles of the body materials. Since the volatile matter of a binder is driven off in baking, the best binder, from the standpoint of the finished electrode, would be the one

TABLE III—CHEMICAL ANALYSES OF BINDERS USED IN ELECTRODE MANUFACTURE

Material	Melting Point, Deg. C.	Viscosity (MacMichael) (Seconds Per 100 Revolutions)	Free Carbon, Per Cent	Coking Value, Per Cent	Softening Point, Deg. C.
Coal tar	Liquid	3–15	7–25	10–30	.....
Retort gas tar	Liquid	5–30	20–40	40–65	.....
Oven gas tar	Liquid	3–15	12–20	15–30	.....
Water-gas tar	Liquid	3– 8	2– 5	10–20	.....
Pintsch or oil-gas tar	Liquid	....	25–30	25–35	.....
Electrolytic pitch	Semi-solid	3–25	15–25	20–35	20
Pitch:					
Soft	50–70	3–35	15–25	20–35	35–60
Medium	70–90	15–40	25–35	30–40	50–80
Hard	90–140	20–250	30–50	35–55	80–115

that had the highest coking value; or, in other words, loses as little as possible during calcining.

The earlier investigators used many different viscous matters to hold together their carbonaceous materials. These included caramelized sugar, sirups, molasses, resins, turpentine and various products from the distillation of organic substances.

Viscosity is more or less a measure of the binding power of a material. Viscosities are not absolute figures (unless absolute viscosities are used, reported in dynes per centimeter) and serve only as comparisons, one to the other. A binder with a high viscosity will tend to have a greater cohering power than one with a low viscosity. In measuring viscosity, either the Sturner, also known as the MacMichael, or the Engler types of instrument are most commonly used.

Tars

Coal Tar. This material is too well known to require any extensive description of its properties. It is a black, viscous liquid, composed largely of hydrocarbons, with a low percentage of "free" or elemental carbon. It varies greatly in composition, and may better be classified according to its method of production into retort-gas tar and oven-gas tar. Coal tar used in making electrodes is usually a mixture of tars from different sources. Its viscosity is low; in the case of some thin tars, it can be measured only with difficulty in the MacMichael instrument.

Retort-Gas Tar. This tar is obtained as a condensation product in the hydraulic mains, scrubbers or condensers in the manufacture of coal gas for illuminating purposes. It is less fluid and contains less of the lighter hydrocarbons, more naphthalene, anthracene and their accompanying oils and more free carbon than tars from other sources. The composition varies with the heats and coals employed. In general, the lower the carbonization temperature of any coal the more fluid the tar and the lower its carbon content.

Retort-gas tar contains 20 to 40 per cent of free carbon and yields on distillation from 50 to 75 per cent of pitch, or if the distillation is carried all the way, 45 to 65 per cent of coke.

Oven-Gas Tar. This material is obtained in the distillation of coal in byproduct coke ovens. It is similar to retort-gas tar, except it is more fluid. It contains more of the hydrocarbons and considerably less free carbon, which latter usually runs from 12 to 20 per cent. The composition changes, of course, with the coal, type of oven and the coking temperature.

Water-Gas Tar. The tar obtained from the manufacture of carburetted water gas for illuminating purposes differs mainly from coal tar in the entire absence of tar acids and ammoniacal liquor, and in the small amount of free carbon present, which is usually less than 2 per cent.

Water-gas tar on distillation yields from 35 to 60 per cent of pitch, or, if carried further, 20 to 40 per cent of coke of the weight of the dry tar.

Pintsch or Oil-Gas Tar. This material comes from the manufacture of oil gas used for railway lighting. It is similar to water-gas tar, but contains much larger amounts of free carbon, frequently 25 to 30 per cent or even more.

Coal tar, being usually a mixture of some or all of the above tars in varying proportions, is largely used in the manufacture of molded electrodes where great pressures are required, sometimes running as high as 25,000 lb. to the square inch. Tar is never used alone as a binding material in making extruded carbons, since tar binder mixtures are practically unextrudable. Dehydrated tars, containing less than 0.5 per cent of moisture, are mixed with pitch. Tar is often employed to lower the melting points of pitches, and in small percentages, to give a more plastic mix for extruded electrodes. Where high-density carbons are desired, its low coking value is a disadvantage. Its use produces an electrode high in porosity, since a large proportion of it is volatilized during the baking process.

Pitches

Electrolytic Pitch. This material is the result of the partial distillation of tar, in which only the lighter fractions are driven off. It is semi-fluid at ordinary temperatures and its properties are intermediate between those of tar and pitch. It is higher in free carbon and has a higher viscosity than tar. For a number of years it was used in some localities for making molded carbons but is no longer produced in large quantities.

Pitch. Pitch is the residue obtained in the distillation of coal tar after all the light oils, intermediate fractions and heavy oils (creosotes, anthracene, etc.) have been distilled.

Pitches may be classified, according to their melting points, into (1) those which at ordinary temperatures are soft and easily melted, (2) those which are midway between soft and hard and (3) those which are hard and require a much greater amount of heat to convert them to a liquid condition. This division is purely arbitrary. Soft pitches run from melting points of 50 to 70 deg. C.; medium from 70 to 90 deg. and hard pitches from this point to 140 deg. or higher. Over a wide range of melting points, the free carbon content and the coking value will increase with the melting point of the pitch. The same holds true for viscosity. Neither of these generalizations applies, however, over small ranges of melting points.

In making extruded electrodes pitches are used as binders, to the exclusion of practically all other substances. They are often employed, in small proportions, to stiffen the mix, especially in making molded carbons with a tar binder.

Selection of Pitch for Electrode Manufacture

Pitches are made by three methods of distillation.

(1) Tar is distilled to a hard, "core" pitch of high carbon content and with high melting point (150 deg. C. or higher) and then "cut back" with tar distillate to give a pitch with the required melting point.

(2) Tar is distilled to the required melting point under vacuum by the use of steam in the still. The steam assists in removing the high-boiling oils and helps to prevent the deposition of coke on the sides of the still.

(3) Tar is distilled in direct-fired horizontal stills rrying on the process without steam or vacuum and cting the products of distillation pass off under the essure at which they were generated.

For extruded electrodes, large-scale experiments have own that pitches made by the second and third ethods are superior to those made by the first. The lection of tar distillates to be used in thinning down tches, carried to the full limit of distillation (method is especially important, since it has been found that nen creosote or naphthalene are employed for this rpose the resulting pitch is lacking in binding power. nis defect is obviated only by the use of heavier dis-lates, such as "green" oils of a more viscous char-ter.

Pitch is normally about two-thirds of the weight of e tar from which it was distilled. Its physical char-ter is mainly dependent upon the temperature em-oyed in distillation, but its ultimate chemical analysis governed by the tars used in its manufacture and the ality and composition of the coal from which the rs were produced.

About the only other material entering into carbon aking is so-called "summer" oil. This is a crude troleum oil from which the lighter fractions have en distilled. Since it produces a more plastic mix it often used as constituent of the mix for extruded rbons in order to cut down the pressure necessary r extrusion. It has no binding properties. When it used it cuts back the pitch and lessens its binding wer.

Handling and Storage of Materials

The carbonaceous materials are received at the plant gondolas and are usually unloaded into track hoppers, hich in turn are emptied by pan conveyors. Coal is rchased in run-of-mine size, petroleum coke just as it as broken out of the still, and butts as they were pro-uced in the electrode-consuming processes. The mate-als are given a preliminary crushing in jaw or roll ushers to a 3-in. size and either carried direct to the lcining operations or are placed in storage.

Tars are usually stored in underground tanks, to hich they can be unloaded from tank cars. The same olds true for summer oil. Pitch is commonly shipped box cars. It is in the sizes in which it was removed om the stills and must be given a preliminary crush-g in a roll or gyratory crusher.

Materials as received are sampled for chemical alysis and these are prepared for the laboratory by ie methods of the Bureau of Mines.[13] The carbo-aceous substances are analyzed for moisture, volatile atter and ash, if they are to be used for electrothermic rbons; and in addition, for iron and silicon if em-oyed for electrolytic electrodes. Binding materials e tested for melting, and softening points if they are lid; viscosity, free carbon, and coking value. The alytical procedures in the case of the tars may be und in any standard handbook on this subject.[14]

The third article of this series will appear in a sub-quent issue and will discuss the calcining operations r electric- and gas-fired calciners with special reference their use in American practice.

[13] G. S. Pope, "Methods of Sampling Delivered Coal," Bulletin 6, U. S. Bureau of Mines.

[14] Such, for example, as that of J. M. Weiss, "Examination of rs and Tar Products," published by The Barrett Co., New rk City.

How the Cement Industry Educates Public on Uses of Its Product

By Thomas J. Harris

THE Portland Cement Association, with its staff of 300 men, most of whom are engineers, is, I believe, the largest association of its kind. Briefly stated, the work of the association is to improve and extend the uses of concrete, which implies educational, promotion and research work. Obviously so small a staff could not make personal visits to more than a very small percentage of concrete users, so the Association has become a somewhat prolific publisher on the subject of "How, Where and Why to Use Concrete." More than 100 treatises or booklets are kept constantly revised for those who are in need of information and, as in all other activities of this organization, no charge or fee is made.

Technical men will readily understand the need for such work as the association does; the user of cement must manufacture his house or well-curb or road right on the ground. It is a chemical and also an engineering process, and though simple, needs close attention and supervision.

The Association is a purely voluntary organization. Any cement manufacturer may belong to it; none need belong. At present eighty-five independent companies are members. Practically all of the cement manufacturers in the United States and Canada do belong and there are foreign members in Cuba, Mexico and South America. These foreign firms become members because of the far-reaching effect of the educational work and the value which cement manufacturers placed upon it as an aid to stabilizing and expanding the market for their product.

The Birth of a Cement Association and Its Raison d'Etre

The inception of the Association is interesting. In 1902 several portland cement manufacturers met at a dinner in New York to discuss a common problem—empty sacks. With the change of the shipping container from the wooden barrel to the returnable cloth sack came the difficulty of getting the sacks back to the mill whose brand they bore. Out on the job, two or more brands of cement might be in use, and the builder seldom took the trouble to bundle separately the empty sacks of different brands. From serving as a clearing house for empty sacks, the meeting grew into a forum for the discussion of other common problems in cement manufacture.

The greatest problem was that of getting the public to use more cement. More mills were being built and operated than could find a market for all of their capacity. Several small associations of cement manufacturers in various parts of the country had been organized, and in 1904 these united to form the Association of American Portland Cement Manufacturers—the first really national organization. One of the great problems of that time was to make the product conform to the many different specifications under which cement was made. Almost every construction engineer prepared his own specifications and the provisions which had to be met were as many and as varied as the names of the engineers. The association appointed a committee on specifications to co-operate with the

American Society for Testing Materials, the American Society of Civil Engineers and the United States Government toward much needed standardization of specifications.

The difficulties about conflicting specifications for portland cement have now been cleared up through this liaison. Standard specifications are agreed upon which are now recognized throughout the United States. By a subsequent amendment to its bylaws, membership in the Portland Cement Association cannot be retained unless the product of the mill conforms fully to the specifications for portland cement as adopted. Thus membership in the Association has become a badge of quality.

Growth and Enlargement of Scope

In 1905 an office with a permanent secretary was opened in Philadelphia, and the organization grew slowly from 1905 to 1916. The beginning of the use of concrete for pavements about 1910 created a great opportunity for service. It was realized that the use of portland cement would increase only with popular understanding of its possibilities. Intelligent and purely commercial self-interest pointed to a policy of public education regarding the proper use of concrete as the surest means of extending the market for cement. There was much that was known about the fundamentals of good concrete, but there was still more unknown. Consequently the Association set to work to tell the public what was known about good concrete, to find out about those things which were unknown, and to tell the public of other facts as they became established.

In 1916 the name of the organization was changed to Portland Cement Association. The general offices were moved from Philadelphia to Chicago, to obtain the advantage of a central location for a truly national organization, and district offices were established in twelve cities, each in charge of an engineer skilled in concrete construction. Each of these district offices had a staff of field engineers who traveled in assigned territories calling on engineers, architects, contractors or any one who might be interested in concrete construction of any kind. This form of field organization is in use today. These field engineers give direct assistance in design and construction problems involving concrete, and the field staff is supplemented by a staff of engineers in the general office at Chicago, prepared to render consulting service on matters which could not be handled directly by the men in the field or by the district offices. Since 1916 the number of district offices has grown to twenty-four, one of which is located in Vancouver, B. C.

The main office at Chicago, as well as the various district offices, is divided into groups, each in charge of a special field of educational promotion. Agriculture, building construction in its broadest sense, sanitation, highway engineering are all reduced to terms of concrete.

The Structural Materials Laboratory

Probably the most important part of the whole educational scheme is the Structural Materials Research Laboratory operated jointly and in co-operation with the Lewis Institute of Chicago. Here a corps of technically trained men are engaged in research work in the various uses of cement and concrete. Considerably more than 100,000 chemical and physical tests have been made in this laboratory since 1916, and the sc purpose of this work is to determine how best to u concrete as well as how not to use it.

In spite of the fact that the Association is now years old and during all that time has been absorbi knowledge on the use of concrete, within the last sev or eight years more has been learned about how use it than was known in all the years before. Un comparatively recent times nothing was known of t effect which clay and other impurities in concrete mig have upon the finished structure. Studies were ma in the association laboratory on the size and gradi of aggregates, the use of different types of aggregat the effect of various impurities in the aggregate, t incorporation of various powdered admixtures in po land cement such as coloring matter and hydrated lin There was also much experimentation on the effect impure mixing water containing impurities due to i dustrial waste, etc. These studies were necessary order that cement should not be blamed for troul really caused by poor workmanship or impurities in t aggregate or water. This research work has in its sometimes become promotional in character, as will noticed in the following incident:

The Imperial Valley of California is now building concrete road. At the quarry where aggregates we being obtained for the concrete used in this paveme methods employed in screening and crushing stone f the concrete mixture caused a waste of 35 per cent the materials taken from the quarry. One of the fi engineers who was watching the progress of this wo suggested a change in the methods of screening ma rials based on laboratory tests. This step, he believ would considerably reduce the waste of materials. H suggestion was adopted with the result that the wa was cut down to 15 per cent. On this particular job cut the cost of stone from $1 a ton to 42 cents a ton a saved $30,000 on the job. This made it possible f the community to build an extra mile of concrete ro furnishing an outlet for more cement.

Co-operative Work Undertaken by the Association

Among the various classes of educational work c ried on are lectures before agricultural colleges, far ers' institutes, engineering colleges and universiti co-operation with county agents, architects, enginee contractors, building commissioners, revision of bui ing codes, establishment of simple courses in the u of concrete in vocational schools.

Portland Cement Association engineers act in advisory, consulting or inspecting capacity on ma pieces of field construction. Practical demonstratio are given on a motor truck with complete concreti equipment traveling throughout various parts of t country.

Many men have been helped to enter the contracti field, specializing in concrete construction. Throu educational work there has been promoted a high standard for buildings in many cities, and this work being continued everywhere aid is asked. The res of this should ultimately be expressed in economies construction, more fire-resistant construction and c sequent reduction of national fire losses.

Several million educational-informational bookl were distributed last year. These discussed the adv tages of the use of cement in the form of concr construction in many fields. "Concrete on the Da

Farm," "Concrete on the Hog Farm," "Concrete Around the Home" are typical titles of these booklets. Booklets or series of booklets devoted strictly to concrete construction in specialized structural fields are kept available. These booklets are revised by the incorporation of the latest information disclosed by study, research or experience and kept up to date.

Motion Pictures of the Industry

The Association uses motion picture films extensively. There is a film showing the process of manufacture of portland cement. It is designed to develop the idea that a sack of cement represents the combined cost of many operations, one of which, for example, is the use of 50 lb. of coal.

The advantages of paved barnyards are displayed through the medium of animated cartoon films circulated in rural communities. Many reports have been received showing that after a local cement dealer had displayed an animated cartoon film in his community he sold within a week or ten days cement for several concrete feeding floors. The Portland Cement Association has no connection with cement dealers except to aid them in developing the cement market by placing at their disposal motion picture films or other educational matter which they may wish to use.

Several Vital Policies

The most important of the policies that have guided the Association from its start was that of excluding rigidly from its activities any matters relating to the sale or distribution of portland cement. Association employees were told that their mission was to create an increased market for cement by helping the public to make good concrete economically, and to give assistance in the planning of concrete improvements so that such structures would best fulfill their intended purpose.

Chicago, Ill.

Elimination of Borates from American Potash*

The Story of the Steps Taken by Producers to Eliminate this Objectionable Impurity from Domestic Fertilizer as Told by the Bureau of Soils

By William H. Ross and William Hazen

THE principal borax or sodium borate deposits in the United States occur at Searles, Borax and Hachinhama Lakes, Calif., and at Rhodes Marsh, Nevada. These lakes are all of the playa type and contain a concentrated brine in association with crystal salts. Crystals of borax ($Na_2B_4O_7.10H_2O$) are found associated with the other salts at each of these lakes, but owing to its relatively low concentration in the original lake water the greater part of the borax still remains dissolved in the brine of the lakes.

Borax may also be obtained commercially from other borate minerals, the most important of which are colemanite, ulexite and howlite.

Colemanite is a hydrated calcium borate, having the composition $Ca_2B_6O_{11}.5H_2O$. It crystallizes in clear glassy monoclinic crystals which are very easily distinguished from the other borates in that they decrepitate on heating and fall to a powder. Colemanite is now the most important source of boric acid and the borates of commerce. The powdered mineral is somewhat soluble in water and is readily soluble in weak acids.

Ulexite is also a hydrated mineral, the composition of which is represented by the formula $NaCaB_5O_9.8H_2O$. It occurs in aggregates of soft acicular crystals, popularly called "cotton balls." It may be fused in a gas flame to which it gives a yellow color. It is readily soluble in acids and is decomposed by hot water.

Howlite is a borosilicate of calcium, $H_5Ca_2B_5SiO_{14}$. It occurs either as friable masses of monoclinic crystals, or as hard porcelain masses. It fuses in a flame, giving it a green color. Howlite is soluble in acids, but much less soluble in water than either colemanite or ulexite.

These minerals are more widely spread than the borax deposits, and are found in San Bernardino, Inyo, Lake and Los Angeles Counties, Calif.; in Clark, Churchill, and Esmeraldo Counties, Nevada; and in Curry, Harney, and Lake Counties, Oregon. They are found associated with borax at Borax Lake, Rhodes Marsh and other places, but sodium borate and tetraborate (borax) are the only borates known to occur at Searles Lake. The deposit at Searles Lake also differs from any of the other deposits mentioned in that the brine is used as a commercial source of potash, as well as of borax. The brine of this lake is a saturated mother liquor, which remained after the crystal salts were formed by the natural concentration of the water from the ancient lake that occupied this basin. The brine is therefore richer than the crystals in such soluble materials as potassium chloride and borax, which occurred in relatively low concentration in the water of the original lake. Analysis of samples of brine taken from various parts of the lake and at different depths show a close uniformity in composition. The composition of an average sample is given in Table I.

TABLE I—CHEMICAL COMPOSITION OF SALTS DISSOLVED IN THE BRINE OF SEARLES LAKE

Total Anhydrous Salts in Brine is 32.85 Per Cent

Constituents	Per Cent of Anhydrous Salts
Sodium, Na	33.57
Potassium, K	6.06
Lithium, Li	0.01
Barium, Ba	none
Magnesium, Mg	trace
Calcium, Ca	none
Alumina, Al_2O_3	0.012
Iron Oxide, Fe_2O_3	0.003
Copper, Cu	none
Manganese, Mn	none
Silica, SiO_2	0.023
Chlorine, Cl	37.02
Bromine, Br	0.094
Iodine, I	0.004
Sulphate, SO_4	12.96
Carbonate, CO_3	6.70
Phosphate, PO_4	0.30
Arsenic trioxide, As_2O_3	0.083
Tetraborate, B_4O_7	3.00
Total	99.839

*Published by permission of the Secretary of Agriculture.

The relation between the potassium chloride and borax in the brine is shown in Table II. For comparison there are also given the mean of numerous results obtained for these salts by the Geological Survey[1] in the analysis of samples taken from different parts of the lake.

TABLE II—POTASSIUM CHLORIDE AND BORAX IN THE BRINE OF SEARLES LAKE

Salt	Found by Bureau of Soils Per Cent	Found by Geological Survey Per Cent
Potassium chloride, KCl	3.82	4.02
Borax, $Na_2B_4O_7.10H_2O$	2.40	2.07
Anhydrous borax, $Na_2B_4O_7$	1.27	1.08

Table II shows that the maximum quantity of borax that can occur in the potassium chloride prepared from the brine of Searles Lake is in the neighborhood of 25 per cent if the greater part of the potash is recovered with the borax.

Borate Content of Potash from Searles Lake

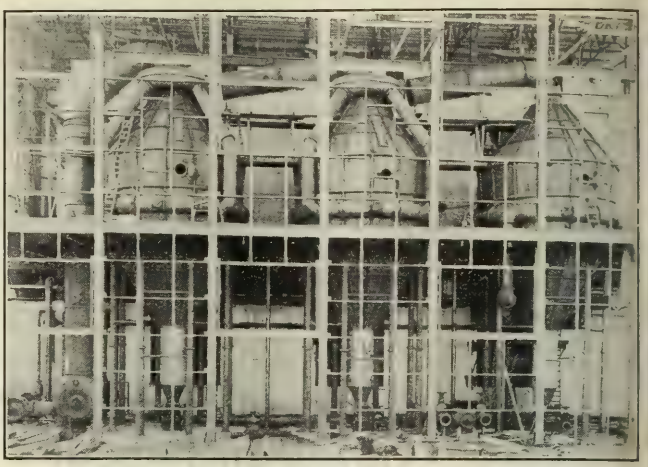
The original process used at Searles Lake for the recovery of potash consisted simply of evaporation and crystallization. The brine was first evaporated to less than half its volume and the solids which separated out from the hot solution, consisting largely of sodium chloride, sodium sulphate, and sodium carbonate were washed back into the lake by a stream of water. The remaining liquor was then run into crystallizing vats and allowed to cool to separate out the potash. The mother liquor from this crystallization was returned to the evaporators to be mixed with fresh brine. The range in the composition of the first crude potash salts produced at Searles Lake is given by the U. S. Geological Survey[2] as follows:

Potassium chloride	60 to 70 per cent
Sodium chloride	5 to 10 per cent
Sodium sulphate	0.5 to 1.5 per cent
Sodium carbonate	1 to 3 per cent
Anhydrous borax	4 to 14 per cent

The first commercial shipments of potash from Searles Lake were made in 1916. During this year a total of 40 shipments were made which were increased to 295 in 1917 and to 376 in 1918. The borax in these shipments showed a wide variation, ranging from less than 1 per cent to a maximum of about 20 per cent.

Crop Injury Due to Presence of Borax in Fertilizer

During the summer of 1919, the attention of the Department of Agriculture was directed to injury to crops by the use of fertilizers. The injury was widespread and serious, especially to the tobacco and cotton crops of the eastern districts of North and South Carolina and to the potato crop of Maine. Several investigators were sent to the regions most affected to study the cause of the injury.[3] Practically all the evidence collected which was later confirmed by field experiments,[4] pointed to the use of fertilizers of potash salts containing borates as the primary cause of the damage to crops. It was observed that the borate content of such mixed fertilizers was roughly proportional to the potash present and that the higher the borate content the greater the injury to crops. The source of the potash salts used in these fertilizers was traced to the salt deposit at Searles Lake.



EVAPORATORS AT TRONA CORPORATION PLANT AT SEARLES LAKE

Analyses of numerous fertilizers reputed to have caused injury to crops showed a borate content varying from 0.75 to 2.0 per cent in terms of anhydrous borax. Considerable difficulty was at first experienced in determining borates in mixed fertilizers by the usual methods of analysis, owing to the interfering action of the soluble organic matter of the fertilizer. However, a modification of the Thompson method was soon developed by the Department[5] which eliminated this difficulty while J. M. Bartlett[6] of the Maine Experiment Station made a satisfactory modification of the Gladding distillation method. The former method gives water-soluble borates in fertilizers and the latter acid-soluble borates. The agreement in the analyses of numerous fertilizers by both methods shows that these fertilizers at least contained only water-soluble borates. This is to be expected inasmuch as the potash salts used in fertilizers are mainly water-soluble and even if there had been added some of the "insoluble" mineral borates, the latter would be rendered soluble by the acid reaction of the mixed fertilizer.

Order Issued by the Department of Agriculture Limiting Borax Content of Fertilizers

As soon as injury to crops by borate-bearing fertilizers was established, the Secretary of Agriculture issued an order under authority of the Control Act of Aug. 10, 1917, which placed such restrictions on the use of fertilizers and fertilizer materials containing borates as would guarantee the use of an application amounting to the equivalent of not more than 2 pounds of anhydrous borax per acre.

[1] Hoyt S. Gale. Potash in 1916. Geological Survey, "Mineral Resources" 1916, Part II, p. 91 (1917).

[2] Hoyt S. Gale. loc. cit. p. 93 (1917).

[3] Crop injury by Borax in Fertilizers. Oswald Schreiner, B. E. Brown and J. J. Skinner. U. S. Dept. Agr., Circ. 84 (1920).

[4] Borax in Fertilizers. S. D. Conner and E. N. Fergus. Ind. Agr. Exp. Sta. Bull. 259 (1920).

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Influence of Fertilizers Containing Borax on the Growth and Fruiting of Cotton. J. J. Skinner and F. E. Allison. *J. Agr. Research*, August (1922).

[5] Methods for the Determination of Borax in Fertilizers and Fertilizer Materials. W. H. Ross and R. B. Deemer. Am. Fertilizer 52, No. 6, 62 (1920); *J. Ass. Official Agr. Chemists*, 5, No. 327 (1921).

Qualitative Method for the Detection of Borax in Mixed Fertilizers. W. B. Pope and W. H. Ross. *Am. Fertilizer* 52, No. 65 (1920).

Report on the Determination of Borax in Fertilizers and Fertilizer Materials. Wm. H. Ross. *J. Ass. Official Agr. Chem.*, 5, No. 1, 80 (1921).

[6] The Distillation Method for the Estimation of Borax in Mixed Fertilizers. J. M. Bartlett. *J. Ass. Official Agr. Chem.*, 5, No. 88, (1921).

GENERAL VIEW OF POTASH PLANT, AMERICAN TRONA CORPORATION

The regulation as applied to mixed fertilizers specified that "hereafter no licensee handling or dealing in fertilizers or fertilizer ingredients shall sell for application to the soil any mixed fertilizer which contains more than 0.1 of 1 per cent of borates expressed as anhydrous borax unless the container thereof be marked, tagged, branded, or labeled so as to show plainly and conspicuously as part of the analysis the percentage of borax present."

The order as applied to potash salts forbade the sale direct to farmers as straight goods, or to any broker or other person for use by farmers as straight goods, potash salts containing borates equivalent to more than 0.5 of 1 per cent of anhydrous borax.

In compliance with this regulation, immediate steps were taken at once by potash producers and fertilizer manufacturers to insure the elimination of borates from all the raw materials entering into the manufacture of fertilizers. Their efforts in this direction have met with such success that since 1919 no mixed fertilizer is known to have been placed on the market with a borate content in excess of the limit specified in the regulation.

Diminished Borax Content of Searles Lake Potash Under Revised Process

On Sept. 5, 1919, an inspection was made of the plant of the American Trona Corp. at Searles Lake, by Dr. J. W. Turrentine of this Bureau. The investigation that was made at that time showed that marked progress had already been made in the refinement of the potash salts. It was found that when the original process was modified so as to bring about a rapid, rather than a normal cooling of the mother liquor from the precipitated sodium salts, the potassium chloride crystallized out as before, but the borax remained in solution. The sludge of crystals thus formed was filtered off and washed in the centrifugals with water for the removal of the retained mother liquor which contained the borax.

Table III gives the composition of samples of the original product and also of material collected at different steps in the process as operated at the time of the inspection in 1919.

At the time the samples listed in Table III were analyzed, an examination was also made of a large number of fertilizer materials from other mineral deposits. A summary of the results obtained is given in Table IV.

The results given in Tables III and IV show that it is commercially feasible to produce a potash product from Searles Lake or any other mineral deposit in this country having a borate content well within the limits set by this Department for that occurring in straight goods to be applied directly to the soil and that the product compares favorably as regards its borate content with the ordinary sodium nitrate imported from Chile.

TABLE III—VARIATION OF BORAX CONTENT OF POTASH SALTS PRODUCED AT SEARLES LAKE BY OLD AND BY THE MODIFIED PROCESSES

No. of Sample	Potash K_2O Per Cent	Anhydrous Borax $Na_2B_4O_7$ Per Cent	Anhydrous Borax Per Unit (20 Lb) of K_2O Pounds
1	31.62	18.14	11.48
2	46.91	2.43	1.03
3	52.57	0.80	0.30
4	52.03	2.61	1.00
5	40.93	0.86	0.42
6	56.26	1.16	0.41
7	54.90	0.28	0.10
8	55.29	0.41	0.14
9	53.23	0.59	0.22
10	50.56	0.20	0.08
11	43.42	0.15	0.07

1. Low-grade potassium chloride prepared by the original process.
2. Medium-grade vat salts prepared by the original process.
3. Potash salts as delivered by filter presses, and before drying and washing in centrifugal driers.
4. Main filter salts unwashed. These are salts as delivered by filter presses without washing in centrifugals.
5. Same as sample 4 but from another section of the pile.
6. Same as sample 4 but from a third section of the pile.
7. Potash shipping salts taken directly from centrifugal driers. The salts represented by this sample were washed on the driers with a small amount of water to remove the mother liquor containing the borax.
8. No. 1 grade filter salts washed with so-called sump solution. From a lot containing 392 tons.
9. No. 1 washed filter salts from another pile of the same grade as that represented by sample 8.
10. No. 2 grade centrifuged filter salts washed with sump solution. From a lot containing 800 tons.
11. No. 2 grade potassium chloride washed with water and which with sample 10 represents the degree to which it is practical to eliminate borax by the modified process.

TABLE IV—BORAX IN MISCELLANEOUS FERTILIZER MATERIALS

Material	Anhydrous Borax Per Cent
Potash salts from Nebraska lakes	0.07 to 0.15
Potassium sulphate from alunite	0.00
German kainite	0.00
German manure salts	0.00
Alsatian manure salts	0.00
Refined potassium chloride from Salduro Marsh	0.00
Refined potassium chloride from Deep Springs Valley, Calif.	0.00
Sodium nitrate from Chile	0.05 to 0.83
High potash nitrate from Chile	0.15 to 3.95

At the request of the American Trona Corporation, a second inspection was made of their plant at Searles Lake, Cal., on April 30, 1922, by Dr. J. W. Turrentine of this Bureau. About 5,800 tons of potash salts were found in storage in the warehouses of the company. Some of this, about 3,000 tons, had been manufactured in the fall of 1920, and the remainder approximately in the spring of 1921. About 300 tons were produced

since the reopening of the plant, 10 days previously. The same general process was being used of separating the potash and borax by rapid cooling with refrigerating brines, as was used in 1919, but certain improved modifications in equipment have been installed. Samples were collected as in 1919, the composition of which are given in Table V.

TABLE V—COMPOSITION OF POTASH SALTS PRODUCED AT SEARLES LAKE DURING 1920 TO 1922

No. of Sample	Potash K_2O Per Cent	Anhydrous Borax $Na_2B_4O_7$ Per Cent	Anhydrous Borax Per Unit (20 Lb.) of K_2O Pounds
1	60.75	0.50	0.16
2	58.72	0.24	0.08
3	57.94	0.39	0.13
4	58.63	0.30	0.10
5	57.64	0.46	0.16
6	61.15	0.36	0.11
7	61.50	0.25	0.08
8	61.80	0.25	0.08
9	59.55	0.27	0.09

1. Potassium chloride from a vertical 5-ft. section of 3,000 tons potash salts manufactured in the fall of 1920.
2. Potassium chloride from loading floor. A part of material manufactured in spring of 1921.
3. Sample of potassium chloride through vertical 5-ft. section near south end of 3,000-ton pile, manufactured during the spring of 1921.
4. Same as sample 3 taken from entire working face 15x50 ft. cross-section of the south end of pile.
5. Same as sample 3 taken from 5-ft. vertical section, middle of pile.
6. Sample from centrifugals as delivered into box for transportation to storage.
7. Sample from box already filled just before being transferred to warehouse.
8. Sample of 300 tons of new potash produced since reopening of plant.
9. Sample of product being delivered by centrifugals, April 30, 1922.

The results in Table V confirm the conclusions arrived at from the data given in Table III, that it is commercially feasible to produce a high grade potash salt from the brine of Searles Lake, having a borate content well within the limits specified by this Department.

This Bureau has followed closely the course of American potash production, not only with a view to assist in establishing commercial sources of potash but also in maintaining a quality of material that would be suitable for use as fertilizer without fear of injury to crops. Borax has been the only substance of a deleterious nature discovered in American potash and the quality of the materials produced during the period from 1919 to 1922 show that the producers have met the requirements of the Department and that under the present method of producing potash at Searles Lake there exists no longer any danger of deleterious effec from the presence of borax.

Potassium chloride and borax ($Na_2B_4O_7$) occur in t brine of Searles Lake in the proportions of about 3.3 1. The maximum quantity of borax that can occur the potassium chloride from this source is therefore the neighborhood of 25 per cent. The first commerci shipments of potash from Searles Lake contained maximum of about 20 per cent of borax which wh used in fertilizers resulted in serious injury to cro By modifying the original process so as to bring abo a rapid rather than a normal cooling of the moth liquors containing the potash salts a high grade pot sium chloride is now being prepared. This contai less than the equivalent of 0.5 per cent anhydrous bor which compares favorably with the content of borax sodium nitrate, a nitrogen carrier long used in fertil ing the crops of this country. Borax has been the on deleterious substance found in American potash and t quality of the materials produced during 1919 to 19 shows that the producers have met the requiremen of the U. S. Department of Agriculture and that the no longer exists the former danger to crops from t presence of borax in fertilizers.

Bureau of Soils,
Department of Agriculture,
Washington, D. C.

Pure Iron-Carbon-Manganese Alloys

As a continuation of the Bureau of Standards' pr vious work on the preparation and properties of pu iron and iron-carbon alloys, there has just been co pleted a series of alloys of electrolytic iron, carbon a manganese, so chosen as to show the effect on t mechanical properties of pure iron of additions carbon up to 1.2 per cent, of manganese up to 1.5 p cent, and of carbon and manganese together in varyi relative proportions up to the same limits. All the alloys were prepared *in vacuo* in order to eliminate far as possible any effects from gases and in ord to obtain sound material without the use of any deo idizing additions. The ingots of this series were roll to flat bars, tensile test specimens cut from them a tested in the fully annealed state. The data from the will soon be available as a Bureau publication. Th same investigation is being extended to cover simp heat treatments of selected vacuum fuse iron-carbo manganese alloys.

SEARLES LAKE, CAL.

Resistance to Corrosion Of Various Types of Chromium Steels

Several Pure Chromium Steels, in Cast, Forged and Heat-Treated Conditions, Were Observed During Immersion in Dilute HCl and in Aërated Distilled Water—Relative Resistance to Attack Is Entirely Different in the Two Series

By Henry S. Rawdon and Alexander I. Krynitsky
Physicist and Associate Physicist (Metallography), Bureau of Standards.

LACK of adequate information on this subject in the technical literature together with the numerous requests for information along this line which have been received has led to the publication of the results of these preliminary experiments which were initially undertaken at the request of one of the prominent American steel men. As the work progressed it appeared desirable to test several other materials besides the chromium steels for purposes of comparison (series 21 to 24 of Table I), one of these being a chromium-nickel steel submitted by the manufacturers for the purpose. The tests were carried out in the endeavor to show the relative corrodibility of the various types of steel rather than to study any one material in detail. Hence it was necessary to limit the number of corroding conditions used.

Materials Investigated

The chromium steels investigated (Table I) were prepared by L. Jordan, of the Bureau of Standards, the fusion being made in the high-frequency induction furnace. Only small ingots averaging about 1 lb. (550 grams) each could be made. Armco iron was used as the base material; this contained approximately 0.02 per cent sulphur and 0.015 per cent carbon, with other impurities negligible in amount. To this was added the requisite amount of chromium in the form of ferrochromium containing approximately 60 per cent chromium and 0.25 per cent carbon. For the steels of a relatively high carbon content, the carbon was added in the form of an iron-carbon alloy prepared with electrolytic iron as a base and containing 4.4 per cent carbon. An addition of a small amount of manganese was made to all the alloys and silicon to a portion of the series in order to obtain sound ingots and to render them forgeable.

After the ends had been cropped, the ingots of chromium steel were heated to a temperature slightly less than 1,000 deg. C. and pressed into plates approximately ½ in. in thickness. All of the steels after forging were annealed at 750 deg. C. and most of them received an additional heat-treatment before the corrosion test, as indicated in the subsequent tables in which the results of corrosion tests are summarized. Portions of the cropped ends of the ingots of the cast metal were also tested as being representative of the material in the cast state. The iron and other steels investigated were in the forged condition; samples of the pure iron in the cast condition were also used.

The specimens used for the test were small pieces of a rectangular prismatic shape, the surfaces of which were carefully ground so that their dimensions could be readily measured by means of a micrometer. The effect of surface finish—that is, rough grinding versus polishing—was also noted.

TABLE I—COMPOSITION OF ALLOYS USED IN CORROSION TESTS

Series	Character of Material	Important Elements (Per Cent)					
		Carbon	Chromium	Manganese	Silicon	Sulphur	Nickel
1	Chromium steel	0.45	12.42	0.27	Not determined. Silicon was not used in preparation of the alloys.	— Not determined —	Not determined, but not present in more than traces.
2	Chromium steel	0.42	11.81	0.27			
3	Chromium steel	1.07	13.18	0.29			
4	Chromium steel	0.28	6.12	0.24			
5	Chromium steel	0.40	7.22	0.23			
6	Chromium steel	0.71	6.55	0.27			
7	Chromium steel	0.057	13.30	.....			
8	Chromium steel	0.040	6.50	.....			
9	Chromium steel	0.38	12.10	0.36	0.36		
13	Chromium steel	0.20	8.60	0.36	0.29		
14	Chromium steel	0.29	13.70	0.76	0.51		
15	Chromium steel	0.29	12.40	0.50	0.61		
17	Chromium steel	0.15	13.00	0.08	0.70		
18	Chromium steel	0.30	5.72	0.06	0.27		
19	Chromium steel	0.40	12.60	0.44	0 27		
20	Chromium steel	0.28	3.90	0.39	0.24		
21	Iron-carbon alloy	0.45	Not detected	Nil	0.003	0.014	
22	Electrolytic iron remelted in vacuo	0.028	Not detected	0.009	0.005	0.016	
23	Invar	0.08	Not detected	0.45	0.18	.....	36.13
24	High-nickel chromium steel	0.32	7.68	0.68	1.03	0.20	20.12 Co 0.10 Cu 0.095 P 0.026

Nature of Test

Two types of tests were used, one for determining the resistance of the materials to corrosive attack by acid, the second one being a simulated "weather" test. Since the purpose of the tests was to demonstrate the relative resistance of a series of alloys of different compositions rather than the behavior of one or two compositions under a series of different conditions, only one acid, dilute hydrochloric, was used. This acid was chosen since its action upon chromium steels is relatively more severe than that of most other acids. The attack is also less complicated in character than is the case with strongly oxidizing acids such as nitric. Results are expressed as the loss in weight in milligrams per square centimeter of surface per day.

The necessity for using either a considerable excess of acid during the acid-immersion test or a rather short period in order to obtain a true measure of the relative solubility of the materials became evident early in the experiments. As the concentration of acid decreased and that of the "corrosion products" increased, the rate of attack, as indicated by the evolution of the gas, was found to diminish noticeably, so that specimens of the same size differing widely in composition were found to lose approximately the same amount if

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the immersion was prolonged enough, although the solutions in which they were immersed showed a strong acid reaction at the completion of the test.[1]

The "weather" test consisted in the exposure of specimens suspended so as to be immersed in distilled water just beneath the surface, the uncovered dish of water being kept near an opened window so that a supply of fresh air at all times was assured. The time required for the appearance of rust for tarnishing of the surface was taken as an approximate measure of the resistance of the material to "weathering" conditions and the specimens could be arranged in order on this basis. A few samples which purposely had not been thoroughly ground free from oxide scale were also tested in this manner to show to what extent the presence of scale affects the rate of corrosion.

In all the tests the samples were suspended by means of silk thread in the water or acid solution used so as to hang freely and not to be in contact with the glass vessel, which might possibly affect somewhat the rate of attack. The identification numbers were not stamped on the material itself, since this might have some effect upon the attack, but were written on a wooden identification tag.

Acid Corrosion

The effect of a hardening treatment upon the rate of attack of typical chromium steels is well shown by series 1 to 6 inclusive in Table II. The apparently anomalous results of series 1 may have resulted from the fact that the quenching temperature used was somewhat low for the composition of this particular specimen. All of the other samples showed a marked decrease in the loss in acid when in the hardened state. The specimens of highest carbon content, for example, 3 and 6, showed the greatest decrease.

TABLE II—RESULTS OF ACID-CORROSION TESTS ON FORGED BARS

Series	Carbon and Chromium, Per Cent	Heat Treatment Received	Character of Surface	Immersion In *N*/2 HCl	Loss in Wt. Per Sq.Cm. Per Day, Mg.
1	C, 0.45; Cr, 12.42	(*a*)	Ground	300 c.c., 3 days	17.50
1	C, 0.45; Cr, 12.42	(*a*)	Polished	300 c.c., 3 days	17.50
					av. 17.5
1	C, 0.45; Cr, 12.42	(*b*)	Ground	300 c.c., 3 days	20.8
1	C, 0.45; Cr, 12.42	(*b*)	Polished	300 c.c., 3 days	14.5
					av. 17.6
2	C, 0.42; Cr, 11.81	(*a*)	Ground	300 c.c., 3 days	30.5
2	C, 0.42; Cr, 11.81	(*a*)	Polished	300 c.c., 3 days	27.2
					av. 28.8
2	C, 0.42; Cr, 11.81	(*c*)	Ground	300 c.c., 3 days	22.0
2	C, 0.42; Cr, 11.81	(*c*)	Polished	300 c.c., 3 days	17.1
					av. 19.5
3	C, 1.07; Cr, 13.18	(*a*)	Ground	300 c.c., 3 days	46.8
3	C, 1.07; Cr, 13.18	(*a*)	Polished	300 c.c., 3 days	36.8
					av. 41.8
3	C, 1.07; Cr, 13.18	(*c*)	Ground	300 c.c., 3 days	10.4
3	C, 1.07; Cr, 13.18	(*c*)	Polished	300 c.c., 3 days	14.2
					av. 12.3
4	C, 0.28; Cr, 6.12	(*a*)	Ground	300 c.c., 3 days	24.5
4	C, 0.28; Cr, 6.12	(*a*)	Polished	300 c.c., 3 days	20.0
					av. 22.2
4	C, 0.28; Cr, 6.12	(*b*)	Ground	300 c.c., 3 days	16.7
4	C, 0.28; Cr, 6.12	(*b*)	Polished	300 c.c., 3 days	11.0
					av. 13.8
5	C, 0.40; Cr, 7.22	(*a*)	Ground	300 c.c., 3 days	34.8
5	C, 0.40; Cr, 7.22	(*a*)	Polished	300 c.c., 3 days	44.7
					av. 39.7
5	C, 0.40; Cr, 7.22	(*c*)	Ground	300 c.c., 3 days	14.1
5	C, 0.40; Cr, 7.22	(*c*)	Polished	300 c.c., 3 days	12.2
					av. 13.1
6	C, 0.71; Cr, 6.55	(*a*)	Ground	300 c.c., 3 days	48.3
6	C, 0.71; Cr, 6.55	(*a*)	Polished	300 c.c., 3 days	31.1
					av. 39.7
6	C, 0.71; Cr, 6.55	(*c*)	Ground	300 c.c., 3 days	12.3
6	C, 0.71; Cr, 6.55	(*c*)	Polished	300 c.c., 3 days	10.8
					av. 11.5

(*a*) Annealed at 750 deg. C., and re-annealed after machining at 750 deg. C.
(*b*) Annealed at 750 deg. C., water-quenched from 813 deg. C., tempered at 180 deg. C.
(*c*) Annealed at 750 deg. C., water-quenched from 1,000 deg. C., tempered at 180 deg. C.

[1] This feature was discussed at length by D. M. Strickland in Chem. & Met. Eng., June 21, 1922, vol. 26, p. 1165.

TABLE III—ORDER OF RESISTANCE TO HYDROCHLORIC-ACID CORROSION OF ANNEALED ALLOYS

Order	Series	Character of Steel	Average Loss of Wt. Per c.c. Per Day, In Mg.
1	24	C, 0.32; Cr, 7.7; Ni, 20; Si, 1.0	0.12
2	23	C, 0.08; Ni, 36.13 (Invar)	0.25
3	22	C, 0.028 (electrolytic iron)	0.8
4	20	C, 0.28; Cr, 3.9	3.2
5	8	C, 0.04; Cr, 6.5	3.3
6	21	C, 0.45 (alloy of electrolytic iron and carbon)	4.2
7	13	C, 0.20; Cr, 8.6	5.9
8	18	C, 0.30; Cr, 5.72	7.7
9	7	C, 0.057; Cr, 13.3	8.8
10	1	C, 0.45; Cr, 12.42	17.5
11	4	C, 0.28; Cr, 6.12	22.2
12	17	C, 0.15; Cr, 13.00	27.1
13	2	C, 0.42; Cr, 11.81	28.9
14	5	C, 0.40; Cr, 7.22	39.7
15	6	C, 0.71; Cr, 6.55	39.7
16	3	C, 1.07; Cr, 13.18	41.8
17	15	C, 0.29; Cr, 12.40	62.6
18	19	C, 0.40; Cr, 12.60	73.8
19	14	C, 0.29; Cr, 13.70	77.7
20	9	C, 0.38; Cr, 12.10	84.5

Tests also indicate that, in general, the cast alloys are more resistant to hydrochloric acid attack than are the same materials after being forged.

The relative order of resistance to acid corrosion of the various alloys is best known by comparison of the specimens in the same physical condition. In Table III have been grouped the data which relate to the forged alloys in the annealed state.

"Weathering" Test

The behavior of the materials when exposed under ordinary conditions of atmospheric corrosion was determined by immersing the steels in distilled water, just below the surface, and exposing the uncovered dish to the free air. By observing the change in the appearance of the previously polished surface of the specimens, the period necessary for the appearance of rust spots, the relative extent of the rusted areas after a certain definite period and the change in weight of the specimens, it was possible to arrange the various steels in certain groups with respect to their corrodibility.

In determining the change in weight, the surface was cleaned by rubbing with the finger so as to remove any loosely adherent rust. Most of the specimens showed a very slight decrease in weight, thus indicating that the rust formed under the conditions used was not very firmly adherent.

In Table IV are summarized the conclusions reached concerning the relative resistance of the various steels to "weathering." In most of the chromium steels the corrosive attack was confined to small areas or pits, a fact which suggests that the average chemical composition of the material as determined by analysis is not the only factor which determines the behavior of the steels with respect to corrosion. Since the attack in most cases did not result in a uniform film over the surface, but was restricted to small isolated areas, the changes in weight noted do not appear of as much significance as would be the case otherwise and hence have not been included.

Discussion and Summary

There will be noted in the foregoing tables, particularly in Table IV, in which are summarized the results of the "weather" tests, some results which are very difficult if not impossible for one to explain on the basis of composition alone. The classification which has been given should be regarded as a very loose one, indicating only the general behavior which may be expected of the

various alloys. However, there are some very definite conclusions which the results of the investigation appear to warrant.

1. *Acid Corrosion.*—A comparison of the results of Table III with those of Table IV shows that the relative resistance of a steel to the hydrochloric acid test is not necessarily a criterion of its behavior in atmospheric corrosion. Pure iron and the steels of low chromium content were found to be much more resistant to attack by hydrochloric acid than those containing considerable chromium. When corroded by water and air the general order of resistance was reversed. It may be concluded, then, that the addition of chromium to iron and steel increases the rate of attack by hydrochloric acid and perhaps by others, although this statement may be modified somewhat according to the condition of the steel with respect to the heat-treatment it has received. Specimens which had been hardened by suitable heat-treatment were found to be considerably more resistant to acid attack than samples of the same composition in the annealed state. The addition of nickel is much more effective in reducing the intensity of the attack by hydrochloric acid than is chromium. The steels containing a considerable amount of nickel were found to be the most resistant to acid of all those which were used.

Specimens having a polished surface were found, almost invariably, to show a smaller loss in acid than those which were roughly ground. This difference may be only apparent, however. Although the measured surface of the two specimens may appear to be exactly the same, the one with a "ground" finish has a slightly greater area exposed on account of the minute grooves and ridges which make up the surface than has the polished specimen.

TABLE IV—RELATIVE RESISTANCE OF THE STEELS TO CORROSION IN DISTILLED WATER

Order	Approximate Period Before Rust Was Noted	Approximate Area Which Had Lost Luster or Was Rusted After 19 Days	Series of Steels
1	150 days (no rust)	.....	17, 17 (*a*)
2	63 days	.....	9
3	22 days	.....	24
4	13 days	Few very small specks	2 (*H*)
5	7 days	Larger specks, approximating $\frac{1}{8}$ to $\frac{1}{4}$ of surface area	1 (*H*), 3 (*H*)
6	3 days	Ditto	1 (*A*), 9 (*a*), 13, 14, 15 (*a*), 19 (*a*), 17 (*a*), (*b*)
7	18 hours (trace of rust)	Ditto	7, 7 (*a*), 7 (*b*), 7 (*b*) (*a*), 9 (*b*) (*a*), 13, 14 (*a*), 15, 15 (*a*), 17 (*b*), 19, 19 (*b*), 19 (*b*) (*a*)
8	18 hours (trace of rust)	About $\frac{1}{2}$ surface	8, 8 (*a*), 8 (*b*), 13 (*a*), 13 (*b*)
9	18 hours (small amt. of rust)	Small portion of approximately $\frac{1}{2}$ area retained its luster	2 (*A*), 3 (*A*), 4 (*A*), 4 (*H*), 5 (*H*), 6 (*A*), 6 (*H*), 18, 18 (*a*)
10	18 hours (small amt. of rust)	No luster remained. Surface was etched and has a mottled appearance	5 (*A*), 18 (*b*), 18 (*b*) (*a*), 20, 20 (*a*), 20 (*b*) (*a*), 20 (*b*)
11	18 hours (considerable amount of deposit)	No luster remained on surface	21, 22 22 (*a*)

(*a*) Cast, annealed at 750 deg. C. reheated to 500 deg. C. after machining.
(*b*) Specimens had adhering specks of oxide scale on the surface, otherwise they were the same as others of the series.
(*A*) Annealed at 750 deg. C. after forging, annealed at 750 deg. C. after machining.
(*H*) Heat-treated; annealed 750 deg. C., after forging, water-quenched from 1,000 deg. C. (except 1 and 4, 813 deg. C.), tempered 180 deg. C.
Other specimens (except 21 and 24) were annealed 750 deg. C. after forging at approximately 1,000 deg. C. reheated to 500 deg. C. after machining. Specimens 21 and 24 were cut from a forged bar and annealed at 500 deg. C.

2. *Atmospheric Corrosion.*—For resisting corrosion by water and air a considerable amount of chromium in a steel is necessary. The alloys of this general type were found much more resistant than were those of low chromium content. These latter steels, however, were found much more resistant than the simple carbon steel or "pure" iron. Hardening the chromium steel by heat-treatment was found to have a similar effect in retarding corrosion by water and air as in the acid tests. This was true in particular for the steels of high chromium content. The specimens lower in chromium showed very little difference in resistance to corrosive attack regardless of their condition with respect to heat-treatment. Adhering patches of oxide scale upon the surface were found to have a very noticeable effect in accelerating the rate of attack of the chromium steels.

The alloy containing a high percentage of nickel as well as chromium which was found to be attacked the least by acid also proved very resistant to atmospheric corrosion. It was much better than most of the chromium steels used, although it was far surpassed by certain of the high chromium materials tested.

It was noted in most cases that the corrosion of the chromium steels consisted in an attack at small isolated spots rather than in a general tarnishing and coating of the surface. This, in view of the fact that adhering particles of oxide scale accelerated the corrosive attack of a steel to a very marked degree, suggests that the presence of inclusions or other defects within the material may be responsible in large measure for the character of the surface pattern resulting from the corrosive attack of these steels.

It will be noted that the high-chromium steel which proved to be superior to all the others in its resistance to "weather" corrosion contained a considerable amount of silicon. However, whether this fact is of real significance is a matter of conjecture so far as the present tests indicate. Specimens 14 and 15, which also contained considerable silicon, though less than specimen 17, did not show any unusual corrosion-resisting properties. The difference in carbon and manganese contents in these specimens may be of pronounced significance, however, in this respect.

In the choice of a "non-corrodible" steel, the character of the service will be the criterion which determines which is the proper type to use. For example, it is evident from the preceding results that as a material for which the resistance to severe acid attack, such as hydrochloric, is the principal requirement, a high-chromium steel would be the least suitable of all the materials used in this investigation. In most cases, however, the service which any material will undergo is a combination of various factors. Thus, for example, cutlery steel must withstand both acid and atmospheric corrosion as well as possess certain necessary mechanical properties, "forgeability," hardness, etc. No single type of non-corrodible steel appears to be suitable for each and every purpose which may arise.

Competition of Indian Mica

A feature that renders it almost imperative for the America mica producer to develop more efficient methods is the competition with cheap Indian labor, acccording to Oliver Bowles, mineral technologist of the Bureau of Mines. Labor costs in India are exceedingly low and it is difficult, therefore, for Americans with their higher standards of living and consequently higher wages, to compete successfully with the Indian product. Mining methods in India are very crude and laborious and it is only by taking advantage of superior methods that America can hope to succeed in establishing a flourishing mica industry.

Maturing Flour—I

Summary of Present Knowledge Regarding the Action of Chlorine on Flour—Maturing Effect—Baking-Quality Stabilized as Result of Arresting Enzyme Activity So That the Acidity May Be Maintained at the Optimum Point

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WHILE a large number of methods have been proposed for treating flour in order to improve its color or quality—as is evident from a study of Dr. Morison's résumé of flour-treating methods published recently in *Baking Technology* under the caption "Why Bleached Flour?"—very few of these have been of any particular moment in a practical and operative way and have achieved anything like a commercial success.

So far as practical adoption by millers is concerned, the forerunner of all the methods is what is known as the nitrogen dioxide process. As now conducted, its operation depends on the heat generated by an electric discharge causing some of the oxygen and nitrogen of the air to combine, with the formation of nitric oxide. This substance then takes up oxygen from the air and forms nitrogen dioxide. It is this latter that is the active agent in this process for treating flour.

This method of treating flour with NO_2 is the earliest of the commercial methods used in the United States, and the flour so treated was known as "bleached flour." The method and product produced by such method have been the source of extensive litigation both in this country and in England. Nitrogen dioxide-treated flour was the one which became more or less generally known through government activities, for at that early period it was the sole treated flour on the American market. Published results of experiments both in this country and abroad indicate that flour treated with nitrogen dioxide, while very much whiter than before treatment, is not materially affected in its baking quality.

While the term "bleach" from a dictionary standpoint does mean "to make white," yet with this historical setting, it has come to mean the treatment of a flour whereby such flour is made whiter, but nothing else.

Aging of Flour

Flour when it ages turns whiter and increases in the quantity of acidity. As flour ages, it becomes a better flour, for it produces a larger and better loaf of bread. Freshly milled flours do not produce the best of which they are capable. A great advance was made in the milling art by the introduction of a method for treating flour in the mill, whereby such freshly milled flour at once took on the properties of a properly aged flour, so that the flour could then go to the consumer in condition to render at once its highest baking value.

The aging of flour is not commercially feasible. The cost is against it, for one thing. Another objection, from a commercial standpoint, is the impossibility of following the condition of the aging flour, especially if one wishes to catch it at its peak, for stored flour is constantly varying in its baking capacity, finally reaching an optimum and then beginning to decline. Hence any method which the miller can employ, assuming for the moment that it is unobjectionable from a health standpoint, which will instantly convert a flour to its optimum baking value and then stabilize it, is of great moment to the public.

Maturing of Flour by Chlorine Treatment

This state of affairs is brought about in flour by treating it with chlorine, and the general result is known as "maturing"—*i.e.*, the general effect of "maturing" flour is that which nature produces in aging flour—a whitening effect together with greatly improved baking qualities. It is quite evident that there is a distinction between "bleached" and "matured" flour.

Nature of Coloring Matter in Flour

Whatever the method used to treat flour, if the resultant product is whiter, then it is certain that the yellow coloring matter of the flour has been discharged to a greater or less extent. Not much is known concerning this yellow coloring matter of flour, but in 1912 Dr. G. W. Monier-Williams established its identity with carotin, the yellow coloring matter found in carrots and also in the green portions of plants.[1] While the amount of carotin contained in flour will vary considerably, in no case is it very large, Monier-Williams having found 1.3, 1.4 and 2.0 parts per million in samples of patent flour.

Willstätter and Mieg[2] have shown that carotin is a hydrocarbon, $C_{40}H_{56}$. It forms red crystals of a coppery luster having a melting point of 167.5 to 168 deg. C. With the halogens it forms addition compounds of the type $C_{40}H_{56}I_2$. The relative toxicity of carotin and dichlorcarotin, $C_{40}H_{56}Cl_2$, has been studied by Wells and Hedenburg,[3] who reached the following conclusion: "Evidently carotin possesses no considerable toxicity if any, and chlorination does not make it demonstrably toxic. The quantities of carotin used in these experiments are enormous in comparison to the amounts that could be obtained from any food, even carrots. The larger doses used, 0.2 g., are as much as is contained in 200 kg. of flour. . . ."

Oxidation of Carotin Causes Whitening of Flour

Willstätter and Mieg say that carotin absorbs oxygen and is thereby completely decolorized. The oxidation goes on rapidly even in the dark and in the absence of moisture. In one set of experiments Monier-Williams exposed 0.1 to 0.2 g. samples of carotin to the air for two months in both the city of London and in Widnes.

[1] Report to the Local Government Board by Dr. G. W. Monier-Williams, on the nature of the coloring matter of flour and its relation to processes of natural and artificial bleaching.
[2] *Ann.*, vol. 355, p. 1 (1907).
[3] *J. Biol. Chem.*, vol. 27, p. 213 (1916).

se increased in weight about 30 per cent and became ter in color—i.e., a light orange red. The increase weight was at first very slow, being scarcely per- tible for six days, but after this it became fairly id. In one sample, equilibrium was reached in 75 s with 32.3 per cent "oxygen absorbed." This cor- ponds fairly well with the 34.3 per cent oxygen orption obtained by Willstätter and Mieg, in treating otin with pure oxygen.

The Role Played By Nitrites in Whitening Flour

An interesting observation of Monier-Williams on se exposed samples is that the smallest trace of rite could not be detected in any of these carotin nples by the Griess-Ilosvay test, even after the otin had been submitted to long exposure to the osphere, nor could any nitrogen be found by the ldahl method on a 0.2-g. sample using salicylic acid sodium thiosulphate. He remarks that "it is only sonable to assume that the natural aging of flour similar process." It is reasonable to assume that nier-Williams means that the whitening of flour ough aging is a phenomenon due to the oxidation of carotin.

He showed that carotin combines or reacts readily h NO_2, and also states that flour exposed to the air es up nitrite-reacting material or such nitrite- cting material is produced within the flour itself. uld not the inference be a fair one from Monier- liams' and Willstätter and Mieg's results, that in likelihood nitrite-reacting material plays little or no t in the whitening of flour on aging, but that oxygen ys the major rôle? Be that as it may, Wesener l Teller state with respect to the use of NO_2 that idently the artificial aging of flour is identical with natural aging which has been going on ever since ite flour was produced."

Action of Chlorine on Flour

So far as the action of gaseous chlorine on flour is cerned, it would seem that the broad principles of h action may be stated by saying that it acts on carotin and unsaturated glycerides, forming addi- n products. We know further, that water and orine react, this reaction being carried on until an ilibrium is established between the HCl and HClO med and the H_2O and Cl. Hypochlorous acid would, course, be readily reduced with the formation of drochloric acid. The equilibrium would then be re- ablished with subsequent reduction of the HClO and on, until the chlorine has been converted into hydro- oric acid. It is the hydrochloric acid which gives increased acidity to flour which is treated with orine, and this increase is capable of control by the ree of treatment.

Baking Quality Stabilized by Maturing

There are also other interesting changes which take ce in flour which has been subjected to this action. ong these is one which acts so as to maintain the lity of the treated flour at a constant point. This stitutes a marked differentiation from untreated r, the acidity of which keeps constantly increasing. smuch as the intensity of the acidity is probably the t important variable in determining the baking ue of any flour, it will be of interest to give an mple of results obtained from a fresh flour and the same flour subjected to treatment with chlorine. The sample in question was a spring wheat:

Flour	Time	Ash, Per Cent	Acidity	Volume, c.c.
Fresh	At once	0.40	0.112	2,060
Matured		0.40	0.151	2,340
Fresh	After 116 days	0.40	0.133	2,300
Matured		0.40	0.151	2,350
Fresh	After 259 days	0.40	0.135	2,390
Matured		0.40	0.151	2,350

From these results it can readily be seen that the fresh flour had nearly reached its optimum in baking capacity, whereas the matured flour remained constant. The greatest change in the baking value of the fresh flour developed after four months of storage, but the baking value continued slowly to increase up to the ninth month and had not yet begun to recede.

On the other hand, a sample of fresh flour in storage gave these results: The volume of the loaf was, when the flour was baked at once, equal to 2,050 c.c. After 117 days this volume had increased to 2,440 c.c.; after 308 days the volume had decreased to 2,250 c.c. The difference in the time it takes a natural flour to age to its optimum value is undoubtedly not only influenced by storage conditions, but by the different blends of wheat from which the flour is produced and by the method of tempering, as well as the manner of milling.

In this connection, it is interesting to note a reference to some, as yet unpublished, work of Bailey and Johnson, which is found in the concluding installment of Dr. Morison's article on "Why Bleached Flour?":[4] "Bailey and Johnson (1922) have studied the effect of chlorine bleaching upon the electrolytic resistance and hydrogen-ion concentration on water extracts of flour. They found that bleaching flour with chlorine increases the specific conductivity, hydrogen-ion concentration, and buffer action of flour extracts in direct ratio to the quantity of chlorine used. These differences apparently do not disappear on storing the flour for some months."

Enzyme Activity Arrested

This stabilizing of the baking quality of a matured flour, which baking quality depends so largely on the hydrogen-ion concentration, is undoubtedly due to the action of the chlorine on the enzymes normal to the wheat berry, whereby their activity is arrested. This raises the question as to what the increase in acidity of a stored flour is due. So far as we now know, the acidity of flour is due to phosphoric acid or its acid salts, and to amino acids; the former are doubtless of more importance from the standpoint of acidity. The source of the phosphoric acid or its acid salts is phytin, which undergoes hydrolytic cleavage through the activity of the enzyme phytase. Proteolytic enzymes would hydrolyze the proteins, with the formation of amino acids as a final cleavage product. Proteolytic enzymes do not all have the capacity to hydrolyze proteids to the extent that amino acids are formed. For example, pepsin causes a hydrolysis of proteids with formation of proteoses and peptones, which are only an intermediate step toward the amino acids.

The arresting of the activity of the enzymes in flour by the action of chlorine is not a serious matter. The enzymes that are present are there for the sole purpose of acting when the wheat berry is utilized to produce its kind. Then these enzymes become necessary to split the contents of the berry into suitable food, for

[4] *Baking Technology*, vol. 1, p. 135 (1922).

nourishment of the growing embryo, until the root system has been established and the young wheat plant can obtain proper food from the soil. In discussing some work of Baker and Hulton,[5] who had carried on experiments to determine the value of the enzymatic constituents of flour as they might effect bread making, Humphries has remarked that "these ferments were there to make the kernel of wheat available as food for the young plant," and that "nature in making wheat was more concerned with the reproduction of its kind than in feeding human beings."

Amount of Chlorine Varies With Nature of Flour

It is not possible to give any exact figures on the amount of gaseous chlorine necessary to add to any flour in order to produce that concentration of hydrogen ions so necessary to develop in the flour its highest baking value. It is somewhere in the neighborhood of 150 parts per million, but it may be more and it may be less. In a comparison of the different grades of flour it is necessary to contend with a greater buffer effect in the lower grades than in the higher, so that the lower grades on this account require a larger amount of chlorine to produce the necessary intensity of acidity. This buffering effect is due probably to phosphates, and possibly to the proteids too, as has been pointed out by Jessen-Hansen, Lüers and others. Recent work of Bailey and Peterson[6] lead them to the view that in the extracts from flours the phosphates may be the principal buffers. They say that "electrometric titration curves show the extracts of high-grade flours to be buffered less than the extracts of lower grades. It consequently requires less acid to bring the hydrogen-ion concentration of a high grade or patent flour dough to the optimum for bread production than is required for a low-grade flour. Possibly some of the difficulties experienced in making satisfactory bread from the lower grade or clear flours may be due to failure to obtain the optimum hydrogen-ion concentration of the dough." They also say: "In view of the decided differences in the buffer action of high-grade or patent, and low-grade or clear flours, it is possible that some of the difficulties experienced in producing satisfactory yeast-leavened bread from the lower grades may be due to failure to obtain the proper hydrogen-ion concentration of the dough. Further experimentation with these lower grades of wheat flour, containing more than 0.60 per cent of ash, should be conducted to ascertain the possibilities in this direction. Since conditions generally are unfavorable to the production of choice bread from clear flour, it is probable that a more careful adjustment, within narrower limits, is necessary than in case of doughs made from patent flour."

Importance of Controlling Hydrogen-Ion Concentration

Within the limits of this paper it is not practical to discuss the splendid experimental work which is being done on flours not only in this country but also abroad. The general trend of all these investigations is toward the utilization of physicochemical methods in studying flour *per se*, as well as gluten. Out of all this work has come some splendid results, and it is to be hoped that the time is not far distant when that most important scientific question of what constitutes the strength of flour will be solved. Whether the answer will be found revolving around the colloid properties of the various flour constituents remains to be seen. Already considerable is known about the effects of varying hydrogen-ion concentration and salts on the imbibition properties of gluten. This affects markedly the physical properties of the dough and the elasticity of the gluten. In order to get best baking results the gluten must have the proper elasticity and the dough the proper viscosity. The intensity of the acidity of the flour or dough is the most important variable in bread making. We know that when we control, in a proper fashion, the hydrogen-ion concentration through the treating of flour with chlorine, we are on substantial scientific grounds. In this fashion we are able to influence the viscosity of the dough until it becomes practically a minimum, at which point the gluten seems to have the proper degree of elasticity. As Bailey and Peterson have said:[7] "Through the proper hydrogen-ion concentration the elasticity of the gluten and the activity of the yeast and of 'rope producing' bacteria are affected in the right direction."

Henderson, Fenn and Cohn,[8] in their study of the "Influence of Electrolytes Upon the Viscosity of Dough," remark that " . . . it is evident that with variation in hydrogen-ion concentration, viscosity passes through a minimum a little on the acid side of *pH*5. Jessen-Hansen found *pH*5 to be the best hydrogen-ion concentration in bread making, and it is also as has been observed, the most favorable for the rising of dough." They also state that their studies indicate that so far as CO_2 production during fermentation is concerned, the best results are obtained near the point of minimum viscosity.

It is also probable that it is due to the favorable action of the hydrogen-ion concentration on the activity of the yeast enzymes that we find that the fermentation period of a dough is materially decreased as we approach that point where the intensity of acidity is most favorable for the optimum baking results.

Cohn and Henderson[9] have summed up quite concisely the value of acidity: "In the first place the desirable length of the fermentation is determined by the acidity of the dough. Increase in the acidity increases the activity of the yeast and shortens the fermentation. Consequently the amount of sugar required by the yeast is diminished (unpublished observations of the authors). Besides, the rate of carbon dioxide production of the yeast within the dough, the tenacity and elasticity of the dough and the escape of gas from the dough are dependent upon the acidity. Experience in this and other laboratories has shown that the best acidity for the baking of bread is indicated by the turning of methyl red from orange to red. In sum, the acidity of the dough at the time of baking seems to be the most important variable factor in bread making."

In this connection the following quotation from an article by Henderson[10] is of interest: "It is possible, however, to measure the hydrogen-ion concentrates of bread by the addition of the ordinary solution of methyl red (0.02 per cent in 60 per cent alcohol) to the pale cut surface of the loaf. Three or four drops of the indicator should be placed upon a single spot and two minutes should be allowed to pass. Then, if the color is a full red without an orange nuance, the hydrog-

[5] *J. Soc. Chem. Ind.*, vol. 27, p. 273 (1908).
[6] *J. Ind. Eng. Chem.*, vol. 13, p. 916 (1921).
[7] *J. Ind. Eng. Chem.*, vol. 13, p. 916 (1921).
[8] *J. Gen. Phys.*, vol. 1, p. 387 (1919).
[9] *Science*, vol. 48, p. 50 (1918).
[10] *Science*, vol. 48, p. 247 (1918).

on concentration is approximately 10^{-5}N, or more. If n orange tint develops, greater amounts of acid should e added to successive batches of dough until the test vith bread just gives the desired color. . . ."

So far as "rope" is concerned, it has been clearly stablished that the growth of the *bacillus mesentericus* vhich causes rope is practically inhibited at a *pH* of bout 5.

Summary

The chemical phases of the maturing of flour, in particular the action of chlorine, have been described. The nain conclusions to be drawn from the foregoing discussion may be summed up as follows:

Any treatment of flour, to condition it for its best aking results, which does not increase the intensity f its acidity does not condition the flour in the same nanner as such flour is conditioned in storage. As essen-Hansen[11] has so aptly put it: "Of the different rtificial means advocated in recent times as being apable of ameliorating flour, none are of value other nan those which increase the hydrogen-ion concentraion in the dough."

The proper control of the intensity of the acidity of our, such as may be accomplished through treatment vith chlorine, or any other means which accomplishes ne same results, affects favorably those factors which re so essential to the satisfactory baking efficiency of flour.

The optimum intensity of acidity for the best results s such that methyl red should just turn red without ny orange nuance when this indicator is applied to ne freshly cut surface of the oven product. This nange in the color of the indicator is produced when ne concentration of the hydrogen ions is about 10^{-5} ormal, or, in other words, the *pH* is about 5.

The intensity of acidity is that factor which, under roper control, favorably affects the dough viscosity, y reducing it toward its minimum and, at the same me, produces those changes which increase the elasticy of the gluten. It lessens the period of fermentation y increasing the activity of the yeast. It also acts avorably in the control of "rope."

Flour which has been submitted to the chlorine treatent is stabilized in the sense that its improved baking apacity remains constant for many months. This abilizing is brought about by arresting the actions of ose enzymes to which is due the increase in acidity f an untreated flour when stored.

The acidity of flour is its most important variable. ence the treating of flour with chlorine and the conequent production of the optimum intensity of acidity at once a great asset to the miller as it is to those ho use his output and that means each and every one f us. This means of controlling this important factor -acidity—is a great advance in the milling art. Now, ne flour buyer can obtain a stabilized flour at its nhanced baking capacity. Although not previously scussed, it may not be amiss to say that such chlorineeated flour is stabilized in yet another sense, and this of importance too. Such flour is much less readily ubject to the usual rancidity, mold and insect festation.

Part II, dealing with the method for treating flour ith chlorine on a commercial scale, will be published a subsequent issue of "Chemical and Metallurgical ngineering."

[11] *Compt. rendus. trav. lab. Carlsberg*, vol. 10, p. 179 (1911).

Some New Sources for Vegetable Oils

The development of tomato catsup and soup manufacture has resulted in a great production of tomato seed each year that has been going to waste. The oil from these seeds has been found after refining to be a suitable food oil. By pressing, the yield is about 18 per cent of the dry weight of seed, and if a solvent is used the yield is increased to 20 or 22 per cent. In Italy, where the tomato-pulping industry has been developed on a large scale, tomato-seed oil is a commercial product. It is estimated by the Department of Agriculture that the equivalent of 1,500 tons of dry seed is produced annually in the United States.

The sunflower is a possible source of oil, a large quantity of it having been made from sunflower-seed in Russia before the war. The cold-pressed oil is used for culinary and other purposes where a high-grade edible oil is required, while the hot-pressed is employed in making soaps and Russian varnishes. In 1911, more than 500 mills in the Caucasus were engaged in pressing sunflower seed. It is possible that the sunflower may some day be an important oil-producing plant in this country. The crop is now grown to quite an extent in some parts of the country, notably Missouri, for poultry feed.

Considerable quantities of okra seed could be produced every year by letting the plants ripen seed after the harvesting season is over. This seed contains about 18 per cent of an oil that much resembles cotton-seed oil; in fact, okra and cotton belong to the same, botanical family.

Cohune nut oil, which is obtained from the fruit of a variety of palm tree that grows in Central and South America, has been examined by the department. It resembles coconut oil and can replace it for many purposes. The supply of these nuts is almost unlimited and several firms are now attempting to establish the manufacture of the oil on a commercial basis.

Swiss Aluminum Industry

Before and during the war the policy of the Swiss aluminum industry was directed towards supplying German industries with aluminum, according to a recent number of *The Iron and Coal Trades Review*. The depreciation of the mark and the increase in German aluminum production during the war however, induced the German industries to abandon the Swiss metal. While, in 1913, 5,645 metric tons of aluminum and in 1920 even 3,542 tons were exported to Germany, the exports dropped in 1921 to 1,646 tons. This compelled the Swiss aluminum industry to look for new markets, which were found in 1921 in the United States and Japan. Thus in 1921, 3,421 tons of aluminum found their way to the United States, and 894 tons to Japan. Besides this, Switzerland's aluminum industry, which is concentrated in the hands of the Neuhausen concern (capital 42,000,000 fr.) has commenced paying more attention to the aluminum-working industries in Switzerland, and to participate financially in them. At the present time there are in Switzerland a number of mills which roll the metal into bars, plates, tubes and wire, and which exported during 1921, 1,193 tons. Half of this amount went to the United States and one-quarter to British India. Several factories of aluminum vessels and other goods exported close upon 5,000,000 fr. ($1,000,000) worth of goods in 1921.

Book Reviews

MECHANICAL TESTING by *R. G. Batson* and *J. H. Hyde*. Vol. 1: Testing of Materials of Construction. London: Chapman & Hall, Ltd. 413 pp. 1922.

The authors, members of the engineering staff of the National Physical Laboratory, have undertaken to write what can be considered a textbook on mechanical testing. Their excellent work fills a definite and longfelt want for such a book, particularly for one covering Anglo-Saxon technique.

In discussing the standard shape of "load-extension curve," p. 30, would it not be advisable to call attention to the fact that these curves from recording machines are always misleading in their appearance, since the "maximum load" is indicated for a cross-sectional area of the specimen which no longer exists when that load is reached. Irregularities in curves, when the metal passes from the elastic to the plastic state, can not be explained by inertia of the elastic system present in the apparatus; these irregularities are present in irons and plain carbon steels, but not at all in other metals. This link in the curve is still an unsolved problem; it seems that no means are as apt to solve this mystery as Dalby's optical load-extension recorder.

While theoretically the use of dead weights is the best method for calibration of testing machines, the "standardizing boxes" mentioned under paragraph 52 have been found to be quite accurate and constant, both in tension and compression, and they certainly are very much handier than dead weights or calibrating levers.

The title of Chapter XVIII, "hardness and abrasion tests," is confusing, since hardness (commonly interpreted as "resistance to permant deformation") and resistance to abrasion are properties of entirely different nature and should be treated separately. The confusion in the field of hardness testing is already so large that nothing should be done to increase it. Furthermore, the reviewer cannot agree with the authors' two categories of methods for testing hardness. Abrasion and scratch tests are of different nature. In the abrasion or "wear" test (which is not a hardness test) particles of the material are progressively torn away. In the scratch test of Turner, Martens or the "microcharacter" a groove is obtained by successive compression of the metal over adjoining micro-sections of the surface; it therefore is also an indention test. The definition of hardness as "resistance to permanent deformation" is in no way disturbed by measuring hardness by a scratch test. It must be kept in mind that no "indentation" test gives any information on the resistance to abrasion.

In this connection, I believe it incorrect to state (as the authors do in paragraph 188) that the abrasion test has been applied as a scratch test or as a drill test; abrasion resistance can be investigated only by abrasion. Drill tests are again of entirely different nature. We must differentiate between the micro-drill test of Jaggar which—like the diamond or sapphire scratch test—is a test for the comparative hardness of the individual crystals, and the drill test of Bauer, Keep, Kessner or Ludwik, who, by means of a large steel drill, investigated the resistance of metals to drilling in order to determine their "machineability." In the section on small machines for determining Brinell hardness of thin sheets (paragraph 182) the special machine developed for this purpose by Brinell and made by the Alpha Co. should be mentioned, as later machines are patterned after Brinell's. One might mention that the Brinell or other indentation hardness of thin sheets, as far as annealed stock is concerned, is of rather doubtful value; the Erichsen cupping test will be found more convenient, and it yields more direct information on how the material will "work." It is perhaps superfluous to remark that depth indicators (paragraph. 185) should never be used while the metal is exposed to pressure, "during the test," but only after the load has been released. The first instrument of this kind, of the mercury capillary type, was designed by Brinell and is still being made by the Alpha Co. All depth indicators give very confusing results and for this reason the measurement of the diameter of Brinell impressions is preferred by most of the American laboratories.

The "Auto Punch" described in great detail on pp. 286 and 287, recently imitated by several German apparatus manufacturers, does not give results comparable to Brinell numbers, as the resistance of metals to impact penetration is quite different from that to static ball pressure and this factor varies with the alloy. Besides this fundamental point which in itself excludes accurate results, the springs in these instruments cannot remain constant in usage. The "Waldo hardness tester," pp. 288 to 289, might be eliminated, as this instrument, for obvious reasons, is not in use anywhere.

Methods and apparatus for investigating the cutting efficiency of tool steels are not mentioned; these investigations are as difficult to carry out as they are important and it is to be hoped that the authors will discuss them in detail in a future edition of their book, particularly since splendid work in this direction has been carried on at Sheffield for a number of years.

These few points where the reviewer is inclined to disagree with the authors, should not be allowed to overshadow the thousands of accurate facts contained in the book.

In general, Batson and Hyde's book is very well written, clear and concise, and it gives much valuable information on the technique of mechanical testing. It should be on the desk of every metallurgist and engineer of materials. It will also serve admirably as a textbook in college courses on mechanical testing; in fact, the testing of the mechanical properties of metals should form and will ultimately form an important part of the curriculum in metallurgical engineering, as well as in mechanical engineering.

HERMAN A. HOLZ.

Steel Worker's Handbook

"HÜTTE," TASCHENBUCH FÜR EISENHÜTTENLEUTE. Published under the auspices of the *Akademischen Verein Hütte*, Berlin. Second Edition. *Prof. Hanemann*, Editor-in-Chief. June, 1922. Wilhelm Ernst and Son, Berlin, Germany. 963 pages, 511 illustrations 738 marks.

Hütte has been the constant companion of more than one generation of Continental engineers, and editions of various dates are to be found in the working libraries of many Americans. Covering in a comprehensive manner the entire field of engineering it could only be supplanted by a collection of handbooks covering civil, mechanical, electrical, metallurgical and mining engineering. In 1910 it was decided to collect together the material applying directly to the engineering of iron and steel works and foundry and supplement it by auxiliary material sufficient for a self contained separate volume. The present book is the second edition of this separate. It has been thoroughly revised by an imposing array of *Prof., Dr.-Ing. Geh. Reg.-Rat., Direktors*, etc., and over 100 new pages added.

It is principally concerned with the design and construction of iron and steel works and foundries. Little attention is paid to metallurgical practice—for instance, the details of a converter and its accessories occupy 18 pages while 3½ suffice for the "metallurgy and operation." No attempt is made to discuss the properties of the resulting product. But in the field of design and construction it is quite comprehensive, outlining an enormous amount of material on all branches of the industry from coke oven, through the power plant, blast furnace, steel making departments, to the rolling mills, not forgetting such specialties as sheet coating departments, hammer and press work, pipe making, wire drawing and the manufacture of wire products. An excessive amount of space—about 50 pages—is given to roll design and rolling mills are discussed at length and in great detail.

Therefore, while the book would undoubtedly be of great use to a engineer engaged in the design and construction of steel works, it is of only secondary interest to the operator or metallurgical engineer and practically of no use to the purchaser of fabricator, foundry, machine shop, or manufacturer of metallic articles. An attempt has been made to widen the scope of the book by including a pre

iminary section on Allied Sciences. This contains an outline of metallographic practice, and an especially good description of the binary alloy systems between iron and all the common elements. Another notable chapter is on the thermal characteristics (and methods for such determinations) of metals, slags and refractories. An outline of qualitative and quantitative analysis of steels and furnace and coke oven materials and products is also included.

From a book-lover's viewpoint, the present volume, when compared with the pre-war editions, is a vivid reminder of the economic plight which has descended upon Germany since their failure to grab world dominion. The old volumes are bound in delightfully rich, smooth and flexible leather, and printed on the finest coated paper. The present edition is on paper suspiciously like news print, and the binding is like that which we are given on the latest "best sellers."

E. E. THUM.

Recent Chemical & Metallurgical Patents

British Patents

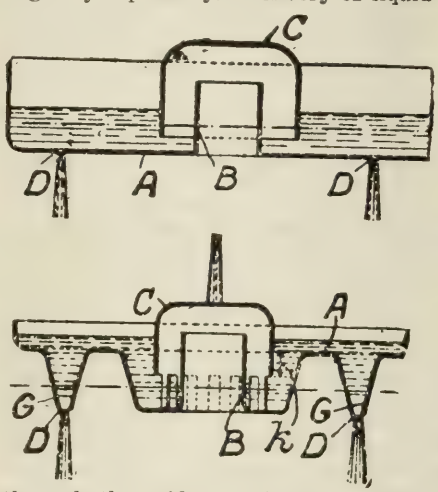
For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Activated Carbon — Active charcoal is made by impregnating lignite or peat or a coked product thereof with caustic alkali or alkali carbonate, heating to a high temperature and removing the alkali. The activity is increased by subjecting the material to a partial vacuum before impregnation. (Br. Pat. 178,779. W. Carpmael, London. June 21, 1922.)

Anthraquinone — Anthraquinone is prepared by condensing orthobenzoylbenzoic acid with sulphuric acid of 75 to 80 per cent strength. The process may be made continuous by continuous addition of molten ortho-benzoylbenzoic acid and by maintaining the strength of the sulphuric acid either by evaporation such as by blowing in air or by addition of oleum. The anthraquinone separates on cooling from the comparatively weak acid. (Br. Pat. 176,-335. F. W. Atack, Manchester. April 6, 1922.)

Oleomargarine Manufacture—In the manufacture of margarine and other edible fats especially from vegetable fats, an oleaginous material having "water-dispersing properties" is added to the usual ingredients, or to margarine after manufacture, so that an emulsion is formed having the aqueous liquid as the internal phase in a state of very fine subdivision. The water-dispersing medium may be prepared by heating soya-bean oil and passing air through it until coagulination sets in; oils, such as cotton-seed, ground-nut, or sesame oil, are then stirred in. The watery constituents of the emulsion may consist of water or milk and sugar, glucose, or other fermentable substances, which may contain vitamines and salts may be added. The fermentation of such substances is checked by the film of the water-dispersing medium surrounding the aqueous globules. The emulsion may be dissolved in a suitable fat or oil before adding to the margarine, etc. The water-dispersing medium may be added direct to the coconut oil or other fat from which the margarine etc., is to be made, or part of the medium may be so added and part added in the form of an emulsion. (Br. Pat. 178,885. E. V. Schou, Palsgaard, Denmark. June 21, 1922.)

Dephlegmating Column—A bubbling device for a rectifying or other column comprises a plate *A* having capped chimneys *B* for the passage of gases and one or more orifices *D* in the plate through which liquid descends to the next lower plate, the cross-section of the orifices being such that the liquid filling them adheres to their edges by capillarity. Delivery of liquid



through the orifices and the height of liquid on the plates vary according to the supply of ascending gas. A circular guide-wall may surround the cap *C*, and, in a further modification, the quantity of liquid required on a plate may be reduced by the formation of funnels *G* terminated at their lower ends by the orifices, the minimum height of the funnels being the distance *k* between the solid edge of the caps and the bottom *A* of the plate. (Br. Pat. 178,852. Not yet accepted. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude, Paris. June 21, 1922.)

Adhesives; Starch—An adhesive is made by treating potato starch paste with an alkaline or a neutral peroxide in presence of an alkali in a quantity insufficient for the production of soluble starch. Suitable per-salts such as persulphates, percarbonates and perborates or the peroxides of barium, calcium, magnesium, zinc or hydrogen may be used. Alkali carbonates or alkaline earth hydroxides may be added when neutral per-salts or peroxides are used. In an example, 100 kilos potato flour are mixed with 2½ kilos ammonium persulphate and 1 kilo ammonia solution of 22 deg. Bé. (Br. Pat. 179,765. A. G. Bloxam, 30 Southampton Bldgs., Holborn, London. July 5, 1922.)

Extracting Essential Oils — Essential oils and like volatile products are extracted from solid materials such as sandal wood, by means of a heated gaseous vehicle such as nitrogen or other inert gas or an unsaturated

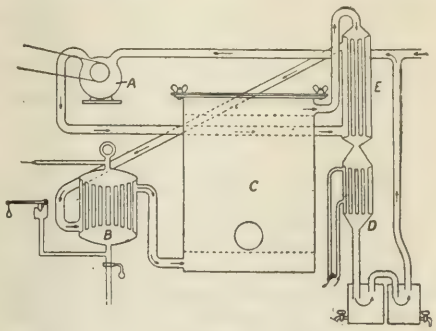


FIG. 1

vapor which is not condensed on cooling to separate the essential oil or by means of steam which is condensed in such a way as to generate a further quantity of steam for use in the extraction. In using an inert gas, the gas is circulated in a closed circuit through a heater *B*, Fig. 1, extraction-vessel *C*, heat-exchanger *E*, condenser *D*, pump *A*, and back through the heat-exchanger *E* and heater *B* to the vessel *C*. The heater may be formed as a jacket surrounding the vessel *C*, and containing a steam coil on an electric heater. Steam, when used, is passed through an extraction vessel *S*, Fig. 2, and to a condenser *E* which forms a vacuum evaporator, for example of the Kestner climbing-film type. The condensation of the steam and essential oil serve to generate steam at a lower pressure, which is compressed by a pump *C* and passed

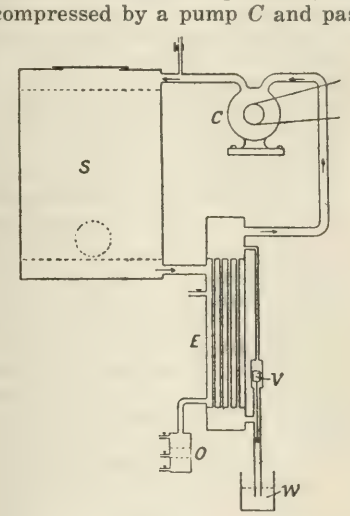


FIG. 2

into the extractor-vessel. The condensed water is separated from the essential oil in a vessel *O* and may be passed into the well *w* to be evaporated in the condenser. A float device *v* serves to maintain a definite level of water in the condenser. (Br. Pat. 176,104. F. L. Usher. Bangalore, India and E. P. Metcalfe, Hove, Sussex. April 26, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Shortridge Speech Came Too Late

Might Have Saved the Dye Embargo Had Results of Monopoly Probe Been Officially Announced in Advance of Senate Vote—Chances Now Are Against It

HAD SENATOR SHORTRIDGE of California acquainted the Senate with the fact that his investigation of the dye industry had disclosed no irregularity in the conduct of the domestic dye industry and with the fact that his painstaking probe had disclosed nothing approaching a monopoly in this industry, before the vote on the embargo was taken rather than afterward, it is believed several votes which were cast against the embargo would have been registered for it.

The Senate investigation of the conduct of the dye industry was completed several weeks ago. No formal report as to the conclusions of the sub-committee, which conducted the investigation, has been submitted. There also has been a long delay in making available printed copies of the testimony taken at these hearings. While it had been assumed very generally that Senator Shortridge would report that no proof of monopoly or other wrong-doing had been disclosed, his statement made after the roll-call on the dye embargo was the first authoritative announcement of that conclusion. For that reason friends of the embargo are hopeful that the complete vindication of the domestic industry, which was announced in such a belated manner, will influence some of the Senators who voted against the embargo in Committee of the Whole to vote for it in the Senate proper in view of this finding.

Vote Likely to Stand

On the other hand it is recognized that it is very difficult to induce Senators to change their position after a record vote has been taken. It is admitted very generally in well-informed legislative circles that the chances are against a favorable vote for the embargo when a vote is had on Senator Frelinghuysen's amendment, which proposes to re-insert the embargo provision in the bill. If the President should use his influence actively in behalf of the embargo it is admitted that the chances then would favor its adoption by the Senate.

How the Senators Voted

Senators voting for the embargo when the Committee of the Whole rejected the Finance Committee's amendment were: Ball, Delaware; Brandegee, Connecticut; Bursum, New Mexico; Calder, New York; Curtis, Kansas; du Pont, Delaware; Edge, New Jersey; Ernst, Kentucky; Fernald, Maine; France, Maryland; Frelinghuysen, New Jersey; Gooding, Idaho; Hale, Maine; Jones, Washington; Ladd, North Dakota; Lenroot, Wisconsin; Lodge, Massachusetts; McCumber, North Dakota; McKinley, Illinois; McLean, Connecticut; McNary, Oregon; New, Indiana; Oddie, Nevada; Pepper, Pennsylvania; Phipps, Colorado; Rawson, Iowa; Shortridge, California; Sterling, South Dakota; Townsend, Michigan; Warren, Wyoming; Watson, Indiana, and Willis, Ohio.

Senators voting against the embargo were: Ashurst, Arizona; Borah, Idaho; Capper, Kansas; Caraway, Arkansas; Culberson, Texas; Cummins, Iowa; Dial, South Carolina; Fletcher, Florida; Harreld, Oklahoma; Harris, Georgia; Harrison, Mississippi; Heflin, Alabama; Johnson, California; Kellogg, Minnesota; Kendrick, Wyoming; Keyes, New Hampshire; King, Utah; McCormick, Illinois; Moses, New Hampshire; Nelson, Minnesota; Nicholson, Colorado; Norbeck, South Dakota; Norris, Nebraska; Overman, North Carolina; Pomerene, Ohio; Ransdell, Louisiana; Robinson, Arkansas; Sheppard, Texas; Shields, Tennessee; Simmons, North Carolina; Smith, South Carolina; Smoot, Utah; Stanley, Kentucky; Swanson, Virginia; Trammell, Florida; Underwood, Alabama; Walsh, Massachusetts; Walsh, Montana.

Twenty-six Senators did not vote, Most of them were paired, but two additional votes at least would have been cast for the embargo had they been present.

Carnegie Tech to Teach Metallurgy to Naval Officers

Carnegie Institute of Technology at Pittsburgh has been selected by the United States Naval Academy at Annapolis to give advanced courses in metallurgy to its graduate officers. Beginning next September, the Naval Academy will send two ordnance officers, graduates of the Academy, for a year's study in advanced metallurgy. Their studies will be confined principally to advanced metallurgy but will include some studies in electricity and physical chemistry. Other groups of graduate officers are assigned each year to various colleges or universities to study along specialized lines.

F. F. McIntosh, associate professor in metallurgy at Carnegie Tech, will supervise the studies of the naval officers. Lieutenants Gilbert C. Hoover and John H. Keefe have been assigned to take the work the next college year.

Says Dye Embargo Is Working Well

Dickson Describes Work of Treasury Department in Controlling Imports

In recent testimony before the House Appropriations Committee, F. S. Dickson, in charge of the dye and chemical section of the Treasury Department referred to the work of the section in controlling dye imports.

The section bases reasonable prices on dyes upon the relation between the American cost of production and the American selling price, unless it can be shown that the cost of production abroad is comparable. It does not base a reasonable price upon the relation between the American and foreign prices. Mr. Dickson stated that for some articles of which there are small sales, moderately large profits are obtained.

Mr. Dickson said he had not found any profits in the dye manufacturing business in this country. About 10 per cent of the American consumption of dyes is imported. Because of the temporary tenure of the dye section it has been unable to determine whether the American industry is able to supply the domestic dye needs to the advantage of the manufacturer and consumer. He referred to the fact that the section is handicapped in having a laboratory.

Keeping Out Foreign Dyes

It was further testified by Mr. Dickson that the dye embargo so far has kept out foreign dyes. This year a total of 6,200 permits for importation of dyes have been issued for materials the domestic manufacturers could not supply. He had not observed a case of excessive charges, although suspicion had attached to one case and the price came down. He referred to the possibility of dyes being imported unlawfully through false billing which could be detected only by chemical analysis. Some imports have been checked at New York but have been found satisfactory. Ninety per cent of the imports are through New York, with a few through Boston and Philadelphia. The imports are largely from Germany and Switzerland, with a few from France and England.

Chemical and Engineering Societies Pledge Support to the Chemical Foundation

Federation's Committee on Procedure Asks Harding to Save Chemical Patents—Representatives of American Chemical Society Refused a Hearing at the White House

APPARENTLY the Department of Justice has lost some of the enthusiasm which characterized its initial activities against the Chemical Foundation. The administration is hearing from the country and at the White House inquirers are told that the Chemical Foundation case is a Department of Justice matter. Such an avalanche of protest has reached Washington that there is an entirely different attitude in evidence at the Department of Justice and at the office of the Alien Property Custodian, nevertheless there is no lessening of the determination to go ahead with the suits.

The announcements and statements made by officials of the Department of Justice and by the Alien Property Custodian's office indicate that the case against the Chemical Foundation is a legalistic structure in which more importance is attached to technicalities than to the fate of a great American industry. Apparently, the prosecuting officers launched into the case without full understanding of it, as is indicated by the inaccuracies in their written and verbal statements.

Federated Engineers Appeal to President to Save Patents

That the Chemical Foundation enjoys the confidence of substantial interests outside of the chemical industry is indicated by the action of the Federated American Engineering Societies in adopting the following resolution:

> Whereas the President of the United States has ordered the Alien Property Custodian to recover that part of the patents formerly owned by enemies sold to the Chemical Foundation and
>
> Whereas these patents have become the nucleus of our American synthetic organic chemical industry which must be encouraged for scientific research, public welfare and national defense
>
> Therefore be it resolved that the Federated American Engineering Societies, through its committee on procedure, expresses the hope that no action will be taken without hearing representatives of chemists, chemical manufacturers, the medical profession and others most directly concerned and implores that nothing be done which can in any way or to the slightest extent tend toward the ultimate return to former owners of patents or other property lawfully sequestered and sold to Americans.

In announcing this resolution, Dean Mortimer E. Cooley of the University of Michigan and president of the Federated Engineering Societies emphasized the fact "that the Federated American Engineering Societies speaks concerning national problems for thirty-odd national, state and local engineering societies. The federation, therefore, speaks on behalf of some 55,000 engineers."

The Federation's Committee on Procedure includes Dean Dexter S. Kimball of Cornell, J. Parke Channing of New York, William McClellan of Philadelphia, and William E. Rolfe of St. Louis. Its chairman is Calvert Townley, vice-president of the Westinghouse company.

Told That "Chemists Had Too Many Committees"

So that the President might have the advantage of the views of a group of prominent men interested in the promotion of chemistry as a science, the American Chemical Society on July 12 sought an interview with the President for a committee which had been named. The request was followed up by telephone without result, and later a member of the committee called at the White House to inquire about it. He was told by the President's secretary that the chemists had too many committees. He apparently is of the opinion that since an interview had been granted to the committee headed by Dr. Herty, this should be sufficient. The secretary's attention was called to the fact that the interest of the American Chemical Society is different from that of the manufacturing chemists.

This attitude was confirmed on the following day by the receipt of a perfunctory statement from the President's secretary to the effect that the President is too busy with the coal strike to arrange to receive the committee from the American Chemical Society. In view of the fact that he is receiving a great many other persons, the reply is not entirely satisfactory.

Intentions of Committee

Had the American Chemical Society committee been granted an interview it was the intention of its members to tell the President that, so far as they have been able to learn, the purposes of the Chemical Foundation are laudable and that it has been conducted without irregularities. A representative of the chemists' committee had listened to a two-hour explanation of the position of the Department of Justice without having elicited any information as to illegal conduct on the part of the Foundation. In view of those facts, President Harding was to be asked if he had any information which he could impart to them, in confidence if necessary, which would indicate that the society is wrong in placing its support behind the Chemical Foundation. The members of the committee had hoped to tell the President that, in the light of all the information they have been able to gather, they can see no reason for this blow dealt to research.

Personnel of Committee

The Chemical Society's committee is composed as follows: Edgar F. Smith, president American Chemical Society and former provost of the University of Pennsylvania; John E. Teeple, consulting chemist of New York City and treasurer of the American Chemical Society; Julius Stieglitz, of the University of Chicago and former president of the American Chemical Society; William Hoskins, consulting chemist of Chicago; E. R. Weidlein, director of the Mellon Institute of Industrial Research; Arthur D. Little, past president of the American Chemical Society and of the American Institute of Chemical Engineers, and a member of the corporation of the Massachusetts Institute of Technology; J. F. Norris, professor of organic chemistry at the Massachusetts Institute of Technology; R. H. McKee, professor of chemical engineering at Columbia University and past chairman of the New York section of the American Chemical Society; George D. Rosengarten, member of the national policy committee of the American Chemical Society, and H. E. Howe, editor of the *Journal of Industrial and Engineering Chemistry*.

Atmospheric Pollution Litigation Held in Abeyance

Although one of the cases was decided many years ago and the other was filed six years ago but not prosecuted, the U. S. Supreme Court continues to maintain on its docket two chemical cases of general interest. One of these is the State of Georgia vs. the Tennessee Copper Co., involving smelter fumes. This case was decided by the court more than a dozen years ago and the company was required to prevent the destruction of vegetation through further exhaust of fumes. The court retains the case on its docket from year to year, however, on the ground that it does not care to lose jurisdiction in the matter should any new developments arise in the situation.

The other case is that of the State of New York vs. the Bulls Ferry Chemical Co. of New Jersey, which was filed by the state in the court on March 11, 1916, but which has never been prosecuted. In this case the State of New York sought to restrain the operation of a factory of the chemical company at Edgewater, Bergen County, N. J., on the ground that the fumes, smoke, gases and other vapors emitted by the plant are offensive, obnoxious and destructive to New York, principally the residential district on Riverside Drive.

The constitutionality of the federal water power act in its application to state streams, brought by the State of New York just before the last term of court adjourned, will be carried over on the docket for the new term beginning in October.

New York University Offers Courses in Raw Materials

New York University announces two new evening courses in the geology of commerce and finance beginning this fall. The purpose of the courses is to acquaint the student with the fundamental facts underlying our mineral and raw materials situation. The character and source of supply, the methods and cost of preparing them for market and their relation to other lines of business will be discussed in a series of lectures. The subjects will include building stone, lime and cement, brick and tile, water supply, sulphur and pyrites, salt, borax, fertilizer fuel and power.

Ernest R. Lilley, the lecturer, is an experienced geologist and mining engineer and one of the best informed men in the country on the economic problems of the raw material industries.

The second term, beginning in the spring, will cover the more complex problems of the metal industries. The lecturer will divide his subject into four main divisions—the iron group, the non-ferrous metal group, the precious metals, and the process minerals. Because of the special problems involved in preparing these materials for the market, stress will be laid upon the nature and cost of smelting and refining.

Alpha Chi Sigma to Reorganize Alumni

At the seventh biennial conclave of Alpha Chi Sigma, the professional chemical fraternity, held recently in St. Louis, a plan was adopted for the organization of the alumni into professional groups. This reorganization had been looked forward to since the previous conclave of 1919, at which time the old scheme of alumni organization was discarded and the various alumni groups were asked to form, test out, and report at the next conclave their various plans for reorganization.

The plan accepted is a compromise on the various plans submitted and it is believed the first step has been taken toward the organization of professional groups to replace the previous alumni chapters.

The following officers were elected for the next two years: President, Dr. Stroud Jordan, Brooklyn, N. Y.; vice-president, Dr. Robert Burns, New York City; secretary-treasurer, A. L. Davis, Wood River, Ill.; National Alumnus, L. J. Trostel, Bureau of Chemistry, Washington, D. C.; editor of *Hexagon*, John R. Kuebler, Indianapolis, Ind.

Chemical Warfare and Muscle Shoals Appropriations

Construction work, at a cost of $262,000, for the Edgewood Arsenal of the Chemical Warfare Service and also for Camp Lewis, Washington, is authorized by the War Department appropriation bill passed by Congress and approved by the President.

The Chemical Warfare Service also receives $17,240 for administrative expenses and $600,000 for investigations.

For construction of Dam No. 2 at Muscle Shoals, Ala., $7,500,000 is appropriated, but it will not be available until October 1.

Preliminary Program for A. I. M. E. Meeting

Society Will Journey to Coast by Special Train, Picking Up Members En Route

A preliminary program of the 126th meeting of the American Institute of Mining and Metallurgical Engineers has been announced. The meeting is to be held in San Francisco, Sept. 25 to 29.

A party including President and Mrs. Dwight will be made up in the East. It will pass through the central western and northwestern states, and, it is hoped, will be joined by members from those states. The party will arrive in San Francisco on Sept. 24.

Monday, Sept. 25, will be devoted to technical sessions which will be held at the Engineers Club and there will be as many sessions as may be required to present the papers available. Owing to the lateness of announcing the meeting in San Francisco, several papers that should be presented at this meeting will not be prepared in printed form for distribution prior to the meeting.

The following day, a party limited to 50 men will leave for Hetch Hetchy, San Francisco Water Project, under direction of M. M. O'Shaughnessy, Chief Engineer. Those not taking this trip will visit a number of interesting points in the vicinity of San Francisco. These trips will occupy four days up to Sept. 30, when the party will take the train for Los Angeles. The program provides for a one-day stop in this city and in Kingman, where the mines and mills in the vicinity will be visited. The return trip allows for stops at the Grand Canyon, the Roosevelt Dam and the Apache Trail.

Among the papers to be presented are the following:

"Deposition of Copper Carbonate from Mine Water," by P. D. Wilson.

"Surface Tension and Adsorption Phenomena in Flotation," by A. F. Taggart and A. M. Gaudin.

"Conditions of Stable Equilibrium in Iron-Carbon Alloys," by H. A. Schwartz, H. R. Payne, A. F. Gorton and M. M. Austin.

"Neumann Bands as Evidence of Action of Explosives on Metal," by F. B. Foley and S. P. Howell.

"Effect of Nickel Chromium on Cast Iron," by Richard Moldenke.

"Shot Firing by Electricity," by N. S. Greensfelder.

"Automatic Electric Regulation of Ball-mill Feed," by B. H. Smith.

"Heating and Cooling Curves of Large Ingots," by F. E. Bash.

"Electrochemical Process for Treatment of Copper and Other Ores," by Henry S. Mackay.

"Industrial Relations in California Petroleum Industry," by Roy W. Kelley.

"From Drill to Service Station—The Story of Oil in California," by Roy W. Kelley.

"Mining Iron Ore in the Adirondacks," by John E. Hodge.

Societies Will Meet at Chemical Exposition

The next regular meeting of the recently organized Technical Photographic and Microscopical Society will be held in conjunction with the Eighth National Exposition of Chemical Industries during the week of September 11 to 16 at the Grand Central Palace New York, on Thursday, September 14. In addition to meeting, the organization has already made arrangements for the display and explanation of the work of individual members in technical photography and photomicrography with its application to the everyday problems of the chemical or chemical consuming plant. A booth at the exposition has been reserved for the purpose.

Other associations, announcement of whose meetings in conjunction with the Chemical Exposition has already been made, include the Salesmen's Association of the American Chemical Industry, the American Ceramic Society and the Technical Association of the Pulp and Paper Industry. Later announcements of the programs of these societies will be made.

Powdered Coal for St. Louis Power Plant

Recommended as a Means of Guarding Against the Emergencies of Future Coal Strikes

Decision to burn powdered coal in the new $6,000,000 power plant of the Union Electric Light & Power Co. of St. Louis has been announced by the company's engineers, McClellan & Junkersfeld, Inc.

Extensive tests and investigation of stoker equipment and pulverized fuel equipment proved that coal in powdered form was a most desirable fuel giving more economical results than any other type of combustion equipment and permitting the use of mine sweepings, low grade and non-marketable coals, which are often wasted.

The possibility of using such waste coals is of very great advantage, from the standpoint of economy. The burning of powdered coal is as simple as the burning of fuel oil, has many of the advantages of this fuel, and, in case of emergency due to miners' strikes or other unforeseen causes, fuel oil may be used in the same furnaces without change.

The new plant, of which 60,000 kw. will probably be in operation next year, will have an ultimate capacity of 240,000 kw., and is to supply the rapidly increasing industrial and lighting load in St. Louis, in addition to that now being supplied from the Keokuk dam and from an existing large steam plant

troleum Committee Conference mends Gasoline Specifications

The Interdepartmental Petroleum ndards Committee of the Governnt held an open conference in Washton, July 3. At that time the comtee was again urged to amend the vernment specifications for gasoline increasing the "end-point" of the tillation test. It was urged by some ers in attendance that the demulsiity test also be modified, or for ne products eliminated from the cifications. Numerous other changes detail were also proposed. The mmittee will take these matters unadvisement at an executive meetto be held in the very near future er which the results of their delibtions will be announced. As in the t, the specifications recommended by s committee will undoubtedly be the cial basis for government purchases. r that purpose they require approval the Federal Specifications Board this approval will doubtless be nted promptly, as the committee resents all of the interested departnts.

New Chemical Companies

Fewer companies for the manufacre and distribution of chemicals, dyes l drugs were organized during June n in any month since May, 1921, ording to the compilations of the w York *Journal of Commerce*. The toindicated investment of the nine new mpanies was $2,600,000, which comes with an aggregate of $3,671,000 the twenty companies organized ring May, 1922. The record for the sent year was made during January en an investment of $37,650,000 was licated.

The names and indicated investment the nine companies formed during month of June are as follows:

rier Chemical Co.	$150,000
hardt Medicine Co.	50,000
chris Corporation, The	750,000
ific Ammonia & Chemical Co.	300,000
ack(Dr.) Health Products Corporation	100,000
nsylvania Pharmacal Co.	100,000
wartz Drug Co.	100,000
ndard Flexible Compound Co.	1,000,000
(W. J.) & Sons Co., Inc.	50,000
otal	$2,600,000

r Reduction Co. to Manufacture in Birmingham

Announcement is made that the dquarters, office and plant of the Reduction Sales Co. will be reved from Atlanta, Ga., to Birmingn, and that a $250,000 plant will be cted in North Birmingham, where es and equipment for the oxyacetyle welding and cutting will be manutured.

The site for five of the buildings has eady been purchased and consists of ee and one-half acres at Twentyth Ave. and Twenty-fifth St., North mingham. The products of the con will consist of oxygen, acetylene, rogen, argon and other atmospheric ducts, welding and cutting apparatus and supplies, acetylene generators, and specially designed machines for welding and cutting.

L. B. Allen, field representative, will arrive in Birmingham within a few days to begin construction of temporary buildings.. The permanent plant is expected to be completed by January 1, although it is stated that the concern will be in operation in two or three months, as soon as the temporary buildings are ready. The plant will be in charge of H. G. Boyer, district sales manager.

Arsenic Tariff Causes Senate Flurry

Southern Senator Accuses Smelting Interests of Attempting to Profit Unduly at Expense of Boll-Weevil Sufferers

Although a duty of two cents per pound on white arsenic had been approved by the Senate over two weeks ago, the subject was reopened on July 21 when Senator Smith of South Carolina made the startling charges that this tax on insecticide users was made in order to increase the profits of the smelting interests, principally those of the Guggenheims.

"To date," said Senator Smith, "the Department of Agriculture has spent something like $12,000,000 to find some method of checking the boll weevil, the ravages of which insect to a great extent remain unchecked. Now we have some hope in the application of calcium arsenate and the Senate votes a tax that will add 50 cents per acre for every acre poisoned. There are 35,000,000 acres of cotton land in the South and if it were possible to poison all of these fields, this would mean an added cost of something like $17,000,000."

The Insecticide and Disinfectant Manufacturers Association of New York City brought the arsenic duty to the attention of Messrs. Underwood, Smith, Simmons and other Southern Senators. The association estimated that 16,000 tons of arsenic would be needed this year to supply the demand of cotton planters and orchard owners, and that the shortage would be 3,000 tons. The greatest annual production in this country on record is 11,500 tons. Japan is the principal source of the imported arsenic.

Smoot Defends Duty

Senator Smoot challenged the statements of the Carolina Senator, declaring that the greatest amount of arsenic, including that imported, ever disposed of in this country in one year was 20,000,000 pounds, and, therefore, in order to add a burden of between $17,000,000 and $18,000,000 to the poisoning cost, it would be necessary, he said, to use up 90,000,000 pounds of arsenic. The difficulting in reconciling these figures is due, of course, to the fact that Senator Smith's very enthusiastic estimates were based on calcium arsenate tonnage, while Senator Smoot had in mind white arsenic, As_2O_3.

Farmers Using Excess Picric Acid Stocks

That the farmers of the country have not been slow to avail themselves of the opportunity to obtain a good agricultural explosive at a low cost is shown by the fact that in the fiscal year ending June 30, 1922, 3,264,700 lb. of picric acid has been distributed by the Bureau of Public Roads, U. S. Department of Agriculture. Originally about 12,000,000 lb. of picric acid was available as a surplus of war stocks. A considerable amount has been used for road building purposes and there now remains about 5,500,000 lb., practically all of which is located at Wingate, New Mexico. A study of the distribution figures during the past year shows that Minnesota, Wisconsin and Michigan took by far the largest amounts, Minnesota alone taking 1,091,300 lb.

High freight rates and long shipping distances have operated adversely. The unfavorable financial situation in the South also is reflected in the distribution figures. Some twenty states have agree to carry on the distribution during the present fiscal year. The picric acid is being distributed in most cases through the Extension Services. The cost to the farmers is 7 cents per lb. for cartridging and loading plus the freight charges.

Engineering Societies Ask Opinion on Depreciation Regulation

In a letter to the Secretary of War, L. W. Wallace, the executive secretary of the Federated American Engineering Societies, asks what has happened to the appeal of the electrical industries against the depreciation regulation drafted for use in connection with the waterpower act.. Mr. Wallace's letter reads as follows:

"For many months, there has been pending before your Commission an appeal from the electrical industries against the depreciation regulation which it was proposed to enforce in the administration of the waterpower act.

"Many of the engineers who compose this organization are particularly anxious to see our waterpower resources utilized as extensively and as promptly as is possible, and some of them have requested that I secure an authoritative statement as to the status of the matter. There is a feeling that the uncertainty in regard to depreciation is tending to retard this development.

"May I inquire what are the prospects for action on the depreciation regulation? It would be very helpful to our members if we could have the advantage of any personal views on the subject which you may care to express."

Fertilizer Contracts Are Declared Binding

Drop in Price of Nitrate of Soda Involves Losses to Both Farmers and Fertilizer Companies

Contracts made by Georgia farmers with fertilizer companies in 1920 for subsequent deliveries of nitrate of soda are binding, according to the State Court of Appeals. A test case was being brought through the courts and will now be appealed to the Supreme Court of Georgia.

The controversy between farmers and fertilizer companies developed early in 1921. The farmers had placed orders the previous year for nitrate of soda to be delivered in January, February and March, 1921, at $84 per ton. At the time of delivery the market price had dropped to $50, and farmers throughout the Southern States refused to pay the difference. Consequently many suits to recover the difference claimed by the fertilizer dealers were filed. The farmers claim that their loss amounts to $3,000,000. In reply to this, Russell Porter, of Atlanta, president of the Southern Fertilizer Association, issued the following statement:

"The fact is, the contract involved in this suit is the one under which the fertilizer manufacturers of Georgia lost millions of dollars by reason of carrying out their obligations.

"This is only one of the many contracts for fertilizer materials on which the fertilizer manufacturers lost so much money."

Would Repudiate Government Interest in Reparation Dyes

Senator King, of Utah, has introduced a resolution expressing the sense of the Senate that the State Department should annul and cancel any authority on the part of any representative of the United States or other persons to deal with the Reparation Commission "respecting the purchase and importation of reparation dyes into the United States."

The resolution also suggests that the State Department advise the Reparation Commission that the United States Government has no concern with the purchase of reparation dyes for importation into the United States, and that "neither the Textile Alliance, Inc., nor Roland W. Boyden has any authority to negotiate with the Commission on behalf of the government of the United States concerning the purchase and importation of reparation dyes for sale in the United States."

The resolution is prefaced by nine "whereases," in which it is charged that the Textile Alliance has carried on propaganda to mislead Congress into the belief that the government has valuable interests and rights in and to the dyestuffs received from the Reparation Commission from Germany. The King resolution declares that the United States Government has no interest in the reparation dyestuffs, no rights with respect to the proceeds of the sale of such dyestuffs and no interest in the purchase of such dyes for sale in the American market. The resolution charges that the Textile Alliance has made profits of $2,000,000 in traffic in reparation dyes and repudiates the claims of the Alliance for exclusive agency for the purchase and importation of these dyes.

Plans Dye Tariff Amendments

Senator King has announced that he will offer a thousand amendments to the chemical schedule when that section of the revised tariff bill is taken up for final action. He indicated however, that he will debate only a part of these amendments.

Potash Bounty Proposal May Be Extended

The decision of the Senate Finance Committee to put a bounty on potash to replace the proposed duty has caused much discussion of the advisability of extending the plan to other commodities. Some are of the opinion that it could be applied successfully to manganese and other commodities where there is no early opportunity of developing domestically more than a fraction of the country's requirements.

While the sugar bounty, put into effect by Congress in 1890, was unpopular, it was not discontinued for that reason but because sugar is an ideal source of customs revenue, since the tax is distributed to every resident of the country.

In the case of potash, a duty means that the tax will be paid largely by the farmers. A bounty will cost less and will allow that lesser burden to be divided equally among all taxpayers. In the case of manganese, the situation is somewhat different. The tax at the Custom House would fall largely on the steelmakers. In their industry, however, it is comparatively easy to pass the tax on. This means it will be collected ultimately from the construction industries. The tariff makers are particularly anxious to encourage these industries and are trying to avoid adding to their burdens any more than is necessary. This is one of the reasons for the very determined opposition to high rates on ferroalloys. A bounty would distribute the tax better, it is admitted, but the Finance Committee hesitates at launching too heavily into a bounty policy.

Opposition to Potash Duty

Representative Goldsborough, of Maryland, opposing the proposed duty on potash, declared it to be "worse in principle than the ship subsidy. It proposes to subsidize the producers of potash and to make the American farmer pay the tribute to the tune of about $51,350,000 a year."

Mr. Goldsborough gave an extended statement of the American Farm Bureau Federation in opposition to the potash duty.

Civil Service Opening

Competitive examinations are announced by the U. S. Civil Service Commission for Junior Chemist at a salary of $1,200 to $1,800 per year.

Application for this position should be made on form 1312.

Personal

F. L. Childs will continue as sales manager of the Heyden Chemical Co. New York City, following the recent reorganization of the company.

S. F. Cox, formerly assistant to the consulting engineer of the Pittsburgh Plate Glass Co., has accepted a position with the Calorizing Co. of Pittsburgh, Pa., as chief engineer. He will have direct charge of the Wilkinsburg Pa., plant, in addition to other duties.

Philip DeWolf, who has been doing consulting chemical engineering at Westport, Conn., has become associated with the industrial real estate concern, Louis Schlesinger, Inc., of New York City and Newark, N. J. Mr. DeWolf will specialize in industrial and factory real estate.

Thomas French, formerly of Welland, Ontario, Canada, has undertaken the construction of a plant at Albany N. Y., for some metallurgical products. His address at the present times is 363 Edgecombe Ave., New York City.

General Amos A. Fries, head of the Chemical Warfare Service, recently underwent an operation for appendicitis. He is recovering rapidly and expects to be at his desk again before the end of the month.

Dr. George F. Richmond of Antoine Chiris Co., Delawanna, N. J., has been appointed chairman of the nominating committee of the New York Section of the American Chemical Society. Other members are Dr. J. E. Zanetti and S. D. Kirkpatrick.

Julian F. Smith, formerly a member of the research staff of the National Aniline and Chemical Co., Buffalo N. Y., has accepted a position with the Commercial Solvents Corp., Terre Haute, Ind., to become effective Sept. Mr. Smith will have charge of the research and information service.

Ernest T. Trigg, an official of John Lucas & Co., Inc., Philadelphia, Pa., manufacturer of paints and varnishes and president of the National Paint Oil and Varnish Association, gave an address before the first Pacific Coast regional convention of the latter organization, Portland, Oregon, on July 1.

George S. Weith has obtained an indefinite leave of absence from the Redmanol Chemical Products Co. to recuperate from sickness.

Dr. Gerald L. Wendt resigned on July 1 as associate professor of chemistry at the University of Chicago to join the staff of the Standard Oil Company of Indiana in the direction of research.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Car Loading as an Index of Distribution

Production and Consumption of Commodities Are Normally Reflected in the Week-to-Week Changes in the Loadings of Revenue Freight

IN NORMAL TIMES the trend of business movements may be conveniently and accurately followed by observing the changes in the number of freight cars loaded during a certain period. Especially when this figure is studied in connection with statistics of production, is it possible to interpret it in terms of distribution and stocks. In other words when the volume of manufacture exceeds car loadings, stocks are usually piling up. On the other hand an excess of loadings means that distribution is going ahead of production, generally at the expense of lower commodity stocks.

Car loadings also have a qualitative significance in showing the kind of commodities that are entering into consumption. Thus it will be recalled that just before the coal strike started on April 1 there was unusual activity at the mines. March showed abnormally higher coal loadings which favorably affected the total for revenue freight. In April shipments of coal dropped off tremendously and there was a noticeable decline in car loadings during that month. Since that time and in spite of the coal strike there was an increase during both May and June—a very encouraging development as affecting the general commodity situation.

On July 21 the American Railway Association issued its report for the week ended July 8, which was the first since the beginning of the shopmen's strike. The total showed a reduction of 158,577 cars as compared with the last week of June, but 77,784 more than for the corresponding week in 1921. It was less than that in the first week of July, 1920, by almost exactly the same number. It should be pointed out, of course, that some reduction might ordinarily be expected because of the intervention of the holiday on July 4.

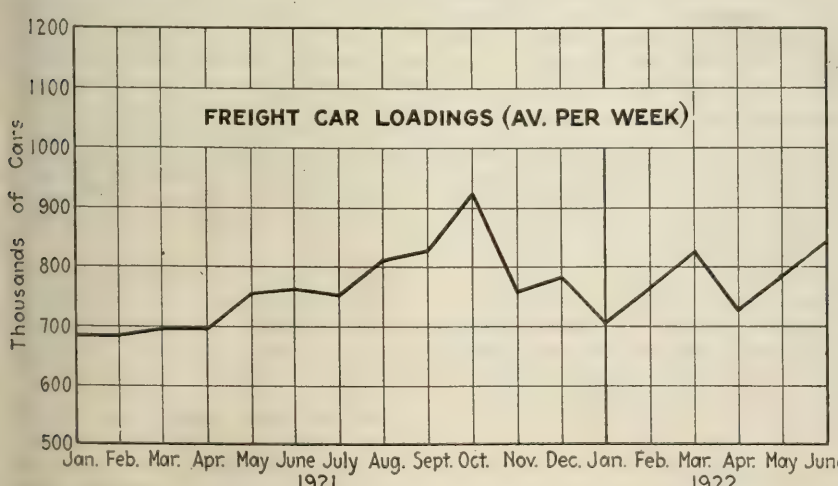
Coal loadings showed a decrease of 68,996 cars, a decrease from the preceding week of 25,752 and a decrease of 54,974 as compared with the same week of last year.

Merchandise and miscellaneous freight, which also includes manufactured products, totaled 482,079 cars, a decrease of 93,067 cars as compared with the previous week and an increase of 89,286 cars over the same week of 1921.

Loadings of revenue freight since the first of the year are compared with the corresponding periods of 1919, 1920 and 1921 in Table I.

TABLE I. CAR LOADINGS OF REVENUE FREIGHT, BY WEEKS SINCE JANUARY 1, 1922

	1922	1921	1920	1919
July 8	718,319	640,535	796,191	809,847
July 1	876,896	776,079	891,621	743,226
June 24	877,856	775,447	911,503	845,684
June 17	860,722	775,278	916,686	807,907
June 10	846,002	787,283	930,976	807,205
June 3	750,645	693,903	828,907	776,610
May 27	821,121	795,335	898,169	763,761
May 20	792,459	770,991	862,074	777,330
May 13	777,359	751,186	843,155	139,945
May 6	755,749	721,722	843,184	753,025
April 20	758,286	721,684	800,960	751,997
April 22	714,988	704,632	717,777	715,027
April 15	706,713	702,116	601,695	705,996
April 8	714,268	694,881	801,559	710,720
April 1	827,001	663,171	858,827	688,567
March 25	846,035	686,567	895,386	713,275
March 18	823,369	691,396	855,060	699,720
March 11	829,128	700,440	819,329	701,266
March 4	803,255	711,367	811,166	675,270
Feb. 25	735,286	659,242	183,295	666,708
Feb. 18	780,924	692,007	772,102	700,913
Feb. 11	788,412	687,867	786,633	687,128
Feb. 4	753,886	699,718	762,680	692,614
Jan. 28	743,728	701,605	893,332	718,297
Jan. 21	738,275	708,658	804,866	734,293
Jan. 14	720,877	715,855	840,524	758,669
Jan. 7	605,992	697,611	830,073	723,801



WEEKLY CAR LOADINGS OF REVENUE FREIGHT BASED ON REPORTS FROM THE RAILROADS OF THE U. S. BY THE CAR SERVICE DIVISION OF THE AMERICAN RAILWAYS ASSOCIATION

The Arsenic Situation

During the last few weeks there has been an acute shortage of both white arsenic and calcium arsenate. Usually the arsenic season extends from November to March but this year there has been an abnormal demand from the insecticide consuming districts, particularly in the cotton growing regions. The use of calcium arsenate in combating the boll weevil was largely brought about through governmental research and it is perhaps natural that the cotton growers have been appealing to the federal and state governments for help in meeting the situation caused by the shortage of these materials. The Georgia State Department of Agriculture is reported to have created a revolving fund with which to buy calcium arsenate and distribute it at cost to farmers in that state. A contract secured early in the year at 9c. per lb. has been disposed of and the supply is said to be running short. Farmers in many of the other states are reported to be facing as serious a situation and this scarcity is already evident in the arsenic market.

While the abnormal demand from the insecticide trade is doubtless the principal cause for the arsenic shortage, there are a number of contribut-

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	153.58
Last week	154.65
July, 1921	148
July, 1920	274
April, 1918 (high)	286
April, 1921 (low)	140

For the third consecutive week this index number has declined. This is probably attributable to the seasonal inactivity of the chemical market rather than to any broad market movement. Lower prices for caustic soda and linseed and cottonseed oils were responsible for this week's decline.

ing factors. The reduced output of copper (and consequently of domestic byproduct arsenic), and the decrease in imports from Mexico and Japan are most important. Neither Germany nor England have been a factor in the arsenic market for at least 6 years.

Production and Consumption

The maximum annual consumption of white arsenic in the United States was in 1920 when it was estimated that approximately 15,000 tons were used. In 1921 this dropped to not more than 9,000 tons. It is difficult to estimate the amount of white arsenic consumed in the United States because of its wide variance—from 3,400 tons in 1904 to 15,000 in 1921. The following figures, estimated by a leading factor in the industry, are believed to be as accurate as are available:

	Tons
By the glass manufacturers	2,500 to 3,000
Sheep and cattle dips, approximately	1,500
For dyes, pharmaceutical and other purposes, approximately	500
In the manufacture of lead and calcium arsenates, insecticides, and weed killers, approximately	5,000 to 9,000

Prior to 1914 by far the larger share of arsenic used in this country was imported. From 1901 to 1910 the United States produced only an average of about 975 tons, while imports averaged 4,235 tons. Production from 1911-1920 is given by the Geological Survey as follows:

Year	Quantity (Short Tons)	Value
1911	3,132	$73,408
1912	3,141	190,757
1913	2,513	159,236
1914	4,670	313,147
1915	5,498	302,116
1916	5,986	555,187
1917	6,151	1,118,313
1918	6,323	1,213,000
1919	6,029	.....
1920	11,500	.....

Conflicting Views on Labor Troubles

Economists, as well as doctors, often differ in their diagnostics. Industrial ills are now a fitting subject of study and they are being approached from many different angles. Two outstanding groups of economic students have recently offered views on the labor situation, which at first glance might seem to be at considerable variance. Underlying both, however, is the firm belief that present labor difficulties are but a temporary deterrent to continued industrial progress.

In the following paragraph quoted from a recent letter of the Harvard Economic Service, a striking parallel is shown by a comparison of industrial conditions in the fall of 1919, with those of the present.

> Labor trouble is the darkest cloud upon the present business horizon. Seldom has the country ever faced as many serious strikes as at the present time. The situation in this respect bears a strong resemblance to the fall of 1919. Numerous strikes at that time—those in the steel and soft coal industries being the most important—restricted output at a time when it otherwise would have expanded rapidly. * * * It will not be surprising if this episode is repeated in 1922. As yet, however, current output has manifested little retardation. Unless the existing labor difficulties are of unusual duration or spread to other industries, like interstate transportation, no general loss of industrial pace is to be expected.

Roger Babson, on the other hand, points out in one of his recent barometer letters that there is an evident tendency at the present time to overestimate the significance of labor difficulties. "The labor situation is by no means as bad as it seems," he declares. "The coal and railroad strikes make spectacular news and, of course, are important. Taken as a whole however, the labor situation is very much improved. At present we have a few large strikes, whereas during the last few years we have had a number of small strikes."

Mr. Babson then refers to a chart "which shows that in actual number there are fewer strikes in progress than during 1917, 1918, 1919 or the greater part of 1920. Considering that spring and summer are the 'strike seasons' the current year's record is the most favorable since 1915."

The New York Market

New York, July 24, 1922.

Trading in the chemical market during the past week has been unusually quiet, due presumably to adverse conditions existing in several leading industries. Difficulties on the railroads, tariff reversals and labor troubles have added to the severe strain on the chemical industry. The chief demand at present is for small lots, with larger quantities commanding little attention. The export situation for alkalis has not shown any unusual strength and trading has been along very limited lines. The market in several commodities has uncovered some strong features, with white powdered arsenic and sulphate of ammonia showing most improvement. Manufacturers of lime acetate announced another increase effective July 22. It is expected that both acetone and acetic acid will be advanced proportionately.

General and Special Chemicals

Acetate of Lime—Factors have again advanced prices on this commodity, due to the increasing demand and the curtailed production. The new prices are around $2.35 per 100 lb. for carload quantities.

Ammonium Sulphate—Spot supplies are exceedingly scarce with sellers offering only small lots. A good export inquiry has reached this market and prices ranged from $3.55@$3.60 per 100 lb., f.a.s. in double bags.

Arsenic — The prime white material is much firmer on spot and leading dealers were not anxious to book business at under 8c. per lb. Demand from the insecticide trade continues unabated. Foreign shipments have been delayed as much as three months, causing a pronounced shortage in the spot market. Prices ranged from 8@8¼c. per lb.

Barium Chloride — Spot goods were rather easy during the interval and sellers named prices around $90@$95 per ton. Shipments from abroad were held at $85 per ton, c.i.f. New York.

Bichromate of Potash — Round lots were sold down to 9½c. per lb. Smaller transactions were heard up to 10c. per lb. Buying has been very quiet in this product during the past week.

Caustic Soda — Export business has been somewhat slow, with a few sales noted at $3.55 per 100 lb. The general range is from $3.55@$3.60 per 100 lb., f.a.s. Domestic material is moving moderately at $3.75 per 100 lb. ex store.

Hyposulphite of Soda—Domestic factors report sales for regular crystals at 3c. per lb. Pea crystals are quoted at $3.50@$4 per 100 lb. The demand is fair.

Nitrite of Soda — There has been very little improvement in demand during the past few weeks in this product. Resale lots are being quoted at 8@8½c. per lb. Producers' figures are unchanged at 9c. per lb., f.o.b. works.

Prussiate of Potash — The yellow variety was fractionally lower at 31½c. per lb. for limited quantities. Shipments from abroad are held around 30½c. per lb. The red material is unchanged at 90c. per lb.

Soda Ash—Leading sellers have not changed their prices and quote $1.75 per 100 lb. for single bags, in carload lots, and $1.90 in barrels. Producers report a firm market for contract requirements.

Coal-Tar Products

There have been no unusual features in this market during the past week. Business has been moderate with the general demand for small lots. Lower prices were reported for dinitrochlorbenzene and alpha naphthylamine. Crude products have continued to show strength with no special price changes reported.

Alpha Naphthylamine — Inquiries have been heard from various consuming quarters and the market is in a very promising condition. Small lots are moving at 28@30c. per lb.

Aniline Oil—Producers report a fair demand, with quotations heard around 14c. per lb. The market has shown a steady tone of late and any buying improvement will advance present levels.

Benzaldehyde—The demand is somewhat active and producers are satisfied with the amount of passing business. First hands report the U.S.P. grade at $1.25 per lb. and technical at 60@70c. per lb.

Beta Naphthol — Producers are not inclined to shade their prices and quote 24c. per lb. as the low figure. The movement, in general, is rather quiet, with competition keen for any new business. Some small lot sales through second hands were transacted at prices as low as 22c. per lb.

The St. Louis Market

ST. LOUIS, MO., July 20, 1922.

There have been no important developments during the past two weeks in this market and the actual business transacted has been on a par with the corresponding period of last month. The usual summer lull has not gained its full sway as in past years. Price changes have been very few and the general tone of the market is firm. Imports have not been so numerous, with the result that there has been a very heavy demand for certain domestic commodities. One of the groups which is very prominent at this time is the insecticides, and also the chemicals used in their manufacture.

GENERAL AND SPECIAL CHEMICALS

The alkali market has recently been thrilled with the oft repeated post war cry, "Open prices openly arrived at." Two of the largest manufacturers having adopted the novel scheme of displaying their complete price schedules. These prices for St. Louis are as follows: *Soda ash* in bags, \$2.19 per 100 lb.; in bbls., \$2.43 per 100 lb. for 58 per cent light. *Caustic soda*, solid, \$3.90, flake \$4.39, basis 76 per cent. *Bicarbonate of soda*, bbls., \$2.35; kegs, \$2.60 per 100 lb. These prices are for truck load quantities f.o.b. buyers' door. Smaller quantities sell at a reasonable advance. We believe that these prices will be generally adhered to. *Sal soda* is rather quiet with prices steady.

The whole situation on heavy mineral acids is very good today with several advances in *sulphuric*, also in *hydrochloric*. The *citric-acid* situation has eased and spot stocks are more easily obtainable. *Oxalic acid* continues to stiffen, with makers quoting from 2½@16c. per pound, occasional buyers having difficulty in locating spot stock. *Tartaric acid* while doing very well a month ago has slowed up a trifle. There is still a scarcity of *white arsenic* with the demand good and the market strong, prices being quoted at 8c. f.o.b. New York. *Carbon bisulphide* continues to be in heavy demand from the agricultural centers. Due to the present condition of the steel mills there is again a scarcity of *copperas*, and quotations are firm. *Glycerine* has taken another sharp advance and is firm at 15½c. in drums with producers completely in command. As a matter of fact they are somewhat reluctant about new business and are apparently sold to capacity for some time to come. While there is a regular but limited demand for *potassium cyanide*, the smallness of stocks is not noticeable. *Photographic chemicals* are showing a steady improvement, and a nice volume of business is being done. *Sulphur* is still going at about the same pace with no noticeable change in price or volume of movement. *Zinc dust* has been very quiet, but in sympathy with spelter has recently advanced from ½ to ¾c per pound. Stocks of *zinc spelter* have been reduced over 50 per cent during the last thirty days, and actual supplies available at this time are less than thirty days. The market is very strong and is around \$5.80 per 100 lb. *Zinc sulphate* continues to be very strong and has sharply advanced, now being quoted \$2.75@2.85 per 100 lb. carload lots f.o.b. St. Louis.

VEGETABLE OILS AND NAVAL STORES

Turpentine went as low as \$1.21 in single barrels, but is now on another rebound and commands \$1.32 per gallon. *Linseed oil* is very quiet and price remains about as previously reported. Considerable spot business is now being done, but it is all a "hand to mouth" transaction. *Castor oil* is again stepping up, another one-half cent having been added to the old price of 12¾c. A good volume of business is being done on this item and further advances may come along at any time.

PAINT MATERIALS

This is the dull season between the spring and fall rush and aside from general routine purchasing, very little is going on. Several of the prominent paint grinders are taking advantage of low freight rates on Mississippi barge lines from New Orleans and are having carloads of *ochre* shipped direct from France via New Orleans.

The Iron and Steel Market

PITTSBURGH, July 21, 1922.

The dominant factors in the iron and steel situation are transportation conditions and the coal strike. Following the congestion that began about the middle of June on the railroads serving non-union coal districts in West Virginia and Kentucky came the strike of railroad shopmen July 1, and transportation conditions in many sections are now decidedly poor. Supplies of non-union coal to steel mills and by-product coke plants, particularly in Ohio, Western Pennsylvania and the Buffalo district, are greatly curtailed, while the movement of finished steel products is beginning to grow difficult. Even the movement of scrap is affected in some cases.

This week's developments at Washington in the coal matter make it the present outlook that the national organization of coal miners will be shorn of much of its power but that there will be a long and difficult struggle, during which coal will be scarce and high priced.

DECLINE IN STEEL PRODUCTION

The steel market is a matter of tonnage and price. As to tonnage, production has already decreased slightly, not enough to make much difference at the moment, but enough to show that the rate of production is decreasing, after having increased almost constantly for six months. The sharp increases were in the first three months of the year, with more moderate increases in April and May, followed by a merely perceptible increase in June, the rate in June being about 80 per cent over the rate in December. Since then the rate has decreased slightly, but possibly by as much as 5 per cent. With the present trends, there will be a greater decrease in the next fortnight.

The price of steel is another matter. It requires coal and transportation facilities to consume steel as well as to produce steel, a fact that is occasionally overlooked. Thus far there has been no definite sign that steel consumption is materially reduced, but there are distinct possibilities that it may be.

While the actual rate of steel consumption cannot be scrutinized closely, the attitude of steel buyers can be observed. This attitude has undergone some change. There is somewhat more eagerness to buy prompt lots, not in large quantities but in moderate sized lots, and there is willingness to pay extra prices. Some steel products, such as butt weld pipe, are being bought in carload lots from warehouse at regular warehouse prices, representing a differential over prices for mill deliveries that would be a stupendous advance if written into the mill price. On the other hand, buyers are showing a strong disinclination to commit themselves on purchases for delivery in the late months of the year. The turnover in far-forward deliveries is very light. Very probably the mills would not care to sell freely for such deliveries but the market shows that they do not have the opportunity now, as they did have a few weeks ago.

STEEL AND IRON PRICES

Basis prices are practically unchanged and there is little if any disposition on the part of mills to advance them, evidently by reason of fear that advances would merely invite a reaction later on. Prompt deliveries are higher in some cases, particularly in bars, shapes and plates, which have been going at prices as high as 1.80c. or 1.90c., the basis price, for late delivery, remaining at 1.60c. Sheets are moving less at premium prices than formerly, and some mills formerly demanding a premium for shipment from stock are now offering stock sheets at basis prices, 2.40c. for blue annealed, 3.15c. for black and 4.15c. for galvanized.

The \$2.50 price on nails instituted by independents about the middle of April has practically disappeared, the regular market being \$2.40; the price the American Steel & Wire Co. has adhered to. Demand is better than usual at this time of year. Wire fence has been stimulated somewhat by the recent reduction of 2½ points.

Pig iron continues dull as to actual turnover. Consumers are not disposed to take hold, despite the prospect that production will decline considerably in the next few weeks on account of coke shortage. The local market is quotable at \$25 for Bessemer and \$24 for basic and foundry, both basic and foundry being a shade lower than the average market price ruling in May and June. At present, coke prices are far below cost of production.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0.11 – $0.11½	.11¾ – .13
Acid, acetic, 28 per cent	100 lbs.	2.35 – 2.50	2.55 – 3.00
Acetic, 56 per cent	100 lbs.	5.00 – 5.25	5.30 – 5.50
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		9.75 – 10.00	10.25 – 10.50
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	..... –	.44½ – .45
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11¾ – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06½	.06¾ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.14½ – .14¾	.15 – .15½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 – 10.00	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent(oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent(oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.28½ – .29
Tartaric acid, imported, powdered	lb.	..... –	.29 – .30
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.28 – .31
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.28 – .31
Alum, ammonia, lump	lb.	.03¼ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03¾ – .04
Alum, chrome lump	lb.	.05 – .05½	.05¾ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08 – .08¼	.08½ – .09
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	..... –	2.00 – 2.25
Arsenic, white, powdered	lb.	.08 – .08¼	.08½ – .08¾
Arsenic, red, powdered	lb.	.12 – .12¼	.12½ – .13
Barium carbonate	ton	61.00 – 63.00	64.00 – 68.00
Barium chloride	ton	90.00 – 93.00	94.00 – 105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2.50
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2.40	2.45 – 2.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.80 – .83
Carbon bisulphide	lb.	.06½ – .06¾	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – ....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6.60	6.65 – 7.00
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.07¼ – .07½	.07¾ – .08
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth—imported powdered—net	ton	30.00 – 32.00	..... – .....
Fusel oil, ref.	gal.	..... –	2.25 – 2.65
Fusel oil, crude	gal.	..... –	1.45 – 1.50
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.15½ – .15¾
Iodine, resublimed	lb.	..... –	4.20 – 4.25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate	lb.	..... –	.09½ – .11½
Lead arsenate, powd	lb.	.13 – .13½	.13¾ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08 – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07¾
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.10 – .10½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.09½ – .09¾	.10 – .10¼
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05½	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb.	..... –	.50 – .52
Potassium hydroxide (caustic p tash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06¼ – .06½	.07 – .08
Potassium permanganate	lb.	.14 – .14¼	.14½ – .15
Potassium prussiate, red	lb.	..... –	.90 – .95
Potassium prussiate, yellow	lb.	.31½ – .32	.32½ – .32½
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .07	.07¼ – .08
Salammoniac, gray, granular	lb.	.07½ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	20.00 – 25.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06½ – .06¾	.07 – .07½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.06½ – .07	.07¼ – .07½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05½
Sodium chlorate	lb.	.06¼ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 – 13.00	..... – .....
Sodium cyanide	lb.	.21 – .22	.22½ – .25
Sodium fluoride	lb.	.09½ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.55 – 3.60	3.75 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03½	.03¾ – .04
Sodium nitrite	lb.	.08 – .08½	.08¾ – .09
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.20½ – .21	.21¼ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04¼ – .04½	.04¾ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09¾ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 – 20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 – 40.00	..... – .....
Talc—domestic powdered	ton	18.00 – 25.00	..... – .....
Tin bichloride	lb.	.09 – .09¼	.09¼ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.06 – .06½	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07¼ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.50 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Dipnenylamine	lb.	.59 — .65
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.95 — 1.00
Monochlorbenzene	lb.	.09 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06¼ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

itro-toluene	lb.	.15 —	.17
-W acid	lb.	1.15 —	1.30
ho-amidophenol	lb.	2.40 —	2.50
rtho-dichlor-benzene	lb.	2.15 —	.20
rtho-nitro-phenol	lb.	.70 —	.75
rtho-nitro-toluene	lb.	$0.10 —	$0.13
rtho-toluidine	lb.	.14 —	.18
ara-amidophenol, base	lb.	1.25 —	1.30
ara-amidophenol, HCl	lb.	1.30 —	1.35
ara-dichlorbenzene	lb.	.17 —	.20
aranitroaniline	lb.	.75 —	.80
ara-nitrotoluene	lb.	.55 —	.65
ara-phenylenediamine	lb.	1.55 —	1.60
ara-toluidine	lb.	.90 —	1.00
thalic anhydride	lb.	.35 —	.38
henol, U. S. P., drums	lb.	.15 —	.15½
yridine	gal.	1.75 —	2.75
esorcinol, technical	lb.	1.30 —	1.35
esorcinol, pure	lb.	1.75 —	1.80
-salt	lb.	.60 —	.70
ilicylic acid, tech., in bbls	lb.	.25 —	.25½
ilicylic acid, U. S. P	lb.	.26 —	.26½
olvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
olvent naphtha, crude, heavy, in drums, 100 gal	gal.	.14 —	.18
lphanilic acid, crude	lb.	.24 —	.26
olidine	lb.	1.20 —	1.30
oluidine, mixed	lb.	.30 —	.35
oluene, in tank cars	gal.	.25 —	28
oluene, in drums	gal.	.30 —	.35
ylidines, drums, 100 gal	lb.	.40 —	.45
ylene, pure, in drums	gal.	.40 —	.45
ylene, pure, in tank cars	gal.	.45 —	....
ylene, commercial, in drums, 100 gal	gal.	.33 —	.35
ylene, commercial, in tank cars	gal.	.30 —	....

Waxes

All prices remain same as previous report

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on rload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

osin B-D, bbl	280 lb.	$5.55 —	$5.95
osin E-I	280 lb.	6.00 —	6.45
osin K-N	280 lb.	6.55 —	7.65
osin W. G.-W. W	280 lb.	7.75 —	8.30
ood rosin, bbl	280 lb.	6.25 —	....
irits of turpentine	gal.	1.22 —	1.23
ood turpentine, steam dist	gal.	.85 —	....
ood turpentine, dest. dist	gal.	.70 —	.70
ne tar pitch, bbl	200 lb.	..... —	6.00
ar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
etort tar, bbl	500 lb.	—	9.00
osin oil, first run	gal.	.36 —	.....
osin oil, second run	gal.	.38 —	.....
osin oil, third run	gal.	.46 —	.....
ne oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
ne oil, pure, dest. dist	gal.		.95
ne tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
ne tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
ne tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
ne tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
ardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
newood creosote, ref	gal.		.52

Fertilizers

mmonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
ood, dried, f.o.b., N. Y	unit	4.50 —	.....
one, 3 and 50, ground, raw	ton	37.00 —	39.00
sh scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
trate of soda	100 lb.	2.60 —	2.65
nkage, high grade, f.o.b. Chicago	unit	3.50 —	3.60
osphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	4.00 —	4.50
Tennessee, 78-80%	ton	8.00 —	8.50
tassium muriate, 80%	ton	33.50 —	34.00
tassium sulphate	unit	1.00 —	.....

Crude Rubber

ra—Upriver fine	lb.	$0.19 —	.19½
Upriver coarse	lb.	.13½ —	.13¾
Upriver caucho ball	lb.	.13¾ —	.13¾
ntation—First latex crepe	lb.	.14¾ —	.15
Ribbed smoked sheets	lb.	.14¾ —	.15
Brown crepe, thin, clean	lb.	.13½ —	....
Amber crepe No. 1	lb.	.14 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

stor oil, No. 3, in bbls	lb.	$0.11 —	$0.11½
stor oil, AA, in bbls	lb.	.12 —	.12¼
na wood oil, in bbls	lb.	.12½ —	.12¾
conut oil, Ceylon grade, in bbls	lb.	.08⅝ —	.08¾
conut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
rn oil, crude, in bbls	lb.	.11 —	.11¼
ttonseed oil, crude (f. o. b. mill)	lb.	.08½ —	.08⅝
ttonseed oil, summer yellow	lb.	.10¾ —	.11
ttonseed oil, winter yellow	lb.	.11¾ —	.12
seed oil, raw, car lots (domestic)	gal.	.89 —	.90
seed oil, raw, tank cars (domestic)	gal.	.84 —	.85
seed oil, boiled, in 5-bbl lots (domestic)	gal.	.92 —	.93
ve oil, denatured	gal.	1.15 —	1.17
lm, Lagos	lb.	.07 —	.07⅛
lm, Niger	lb.	.06¼ —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09½ —	.09¼
Peanut oil, refined, in bbls	lb.	.12½ —	.12¼
Rapeseed oil, refined in bbls	gal.	.82 —	.83
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.12 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¼ —	....

FISH

Light pressed menhaden	gal.	$0.51 —	....
Yellow bleached menhaden	gal.	.53 —	.54
White bleached menhaden	gal.	.55 —	56
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1, crude, tanks, coast	gal.	45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700.00	$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	75.00 —	110.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24.00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	16.00 —	20.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, No. 1 pottery grade	long ton	6.50 —	6.75
Feldspar, No. 2 pottery grade	long ton	5.75 —	5.90
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00 —	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	.....
Kieselguhr, f.o.b. N. Y	per ton	50.00 —	55.00
Magnesite, calcined (powdered)	per ton	8.00 —	12.00
Pumice stone, imported	lb.	.03 —	.05
Pumice stone, domestic, lump	lb.	.05 —	.05½
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.81 —	.82
Shellac, orange superfine	lb.	.83 —	.84
Shellac, A. C. garnet	lb.	.68 —	.69
Shellac, T. N.	lb.	.79 —	.80
Silica, glass sand, f.o.b. Indiana	per ton	1.50 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00 —	16.00
Silica, building sand, f.o.b. Pa	per ton	2.00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16.00 —	20.00

Refractories

Quotations Remain Same as Previous Report

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
Ferromanganese, 78-82% Mn, German	gross ton	67.00 —	67.50
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	.....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58.00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V	lb.	3.50 —	4.00

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent	18.00–19.00
Antimony, wholesale lots, Chinese and Japanese	5.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	31.625
Lead, New York, spot	5.65– 5.75
Lead, E. St. Louis, spot	5.375– 5.40
Zinc, spot, New York	6.10 – 6.15
Zinc, spot, E. St. Louis	5.75 – 5.80

OTHER METALS

Silver (commercial)	oz.	$0.70⅜
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.10
Platinum	oz.	90.00
Iridium	oz.	170.00@175.00
Palladium	oz.	55.00@ 60.00
Mercury	75 lb.	55.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The Benson Paint & Varnish Co., 2317 1st Ave. recently organized with a capital of $50,000, is planning for the installation of additional equipment for the manufacture of its regular line of paint products. K. Y. Benson is president.

MONTGOMERY—The American Cotton Oil Co. has preliminary plans in progress for the construction of a new building at its plant on Decatur St., near Pollard St., estimated to cost about $13,000.

MOBILE—The Fish Products Corp., recently organized with a capital of $50,000, has acquired property on the Bayou la Batre as a site for the erection of a new plant for the manufacture of fertilizer products. The initial works will be equipped for a capacity of about 10 tons of commercial fertilizer daily. The company is headed by W. B. Jones, Biloxi, Miss., and John E. Rolston, Coden, Ala.

California

SANTA PAULA—The Standard Oil Co. of California, San Francisco, has plans under way for the construction of a new oil distributing plant. A local site has been acquired. The plant will consist of a number of 1-story buildings.

PITTSBURG—Following a merger of the Columbia Steel Co., Market St., San Francisco, and the Utah Coal & Coke Co., operating in Carbon and Iron Counties, Utah, the new company, to be known as the Columbia Steel Corp., capitalized at $15,000,000, has extensive plans under way for expansion. It is proposed to enlarge the present mill at Pittsburg as well as the steel foundry at this location; the Utah properties will also be developed. The work is estimated to cost in excess of $1,500,000.

SAN LUIS OBISPO—The Associated Oil Co. has commenced the construction of a new distributing and industrial plant on the Islay Road. It will consist of a number of 1-story buildings, with tanks, etc., estimated to cost about $35,000.

LOS ANGELES—Kay & Brunner, 2714 Frederick St., operating a foundry, have filed plans for the erection of a new 1-story addition.

Connecticut

HARTFORD—The Capital Glass Co., 14 Chapel St., has filed plans and commenced the erection of a new addition, estimated to cost about $29,000.

Florida

DAYTONA—A new company is being organized by L. E. and L. N. Treadaway, Daytona, to construct and operate a local plant for the manufacture of insect powders and other chemical specialties. The company will be capitalized at $85,000 and it is said that the new plant will cost close to $40,000, including equipment.

Indiana

EVANSVILLE—The Southern Indiana Gas & Electric Co. has commenced the construction of a new gas-retort building, in connection with a number of gas plant improvements, estimated to cost close to $500,000.

EVANSVILLE—William S. Baerich and associates have acquired the local plant of the Stronghold Tire & Rubber Co., from the receiver. The factory was commenced a number of months ago but was never completed. The new owners are said to be planning to reorganize the company, finish the plant erection, and install equipment for the manufacture of tires and other rubber goods.

Illinois

JOLIET—The Standard Wall Paper Co., Hudson Falls, N. Y., has awarded a contract to the Austin Co., 208 South LaSalle St., Chicago, for the construction of a new 1-story plant on East Washington St., 60x100 ft., estimated to cost approximately $75,000, including equipment. Winfield A. Huppuch is president.

GRANITE CITY—The National Enameling & Stamping Co., 411 5th Ave., New York, N. Y., manufacturer of enameled ware, has plans nearing completion for the construction of an addition to its local plant, comprising 6 new buildings, estimated to cost approximately $1,500,000, including equipment. George W. Niedrinhous is president.

EAST ST. LOUIS—The Obear-Nester Glass Co., 25 North 2nd St., St. Louis, Mo., has commenced the construction of its proposed new local plant at Broadway and 22nd St., to be 1-story, 150x230 ft. and estimated to cost about $40,000. The company specializes in the manufacture of glass bottles and containers.

CHICAGO—The Chicago Butchers' Calf Skin Association, 3208 South Robey St., is taking bids and will soon award contract for the construction of a 3-story addition to its fertilizer manufacturing plant at location noted, 24x140 ft., estimated to cost about $50,000. H. C. Christensen, 7258 Union Ave., is architect. William Haffel is president.

ROCKFORD—The Rockford Malleable Iron Works, Inc., has awarded a contract to The Austin Co., 208 South LaSalle St., Chicago, for the construction of a new 1-story foundry, 150x200 ft., estimated to cost about $125,000, including machinery.

Kentucky

ASHLAND—The Indian Refining Co., 27th St. and Greenup Ave., has preliminary plans under way for the construction of an addition to its local oil plant, to consist of a number of 1-story buildings.

LOUISVILLE—The Peaslee, Gaulbert Co., 413 Main St., manufacturer of varnishes, wood finishes, etc., has commenced excavations for its proposed plant addition at 15th and Lytle Sts., to be 1-, 2- and 3-story, estimated to cost about $100,000, including equipment. Alterations and improvements will be made also in the present factory. D. X. Murphy & Brothers, Louisville Trust Bldg., are architects.

Maryland

BALTIMORE—The Board of Directors, Johns Hopkins University, has plans nearing completion for the construction of a 4-story chemical laboratory at the institution, 200x200 ft., estimated to cost about $500,000. Carrere & Hastings, 52 Vanderbilt Ave., New York, N. Y., are architects; Charles L. Reeder, 916 North Charles St., Baltimore, is engineer.

BALTIMORE—The Oil Products Co., 304 North Holiday St., manufacturer of lubricating oils, greases, and chemical specialties, recently reorganized with a capital of $35,000, has plans under way for enlargements in its 3-story plant for considerable increase in capacity. J. G. Platt is president; A. L. Kibler is vice-president and chemical director.

BALTIMORE—A 1-story foundry, estimated to cost about $25,000, will be constructed at the new plant of the Republic Boiler & Radiator Co., Union Ave, Woodberry district.

HAGERSTOWN—The Security Cement & Lime Co. plans for the installation of a new tube mill at its plant. Inquiries are out for used equipment in first class condition.

Michigan

DEARBORN—The Ford Motor Co., Highland Park, Mich., has plans under way for the construction of a 1-story laboratory building on local site, 200x800 ft. estimated to cost approximately $500,000, including equipment. It will be used for steel and steel alloy testing, and other general laboratory service.

Minnesota

CLOQUET—The Northwestern Paper Co. has awarded a contract to Siems, Helmers & Schaffner, Inc., 514 Guardian Life Bldg., St. Paul, Minn., for the construction of a 2-story sulphite pulp mill, 200x500 ft., to cost close to $500,000, including machinery. George F. Hardy, 209 Broadway, New York, N. Y., is engineer.

Missouri

JOPLIN—The Wilhoit Refining Co. has plans under way for extensions and improvements in its local oil refinery to cost about $75,000.

New Jersey

BAYONNE—The International Nickel Co., Oak and Hobart Aves., has filed plans for the construction of an addition to its local plant to cost about $15,000.

New York

PEEKSKILL—Fire, July 11, destroyed two of the buildings at the local plant of the Fleischmann Yeast Co., with loss estimated at about $125,000, including equipment. It is said that the plant will be rebuilt. Headquarters of the company are at 701 Washington St., New York, N. Y.

North Carolina

NEWTON—The Newton Oil & Fertilizer Mill, Inc., has preliminary plans under consideration for the construction of a new local plant for the manufacture of commercial fertilizers. S. D. Hauk is head.

FOREST CITY—The Forest City Oil Mill Co., manufacturer of cotton-seed oils, has plans nearing completion for the construction of a new local plant, estimated to cost about $90,000. Of this amount, approximately $65,000 will be expended for equipment.

Ohio

AKRON—The American Vitrified Product Co. has filed plans and will commence the immediate erection of an addition to its plant to replace a structure recently destroyed by fire.

AKRON—The Firestone Tire & Rubber Co. will soon commence the installation of equipment in a new building at its plant completed a number of months ago and heretofore unoccupied. It will be used for the manufacture of steel specialties, including rims etc., for automobile tires.

BARBERTON—The Lambert Tire & Rubber Co. will install equipment at once at its plant, to double the present capacity.

Oklahoma

OKLAHOMA CITY—The Apco Refining Co., Colcord Bldg., recently incorporated with a capital of $100,000, has selected a local site and has plans in preparation for the construction of a new oil refining plant with initial output of about 1,200 bbl. per day.

PONCA CITY—The 101 Ranch Co. is reported to be planning for the rebuilding of its tanning plant, including power house, destroyed by fire July 6, with loss estimated at about $50,000, including equipment.

Pennsylvania

STROUDSBURG—Fire, July 14, destroyed the plant of the Nitroloid Corp., manufacturer of celluloid and other compositic products, with loss estimated at about $250,000 including equipment. It is said that the plant will be rebuilt.

JACOBS CREEK—The U. S. A. Drug Chemical Co., Jacobs Creek, has plans under way for the construction of a new 3-story plant on local site, 72x125 ft., estimated to cost about $150,000, including equipment. Peter R. Rossello 406 Congress Bldg., Detroit, Mich., is architect.

READING—Orr & Sembower, Inc., Millmont, near Reading, operating a metal working plant, is planning for the rebuilding of the portion of its brass foundry, recently destroyed by fire. The estimated loss has not been announced.

PHILADELPHIA—E. I. duPont de Nemours & Co., manufacturers of paints, varnishes, etc., have filed plans for the construction of a 1-story addition to their local plant at 3500 Grays Ferry Road, estimated to cost about $15,000.

PITTSBURGH—E. A. Campbell has acquired the plant and equipment of the Eagel Paint & Varnish Co., Galveston Ave., from Elliott Frederick, trustee. The plant is located on a site 150x270 ft., and was secured for a consideration said to be $5,170. The new owner is said to be arranging for a reorganization of the company and the continuance of the plant in operation.

PHILIPSBURG—Thomas J. Lee and associates are perfecting arrangements for the reorganization of the Nickel Fabricating Co. and the operation of the local plant recently acquired under bankruptcy pr

eedings. The plant has been idle for bout six months past. The new company ill make repairs and improvements to the quipment and plan to place the works in ervice at an early date.

Tennessee

CHATTANOOGA—The Scholze Soap & Fertilizer Co., recently organized with a capital of $150,000, has preliminary plans under way for the construction of a new plant on local site for the manufacture of soap roducts. It is estimated to cost about 100,000, including machinery. Henry cholze and J. N. Kline, head the company.

Texas

DALLAS—E. L. Flippen, heretofore vice-resident of the Planters' Cotton Oil Co., nd Hugh E. Prather have acquired the ocal plant of the company, under bankuptcy proceedings, for a consideration of 99,000. The mill is located in the Breezy ill section and was constructed a number of years ago, at a cost said to be 400,000. The new owners will reorganize he company and will make extensions and mprovements to the plant. It is expected o have the mill ready for production early n the fall.

SAN ANTONIO—The Ideal Mfg. Co., recently organized, has plans in preparation or the construction of a 1-story plant on ocal site, 60x175 ft. for the manufacture f polishes, enamels, etc. E. D. Nolan is reasurer.

CROSS PLAINS—The Bristow Refining Co. completing the construction of the first nit of its new local oil refining plant, and lans to place the mill in service at an arly date. It will have a capacity of bout 500 bbl. per day. It is proposed to onstruct additional plant units in the near uture.

Virginia

RICHMOND—The Fish Guano Co. has acuired property at Fulton, near Richmond, nd plans for the constructon of a new 1-tory plant, 105x200 ft., for the manufacture of fertilizer products. It will have an initial capacity of about 25,000 tons of material per annum, and is estimated to cost about $55,000, with machinery. Walter C. Hill is president.

West Virginia

WHEELING—The Wheeling Oxygen Co., 1130 Market St. has commissioned the Industrial Engineering Co., Park Bldg., Pittsburgh, Pa., to prepare plans for the construction of a new plant on 16th St., Warwood, near Wheeling. It will be used for the manufacture of commercial oxygen, and is estimated to cost in excess of $50,000.

SHINNSTON—The Alley Glass Co., recently organized, has acquired a local building for the establishment of a new plant for the manufacture of cut glass products. L. E. Alley is president and general manager; Paul E. Tetrick is treasurer.

LUMBERPORT—The Mound City Glass Co. has commenced the construction of a new finishing department at its plant and will make other extensions and improvements to double, approximately, the present capacity. It is proposed to increase the working force by about 150 men upon completion.

Canada

NEW WESTMINISTER, B. C.—The Westminster Paper Co., affiliated with the Interlake Tissue Paper Co., Merritton, Ont., has preliminary plants in progress for the construction of a new mill on the Frazier River for the manufacture of tissue and other light-weight papers. It is said that the plant will cost in excess of $200,000.

MONTREAL, QUE.—The British Empire Steel Corp. is reported to be planning for the construction of a new steel mill, to cost in excess of $10,000,000. The work will comprise new open hearth furnaces, blooming mills, as well as improvements to present blast furnaces. A number of buildings at the present works will also be remodeled and improved, and new equipment installed.

New Publications and Books

"The Future Independence and Progress f American Medicine in the Age of Chemtry." A report by John J. Abel, Carl L. lsberg, Raymond F. Bacon, F. R. Eldred, eid Hunt, Treat B. Johnson, Julius Stiegz, F. O. Taylor and Charles H. Herty. ublished by the Chemical Foundation, ew York.

Beiträge zu Einer Kolloidchemie des ebens (Biologische Diffusionen). By Dr. aphael Ed. Liesegang. Published by Verg von Theodor Steinkopff, Dresden and eipzig, Germany.

The Imperial Mineral Resources Bureau, ondon, England, has issued pamphlets on old, copper, tin and platinum and allied etals. All of these are for the war period om 1913 to 1919.

The Department of Scientific and Inustrial Research, London, has issued Bultin No. 6 on the Electrodeposition of on. By W. E. Hughes.

The University of Illinois has issued ulletin No. 128, on "The Ignition Temerature of Coal," by Ray W. Arms, and ulletin No. 129, on "An Investigation of ie Properties of Chilled Iron Car Wheels," y J. M. Snodgrass and F. H. Guldner.

The U. S. Department of Agriculture has sued Bulletin No. 983, on "The Manufacre of Ethyl Alcohol From Wood Waste," y F. W. Kressmann, and Bulletin No. 57, on "The Chaulmoogra Tree and Some elated Species," by Joseph F. Rock.

The Scientific and Industrial Research ouncil of Alberta has issued its second nnual report.

The Bureau of Foreign and Domestic ommerce has issued Trade Information ulletin No. 11, "The Steel-Making Facili-s of Great Britain" by H. B. Allin Smith nd Trade Information Bulletin No. 31, "Markets for Chemicals in the Netherands, East Indies and British Malaya" by hn A. Fowler.

New U. S. Geological Survey Bulletins: ome Field Tests and an Assay of Texas otash Salts" by George Steiger. This imeographed report can be obtained on pplication to the Survey office in Washgton. The methods described are for entification and analysis of the mineral lts with special reference to the examinaon of the types of mineral found in the estern Texas fields. The instruction for ld methods are given in elementary form that those with little or no previous aining in chemistry will be able to carry em out. Other bulletins are I: 1, "Cadium in 1921," by C. E. Siebenthal and A. Stoll (Mineral Resources of the U. S., 1921, Part 1) published April 10, 1922; I: 2, "Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1921." by J. P. Dunlop (Mineral Resources of the U. S., 1921, Part I) published May 12, 1922; I: 23, "Quicksilver in 1920," by F. L. Ransome, with a supplementary bibliography by Isabel P. Evans (Mineral Resources of the U. S., 1920, Part I) published March 27, 1922; I: 25, "Lead and Zinc Pigments and Salts in 1920," by C. E. Siebenthal and A. Stoll (Mineral Resources of the U. S., 1920, Part I) published April 26, 1922; I: 26, "Copper in 1920" (General Report) by H. A. C. Jenison (Mineral Resources of the U. S., 1920, Part I) published May, 16, 1922; II: 2, "Graphite in 1921," by L. M. Beach (Mineral Resources of the U. S., 1921, Part II) published June 5, 1922; II: 3, "Peat in 1921," by K. W. Cottrell (Mineral Resources of the U. S., 1921, Part II) published June 6, 1922; II: 29, "Mica in 1920," by B. H. Stoddard (Mineral Resources of the U. S., 1920, Part II) published April 12, 1922.

New Bureau of Mines publications: Bulletin 200, "Evaporation Loss of Petroleum in the Mid-Continent Field," by J. H. Wiggins; Bulletin 207, "The Analytical Distillation of Petroleum and Its Products," by E. W. Dean, H. H. Hill, N. A. C. Smith and W. A. Jacobs; Tech. Paper 258, "Production of Gasoline by Cracking Heavier Oils," by E. W. Dean and W. A. Jacobs; Tech. Paper 263, "Design and Operation of a Low-Pressure Absorption Plant," by W. P. Dykema and A. A. Chenoweth; Tech. Paper 268, "Preparation and Uses of Tar and Its Simple Crude Derivatives," by W. W. Odell; Tech. Paper 298, "Methods for Testing Petroleum Products;" Tech. Paper 305, "Specifications for Petroleum Products adopted by the Interdepartmental Petroleum Specifications Committee."

New Bureau of Standards publications: Scien. Paper No. 432, "An Improved Method for Preparing Raffinose," by E. P. Clark; Scien. Paper 433, "Thermal Expansion of a Few Steels," by Wilmer Souder and Peter Hidnert; Scien. Paper 434, "Electromotive Force of Cells at Low Temperatures," by G. W. Vinal and F. W. Altrup; Scien. Paper 435, "Metallographic Etching Reagents," by Henry S. Rawdon and Marjorie C. Lorentz; Scien. Paper 436, "Interference Methods for Standardizing and Testing Precision Gage Blocks," by C. G. Peters and H. S. Boyd; Scien. Paper 437, "The Solubility of Dextrose in Water," by Richard F. Jackson and Clara Gillis Silsbee; Tech. Paper 210, "The Redwood Viscosimeter," by Winslow H. Herschel.

The smoke investigation of the Mellon Institute has Bulletin No. 10 in press. This publication, which is entitled "Recent Progress in Smoke Abatement and Fuel Technology in England," presents the results of an investigation by Robert J McKay, an industrial fellow of the Institute.

BOOKS

AMERICAN RESEARCH CHEMICALS. By *Clarence J. West.* National Research Council, Reprint and Circular Series No. 35, pp. 37. Price, 50c. The research chemist and the purchasing agent in search of unusual and comparatively unknown chemical compounds will find this compilation extremely valuable. The pamphlet is the report of the Council's committee on research chemicals, of which W. D. Collins is chairman and C. J. West secretary. The subject matter is divided into four parts, viz.: A list of the 80 manufacturers of fine chemicals, the names of approximately 1,800 research chemicals with numerical reference to their manufacturers, 500 biological stains, indicators and their makers' numbers and finally, the principal hydrogen-ion indicators, the index number of the firms making them and a chart showing their *pH* ranges.

MEXICAN YEAR BOOK, 1920-1921. By *Robert Glass Cleland, Ph.D.* Los Angeles: Mexican Year Book Publishing Co., cloth, 6x9 in.; pp. 524. Price, $7.50. Americans desirous of unbiased and systematized information concerning Mexico will find this book unusual in that it has no official Mexican patronage. In addition to authoritative chapters on geography, transportation, commerce, natural resources, etc., the book contains an appendix of practical suggestions for business travelers in Mexico and gives details concerning postal and tariff regulations, the recent colonization decree and the treaties now in force between Mexico and the United States. It also contains a bibliography of works on Mexico. Three maps show the political divisions, principal cities, lines of communication, mining centers and the Panuco-Tuxpam oil fields.

WORLD METRIC STANDARDIZATIONS AN URGENT ISSUE. Compiled by *Aubrey Drury* and collaborators. Published by World Metric Standardization Council, San Francisco, Cal. 524 pp. Price $5. Herbert Hoover is responsible for the statement: "Standardization is an outstanding necessity in the mind of every engineer desirous of the advance of industry and commerce. There is no field where more constructive work can be accomplished in this direction of national efficiency of the whole gamut of production and distribution than in the field of standards." Engineers who are willing to accept this generalization of Secretary Hoover will find much of interest in Mr. Drury's exhaustive compilation, for this volume deals with the "master standards" of the world—the three metric units—meter, liter, gram. The book urges that the units of weights and measures of the United States and the British commonwealths be brought into accord with these invariable standards, for when this advance is achieved, practically the entire world will be upon the uniform metric basis. The compilation of this book is the result of a number of years of intensive study. Over 30,000 letters and papers on the metric movement had been gathered into the files of the World Standardization Council and in addition the compilers drew largely on material in the files of the American Metric Association, the British Decimal Association and a number of other such organizations. The work is a valuable storehouse of information to all who are interested in the progress of metric standardization.

"SUMMARY OF TARIFF INFORMATION, 1921" is the title of a 1,600-page volume just issued by the Tariff Commission, Washington, D. C. Copies may be obtained from the Superintendent of Documents, Government Printing Office, at $1.25.

"DUST EXPLOSIONS" is the title of a new book, by *David J. Price* and *Harold H. Brown*, assisted by *Hylton R. Brown* and *Harry E. Roethe*, just published by the National Fire Protection Association, Boston, Mass., with permission of the U. S. Department of Agriculture. Price, $3. The book contains the results of the dust explosion investigations of the Bureau of Chemistry, U. S. Department of Agriculture and should be of value in the prevention of dust explosions and the reduction of losses to life, foodstuffs and property in the industrial plants of the United States and Canada.

ELEKTRISCHE BEHANDLUNG VON GASEN. By *Henri Silbermann.* Published by Dr. Max Jänecke Verlagsbuchhandlung, Leipzig, Germany.

New Companies

THE TURLINGTON CHEMICAL CO., 339 Equitable Bldg., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical by-products, soaps, etc. The incorporators are Randall A. Turlington, Philander B. Briscoe and Willis R. Jones.

THE COLREX MFG. CO., New York, care of C. E. Toney, 184 West 135th St., representative, has been incorporated with a capital of $25,000, to manufacture polishes and kindred specialties. The incorporators are J. E. Blackwell, D. and J. C. Doles.

THE RELIANCE TILE & FAIENCE CO., Perth Amboy, N. J., has been incorporated with a capital of $300,000, to manufacture tiles, ceramics, and kindred products. The incorporators are Fred Keck, George J. Janovsik and N. F. Herron, 107 Fayette Street, Perth Amboy.

THE NEHOIDEN OIL CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture refined oil products. M. William Lawlor is president and James Keltie, 83 Warren Street, Needham, Mass., treasurer.

THE SUPERIOR CHEMICAL PRODUCTS CORP., 303 West Chicago Ave., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical by-products. The incorporators are Douglas G. Logan, H. J. Logan and Claude H. Pratt.

THE UNIVERSAL PAPER GOODS CO., Los Angeles, Cal., care of Kimpton Ellis, 626 Washington Bldg., representative, has been incorporated with a capital of $20,000, to manufacture paper specialties. The incorporators are G. R. Allenson, L. E. Bartels and H. D. Allenson, all of Los Angeles.

THE BURNOT FIREPROOFING PRODUCTS OF BALTIMORE, INC., 207 West Calvert St., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture fireproof paints and other kindred fireproofing products. The incorporators are William R. Semans, Henry L. D. Standford, Jr. and F. Fulton Bramble.

THE GREAT EASTERN GALENA SILVER, LEAD & ZINC CO., Pottsville, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa., representative, has been incorporated under Delaware laws with a capital of $400,000, to operate zinc, lead and other metal refining plants and properties. The incorporators are Miles E. Reinhart, Palmerton, Pa.; Jacob Brewer, Hazleton, Pa., and C. Crossman, Pottsville.

THE BAYWAY COLOR WORKS, INC., 36 East State St., Trenton, N. J., has been incorporated with a capital of 5,000 shares of stock, no par value, to manufacture colors, chemicals, etc. The incorporators are Edward C. Georges, Louis F. Menage and William Campbell.

THE ACOMA CHEMICAL CO., Clayton, Mo., has been incorporated with a capital of $15,000, to manufacture chemicals and chemical byproducts. The incorporators are Moses Leon, J. F. L. and B. M. Zingre, all of Clayton.

THE BRANFORD BRASS FOUNDRY, INC., Branford, Conn., has been incorporated with a capital of $50,000, to manufacture brass, bronze and other metal castings. The incorporators are F. A. Ellis, H. A. Cox and A. V. Neilson, all of Branford.

THE STEVENS & THOMPSON PAPER CO., North Hoosick, N. Y., has been incorporated with a capital of $1,500,000, to manufacture paper products. The company will comprise a consolidation of the Stevens & Thompson Co., and the Walloomsac Paper Co. Frank L. Stevens, North Hoosick, is the principal incorporator and represents the company.

THE NUEVA OIL CO., Laredo, Tex., has been incorporated with a capital of $40,000, to manufacture petroleum products. The incorporators are O. W. and W. T. Killam, and R. F. Peck, all of Laredo.

THE METROPOLITAN PETROLEUM CO., Long Beach, Cal., has been incorporated with a capital of $200,000, to manufacture petroleum products. The incorporators are Albert Stephens, Claude C. Sumter and F. E. Lewis, all of Long Beach.

Following the acquisition of the Carpenter Steel Co., Reading, Pa., by the Penn Seaboard Steel Corp., Philadelphia, Pa., operations have been increased from 35 to 40 per cent of capacity. The wage schedule of employees has been advanced, those earning 24 cents per hour and under receiving a 3- to 5-cent hourly increase, and proportionate advance to workers earning more.

THE CENTRAL IRON & STEEL CO., Harrisburg, Pa., is planning for the resumption of full operations at its mills in the near future. The plant is now running at close to 75 per cent of normal.

THE ALABAMA IRON & STEEL CO., Gadsden, Ala., is making repairs to the second furnace at its local plant, and is said to be planning to place the unit in blast in the near future.

THE ANDERSON-PRICHARD OIL CORP., Oklahoma City, Okla., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are L. H. and L. M. Prichard and J. Steve Anderson, all of Oklahoma City.

THE PRESTON CLAY CO., Canton, Ohio, has been incorporated with a capital of $2,000, nominal, to manufacture burned clay products. The incorporators are H. S. Preston and H. S. Williams, both of Canton.

THE STANDARD CASTINGS CO., South Bend, Ind., has been incorporated with a capital of $200,000, to manufacture iron, steel and other metal castings. The incorporators are John N. and Charles L. Zigler, and Richard A. Oglesby, all of South Bend.

THE BRICK & TILE CO., Egg Harbor City, N. J., has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. The incorporators are C. A. Lunneman, John R. O'Neill and Alvin P. Risley, all of Egg Harbor City. The last noted represents the company.

MAX SEE & CO., INC., New York, N. Y., care of Littau & Seligson, 277 Broadway, representatives, has been incorporated with a capital of $10,000, to manufacture leather specialties. The incorporators are Max See and R. Mayer.

THE PRIMO PRODUCTS CO., Worcester, Mass., has been incorporated with a capital of $25,000, to manufacture paints, oils, etc. Irving S. Balcom is president and Henry K. Braetter, 73 Wellington Street, Worcester, treasurer.

Industrial Developments

OIL—The Catlin Shale-Oil Products Co., Elko, Nev., is developing a production of about 40,000 gal. of crude oil daily at its local refinery. A byproducts plant is operated for the recovery of gasoline, paraffine wax, lubricating oils, etc.

The Skelly Oil Co., Tulsa, Okla, is increasing production at its oil refineries to a point of about 11,000 bbl. daily. The gasoline plants of the company are running on a basis of about 25,000 gal. of gasoline daily, and this capacity will be advanced to 40,000 gal. at an early date.

IRON AND STEEL—The Illinois Steel Co., Gary, Ind., is now operating on a basis of about 85 per cent of capacity.

The Lebanon Iron Co., Duncannon, Pa., has reopened its local plant, following a suspension since 1920. Employment will be given to about 150 men, and this quota will be increased at an early date.

A total of 21 blast furnaces are now in operation in the Alabama iron districts, 8 of which are running on basic material and 13 on foundry pig. The different operating plants are: Tennessee Coal, Iron & Railroad Co., Birmingham, 8 furnaces; Sloss-Sheffield Steel & Iron Co., Birmingham, 5 furnaces; Woodward Iron Co., Woodward, 4 furnaces; Republic Steel Co., Birmingham, 2 furnaces; Alabama Iron & Steel Co., Gadsden, 1 furnace; and the Gulf States Steel Co., Alabama City, 1 furnace.

The Central Coal & Iron Co., Holt, Ala., is completing repairs to its local furnace and plans to place the unit in blast at an early date.

The Inland Steel Co., Indiana Harbar, Ind., is now operating at about 65 per cent of capacity.

The Central Iron & Steel Co., Harrisburg, Pa. is making additions to its working force and has advanced production in a number of departments.

The Bethlehem Steel Co. is said to be planning for the early resumption of full time production at its works at Steelton, Pa. The plant is now running on a basis of about 70 per cent of capacity.

The Ohio Falls Iron Co., New Albany, Ind., has placed its local plant on a double-shift basis of operation, giving employment to an increased number of men. The plant has been running full, on single shift schedule, for about 60 days past. The wages of laborers have been advanced 25 cents a day, making a rate of $2.50 a day.

Following a short shut-down for repairs, the Reading Iron Co., has resumed operations at its puddle mill at Danville, Pa. Wages have been increased at the plant, puddlers now receiving $7.50 a ton, instead of $6.50, as heretofore. The company is running full at its 9th St. mill at Reading, Pa.

The United States Steel Corp., Pittsburgh, is now operating on a basis of 75 per cent of capacity at its different mills, considered collectively.

The United States Cast Iron & Pipe Foundry Co. is running at maximum capacity at its plants at Burlington, N. J., and Scottsdale, Pa. Production will soon be advanced at the different plants units of the company in the south.

The Carnegie Steel Co. has resumed operations at the skelp mill at its Farrell, Pa., works, placing the plant on a full 10[illegible] per cent basis for the first time in about [illegible] years.

TIN PLATE—The Follansbee Brothers Co. Pittsburgh, Pa., has resumed operations at its tinplate mills at Follansbee, W. Va., and Toronto, O., giving employment to about 2,500 operatives, both plants.

METALS—The Golden Rod Mining & Smelting Co., Cardin, Okla., has resumed operations at its Mill No. 7, which has been closed down for about a year past. The plant will run on a schedule of 1,000 tons a day.

The New Cornelia Copper Co., Boston, Mass., operating properties in Arizona, is increasing production at its plant and expects to develop an output of about 4,000,000 lb. early in August, as against a production of about 1,500,000 lb. during recent weeks. Plans are under way for the construction of a new flotation mill at the properties, with capacity of about 5,000 tons.

MISCELLANEOUS—The Davison Chemical Co., Baltimore, Md., is increasing operations in its acid phosphate department at the local plant. The company reports a marked increase in orders for agricultural chemicals and expects advance production in this line at an early date. The factory is now operating on a basis of about two-thirds capacity.

The Barrett Mfg. Co. is arranging for the immediate resumption of operations at its paper mills at Kingston, Pa. A working force is being recruited.

The Dixie Consolidated Co., Birmingham, Ala., has placed its Pocohontas, Ala. graphite mill on a full capacity basis, giving employment to regular working force.

All cement mills in the Lehigh Valley section of Pennsylvania are now running at full capacity, with normal force of operatives. Continuous operation is planned for an indefinite period.

The McGraw Tire & Rubber Co., Easton, Palestine, Ohio, is advancing production at its local mill. A schedule of 2,300 casings and an equal number of tubes per day has been arranged. The plant is giving employment to about 600 operatives.

The Thomas Maddock's Sons Co., Trenton, N. J., manufacturer of sanitary ware, has developed production to maximum capacity, with regular working force, and expects to continue on this basis for an indefinite period.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold summer excursion meeting to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo, Aug. 13-1[illegible]

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held in the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

THE SOCIETY OF INDUSTRIAL ENGINEERS will hold its next national convention and exhibitions of labor-saving equipment at the Hotel McAlpin, New York, Oct. 18, 19 and 20.

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CHEMICAL & METALLURGICAL ENGINEERING

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GRAHAM L. MONTGOMERY
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The Outlook For Coal

DEVELOPMENTS of the past week in the coal strike demand the attention of every coal-using industry. The complacence with which the strike was faced when it started was based upon two fortunate facts. First, there was a large stock in the hands of consumers; and second, the non-union mines could be depended upon to furnish nearly the normal summer consumption. As time has passed and JOHN LEWIS has specifically refused to yield to anything but a national settlement, the situation has grown more serious. Today the country is confronted with a real coal shortage coupled with a strong demand. The certainties now appear to be that there will be no wage reductions, that high prices will prevail for another year and that federal control probably will last throughout the winter. Of course, some settlement will be reached, but it is not known how long Mr. LEWIS can hold his miners in cash. Apparently he is the key to the situation, because he has persuaded union miners that the existence of their union is threatened and that a compromise will involve its destruction. He has imbued the strikers with this thought more strongly than any other leader has been able to do and consequently his ranks thus far are practically unbroken. No acceptable form of settlement is in sight at the present writing.

Statistically the situation is about as follows: The normal summer consumption has been 8,000,000 tons of bituminous coal per week; and up to July 1 the production of non-union coal was approximately 70 per cent of this figure, or about 6,000,000 tons. The effect of the rail strike, however, which apparently was directed with telling effect in non-union coal fields, has been so successful in curtailing production that last week it amounted to only 3,600,000 tons. Stocks in the hands of consumers on April 1 amounted to about 67,000,000 tons, with possibly 10,000,000 tons in transit. On July 1 the tonnage in the hands of consumers had dwindled to 2,000,000 and undoubtedly the tonnage in transit was greatly reduced as a result of the railroad strike. Thus we are faced with stocks that represent not much more than two weeks' supply, and a non-union production of less than one-half the normal consumption.

Obviously the situation called for federal control and for the consequent creation of a priority list. In fact priorities have been established not only for the supply of coal to industry but for the transportation of commodities as well. The transportation priority list gives preference in the following order: Food for human consumption, feed for live stock, live stock, perishable products, coal, coke and fuel oil. Coal will be furnished to industries according to the following priority list: railroads, ship bunkers, public utilities directly serving the public, electric power and light, gas, water and sewer works, ice plants, hospitals, government institutions, and lastly, "all other purposes," which includes iron and steel and allied industries. This suggests a possible advantage to those industries that buy power from a utility corporation.

Federal control has already shown an increase in the production and movement from non-union fields, amounting to about 20 per cent in the first week. Prices are stabilized and every effort will be made to prevent a runaway market. On the whole the situation is critical and will demand the most careful consideration on the part of consumers. Of the present non-union production of 4,000,000 tons about 3,250,000 tons will be allocated to utilities under the priority list, leaving less than one million tons per week for all other purposes. It is expected, of course, that this production will increase under federal control even if the strike continues. In the event of the resumption of mining in the unionized fields, it is probable that full production and distribution can be accomplished in 30 days. But even then it must be remembered that stocks have dwindled so low that there will still be the effect of a shortage long after full production is resumed.

The Value of Chemists' Clubs

WHEN the late Dr. MORRIS LOEB made the Chemists' Club of New York a living thing, he may have guessed—and again he may not—that many other chemists' clubs would spring into being, following the New York example. The fact was demonstrated that chemists are social beings and that, as in other agencies, there is great value in informal discussions. When chemistry was purely experimental in its nature, there appeared many reasons for workers in the field to keep what they knew to themselves and not to talk too much, lest some fact which the talker had observed might also be noted by somebody else before the former had profited by it in credit or in money. But now that chemistry, thanks to the introduction of physics into chemical thought, is becoming more and more of a deductive science, we—or at least a great many of us—need help and inspiration and jogging along in making our deductions. We need to talk things over, and the royal road for this purpose, to the man who is at once sympathetic and trustworthy, is by way of the club.

Our readers know of the Chemists Club at Chicago, we lately referred to the civic activities of that at Tacoma, Wash., and there are others in various parts of the country, some active and some inactive. Our present purpose, however, is to tell a little of the Chemical Industry Club of London, which is taking its place as a well-known feature of the professional life of chemists in England. Its quarters are in Whitehall Court, which is an institution of itself and is operated

by the same company that manages the Hotel Cecil. This Whitehall Court overlooks the Victoria Embankment and the Thames River, near the houses of Parliament and Westminster Abbey, and it provides sleeping rooms for the members and guests of a score or more of various clubs which it houses. Meals are served in the Chemical Industry Club rooms and in a common dining room, and one may, through his club facilities, also lodge his family in this very agreeable place. It is not available to the public, the charges are moderate, and the service excellent.

The club itself is small and has had the same trouble that the New York Chemists' Club had in the beginning of its career, in getting members to drop in and make themselves at home. But that phase is passing away, and now every table is often taken for luncheon, while at "the cocktail hour," from 5 to 7, one is sure to find a number of members.

The reciprocal arrangements between the Chemists' Club of New York and the Chemical Industry Club of London are a great convenience to the members of each. Membership in one is an introduction to and a warrant for the privileges in the other. None but an offensive and churlish person could miss the cordial welcome and good will that is thus extended to the American chemist in London, and we believe the same holds good of the English chemist in New York. At least, one hears abundant testimony to that effect. These things speak well of the chemical profession; indeed, we know of no other professional calling that provides this international reciprocity. It gives the chemist who has "arrived" far enough to be elected to membership the access to the eminent men in his own walk of life, both at home and abroad, and it adds charm to the profession.

A Rebuke To Insolence

PRESIDENT HARDING never was in better form than last week when he administered a well-merited rebuke to one J. CLEVE DEAN, who, signing himself as Chairman Railroad Employees' Publicity Association, addressed an insolent letter to the Executive. The Dean letter was filled with statements which the President rightly characterized as ungrateful and untruthful. Mr. DEAN indulged in silly sentimentalism when he stressed the strikers' loyalty and war service on European soil. He resorted to a cheap gesture in an effort to becloud the government's action when he warned against any "attempt to draft men into mining or railroad service." He made an idle threat when he predicted that under the government's "attempt to place American labor under the gun, nothing short of a revolution will happen." The President answered these vaporings "with that contempt which is felt by every good citizen in the hour of deep public concern."

There has been far too much loose talk on the part of labor leaders in the present strikes. Mr. DEBS was so incendiary in what practically amounted to a call to arms that most good citizens felt the government would do well to invite him to resume his residence in Atlanta. Mr. LEWIS has talked glibly of the government's use of troops as an "assembling and parading of engines of war to awe American citizens who are merely exercising their inherent constitutional right to cease work." Such words can be uttered only in insincerity and disloyalty.

Mr. GOMPERS has recently repudiated the Dean letter and has announced that there is no such individual. He expressed surprise that Mr. HARDING would answer the letter, but we believe that the country will be grateful to him for speaking as he did. Whether Mr. DEAN is a real or fictitious character, the sentiments expressed in his letter have characterized all too freely the utterances of other leaders who are not mythical characters. It is of no moment whether Mr. DEAN exists or not, but it is a source of gratification to a long-suffering and law-abiding citizenry to have the Chief Executive voice public sentiment in so decisive a manner.

Stabilizing Germany's Financial Affairs

GERMANY'S financial affairs are in such a hopeless tangle that we often catch ourselves bracing momentarily for a crash that seems inevitable. But for some reason or other it never comes. Not long ago when the news of Baron RATHENAU'S assassination caused the paper mark to tumble down to 18 cents a hundred, we thought the fall would surely prove fatal. But it didn't, even though it did represent a depreciation of considerably more than 99 per cent. Just where the endpoint lies we know not, but it seems certain that when the Germans themselves repudiate the mark an economic paralysis of all Europe is bound to follow.

It is no wonder then that the financial experts of England and France, in fact of the whole Reparations Commission, are giving serious concern to this problem. But even the layman can see that there are at least two things wrong with Germany's financial system that must be corrected. In the first place the printing press that has been inflating Germany's floating debt —sometimes at the rate of 10 billion marks a week— must certainly be stopped. And secondly, someone must put an end to the exporting outside of Germany borders of capital and every other movable thing of value. These are basic requisites for any lasting solution of Germany's troubles. The partial remission of the reparations debt and the floating of a German loan are important and essential, but these things take time and there are plenty of reasons to believe that they may come too late.

The proposal recently put forward by the Guarantee Committee of the Reparations Commission is basically sound in that it goes to the real sources of these difficulties. Under this plan two overseers from the Reparations Commission are to be accredited to Germany's Finance Ministry; one is to watch over income and the other over the outgo. These representatives of the Allies are to have access to all of Germany's finances. The floating debt, the budget, tax and customs receipts, imports, exports and all economic and financial dealings of the government are to be watched over by them. Here, however, is the inherent weakness of the plan, for the overseers must act in a purely advisory capacity. They are merely liaison officers between the Finance Ministry and the Reparations Commission and are not empowered to put into effect the reforms that the latter body may deem necessary. But, on the whole, this is a step in the right direction and the German Chancellor wisely sees in it a stabilizing influence that may help to bridge over the gap until a reasonable idemnity is definitely settled and reparations thus changed from a political controversy to an ordinary business debt.

In the meantime it seems that there is every chance

hat favorable developments will come from the meetngs of the French and British Premiers. France, vhich previously has been insisting on conditions that ave made an international loan impossible, has apparntly agreed that reparations shall be reduced from 32 to 50 billion gold marks providing Great Britain s willing to forgive the French debt. This tackling f the problem of interallied debts in relation to reparaions is admittedly a ticklish proposition, which was ut off at Genoa, The Hague and elsewhere largely ecause of America's attitude toward cancellation. The ecision to go ahead independently of the United States vould seem to be the first really constructive step that rance and England have taken in their own behalf.

We are not going to take sides on the cancellation uestion, for it is not an issue with which we are conerned—as yet. But it is our contention that every merican industry should be interested in stabilizing noney values in Europe and can well lend its support o any scheme that will make Germany a solvent urchaser of American goods and at the same time do way with the advantage which the greatly depreiated mark allows her in the world markets.

Wage Fixing By Numbers

DURING the school days of some of us, and at a relatively earlier time as regards others of us, here was published a book "Looking Backward" by EDWARD BELLAMY. The narrator was supposed to be n insomniac, who spent his nights hypnotized in an unlerground chamber, was lost track of when a great ire obliterated the approach to the chamber and was esuscitated long afterward when the United States ad become a socialistic state. It was a great book to ire the imagination of those who had little experience n ways of the world and traits of the human mind.

In this imagined socialistic state everyone had the ob for which he was fitted. The narrator was assigned he task of telling the people of the new generation ow men lived and behaved themselves at the time he ad got lost in his underground chamber. What tartled the new people most was the low price of votes. n the new time, votes had become so valuable, on ccount of the amount at stake, that men would not ell them, and the most intelligent and fairest minded nen got elected. One of the duties of the officials, f course, was to prescribe how much work each person ad to do in order to be given his fraction of the total roduction of commodities, etc.

We have had enough of developments of late to uggest how a socialistic state would work with men onstituted as they are. Some of the advocates of the ocialistic principle have urged that it could be applied radually to one thing after another. We find labor nions in existence, and the unions involving crafts that mploy large numbers of men are conspicuous for the igh wages they demand in proportion to the amount f work done. If in the socialistic state votes could ot be bought for a dollar or two apiece, as BELLAMY ntimated was the case in his time, would not the lasses of voters, by trades, that were in the largest umbers be most influential with the official who allotted he jobs? Is it not probable that if it required two nillion men to do a certain kind of work that craft vould receive the highest wages, the craft involving nly a million men somewhat lower wages, the craft counting up only a hundred thousand much lower wages, and the crafts having only a few members very low wages indeed? The actual difference might not be in wages. It might be in working rules, in hours of labor or in various other devices.

The condition observed today is a parallel to that of BELLAMY'S socialistic scheme. If there are only a thousand of a certain craft in the country, their going on strike makes little trouble. The trouble can probably do without their work for a while, or their places can be filled. If the craft requires a million men the strike soon affects the public, and it is difficult to fill so many places. In brief, it is a bad principle to live under, yet it looks very much as if we are expected to do so.

Does Your Roof Leak?

IT WAS RAINING and the shiftless tenant had just moved his chair a few feet so that the water from the leak in the roof would not drip on him.

"Why don't you fix that roof?" asked a stranger who happened to drop in.

"Well," drawled the tenant, "when it's raining you can't fix the roof, and when it's dry you don't need to fix it."

This remark is justly famous and perhaps we can draw from the story a legitimate parallel with conditions in chemical manufacturing. Not long ago at the convention of the National Fertilizer Association, its president admitted a lack of interest in research. He said that at the present time the industry can buy nitrogen either as nitrates or as sulphate of ammonia more cheaply than it costs to manufacture it synthetically. Therefore, it is not greatly exercised about research in synthetic ammonia or nitric acid. Interest was expressed in the work which the government was doing on phosphoric acid, but the fertilizer maker was not sufficiently excited about it, at least not to the point of spending any money on the problem. In other words, the fertilizer industry sits under a roof which needs patching badly and says: "What's the use of mending it, it isn't leaking now." The sequel to this may be that in five, ten or fifteen years when the fertilizer industry is buying synthetically produced nitric acid, ammonia and phosphoric acid at prices which the manufacturers of these commodities happen to demand they will have no cause for grievance on the subject. In fact it would not be at all surprising if manufacturers of synthetic nitric acid, ammonia and phosphoric acid would displace the present makers of fertilizers.

The fertilizer industry is not by any means the only offender, but it is a large and important one. Manufacturers of dyes in this country are beginning to lie back on their somewhat faded laurels. The minute they curtail research their roofs begin to leak, for dye making demands the most vigorous research of any industry.

It is the same old moral and we feel a little like the Scotch preacher who kept preaching the same sermon to his congregation. After the fifth or sixth repetition one of the elders of the church asked him why he didn't tell them something new, whereupon the wily pastor replied: "When you begin to live up to the message of this sermon, then I'll begin to think about a new message." So it is with chemical manufacturers. When the day comes, though we suppose it never will, when all chemical manufacturers understand and appreciate the vital nature of research work, then we shall stop harping on the old refrain. Meantime, is your roof leaking?

Kotaro Honda, Bessemer Medalist

AT THE annual May meeting of the British Iron and Steel Institute, the Bessemer Medal was awarded to Dr. Kotaro Honda, the Japanese scientist, in recognition of his researches into the magnetic properties of iron and steel.

Dr. Honda was born Feb. 23, 1870, and was graduated in the physics department of the Tokyo Imperial University at the age of 28. He remained in that institution for 10 years, doing post-graduate work and lecturing in physics. At the end of 5 years he received the degree of Doctor of Science. Much of his time was taken up in the study of magnetic phenomena, and several of his papers on magnetism appeared during the time he was at the Tokyo Imperial University.

The years 1908 to 1912 were passed studying in Berlin, Göttingen and Paris. In Berlin the magnetic susceptibilities of various chemical elements were studied in the private laboratory of the late Prof. H. du Bois. Dr. Honda's first work as a metallurgist occurred under Prof. Tammann's direction, in Göttingen, where he investigated the structure of metals and alloys.

In February, 1912, he returned to Japan, having been appointed professor of physics at the newly established Tohoku Imperial University at Sendai, a city of 100,000 inhabitants situated toward the northern end of the main island. The Iron and Steel Research Institute—of which more will be said later—was established in 1919 with Dr. Honda as president. Since that time his attention has been divided between the university and the Institute.

KOTARO HONDA, BESSEMER MEDALIST

The new Bessemer Medalist has an astonishingly fertile pen. Ever since his graduation he has been constantly investigating the problems of magnetism, both in theory and experiment. Forty-one scientific papers, written in English or German, contain the results of these studies. From a strictly utilitarian point of view his labors are more important for the development of a magnet steel of superior qualities. During his first 8 years after graduation Dr. Honda was also concerned with some geophysical problems, such as seiches (stationary undulations) in lakes and bays, geysers, and the periodic changes in level in deep wells —studies which resulted in nine papers written in English. Since his return to Japan in 1913, he has been chiefly concerned with problems in physical metallurgy of iron, steel and other alloys, and has written thirty-six papers recounting his findings, all of which have appeared, either as originals or reprints, in the *Science Reports* of the Tohoku Imperial University. Dr. Honda and his associates developed a method for studying changes in the magnetism of a metal as the temperature varies. Using this new tool, researches into the constitution of plain and alloy steels have been able to furnish a great amount of information on hitherto unsolved problems. Of these, perhaps the most notable are extended investigations into the constitution of chromium steels, tungsten steels and tungsten-chromium (high-speed) steels. Beyond all this, Dr. Honda has found time to publish several books in his native language: an 800-page Text Book on Physics for high school students; a similar but shorter volume for university students; a 320-page monograph on Magnetism and Matter; and three short brochures on certain investigations of iron and steel.

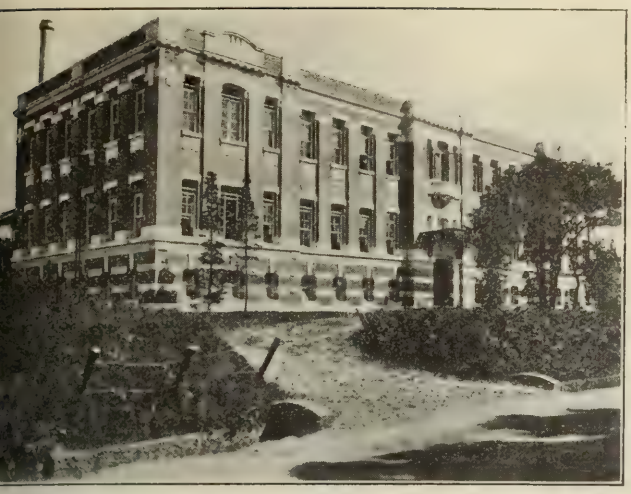
In addition to the Bessemer Gold Medal, Dr. Honda has received the Gold Medal of the Institute of Electrical Engineers of Japan, the Gold Medal of the Institute of Mechanical Engineers of Japan, and the Academy Prize of Japan, consisting of a medal and a grant of money. Dr. Honda, in addition to his duties at Sendai, is a member of the National Research Council of Japan and of the Aëronautical Research Institute of Tokyo.

Notes on the establishment and present scope of the Iron and Steel Research Institute may best be given in Dr. Honda's own words:

"The foregoer of the Institute, a temporary research institute for physics and chemistry, was started under my supervision in 1916 amid the great war with a personnel of six and an annual budget of 7,000 yen only, for the investigation of iron and steel. This budget was subscribed by Baron K. Sumitomo, of Osaka, Japan. Two years later, when research had been recognized by the public as very useful for the progress of science and industry, it was decided that the Institute should have a permanent organization.

Fortunately Baron Sumitomo again offered a donation of a building [shown in two views on the next page] and its equipment to the government; the latter agreed then to establish a permanent research institute for iron and steel belonging to the university. In 1919 the government organization was established with an annual budget of 50,000 yen and a staff consisting of the president, two research professors, five assistant professors, nine assistants and three mechanics.

"In 1921 an extension of the Institute was again undertaken by the government. It is to be completed



FRONT VIEW
IRON AND STEEL RESEARCH INSTITUTE

BACK VIEW
WITH SHOPS AT REAR OF INSTITUTE

n the three years from 1922 to 1924; the Institute is enceforth enabled to investigate not only iron and teel, but also non-ferrous metals and alloys. The ontingent outlay amounts to a total of 240,000 yen; he annual budget for 1922 is 90,000 yen, for 1923, 30,000 yen, and for 1924, 170,000 yen. After three ears, when the organization is completed, the staff will onsist of the president, four research professors, twelve assistant professors, twenty-seven assistants and twenty-five mechanics, etc.

"Though my institute is almost insignificant in its scale compared with a similar institute of metallurgy in your country, such as that in the Bureau of Standards, yet this is the only national research institute in our country—a miserable state from the scientific viewpoint."

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

THE annual meeting of the Society of Chemical Industry has already been described by Dr. Hendrick nd the chemical portion of what has this year been veritable American invasion has, if rumor is correct, ad every opportunity of comparing "dry" states with, or example, dry sulphate of ammonia as made in Scotand. A British contemporary draws attention to the pparent lack of a constructive and progressive policy n the part of the society. Although there has certainly een a "tendency toward routine and repetition" this harge cannot be laid at the door of the Chemical Engineering Group, whose sessions were an outstanding eature of the convention, and in more than one quarter t was suggested that this was a case of the tail wagging the dog. Experienced observers of British charcter, however, realize that new developments are often nitiated without warning and it is by no means improbable that the society may already have something p its sleeve.

SPENT OXIDE INCREASINGLY USED IN ACID WORKS

Many sulphuric acid plants had to burn sulphur instead of pyrites during the war period, but the partial eturn to more normal conditions of working has been elayed by the lack of demand for acid. Spent oxide as been accumulating at the gas works; partly because ome of them found the manufacture of anhydrous amonia more profitable than that of sulphate. These onditions have reacted upon each other to keep the rice of acid abnormally high and the revenue from he sales of spent oxide has been insufficient to offset ne purchases of acid. As a result there is a tendency to use spent oxide, sometimes enriched with sulphur, instead of arsenical cuprous pyrites, with all its attendant disadvantages and the subsidiary processes required for the manufacture of the superior grade of acid. The position will probably gradually adjust itself, but it is unlikely that the use of pyrites will again reach its former dimensions. Ammonia oxidation equipment for sulphuric acid manufacture continues to find favor, particularly in the larger works and for coke-oven installations; several firms are now able to supply standard equipment.

POLICY OF THE BRITISH DYESTUFFS CORPORATION

The annual meeting of the British Dyestuffs Corporation indorsed by a very substantial majority the policy of the directors and was a personal success for Sir William Alexander and his claim that the directing head of such an undertaking should be primarily an administrator with experience in administration of similar undertakings. Dr. J. G. Burnham, who will be remembered as the general works manager of the Gretna munitions factory, will act in a similar capacity to the corporation, and the research department will be continued as before under Professor Green and Mr. Baddiley. It is frankly realized that the corporation has a difficult task before it, but it is already evident that the very straightforward statement of the present position, the radical cutting down of expenses and inventories, and the improvement in quality of colors and in cash assets have restored a large measure of confidence in the future, particularly as personal issues have now been largely eliminated. Referring to the key industries act, it has been decided that boracic acid was wrongly included in the schedule and it will cease to be treated as a fine chemical and will be exempt from

duty. The hearing of a complaint that photographic hyposulphite of soda has been wrongly included in the schedule is of some importance because it is typical of a number of products which are regularly manufactured by the heavy chemical industry in a high state of purity, comparable with the purity of many fine chemicals. A prophet is never without honor save in his own country, but on the basis of recent decisions it is expected that the duty will be removed or a compromise reached.

Proposed Advisory Scientific Committee

Until it was realized that scientific advice was indispensable for the Munitions and War Departments, technical advisers were at a discount for political purposes. There is again a tendency to drop the scientific pilot, and it has brought forth in the form of a letter to the *Times* a concrete proposal from Sir William Pope to establish an advisory science committee to the Board of Trade. There is no doubt that this country has lagged behind other countries in the movement for establishing a system by which the government can consult not only the trades concerned but also more impartial experts before introducing half-baked legislation or regulations, and so avoid their inevitable reconsideration when subsequently criticized or actively opposed. It is felt, however, that liaison with science is essential not merely for the Board of Trade but also for other government departments, and that the continental system of registering scientific legal assessors and attaching them to the courts of law has much to recommend it. Something has already been done in connection with the administration of the dyestuffs and of the safeguarding of industries acts, but there is a dangerous tendency always to put the burden upon the same set of men, instead of spreading these responsibilities and diversions from normal activities to include some of the more active, if less experienced, specialists.

Industrial Devepopments and General Notes

Ransomes, Sims & Jefferies, of Ipswich, are now manufacturing the Kestner water tube boiler in this country and a brief reference may be appropriate as illustrating the way in which what might almost be termed a chemical engineering problem—hitherto an untrodden preserve of the chemical engineer proper—has been invaded by one of the world's leading chemical engineers. The Kestner boiler is the direct outcome of experience in connection with the evaporation and concentration of chemical liquors and resembles a standard evaporator except that the vertical tubes are arranged in the form of a double *W*, over which the flue gases take a zigzag path. To promote circulation, a number of the tubes are made of larger diameter and inside them are fitted smaller concentric tubes supported by spiders. In actual practice it is found that very little scaling takes place with normal waters, tubes can be replaced very easily and, the lower drum being freely suspended, all tubes are free to expand. An interesting feature is the possibility of combined gas and fuel firing, and it is understood that efficiencies of about 80 per cent have been obtained in practice with an evaporation of about 7 lb. of steam per sq.ft. of heating surface. The Kestner company in England has recently become the sole licensee in Europe of the Merrill process of industrial heating by oil circulation, originally developed in America.

Italian Chemical Industries

From Our Special Correspondent

Genoa, July 4, 1922.

THE month of June was full of upsets for the Italian chemical industries. The agitation among the workmen continued. But there was very little actual discontinuation of work and in the case of some soap, perfumery, shoe cream, match, beer, mineral water and superphosphates works, an agreement was reached with the workers that was followed on July 2 by a general contract of work in Liguria, Piedmont, Lombardy and Tuscany.

Petroleum Supplies

A new large firm has been formed for the development of petroleum in Italy and abroad. The Italian Government did its best to make arrangements with Russia, Poland and Rumania for facilitating the importation of petroleum from these countries, and three separate agreements were signed. The exploitation of the petroleum deposits available in Italy itself was also encouraged. The imports of this product during the last half of 1921 reached 64,636 tons, and those of gasoline 57,437 tons.

Caustic Soda

The Italian production of caustic soda continues good and it is gradually being extended. The products are more easily obtained on Italian markets than in the past and are nearly always offered at much lower prices than the imported products. This production is however, unfortunately still small in comparison with what would be required in Italian industry.

Tanning Materials

For assisting the leather industry, that is passing through a very severe crisis, the works producing tanning materials, and especially chestnut extract, kept their quotations low and their behavior was appreciated by the tanners that produced most of their leather through the use of this extract. The Italian producers of mimosa, oak bark and other extracts could increase their production by such procedure as well as making some exports. During the last half of the past year the exports of liquid tanning extracts reached 3,331 tons, and the exports of dry tanning extracts 613 tons; whereas imports of 219 tons of liquid extracts and 1,893 tons of dry extracts were noted.

Fertilizers

The demand for superphosphates, nitrate of soda and nitrate of ammonia was small, whereas a certain activity was noted with cyanamide, Thomas slag, sulphate of ammonia, chloride of potash and sulphate of potash. The imports during the last 6 months of 1921 were as follows: 18,625 tons of mineral and bone superphosphates, 4,075 tons of Thomas slag, 3,324 tons of nitrate of soda, 11 tons of calcium cyanamide, 609 tons of sulphate of ammonia, 3,662 tons of potassium fertilizers.

New Combination for Producing Tartaric Acid

The fusion of the firms Società Appula, of Bari, Società Italiana dei Derivati della Cellulosa, of Milan, and Società Anonima Acido Tartarico, also of Milan, has taken place, forming one large firm with a capital of 25,000,000 lire.

Handling the Finished Products of Industry—IV*

By Graham L. Montgomery

Handling in the Beverage Industry Consists of Handling Empty Bottles to the Filling Machines and Filled Bottles Away From These Machines —This Handling Is Essentially One Problem — Methods Used by the Beech-Nut Packing Co.[1] to Solve It

HANDLING equipment, in a beverage industry which bottles its own product, is an economic necessity. The cost of the labor required to perform this handling without the aid of automatic equipment is out of all proportion to the possible selling price of the beverage. As a result, all successful manufacturers of beverages use handling equipment in so far as they are able to make it fit in with other economic factors in their plants.

Reference to Article I of this series shows the handling equipment for finished products divided into three general classes: First, for handling bulk or unpacked products; second, for handling finished products packed in various kinds of containers; and third, automatic machines for handling the finished product through various processes such as packing, wrapping and filling.

Handling of Bulk Product

Handling of the first class, in soft drink manufacture, consists of handling by pipe line—using gravity head where possible and in other places using pumps. This is because the finished product is all liquid. The last actual process of the manufacture of a soft drink consists of mixing the flavored sirup and the charged water. This occurs exactly at the completion of the first class of handling, when these two finished ingredients are mixed in the bottles. Here we have an exception to the general rules laid down in the first paper of the series—for normally the manufacturing processes are all completed before any operation is encountered which can be justly classed as finished product handling.

Handling of the Second and Third Classes

In bottling a beverage, handling comprised in our second and third classes must be considered as one general process—from the handling standpoint. Here we find that the handling starts with the empty bottle and the empty case, and moves from this point in a continuous path through the operations of preparing the bottle for filling, filling the bottle, sealing, testing and labeling the bottle, packing the bottles in cases for shipment, and moving the filled cases to shipment or storage.

This succession of operations is essentially one problem, the crux being to feed the bottles to the filling head and to take them away from this machine in such a way that its maximum capacity shall be realized. In this paper we shall consider the handling problem of the beverage industry from this point of view.

Beverage Handling at the Beech-Nut Packing Co.

The manufacture of beverages at the plant of the Beech-Nut Packing Co. was described in *Chemical & Metallurgical Engineering* for July 26, 1922. In that paper a description was given of the operation of the automatic equipment as it affected the product. It will be shown here in what manner this automatic equipment ties in with the conveying equipment to make a continuous process of the bottling.

Bringing Empty Bottles and Cases Into the Plant

This plant owns its own box factory, in which the cases are made. Bottles are purchased on contract from various large bottle makers.

Both of these articles are brought to the plant in box cars. Fig. 1 shows several of these cars on the siding along the receiving platform. A car of empty cases is placed near the center of this platform, with a car of empty bottles on its right. A portable gravity roller conveyor is placed to lead from the car of cases to the stationary gravity roller conveyor, which leads along the platform. Another portable gravity roller conveyor is placed to lead from this stationary conveyor to the car of bottles. A third portable conveyor is placed to lead from the car of bottles to a point on the stationary conveyor further toward the right and lower down.

The car of cases is then unloaded onto the conveyor.

*Previous articles in this series have appeared in *Chem. & Met. Eng.* as follows: Article I, vol. 26, No. 18, p. 823, May 3, 1922; Article II, vol. 26, No. 19, p. 885, May 10, 1922; Article III, vol. 26, No. 24, p. 1,114, June 14, 1922.

[1]An article descriptive of the process used in the ginger ale plant of the Beech-Nut Packing Co. appeared in *Chem. & Met. Eng.*, vol. 27, No. 4, p. 150, July 26, 1922.

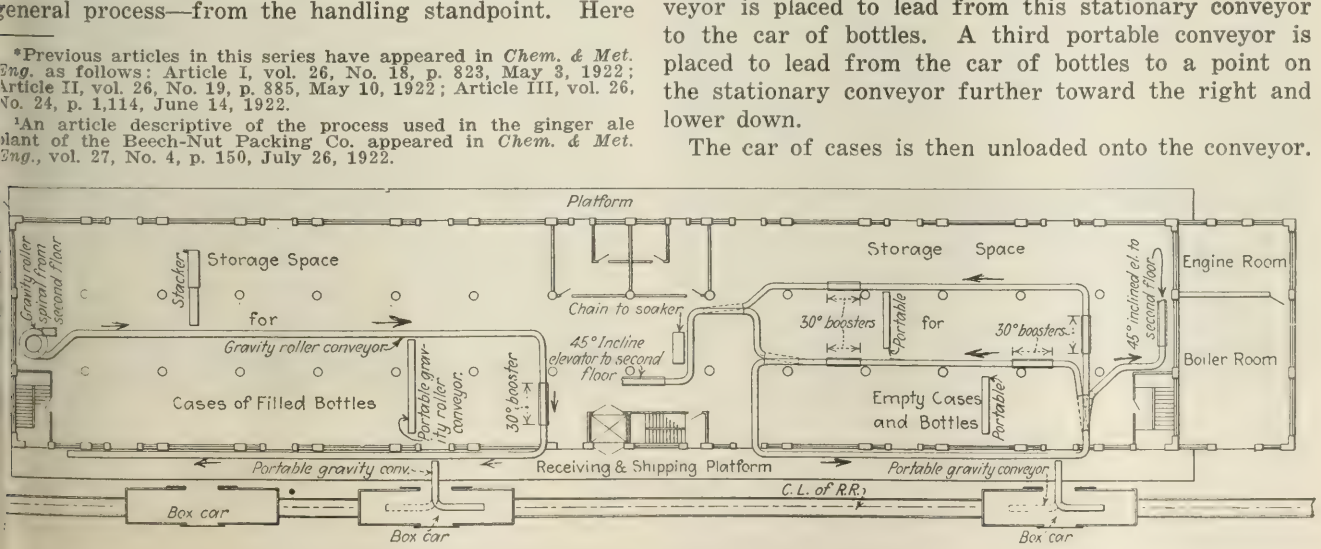


FIG. 1—CONVEYORS ON FIRST FLOOR OF PLANT

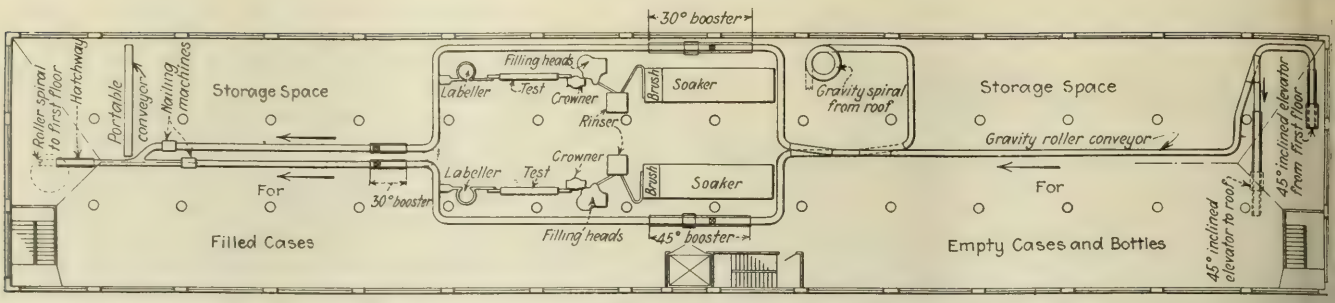


FIG. 2—CONVEYORS ON SECOND FLOOR OF PLANT

The conveyor takes the cases to the car of bottles. Here the workers fill each case with the empty bottles and place it on the third portable conveyor. This conveyor takes the cases back to the main gravity roller conveyor line and they are distributed from this line to the various storage areas for empty cases and bottles.

Storage System for Empty Cases and Bottles

By referring to Figs. 1 and 2 it will be noticed that the floor area at the right side of each drawing is marked "Storage for Empty Cases and Bottles." The space on the roof—shown in Fig. 3—is also used for this same purpose.

As the cases full of empty bottles pass into the building—at the right or east end as shown on the sketch in Fig. 1—they may be directed by means of the three-way switch to any of the storage areas mentioned above. The cases are stacked about 10 ft. high in these areas. It has been found inadvisable to use stacking machines to any great extent, as the same crew that would be used in connection with a stacking machine can stack these light cases more quickly by hand methods. The total floor area of these several storage spaces is about 18,000 sq.ft.

The gravity conveyors used in this system are at no point so high that the workers cannot easily remove a box. For this reason and due to the slope allowed in the conveyor for the purpose of causing the cases to move along it, it is necessary to provide power conveyors at intervals, as shown on the sketches, in order to boost the level back to a point where gravity can again be employed. These boosters, inclined at 30 deg. to the horizontal, are inclined package elevators of the push-bar type. They are made up of bars spaced at about two-case intervals and carried between two power-driven chains. The bed on which the cases slide is of steel slats parallel to the travel of the cases. Several of the photographs used to illustrate this paper show these boosters clearly. The elevators which take cases from one floor to another are of the same type, but are inclined 45 deg.

Conveying the Empty Bottles From Storage to Washing Machines

Before the bottles can be filled, it is necessary for them to be thoroughly cleansed.

Of course, if the required number of bottles and cases for one day's operation of the filling machinery were received each day, it would not be necessary to have any of this storage described above. But railroads do not deliver freight in this manner, and in order to guard against any possible shortage it is necessary to keep the storage area fairly well filled with cases and bottles.

The conveyor which distributes the cases to the storage areas on the roof—shown in Fig. 3—is continuous and also serves to take these cases out of storage. When it is desired to do this, the cases are placed on the conveyor and the conveyor leads them onto the roller spiral conveyor shown in the upper left corner of this sketch. This spiral conveyor, together with a short run of gravity at its lower end on the second floor, delivers the cases with their load of empty bottles to the second floor conveying system.

Out of Storage on the First and Second Floors

The bottles are carried through the soaker—which is the first element of the washing machinery—on conveyor. While the soakers are situated on the second floor, the conveyors that feed them loop down to the first floor, so that the bottles which are to be washed may be fed in on either floor. This serves the purpose of permitting the storage of bottles from cars into the storage spaces of the second floor and room at the same time that bottles are being taken from storage on the first floor to feed the soaker conveyor.

It will be noticed from the sketches and from the accompanying illustration that the gravity conveyors which handle the empty bottles have, in each case, on both the first and second floors a length passing directly in front of the soaker conveyor. The cases each with its load of empty bottles, are taken from storage and placed on a line of conveyor which leads either to the first or second floor soaker loading station; or, if used directly from the cars, they are routed over the central run of conveyor to the loading station on the first floor as shown in Fig. 1.

Handling Bottles Through the Washing Process

The conveying element of the soakers, as can be seen in the photograph, consists of two steel bar power driven chains, which carry the bottle holders spaced at regular intervals. The soaker tenders stand between the gravity conveyor and the front of the soaker. As the cases come along the gravity conveyor, they remove the bottles and place them in the compartments of the

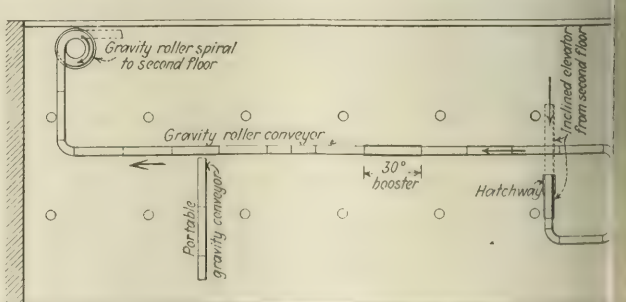
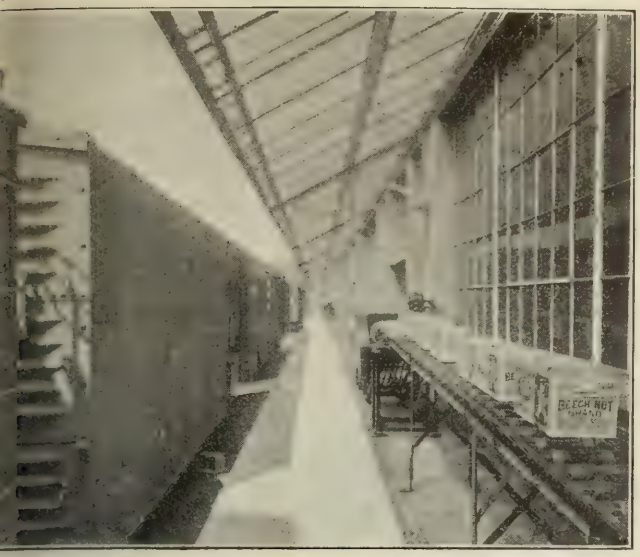
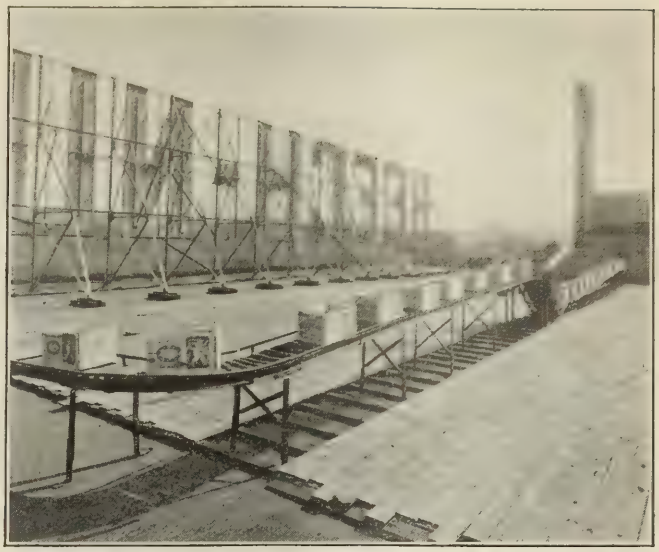
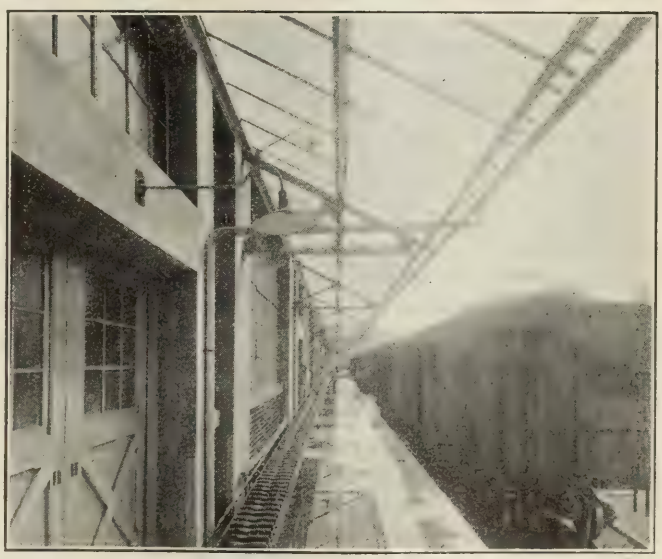


FIG. 3—CONVEYORS ON ROOF OF EAST END OF SECOND FLOOR







UPPER LEFT—RECEIVING CONVEYOR ON PLATFORM

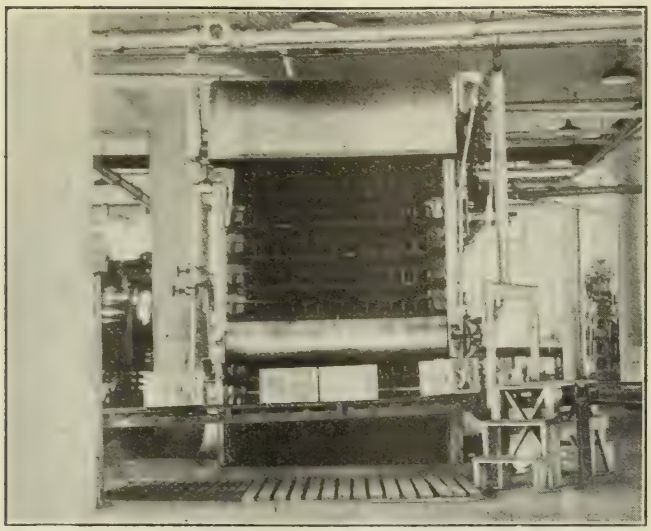
CENTER LEFT—CASES AND EMPTY BOTTLES ON SECOND FLOOR CONVEYORS

LOWER LEFT—CASE-FILLING STATION

UPPER RIGHT—DELIVERING CASES TO ROOF STORAGE

CENTER RIGHT—CASES AND EMPTY BOTTLES ON FIRST FLOOR CONVEYOR

LOWER RIGHT—SHIPPING CONVEYOR ON PLATFORM



GRAVITY CONVEYOR RUNNING IN FRONT OF SOAKER

bottle holders on the soaker conveyor. The empty cases continue along the gravity conveyors toward the west or left end of the building—passing around the washing, filling and other machinery—meeting the filled bottles at the point where these are to be loaded back into the cases. Reference to Fig. 2 will show clearly this routing.

After the bottles are placed in the soaker conveyor, the compartments in which they rest are automatically barred so that each bottle is held firmly and may be reversed without spilling from its compartment. The conveyor then carries the bottles up and down through each of three compartments filled with warm caustic solution and two compartments filled with warm sterilized water. This process—called soaking—requires 30 minutes for completion.

The conveyor, with its load of bottles, emerges from the soaker near the top and traveling straight downward. Part way on its downward path the bars are automatically removed from the bottle compartments and the bottles are discharged into the brushing machine.

Brushing and Rinsing the Bottles

As the bottles leave the soaker conveyor they slide, butt first, into the brushing machine. This machine—which is really one with the soaker—is of the same width and has a separate channel or path for each bottle delivered from the full width of the soaker conveyor—which is fifteen bottles wide. These channels slope sufficiently to cause the bottles to slide under the brushes. From that point they are moved forward mechanically, being rotated on their axes while passing under the brushes. These brushes rotate horizontally on axes at right angles to direction of bottle travel. These two motions serve to clean the outside surfaces of the bottles thoroughly, removing any old labels which adhere.

Passing beyond the brushes, the bottles are moved into an upright position and delivered to a single-chain conveyor traveling at right angles. This conveyor is made up as follows: The chain is a steel roller chain, carried on sprockets rotating in the vertical plane. The top strand runs between guides. The links of the chain carry steel plates in such a manner as to make a moving platform between these guides. On this moving platform the bottles are carried upright and in single file to the rinsing machine.

The rinsing machine takes the bottles automatically from the above-mentioned conveyor. In this machine while the bottles are in continuous forward motion, the inside of each is thoroughly brushed out and rinsed with sterilized water. This being completed, the rinsing machine delivers the bottles—upright and in single file—to a single-chain conveyor exactly similar to that described above.

Filling and Crowning the Bottles

This last conveyor moves the bottles a short distance to the filling machines. There are two of these, the "siruper," where the flavoring sirup is placed in the bottle, coming first and then the "filling-head," where the charged water is introduced and mixed with the sirup. The bottles move through these two machines in a continuous line.

After the filling operation is completed, the "filling-head" delivers the bottles to a third single-chain conveyor. This carries the bottles a short distance to the crowner, where the caps are crimped on. The bottles move continuously through this machine and are delivered to a collecting table.

Handling System for Test-Tank

The bottles are taken from this collecting table and placed by hand in wire baskets. These baskets are in turn placed on a slat conveyor about 6 ft. wide, which leads through the test-tank. This test-tank is about 15 ft. long, 6 ft. wide and somewhat over 2 ft. deep. The slat conveyor comes in over the top at one end, travels along the bottom of the tank and goes out over the top at the other end. In this way the baskets with their loads of filled bottles are submerged and the operator is enabled to detect and discard any that are imperfect. The speed of this conveyor is about 12 ft. every 10 minutes, so that the bottles are under water over 11 minutes.

As the baskets emerge from the tank, the bottles are removed by hand and placed on a single-chain conveyor. This conveyor is exactly similar to that described above and takes the bottles, erect and in single file, to the labeling machine.

This single-chain conveyor delivers its load direct

CONVEYOR FROM LABELING MACHINES TO NAILING MACHINES

the labeling machine. Here the desired labels are fixed and the bottles delivered to still another single-ain conveyor.

By referring to Fig. 2 it will be noticed that there a point—just beyond the labeling machine—where e single-chain conveyor widens into a collecting space. t this point are stationed workers, who take the ottles and place them in the cases waiting on the djoining roller conveyor. The roller conveyor is hori-ontal at this point, so that the cases collect and wait ntil needed. When a case is filled the worker, by a ight shove, sends it on down the conveyor, which has slope beyond this point.

Near the left or west end of each run of gravity onveyor shown in Fig. 2 a nailing machine will be oticed. As the cases come down the gravity to this achine, the nailing machine operator places the cover nd, with his machine, nails it down. At the same me the machine stamps the company's index number nd date on this cover.

To Storage or Shipment

Past the nailing machine, the conveyor delivers the ases to a roller spiral conveyor, which takes them a uniform and easy pace to the first floor. Here ey come onto another gravity roller conveyor. This onveyor, shown at the left or west end of Fig. 1, moves em past the storage spaces, where they may be stored tiers by means of a portable length of gravity con-eyor and a stacking machine; or they may be carried n out to the shipping platform, where a portable ravity conveyor takes them directly into the box cars. his main gravity conveyor is also utilized when cases re to be taken from filled-case storage to shipping atform.

Some Features of the Conveyors

The single-chain conveyors described above are a art of regular bottling equipment and are supplied by e makers of this equipment, as are such items as the onveying element of the soaker. The testing tanks nd conveyors were especially designed and constructed or the Beech-Nut Co. The remainder of the conveying quipment, comprising gravity roller conveyors, roller pirals, 30-deg. and 45-deg. incline package elevators, is lvey-Ferguson standard equipment supplied by the lvey-Ferguson Co. of Cincinnati, Ohio.

A study of the three sketches accompanying this aper in conjunction with the text makes it evident at this system is approximately continuous. It is lso automatic with the exception of the following rocesses: Unloading box cars, loading box cars, load-ng soakers, loading and unloading test-tank, and lacing filled bottles in cases. The only operations hich can hold up production are those included be-ween the soaker and the labeler. In order to guard gainst any delay at this point, this apparatus is in-talled in duplicate, each set having a capacity equal to that desired for the plant. The speed at which the ottles can be filled is the governing factor and the onveying, washing, crowning, testing and labeling quipment all has a greater capacity than the filling quipment, so that production can always be kept at a aximum.

Economic Side of the Installation

The Beech-Nut Co.'s plant here described has been in operation for the past 3 years only. Being thus one of the most modern plants of its type in this country, it was originally designed about as it exists at present. For this reason and because the beverage industry as a whole is near the same stage of development, it is impossible to give any figures which can serve as a guide to the economy of the automatic equipment. It seems, however, to be self-evident that the cost of handling the materials involved in a production of about 1,800 cases per day, such as we find at the Beech-Nut Co., would be absolutely prohibitive were manual handling used.

The installation here described is as near ideal for the purpose as any which could be found. The points of interruption in the flow, where hand transfer takes the place of mechanical movement, are as close to a minimum as the present available equipment will permit. Without doubt it will be possible at some future time to eliminate even more of these hand movements; but such improvement depends on new designs and inventions.

One of the economic features of this system worthy of notice is the small amount of power conveyor used —gravity supplying the motive power to the fullest possible extent. This may seem a small item; but the saving in expenditure over some bottling systems which depend on belts or apron conveyors should easily take care of the fixed charges on the conveyors.

The writer wishes to acknowledge the courtesy of the Beech-Nut Packing Co., of Canojoharie, N. Y., in opening its plant for the collection of the data of this article. The illustrations are supplied through the kindness of the Alvey-Ferguson Co., of Cincinnati, Ohio, manufacturer of the conveying equipment mentioned above.

Legal Notes

By Wellington Gustin

Contract for Use of Invention Valid Pending Application for Patent

An interesting point on an inventor's rights in his invention pending his application for patent is involved in the recent action brought by the Cook Pottery Co. vs. J. H. Parker & Son to recover royalties evidenced by promissory notes.

It appears that William Morrill Parker, one of the defendants, in January, 1915, filed application for letters patent in the U. S. Patent Office for the device known as the "Nailit knob" and thereafter it was controlled by the defendants; that in May, 1915, the plaintiff, learning of this device, entered into negotiations with defendants and procured a contract dated Oct. 8, 1915, for the use of this device in the manufacture of the "Wedge knob," then being manufactured by the plaintiff, on a royalty basis; that defendants further learned, after said contract had been made, that one A. H. Fargo had also applied for letters patent on a device similar to that of the "Nailit knob," and, in order to protect the plaintiff in the license granted it by defendants, acquired by writing under seal from Fargo, sole and exclusive license to use said invention, said sale and exclusive license being taken by J. H. Parker & Son, Inc., but that defendants J. H. Parker & Son should have the benefit of the same in order to

protect the plaintiff in the license granted to it by contract in October, 1915. It further appears that afterward, Feb. 3, 1920, letters patent for said invention were duly issued to an assignee of Fargo, who afterwards, on April 28, 1920, granted to J. H. Parker & Son, Inc., the exclusive right and license to make, use and sell devices embodying the invention, throughout the United States and its territories for the full life of the patent, and that defendants, by virtue thereof, and by the application by W. M. Parker for letters patent, have always controlled the right to manufacture and sell the "Nailit knob," a name used to designate any two-piece knob for electrical work assembled with a nail and fastened together by means of a washer or swedge or other projection on the lower part of the knob.

Plaintiff's Contention

Plaintiff contended that these facts showed that defendants, J. H. Parker & Son, did not have ownership and control of the "Nailit knob" device and that therefore they had no right to make the use of the "Nailit knob" device the basis or consideration of the contract of October, 1915, and that this contract was therefore without consideration, and void; in other words, that pending an application for letters patent, the applicant has no such ownership or control of the device sought to be patented as would give him the right to license or permit another to use it. It was claimed that plaintiff, or any other, already had full power and right to use this device in the manufacture of its "Wedge knob," pending defendants' application for patent thereon, and that, when it signed this contract, although under seal, there was no basis for its so doing—no consideration therefor. But on this point the Supreme Court of Appeals of West Virginia in this case at bar, 109 S. E. 744, laid down the principle that an inventor has an inchoate right of property in an invention pending his application for patent, with which he may deal as an article of property, citing Richardson versus Essex Machine Co., 207 Mass. 219. The court further says a license to use a device for which application for letters patent is pending may be given and if acted upon and the device used by the licensee in the manufacture of articles in which the invention is used, it will avail to protect the licensee in the use thereof after the invention is patented.

Question of Consideration

Now the doctrine is laid down by the United States Supreme Court that pending an application for a patent the applicant has no exclusive right to its use (Marsh vs. Nichols, 9 Sup. Ct. 168), and while this may be true, says the West Virginia Supreme Court, yet the use by another of the device sought to be patented, pending the application, ceases when the patent has been granted. It was pointed out that the inducement and consideration to the Cook Pottery Co. for the contract of October, 1915, was to obtain the right to use this device not only pending the application, but to be protected in its use after the device had been invented. The contract was given under seal and a sealed instrument implies a consideration has been passed.

Other observations in the suit were that where defendants were about to pass through bankruptcy when creditors would receive nothing, the saving of plaintiff's claim from the bankruptcy proceedings was a sufficient consideration for the continuance of an agreement between the parties; and again, when a contract under which one-half of commissions to be paid by plaintiff should be applied on debts owing from the defendan contained no definite agreement as to its terminatio it was not invalid for such reason, a reasonable tim being contemplated as a matter of law, and what woul be a reasonable time was for the court and jury t decide under the circumstances.

Reasonable Time for Delivery of Goods Imported With No Time Limit Set

A problem of purchase and sale of goods to be im ported is presented in the recent action of Garbiss Di sizian et al. against A. Klipstein & Co. to recover dan ages for breach of contract because the company refuse to accept a tender of shipment of 50 tons of gum arabi

Terms of Contract

The contract was dated April 23, 1918, and provide for the sale of 50 tons of 1918 crop, freight avera at 25c. per lb. net, c.i.f. New York. Shipment w "From Red Sea to New York on vessel Phyllis, whi is now on her way to Red Sea" and there was a provisi that "Sellers not responsible if shipment of merchandi or sailing of vessel prevented by any government reg lations in country of export or destination, by act God, perils of the sea, or by any other circumstanc beyond the seller's control."

On trial the defense was that there had been unreasonable length of time consumed before deliver giving the buyers the right to refuse to receive t goods.

Delay Not Unreasonable, as No Delivery Date Was Specified

The Phyllis was a sailing vessel. She began loadi in September, 1918, taking on 10,000 bags of gu arabic. Her cargo was loaded at Massowah. It car from vessels arriving from the Sudan, transferred her, after which she was towed 400 miles to Ade where she arrived in November, 1918. A mail-carryi vessel could not have reached the port of New Yo until December 31, 1918. The Phyllis landed in N York on May 29, 1919. She was a slow boat and h speed was not apparently in the minds of the parti at the time they made the contract. From these fa and circumstances the court found that there was unreasonable delay in making delivery of the gu arabic as required by the terms of the contract. T contract was in the course of performance. The sh was making her course to New York and in the abse of express terms as to time of delivery she had reasonable time under all the circumstances to ma the voyage. When the time is fixed, failure to ma delivery justifies a refusal to be bound by the contra Punctuality as to delivery was disregarded by the p ties in the agreement.

An attempt to rescind the contract or refuse to bound thereby, without warning or demand for t goods from the day of loading until their arrival New York, indicated a desire to find a convenient cuse for avoiding the consequences of the contract. drop in the market price of gum arabic in the meanti to 13c. per lb. may have been the reason therefor, sa the court.

Damages for the difference between the contract pr and the market price were demanded, together w storage, all totaling $12,965. The trial court found the sellers and this judgment was affirmed by the Uni States Circuit Court of Appeals, 273 Federal R. 473.

The Technology of the Carbon-Electrode Industry—III

A Critical Review of the Calcination Process: Why It Is Necessary and What It Accomplishes—Details in the Design and Operation of Electric and Gas-Fired Calciners, With Special Reference to Their Use in American Practice—Recent Developments*

By CHARLES L. MANTELL
Division of Industrial Chemical Engineering, Pratt Institute, Brooklyn

RECEDING articles in this series have dealt with the history of the development of the carbon-electrode industry and have discussed the raw aterials entering into the manufacturing processes. is the intention in the present installment to take up e first step in production—to discuss critically the lcination process and the equipment used therein. As eliminary to that discussion, it is perhaps desirable to rect attention to a number of terms more or less timately connected with the carbon industry. First, us consider the process of calcining itself. It is metimes defined as "the heating of a substance to a ite heat." This probably is in keeping with the iginal derivation from the Latin *calcinare*, meaning burn like lime." In the more restricted sense in ich the carbon-electrode industry uses the term, how-er, calcination refers to the heating of a carbonaceous bstance to the temperature required to yield a mate-l with a content of volatile matter not exceeding 0.5 r cent. Uncalcined materials are generally referred in the industry as "green," implying that further brication is required.

There may be said to be four reasons why calcination carbonaceous substances is necessary in electrode nufacture: (1) The green materials when ground not readily be bound together into an electrode of per density. (2) They are difficult to mold or rude. (3) They give off their volatile matter during king, thus resulting in a very porous electrode. (4) ey are poor conductors and have a much higher re-tivity than the calcined material. Calcination causes actual shrinkage in the volume of the carbonaceous bstance. It therefore effects an increase in the cific gravity or real density of the electrode as it is en termed in the industry.

Calcining Equipment and Its Operation

The calciners used in the electrode industry are either velopments of the industry and its close connection h electrothermic and electrolytic processes, or else adaptations from the manufacture of gas for indus-al or illuminating purposes. The electric calciners, "shrinkers," as they are often called, are example of first class, and the Woodall-Duckam and Glover-st vertical gas retorts are examples of the second. Of the two types of equipment used in the calcining cess—the electric and gas—the latter are by far the re prevalent. The electric calciners, however, were first to be used in the industry, and where electric ver is cheap and abundant they possess certain irable features. Each of the various types of calcining equipment is now to be discussed, with particular reference to those in American practice.

Intermittent Electric Calciners

Intermittent electric calciners usually consist simply of upright cylindrical steel shells lined with a highly refractive firebrick and resting on a ring of refractory brick work. A diagrammatic sectional elevation is shown in Fig. 2. Single-phase alternating current, with a voltage range of 30 to 60, is supplied to the aluminum or copper busbars encircling the shell.[15] Riser buses

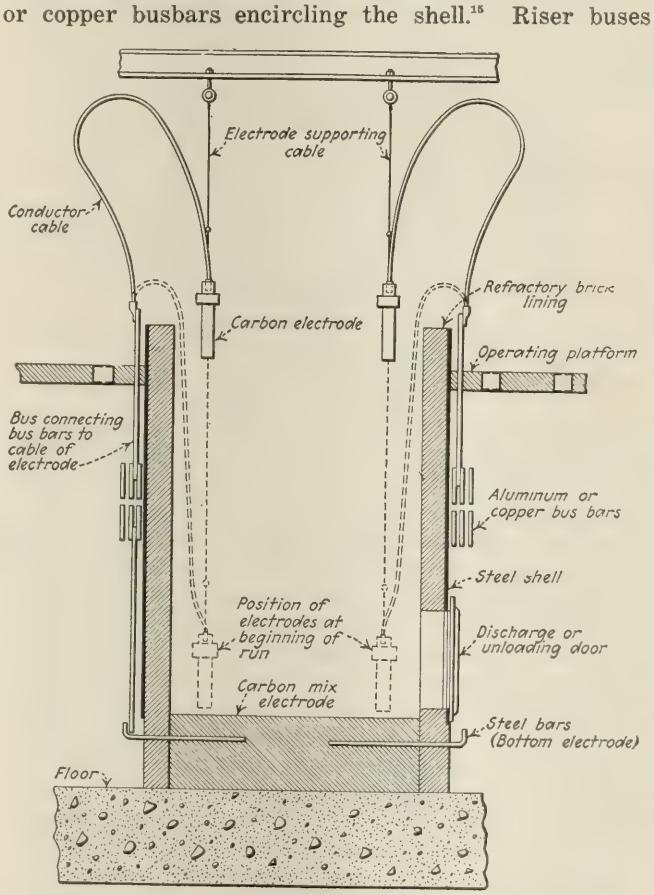


FIG. 2—SECTIONAL ELEVATION OF INTERMITTENT TYPE OF ELECTRIC CALCINER

from the upper ring of busbars serve to carry the current to the flexible conductor cables connected to the electrodes. The electrodes, usually 6 to 8 in. in diameter and 42 to 60 in. long, are suspended from above by the use of steel wire cables. Strain insulators serve to insulate the cast-iron head of the electrodes from the cable and the overhead supporting beams. These elec-

*Part I, which reviewed the history of the industry, appeared *Chem. & Met. Eng.*, vol. 27, No. 3, July 19, 1922. Part II, ing with the raw materials for electrode manufacture, ap-ed in *Chem. & Met. Eng.*, vol. 27, No. 4, July 26, 1922.

[15]For further electrical details than are given in this article, see Yardley, "Production of Shrunk Coke in Electrode Manufacture," *Chem. & Met. Eng.*, Feb. 15, 1922, vol. 26, p. 321.

trodes are protected from rapid oxidation by sheet-iron casings filled with a tar-bound mix of finely ground carbon. The construction is shown in Fig. 3.

The lower ring of busbars supply current to the bottom electrodes through risers which consist of rolled steel bars, bolted on the outside of the shell to the riser buses. The bars, usually 2 in. thick and 8 in. wide, are imbedded in a baked layer of a tar-bound carbon mix, which has been placed in the bottom of the shell while in a plastic condition and baked in place.

The arrangements and spacing of the suspended electrodes and the corresponding spacing of the bottom ones are as shown in Fig. 3.

In operating the calciner the top electrodes are

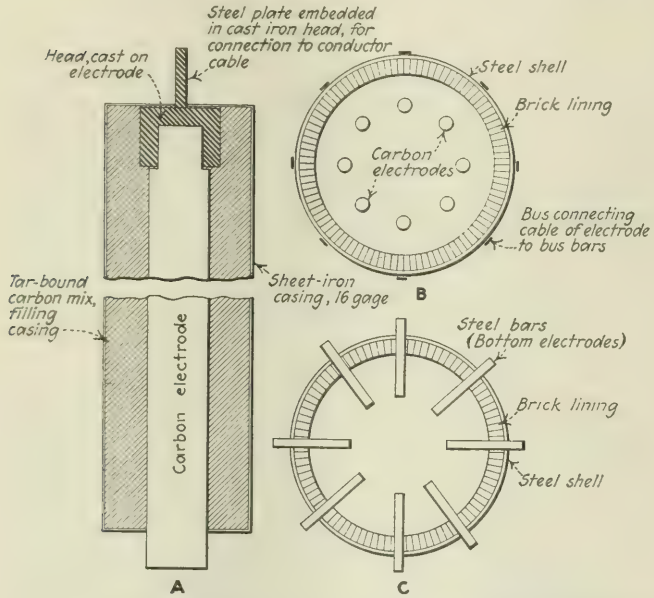


FIG. 3—CONSTRUCTIONAL DETAILS OF INTERMITTENT ELECTRIC CALCINER

A—Sectional elevation of electrode. *B*—Plan of top showing arrangement of electrodes. *C*—Plan of bottom showing arrangement of steel bars in bottom electrode.

lowered so that they almost touch the bottom and thus cause an arc to be formed. Green material, fed in at the top of the furnace, falls to the bottom and is heated by the arc. When the material is heated sufficiently to conduct the current, the electrodes are gradually raised, the arc broken and heating continued through the electrical resistance of the charge. More and more material is fed in at intervals and the electrodes raised as each additional layer of the charge becomes conductive. In this manner the electrodes are gradually raised from the bottom to the top of the calciner during the course of 8 to 12 hours. Heating is then continued, usually for an additional 12 hours. After about 24 hours the top electrodes are raised out of the bed of heated material and the charge is permitted to stand or "soak" for 24 hours before it is unloaded. This is done so that the charge will develop the same heat in all portions of the material, and time will be allowed for the volatile matter to escape through the charge. Furthermore, it is necessary for the whole mass to cool somewhat before unloading. It has been found that the percentage of volatile matter of the calcined coke varies inversely with the "soaking" time; the longer the soaking time the lower the volatile matter.

The charge is unloaded from the calciner by opening the discharge door on the side, breaking down the brick work, and hauling out the coke with long-handled rakes. As the material is still red hot, it is usually cooled by spreading it out on the floor in thin layers, or when necessary, sprinkling it with a fine spray of water. Wetting must be very carefully done, however, in order to avoid an excess that will not be evaporated by the coke. Moisture specifications for calcined coke call for a maximum of 0.3 per cent of water in order that when the material is finely ground it will not clog or "plug" the grinding mills.

The Trend of Recent Developments

The development of electric calcining units, particularly during the last 10 years, might well be shown by a brief review of the patents on the subject during that period. The developments have been along the lines of continuous furnaces, with attention given to the preheating of charges and recovery of the sensible heat of the calcined material as well as to the recovery of the valuable combustible gases produced as a result of calcination.

Attempts have been made at various times to convert the intermittent vertical type of furnace into a continuous one by providing it with some means of removing the calcined coke as it has been calcined. In most of these experiments there was little, if any, cooling of the coke and no sensible heat recovery; furthermore, the gas produced in the process was lost. These studies have resulted in only slight improvements over the original intermittent type of calciner.

Brown[16] is responsible for the adaptation of the hollow electrode to electric calciners. One of his earlier furnaces is shown diagrammatically in Fig. 4. It consists essentially of a hollow electrode located a

[16]John W. Brown, U. S. Pat. 1,067,795 (July 22, 1913).

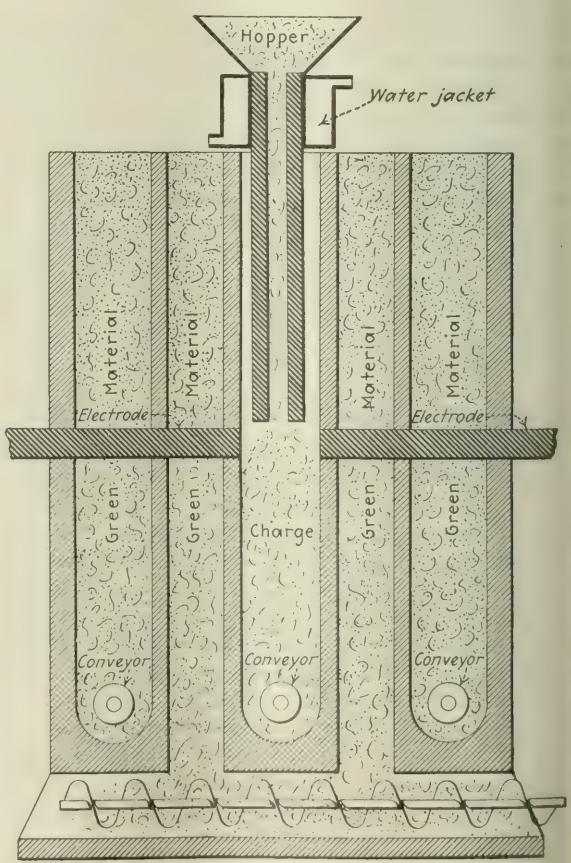


FIG. 4—HOLLOW ELECTRODE CALCINER (EARLY DESIGN)

e top of the furnace and passing through the cover, rough which the material to be calcined is fed. There e two solid electrodes set horizontally through the le walls of the furnace. The radiated heat of the arge undergoing calcination is made use of by caus- g green material to pass on the outside of the mate- al part between the inner and outer shells of the rnace before being placed in the heating zone. The ethod will be easily understood by referring to the ure. Some sort of conveying machinery serves to move the heated coke from the various chambers.

Brown next expanded the idea of using a high tem- rature and exposing the material to this temperature r only a short time by making the passage through e furnace very rapid. Fig. 5 shows an extension of s method of heat recovery by the use of surrounding yers of uncalcined material passing in the same direc- on as the charge.

In 1915 Brown[17] patented an electric calciner which

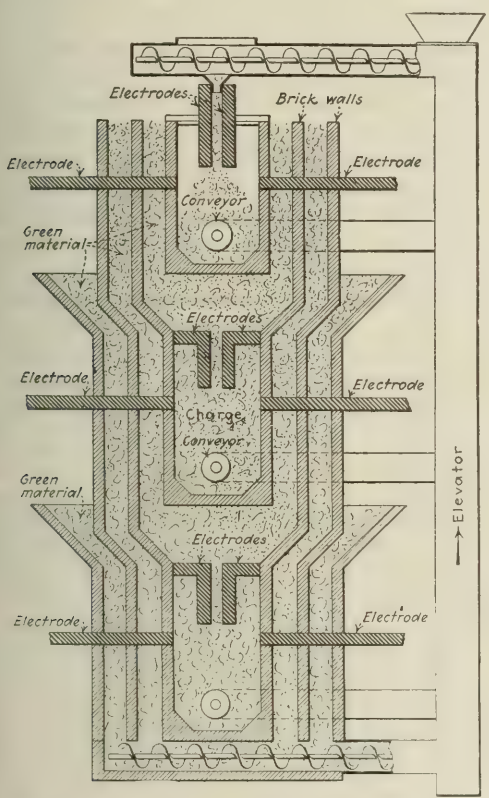


FIG. 5—COMBINATION OF HOLLOW ELECTRODE CALCINERS TO UTILIZE HIGH TEMPERATURE AND SHORTER TIME OF EXPOSURE

is continuous in its operation and recovered the seous products of calcination by a suction system. his is shown in Fig. 6. The charge enters the furnace om the hoppers at the top, dropping down through e opening between the upper electrodes. It is cal- ned during its passage between the upper and lower ctrodes. The lower electrodes are hollow and serve a means of entrance for blowing in gases drawn off other portions of the furnace. These gases cool the ctrodes and in their upward passage after being ated in the heating zone serve to preheat the cool un- lcined coke. The walls inclosing the charge are of rbon, and are insulated from the outer retaining lls by some good non-conductor. The gases resulting from calcination are drawn upward and are cooled in the the condensing chambers C_1, C_2, C_3, C_4, C_5, from which they are drawn through pipes to the exhaust fan. The calcined coke is removed at the bottom of the chamber by a conveying apparatus.

Later a furnace[18] was brought forward which was continuous in operation, recovered the gases resulting from calcination and used these gases to reclaim heat

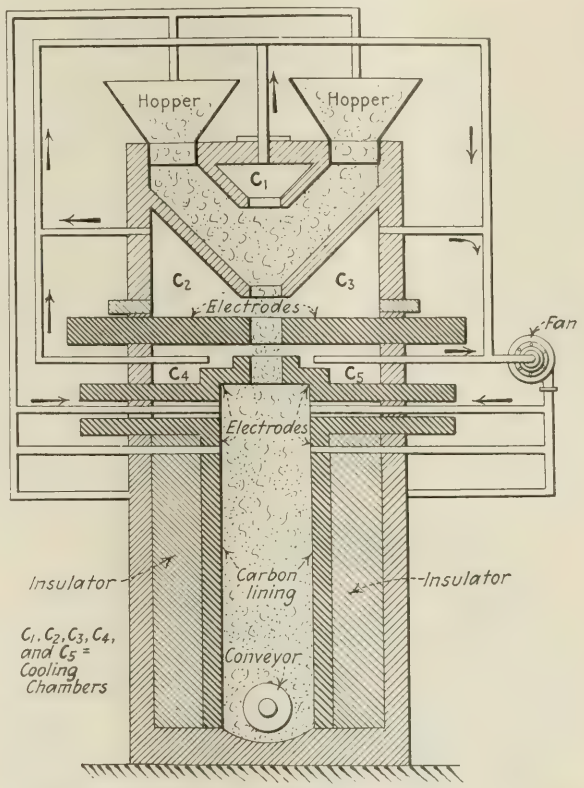


FIG. 6—AN EARLY DESIGN OF A CONTINUOUS CALCINER

from the calcined coke and preheat the green charge. A diagrammatic sketch of the furnace is shown in Fig. 7. Essentially the unit consists of a brick shell in which there is an upper and lower electrode. The charge enters through an opening at the top and passes by the upper electrode into an inverted conical shaped chamber which is carbon lined, then into a restricted cylindrically shaped chamber, also carbon lined, where most of the calcining takes place. Dropping from here into another carbon-lined chamber shaped like the frustum of a cone, the charge finally passes to a conveyor mechanism which removes the material from the furnace. Calcining takes place as current is introduced into the furnace through the upper electrode. Some of the current will pass through the adjacent charge and some through the chamber lining to the cylindrically shaped portion of the furnace, where, due to the negative coefficient of temperature resistance of the carbonaceous charge and the construction of the side wall lining, most of the current passes through the charge. The side wall lining is built of carbon blocks with surfaces corrugated where they come in contact; as a result their contact resistances are very high (see Fig. 7). From then on most of the current passes to the side walls and to the lower electrode and only a small portion through the charge to the electrode. The calcined material is cooled

[17]U. S. Pat. 1,143,940.

[18]U. S. Pat. 1,147,703.

by coming in contact with gases blown in through the bottom of the furnace. The gases in their upward passage cool the heated material, but are themselves heated at the heating zone. The heat they absorb at this point is transferred to the cold green material through which the gases rise, thus preheating it.

At various times patents[19] have been granted for furnaces in which portions of the charge were burned in order to preheat the materials before calcination and also to lower the cost of the process by reducing the amount of electric power consumed.

Probably the most recent patent on the subject is one for a ring-electrode, continuous-type calciner.[20] This type provides for continuous operation, recovery of the sensible heat of the calcined material, recovery of the gaseous products of the process and preheating of the uncalcined material. A diagrammatic drawing is shown in Fig. 8.

The furnace is of the vertical type, made up of three flanged sections. These sections are insulated from one another and the upper and lower ones lined with carbon electrodes or other carbon material. The middle section is provided with an insulating refractory brick lining. The heated portions of the shell are jacketed for water cooling. Material to be calcined is fed into the furnace continuously through the top. Gases arising from the

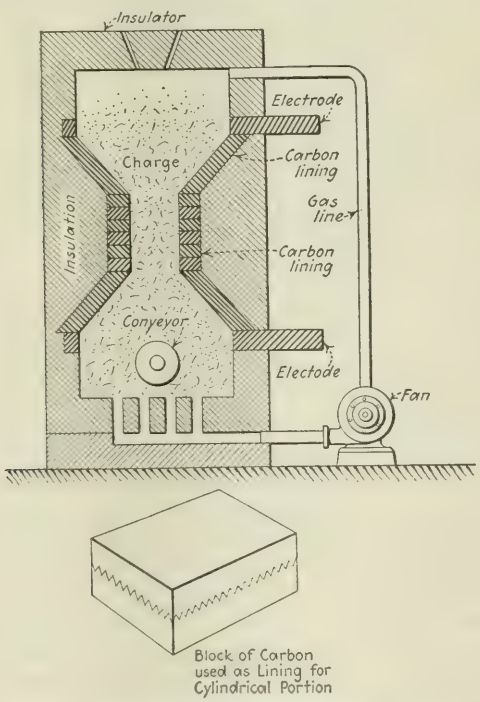


FIG. 7—ANOTHER EXPERIMENTAL DEVELOPMENT OF ELECTRIC CALCINER

expulsion of volatile matter pass off through an offtake at the top. A tee in the pipe allows some of the gases to be returned to the furnace at the bottom after the gases have been scrubbed, cleaned and cooled. The cold gases in passing up through the calciner cool the descending coke, pass through the heating zone between the upper and lower electrodes and cause a more even distribution of the heat. In passing off at the top, since the gases are now very hot, they heat the descending cold green materials and cause them to become conductive by the time they reach the zone of electric heating. Coke is extracted mechanically at the bottom.

[19]U. S. Pats. 1,177,680 and 1,184,817.
[20]U. S. Pats. 1,366,457 and 1,366,458.

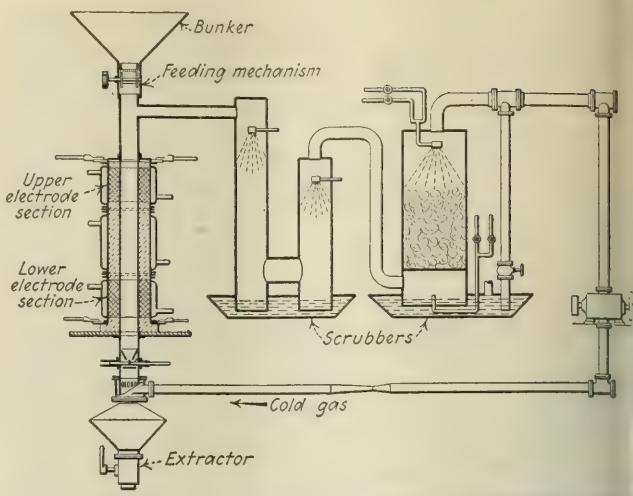


FIG. 8—SECTIONAL ELEVATION OF A PATENTED RING ELECTRODE TYPE OF ELECTRIC CALCINER

Practically all of the types of electric calciners mentioned use single-phase alternating current. In the movable electrode type care must be taken that all of the electrodes carry nearly the same amount of the current, otherwise one portion of the charge will be overheated and another not heated enough. The electrical load on the different electrodes is kept the same by the use of small control board lights. These are low-voltage lamps connected individually to current transformers placed around the riser buses. Evenness of load on the different electrodes is indicated by all the lamps glowing with the same intensity. Due to the negative temperature coefficient of resistance of carbonaceous materials, the tendency during calcination is for the current to follow the path first established. With increased heating, there will be decreased resistance and one portion will absorb most of the current.

Woodall-Duckam Vertical Retort System

The use of Woodall-Duckam retort for calcining carbonaceous materials is an adaptation from the gas industry for which it was originally designed. It was first introduced in England in 1903 and in this country not long afterward. The principle of the system may be more readily understood from Fig. 9.[21] Coke or coal is fed through a hopper at the top of a vertical retort heated on the sides. The speed of descent is so regulated that the coke is gradually calcined in its passage through the retort. The material is heated as it descends, and the gases from the volatile matter are evolved as the material reaches the proper temperature zones. The gases ascend, and are taken from the top of the retort. Thus the process is really one of fractional distillation.

The amount of material fed to the retort and the rate at which the charge descends are automatically governed by the rate the coke is removed from the bottom of the retort.

The retorts are rectangular and tapered from top to the bottom. The retorts walls are formed of tongue-and-groove bricks, paneled out at the back so that the heat is readily conducted to the charge. The heating flues are vertical, the division walls of the bricks being bonded into the walls of the retorts and also into the back walls of the flues.

The gas from the producer (either built in or an o-

[21]The author is indebted to J. S. DeHart, Jr., of the Is... Porter Co., of Newark, for the use of cuts illustrating the Wood... Duckam system.

de one) or else calciner gas om the operation of the re- rt, and the secondary air om the recuperator are ad- itted at the top of the verti- l flues and burn downward. he secondary air passes ound the lower end of the etort before it enters the re- perator. As now built, this ecuperator is of box con- ruction for the waste gas ith the air baffling on the utside. The temperature of he secondary air is raised al- ost to that of the waste ases. Dampers are provided t the bottom of the retorts o that the pull can be reg- lated to both sides of each etort. Main dampers are rovided on the waste gas utlet of the recuperator. egulating dampers are pro- ided on the gas and second- ry air flues to each pair of etorts.

In shrinking petroleum oke in these retorts, tem- eratures of 1,050 to 1,250 eg. C. are maintained, re- ulting in waste gases in the ecuperators with tempera- ures of 650 to 850 deg. C.

In the Woodall-Duckam ex- ractor the coke is cooled by he water jacket before it is ischarged. Fig. 10 shows he sectional elevation of a ypical plant for the calcina- ion of petroleum coke such s is built by the Isbell- 'orter Co. of Newark, N. J., vhich holds the Woodall-)uckam rights in this coun- ry. The plants are built ither with or without an in- ernal gas producer. When etroleum coke is used much ghter gas is given off than ith coal so that the brick- ned gas main may be sub- tituted for the more compli- ated hydraulic main gener- lly used in the calcination f coal.

The temperature of the ombustion chambers is ighest at the top where the eat is most readily absorbed y the cold material, and west at the bottom where the charge is completely lcined.

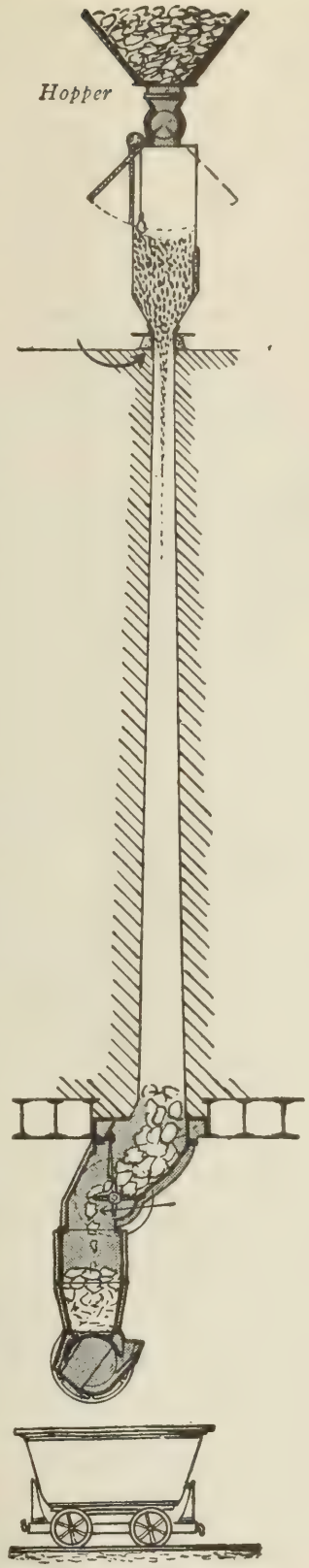


FIG. 9—SCHEME OF WOODALL-DUCKAM SYSTEM

Glover-West Vertical Retort System

The Glover-West system of vertical retorts was based n patents granted in 1905 to Young and Glover. In sic constructional details these retorts resemble those used on Scottish oil shales. In 1909 the present Glover-West system was introduced into England. As in the Woodall-Duckam system the calcination is continuous, but the methods of arranging for this vary in some detail. In the first place, the retorts are oval in section, instead of rectangular, and are built up of concentric fireclay rings. The bottom 3 ft. of each is composed of cast iron or special silica blocks and forms a regeneration chamber for the secondary air entering the producer. The passage of the gas from the retorts may be followed by means of Fig. 11. An outlet is provided at the base of each coal-feeding hopper, whence the gas is conducted by a 7-in. pipe to a dry main. Each outlet pipe is fitted with a valve which is brought into use when a retort is out of action for scurfing purposes.

The coke extraction is continuous and governs the rate at which coal is delivered. The extractor consists of a slowly revolving vertical worm, driven at a speed of one revolution in about 35 to 40 minutes. The extractor is built in two halves so that one half may be removed and the retort readily inspected. The speed of the extractors is adjustable. Dropping from the

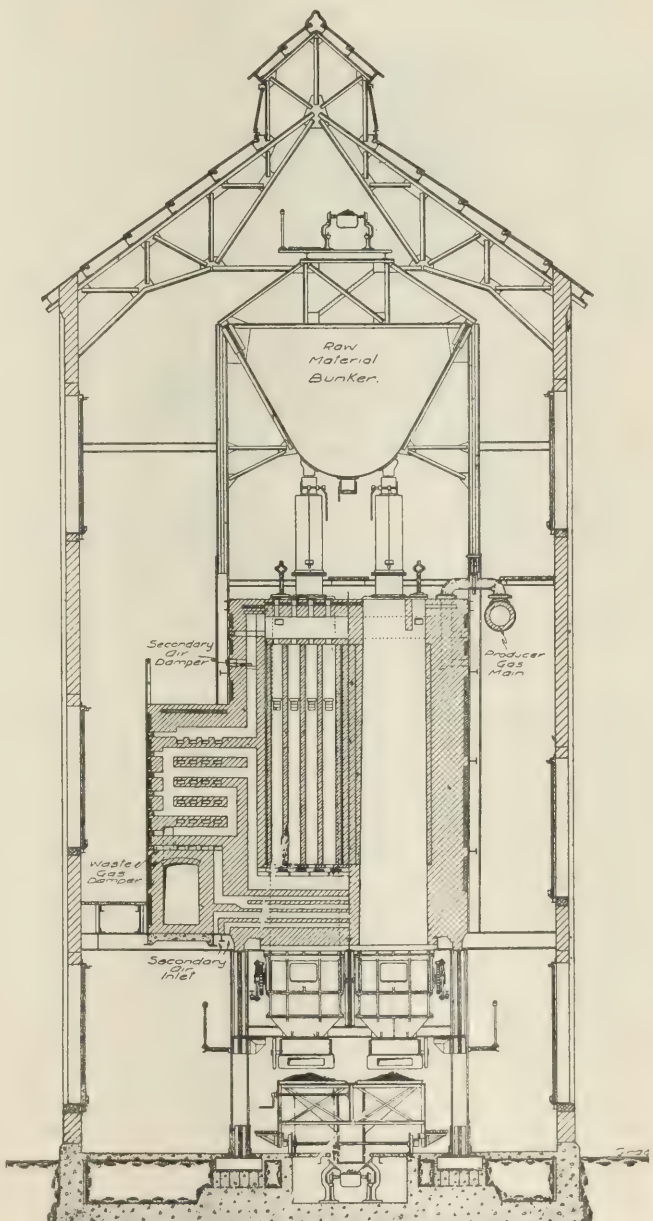


FIG. 10—SECTIONAL ELEVATION OF TYPICAL INSTALLATION FOR REDUCTION OF CARBONACEOUS MATERIAL

extractor, the coke passes into a chamber fitted with a self-sealing lid and is removed from this at intervals of about 2 hours. The system of heating the retorts differs from that of the Woodall-Duckam in that combustion takes place toward the bottom of the retorts and the waste gases pass around the upper portions into the horizontal circulating chambers before finding their way to the chimney. On account of the cooling action of the secondary air passing around the base of the retort, no water quenching is needed and the coke is discharged from the lower chambers practically cold.

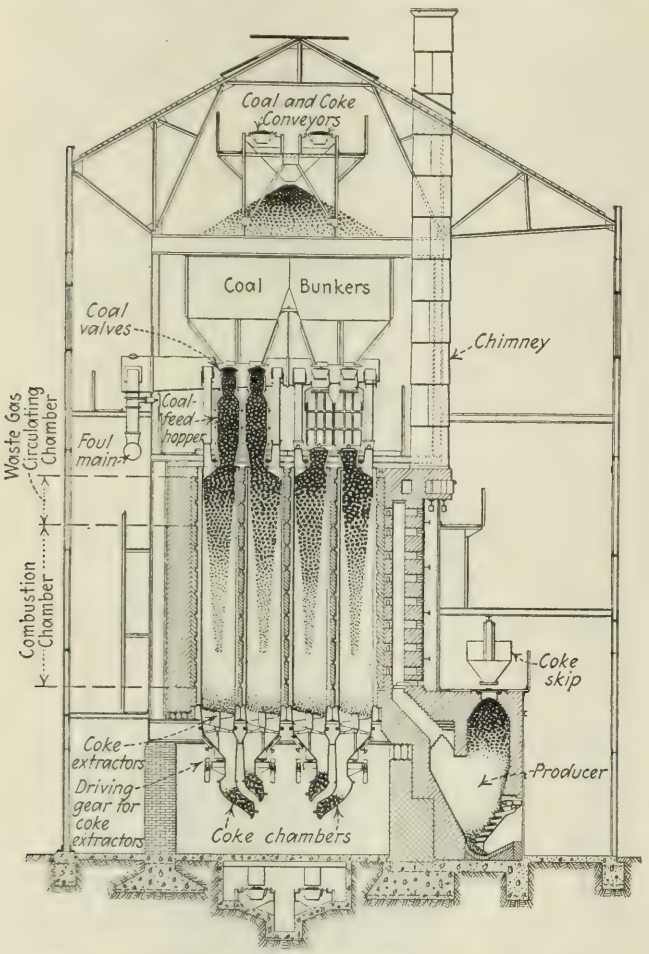


FIG. 11—SECTIONAL ELEVATION OF GLOVER-WEST VERTICAL RETORT SYSTEM

The retorts are heated in a series of superimposed chambers and the heats can be varied at will. The chambers are divided into three portions—the top or waste gas circulating chambers, the middle or heating chambers, and the bottom or regenerator chambers.

The calcined carbonaceous material is tested for volatile matter content by the standard method. The specification for volatile matter limits it to a maximum of 0.5 per cent. Moisture determinations are also made, for the specification allows only 0.3 per cent moisture. Resistivity is determined on ground samples (screened between 35 and 100 mesh), by measuring the drop in voltage at a constant amperage through a definite volume of the material. From this the resistivity is calculated. Usual specifications call for a maximum of 0.05 ohm per inch cube.

Conclusion

In general, due mostly to the high temperatures reached in electric calcining than in gas-fired calciners, a denser coke or calcined product will be produced in the electric calciners. The advantage of gas-fired units lies in their lower operating costs, aided by the fact that they can use the gases driven off in calcining to heat the retorts, so that there will be practically no power cost. In electric calciners there is a tendency to graphitize partly some of the charge and in this manner produce a calcined product of lower resistivity than would be possible with gas retorts.

The basis of the finished electrode may be said to lie in the proper calcination of materials. Without it the arts of the expert carbon maker are of no avail.

Editor's Note—It is the author's intention in the next article to discuss the grinding, mixing, molding and extrusion processes in the electrode industry. This will appear in a subsequent issue.

British National Physical Laboratory Report, 1921*

Work in the laboratory on iron and steel has been devoted mainly to the further investigtion of the constitution of the iron-nickel-carbon alloys, the iron-phosphorus alloys, and to the determination of the temperature of melting in the iron-carbon system. For this latter purpose an electrical method, first developed in connection with the study of the constitution of the aluminum-copper-nickel system, is being successfully applied.

A considerable amount of investigatory test work has been carried out in relation to cases of failure in iron and steel, particularly, the cracking of boiler plates around rivet holes.

The main work to be undertaken under the auspices of the alloys research committee of the Institution of Mechanical Engineers will relate to the study of ferrous alloys, primarily binary alloys of iron with other elements in the absence of carbon. This work will include in the first place the determination of the constitutional diagrams of some of the more interesting systems of this kind, and where possible the correlation of the diagrams obtained with the physical properties of the materials.

Research will be continued upon the physical structure of metals and alloys, particular attention being given to the measurement of the heat generated by plastic deformation. The experiments already made on the behavior of the more plastic metals in tension will be continued and efforts made to obtain a higher degree of accuracy in the determination of the heat evolved. Incidental to the above researches, the further investigation of the properties of amorphous metal is required.

As is well known, the Brinell hardness test is unsuitable for steel whose hardness number exceeds 500, on account of the permanent deformation of the ball which takes place in such cases. Some consideration has been given to the possibility of determining a scale of hardnesses for very hard materials from the amount of permanent flattening of the ball, and an instrument has been constructed in the workshops by means of which this flattening can be measured. Given careful manipulation of the instrument and a trained observer and provided that a supply of steel balls of uniform hardness can be obtained, it is believed that the method will be a valuable one in discriminating between the hardness numbers of very hard steels.

*Abstracted in *The Iron and Coal Trades Review*, June 30, 192

Boiler Plate After Cold-Work or Work at Blue-Heat

High Proportional Limit Exists While Tempering Cold-Rolled Plate at 300 Deg. C., or After Cooling to Room Temperature—Elastic Limit Can Be Made to Approximate Ultimate Strength by Overstraining Successively at Blue Heat With Gradually Increasing Loads

By H. J. French, Physicist, Division of Metallurgy, Bureau of Standards

COLD-WORK increases the elastic properties[1] of steel at ordinary temperatures and to a smaller degree the tensile strength, with an accompanying decrease in ductility. The greater the total reduction by cold-work within the capacity of the material the greater is the increase in strength. The tensile properties of steel at elevated temperatures are likewise modified. Jeffries[2] reports increased strength at blue-heat (200 to 300 deg. C.) after Armco iron has been drawn at room temperature with moderate reductions, but with 96 per cent reduction by cold-drawing the tensile strength is greater at room temperature than at any higher one.

Cold-Rolled Boiler Plate

The tensile properties at various temperatures of cold-rolled firebox and marine grades of boiler plate as determined by the author[3] are shown in Fig. 1. Comparison with curves 1 and 2 of Fig. 2, reprinted from the previous article, indicates that $\frac{1}{16}$ in. cold-reduction, approximating 12.5 per cent of the original plate thickness, increases the tensile strength at room temperature about 20 per cent, a margin which is maintained up to about 465 deg. C. (870 deg. F.), showing that this cold-working effect is maintained until relatively high temperatures are reached.

The changes in proportional limit are more marked and of considerable interest. At ordinary temperatures there is an increase of 80 to 95 per cent. Similarly an increase of 60 to 100 per cent above the values obtained in tests of hot-rolled plates is found at temperatures up to and including 245 deg. C. (470 deg. F.). In the blue-heat range [295 deg. C. (565 deg. F.)] the increase in proportional limit due to cold-work reaches the very high value of 150 per cent in the marine plate and nearly 200 per cent in the firebox grade. This, however, is not accomplished at the expense of ductility, as the elongation, which was reduced by one-half at room temperature, equals that of hot-rolled marine plate when tested at 295 deg. C. The relation between reduction of area of cold- and blue-finished marine steel has likewise increased to some extent, while that for the firebox grade has decreased somewhat slightly.

Effect of Tempering Cold-Rolled Plate

In order to determine whether these changes at blue-heat are maintained at ordinary temperatures specimens were tempered at successively increasing temperatures and then tested at room temperature. The results, which are represented in Fig. 3, illustrate, so far as the tensile properties are concerned, the benefits derived from "bluing" cold-finished products such as thin-wall seamless steel tubes. A short tempering in the blue-heat range, 295 deg. C. (565 deg. F.), materially increases the elastic ratio with little effect on the other tensile properties. This firebox steel had its limit of proportionality increased about 20 per cent. It is likewise apparent that a short tempering at somewhat higher temperature accomplishes little improvement.

Blue-Rolling

Working steel in the ranges where temper-colors are produced has long been considered deleterious and even dangerous. Stromeyer[4] warns against such practice, referring to his series of tensile and bending tests on iron, mild and hard steels, and writes: "It is very common practice amongst boiler-makers to 'take the chill out of the plate' if it requires a little setting, or to set a flanged plate before it is cold. This is really nothing else than working it at a blue-heat and should not be allowed. . . . All hammering or bending of

[4] "The Injurious Effect of a Blue-Heat on Steel and Iron," *Proc.*, Inst. Civil Eng., vol. 34, p. 14 (1886).

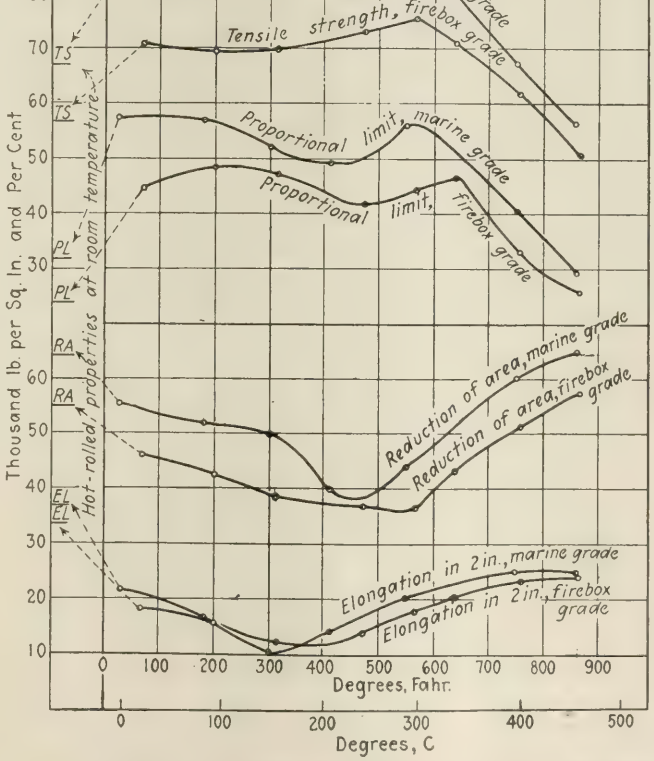


FIG. 1—TENSILE PROPERTIES OF OPEN-HEARTH BOILER PLATE AFTER 12½ PER CENT REDUCTION BY COLD-ROLLING

[1] Published by Permission of the Director, Bureau of Standards.
[2] Yield point, proportional limit and elastic limit.
[3] "Physical Changes in Iron and Steel Below the Thermal Critical Range," "Mining and Metallurgy," 1920, section 20, p. 158.
"Strength and Elasticity of Boiler Plate at Elevated Temperatures," *Chem. & Met. Eng.*, vol. 26, p. 1207, June 28, 1922.

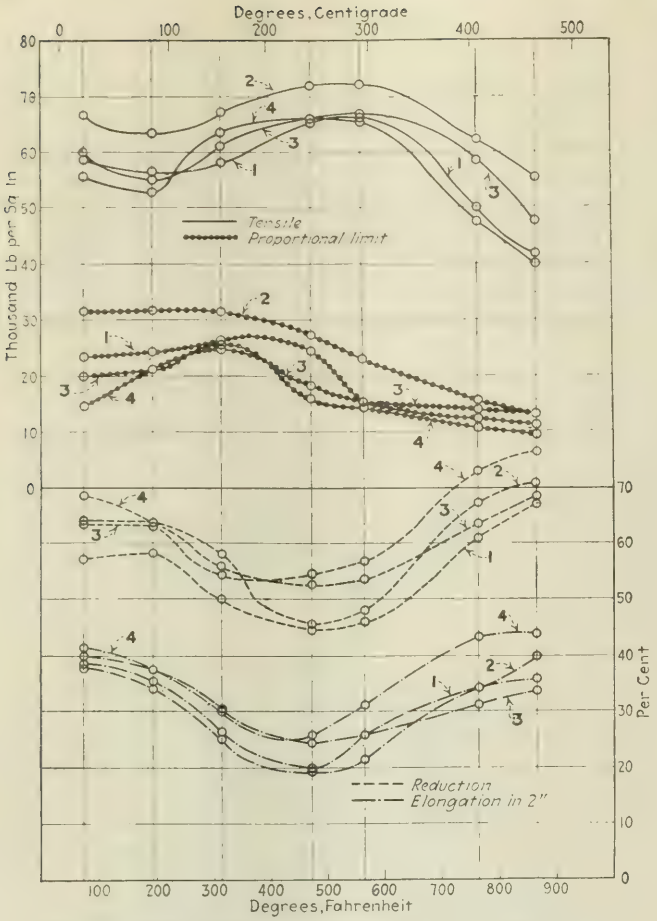


FIG. 2—TENSILE PROPERTIES OF FOUR HEATS OF BOILER PLATE MADE OF OPEN-HEARTH STEEL

iron and steel should be avoided, unless the metals are either cold or red-hot."

Howe in the 1891 edition of his "Metallurgy of Steel" summarized available information relating to what he calls "blue-shortness" and states in part: "Not only are wrought iron and steel much more brittle at a blue-heat[5] than in the cold or at redness, but while they are probably not seriously affected by simple exposure to blueness, even if prolonged, yet if they be worked in this range of temperature they remain extremely brittle after cooling. . . ."

"The loss of ductility as measured by endurance of bending and drifting is enormous; that this is not due to incipient cracks is shown by the simultaneous increase of tensile strength and by the restoration of ductility by annealing. The effect of blue-working on ductility as measured by elongation (on rupture by static tensile stress) is very irregular and apparently anomalous. . . . Heating to redness may completely remove the effects of blue-working."

Howe further called attention to the resemblance between the effects of cold-working and those of blue-working and that the immediate effect of these two operations might be suspected to be identical in nature.

Ridsdale[6] referred to blue-heat [315-370 deg. C. (600-700 deg. F.)] as the state of minimum plasticity and showed that soft steel developed brittleness when worked or soaked in a furnace for a long time in this range. He further pointed out that by reheating to a suitable temperature the good qualities of such steel were restored.

Jeffries[2] has studied the effects of blue-work on the tensile properties of Armco iron and reached the following conclusions:

1. Armco iron deformed at room temperature a given amount does not increase as much in tensile strength as when deformed the same amount at blue-heat.
2. The effect of drawing Armco iron at 200 to 400 deg. C. is to produce greater tensile strength at all temperatures up to 550 deg. C. than would obtain with the same amount of deformation in the cold. The elongation is less after drawing at 200 to 400 deg. C. than after drawing at room temperature. The same conclusion is true, in general, of the reduction of area.

While there seems to be unanimity of opinion that blue-work is deleterious to steel, Howe early called attention to the fact that "millions of car axles, blued from 'hot-boxes,' are chilled with snow and jarred under heavy load at loose rail joints, yet are apparently unharmed. Among the many thousand steel boilers tens of thousands of plates must have been worked more or less at blueness; yet failures are rare."

More recently it has been questioned whether crankshafts for airplane engines can be safely straightened while cooling from the tempering heat.

Plates Rolled at 300 Deg. C.

In order to determine the effect of permanent deformation at blue-heat on the high-temperature properties of boiler plate several pieces of railway firebox steel[3] (series 4) were reduced at about 300 deg. C. from $\frac{1}{2}$ in. to $\frac{15}{32}$ and $\frac{7}{16}$ in., representing respectively 6.25 and 12.5 per cent reduction. The patterns were rolled in a single stand 16-in. mill, a number of light reductions to effect the totals mentioned above being used. An attempt was made to straighten some of the plates cold and also at blue-heat immediately after rolling, but they broke transversely with a very coarse crystalline fracture as soon as pressure was applied. Comparison between curves 4 of Fig. 2 and Fig. 3 shows:

1. The increase in strength at room temperature resulting from cold-reduction of 12.5 per cent (Figs. 2 and 2) is about the same as that produced by half the

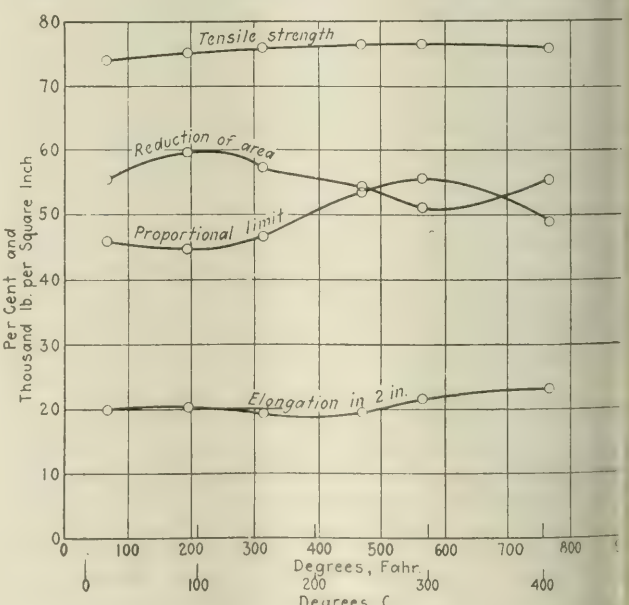


FIG. 3—EFFECT OF TEMPERING COLD-ROLLED BOILER PLATE (FIREBOX GRADE)

[5] The terms blue-work, blue-shortness, etc., as used by Howe, refer to temperatures where ordinarily temper-colors are obtained and may be considered to be within the range 220-320 deg. C. (430-600 deg. F.).

[6] "Correct Treatment of Steel," *J. Iron and Steel Inst.*, 1901, No. 2, p. 52.

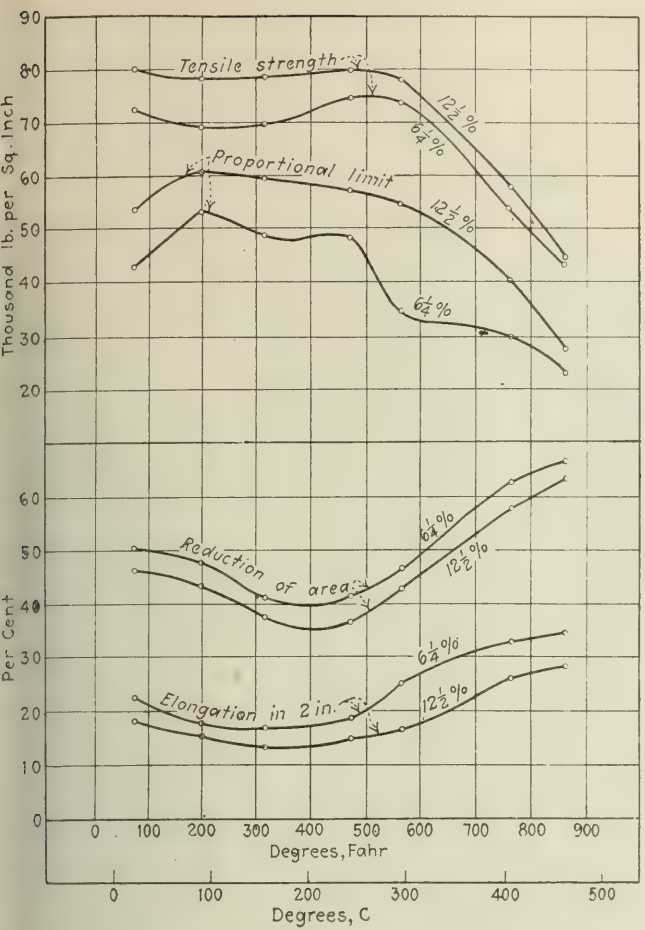


FIG. 4—TENSILE PROPERTIES OF SERIES 4 FIREBOX STEEL AFTER ROLLING AT BLUE-HEAT

eduction (6.25 per cent) at blue-heat (Figs. 2 and 4). This, in general, is also true at temperatures up to 295 eg. C. (565 deg. F.) (blue-heat). Above this temerature the increase in strength resulting from blueeformation is somewhat less than that from cold-rolling.

2. A "blue-reduction" of twice the amount does not ncrease the strength at room or elevated temperatures roportionally.

3. At 245 deg. C. (470 deg. F.) the strength of the lue-worked steel is little in excess of that hot-rolled.

4. The maximum tensile strength of the steel subected to 6.25 per cent blue-reduction is obtained at lue-heat [295 deg. C. (565 deg. F.)] and the shape of ne tensile strength versus temperature curve shown n Fig. 4 is similar to that for the cold-rolled steel Fig. 1). Tensile strength versus temperature curves nange direction quite abruptly at or about 295 deg. C. 565 deg. F.).

5. The increase in the limit of proportionality at oom temperature resulting from 6.25 per cent blueeduction is greater than that obtained from twice as uch cold-reduction. This is also true up to 245 deg. . (470 deg. F.), above which the increases are about qual.

6. The form of the proportional limit versus temerature curve for steel reduced 6.25 per cent at blueeat is similar to that reduced twice this amount in ne cold, but the secondary increase (which in the old-worked steel appears to attain its maximum at out 340 deg. C.) occurs at 245 deg. C. in the blueorked metal. This inflection is not observed in the eel subjected to 12.5 per cent blue-reduction.

7. Elongation and reduction of area decrease to a minimum in the neighborhood of 200 deg. C. (410 deg. F.) and thereafter increase to high values at 465 deg. C. (870 deg. F.). There appears to be a more rapid increase in elongation between 295 and 410 deg. C. (565 and 770 deg. F.) coincident with the rapid decrease of proportional limit mentioned above for steel reduced 6.25 per cent at blue-heat.

The effect of partial annealing of blue-worked steel is shown in Fig. 5. The proportional limit decreases until an annealing temperature of about 500 deg. C. (930 deg. F.) is reached, but annealing with slow cooling up to about 600 deg. C. (1,110 deg. F.) greatly increases the elastic ratio. Annealing for 30 minutes at about 730 deg. C. (1,345 deg. F.) completely removes the effects of blue-deformation.

Depth of Penetration of Effects of Blue- and Cold-Rolling

Since the effects of blue- and cold-work are so marked and maintained over a considerable temperature range, the question naturally arises as to whether the increased strength of the plate is due to hardening of the "skin," or whether the magnitude of the observed effect is substantially the same throughout the cross-section of such light plates as are under investigation.

The surfaces of cold- and blue-rolled bars were accordingly milled to progressively increasing depths and tested in the usual manner at room temperature, and it was found that there is substantially no difference in the strength when even a considerable depth of surface metal has been removed. Ductility (elongation and reduction of area) gradually decreases with removal of increasing layers of metal, due no doubt to the decrease in thickness of the specimen while the width has been kept constant.[7]

Transverse Strength at Various Temperatures

Tests of longitudinal specimens taken from plates rolled at various temperatures do not fully define the effects of such work, even when considering only the tensile properties. Accordingly tests were made on samples taken transversely from hot-, cold- and blue-rolled firebox steel of series 4. The results are given in Fig. 6.

[7] H. L. Moore, "Tension Tests of Steel With Test Specimens of Various Size and Form," *Proceedings*, American Society for Testing Materials, 1918, part 1, p. 403.

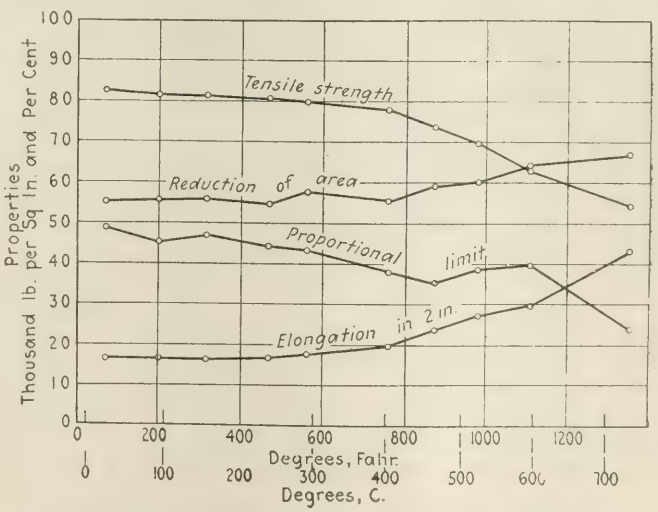


FIG. 5—EFFECT OF TEMPERING AND ANNEALING BLUE-ROLLED BOILER PLATE. (FIREBOX GRADE)

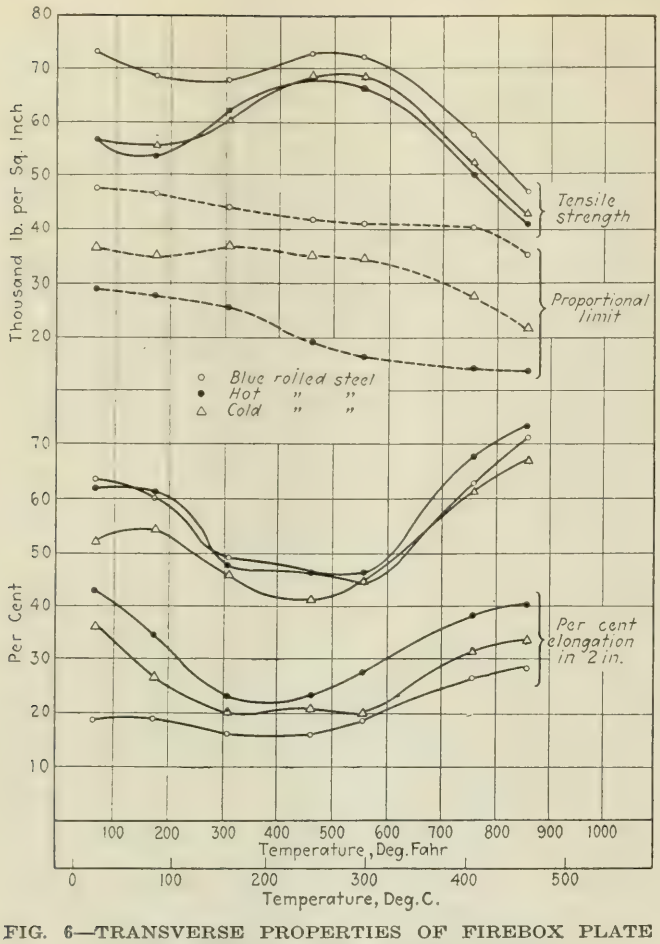


FIG. 6—TRANSVERSE PROPERTIES OF FIREBOX PLATE AT ELEVATED TEMPERATURES AFTER VARIOUS WORKINGS

It is at once evident that the general form of the tensile curves is similar to those for longitudinal tests with the exception of the limit of proportionality, which does not increase with first rise in temperature. Duplicate determinations do not agree as well as those obtained under similar conditions in longitudinal samples. The increase in transverse tensile strength at room temperature resulting from blue- or cold-rolling is very much less than that observed in longitudinal tests for the same mechanical reductions. Similarly the increase in proportional limit and decrease in ductility resul ing from deformation at room temperature or blue-hea are less than the effects observed in longitudinal test The proportional limit of steel deformed cold or a blue-heat is raised more than is the transverse strengt but this difference is not so marked as in tests made o longitudinal samples.

Permanent Deformation Produced by Stretching

Huston[8] found that in loading bridge iron to ju above the "so-called elastic limit" the ductility or toug ness remained unaffected so that the metal would yie with every small increase in load. When stressed ju below that point, the iron became rigid and would n elongate without a decided load increase.

From a large number of tests of wrought iron a low-carbon steel Bauschinger found that when subject to overstrain at ordinary temperatures certain thin occurred: When stretching was produced by a lo between the proportional limit and yield point, t former was raised. An applied stress greater than t yield point resulted in a decrease in the limit of pr portionality, a loss which was recovered upon agi for a long time at room temperature or for short periods at higher temperatures. This aging effect w counteracted by high heating, but the method of co ing was observed to play an important part—high he and rapid cooling being most effective. Aging aft heating and cooling exerted no further effect.

Howe ("Metallurgy of Steel") reported that stret ing at room temperature lowered the limit of prop tionality of steel, often to zero. The effect of rest w slowly to restore the elasticity and finally raise it abo the load that caused the previous deformation, but t occurred more slowly at room temperature than wh the steel was warmed.

Muir[9] found that the elastic recovery of overstrain steel was as marked after 3 or 4 minutes at 100 d C. as in 2 weeks at room temperature and was impe or entirely prevented at lower temperatures around deg. C.

Howard[10] stated that "the effect of straining hot

[8] "Effect of Continued and Progressively Increasing Overstr Upon Iron," *J. Frank. Inst.*, January, 1879, p. 41.
[9] "On the Overstraining of Iron," *Philosophical Trans.*, Ro Society of London, A 193, p. 1, A 198, p. 1; *Proceedings*, A p. 277.
[10] *Iron Age*, vol. 45, p. 585 (1890).

TABLE I—EFFECT OF OVERSTRAIN ON FIREBOX BOILER PLATE (SERIES 1 STEEL)

	First Load			Aging		Final Tensile Properties				
Sample No.	Prop. Limit Found	Imposed Load	Time Maintained, Minutes	At Temperature, Deg. C.	Time, In Minutes	At Temperature, Deg. C.	Prop. Limit	Tens. Str.	Elong. in 2 In.	Red. of Area	At Te eratu Deg.
J9	30,300	39,650	5	Room	5	Room	35,700	58,700	39.0	48.1	Roo
J10	30,600	40,000	5	Room	5	Room	Very low	58,450	42.0	48.8	Roo
J16	24,000	40,000	5	Room	5	Room	37,000	58,100	42.0	47.7	Roo
					at 1,550 lb. per sq.in.						
H26	13,500	30,000	5	295	5	295	28,000	65,900	23.5	41.5	29
H20	.....	16,250	44	295	45	295	17,800	65,800	24.8	35.2	29
H22	.....	16,250	42	295	8	295	17,100	66,000	24.8	42.6	29
H24	15,500	16,250	5	295	5	295	16,400	64,300	27.0	41.5	29
H25	15,000	16,250	5	295	5	295	.....	.....	.....	.....	...
	56,000*	64,800*	5*	295*	5†	295†	56,250	66,340	26.8	40.3	29
H21	.....	13,960	42	407	43	407	13,400	50,450	37.3	59.9	40
H23	.....	13,960	45	407	5	407	15,750	53,300	34.8	54.3	40
J11	16,600	31,400	5	463	5	463	15,500	44,300	35.0	64.3	46
J17	16,600	25,000	5	463	5	463	23,000	43,600	39.0	63.0	46
J23	.....	32,900	5	295	Cooled 1 hr. to room		Very low	58,600	35.0	47.0	Roo
J15	.....	30,000	5	463	Cooled then 46½ hr. at room temperature		36,500	59,100	32.5	48.0	Roo
J21	.....	25,000	5	463	Cooled 30 min. to room temperature		No curves	58,450	37.5	48.1	Roo
J20	.....	25,160	5	463	Cooled 40 min. to room temperature		.....	59,200	38.5	48.7	Roo
J18	.....	25,000	5	463	Cooled; then 45¼ hr. rest at room temperature		35,500	59,600	39.0	48.7	Roo
J19	.....	30,000	5	295	Cooled 3 min. Normalized 843 deg. C. Cooled 2½ hr. to room temperature		32,000	58,250	40.5	50.7	Roo

* Amount at twenty-second load. All loads maintained 5 min. at 295 deg. C. † Specimen aged 5 min. at 295 deg. C. after release of each load.

the subsequent strength when tested cold appears to depend upon the magnitude of the straining force and the temperature when overstrained. There is a zone of temperature in which the effect of hot-straining elevates the elastic limit above the applied stress and above the primitive value, and if the straining force approaches the present tensile strength there results a material elevation of that value when cooled. After exposure to higher temperatures a gradual loss occurs in both elastic limits and tensile strength, and generally there follows a noticeable increase in the contraction of area." Howard found the zone of elevation of the elastic limit had apparently been passed when the steel was subjected to overstrain at about 395 to 425 deg. C. (740 to 800 deg. F.) and noted the importance of time between overload at high temperatures and subsequent test.

Because of the extended field for research along these lines the tests of overstrained steel noted in Table I made by the author were limited to the region about the blue-heat, for the most marked changes in tensile properties have been found in this temperature range.

At blue-heat [295 deg. C. (565 deg. F.)] tensional stress in excess of the limit of proportionality raises this limit in a short time after release of load to a value approximating the stress producing the previous deformation (samples H26, 20 and 22); but when this stretching at blue-heat is followed by cooling to room temperature and subsequent test (sample 33) the immediate effect of the "blue-overstrain" is a lowering of the proportional limit.

Repeated overstrain at blue-heat, whether at constant or increasing loads, raises the apparent limit of proportionality at this temperature in a like manner and to a similar degree. The magnitude of this increase may be considerable. Sample H25 had its proportional limit raised from 15,000 lb. per square inch in steps to a little more than 56,000 lb. per square inch, or 375 per cent, by 22 loads constantly increasing in intensity.

TABLE II—CHANGES IN ELASTIC LIMIT IN COMPRESSION UPON AGING

—Tensional Stress Applied— Lb. Per Sq.In.	At Temperature, Deg. C.	Overload Beyond Proportional Limit, Lb. Per Sq.In.	Proportional Limit in Compression at Room Temperature* Time After Tensional Overstrain, Hours	Average Proportional Limit
45,000	20	13,800	28	13,250
			52	11,250
45,000	295	22,550	3	19,500
			6	19,800
			30	17,500
			49	17,000
			54	14,700
30,000	463	17,500	3	15,650
			29	17,650
			48	21,000
			71	24,000

* Size of compression sample: ¾ in. diameter, 1½ in. long. Gage length of 1 in. used. Samples cut from 1-in. marine boiler plate. Average compressive limit of proportionality at room temperature was 23,750 lb. per square inch. Two samples were tested for each age.

Such deformation does not, however, appear to modify the values of tensile strength, total elongation or reduction of area when the specimen is finally broken. These results appear consistent with Bauschinger's deductions and the work of others mentioned for a very rapid recovery from elastic overstrain; almost immediate elevation of the proportional limit would be expected at the temperature at which the stresses were applied.

Heating to a temperature above Ac_1 and thereafter cooling steel which has been overstrained at blue-heat (sample J19) immediately restores the apparent elasticity of the metal at room temperature. Such thermal treatment does not lower the limit of proportionality, which in a test at room temperature remains at a value approximating the previous overload at blueness.

Metal previously overstrained at moderate temperatures regains its elasticity after rest at room temperatures (samples J15, 18, 20 and 21). It is not quite clear whether the immediate effect is to destroy the elastic properties, but such is probably the case.

Rosenhain in his "Introduction to Physical Metallurgy" states that the hardening of steel by plastic strain is unidirectional and that a piece of steel which had attained an apparently raised proportional limit as a result of tensile overstrain was really weakened in compression. Therefore the total range of elasticity, from the limit of compression to that in tension, had not been materially altered. To test this deduction samples of marine boiler plate were subjected to stretching at several temperatures beyond the limit of proportionality and then tested in compression (Table II). The effect of such tensional overstrain at room temperature, blue-heat and about 465 deg. C. (865 deg. F.) is a lowering of the limit of proportionality in compression when tested at room temperature. When the steel is permitted to rest, the samples stretched at blue-heat or below show a gradual decrease in the compressive limit of proportionality as time passes by, a fact which, taken in conjunction with the rise in proportional limit in tension, indicates that the range of elasticity is not altered, but merely shifted. Steel similarly stretched at 465 deg. C. behaves differently, however, for with age the proportional limit in compression rises for 70 hours until it approximates its original numerical value.

Calculating the Gravity of Liquid Petroleum Products

Since publishing the announcement of the American Petroleum Institute's new scale for reporting the gravity of liquid petroleum products,[1] some question has arisen as to how this scale differs from Baumé standard for liquids lighter than water. As has been previously pointed out, the difference lies merely in the fact that the conversion modulus for the A.P.I. scale is 141.5 instead of 140.

The formula on which the standard American Petroleum Institute scale is based in terms of "degrees A.P.I." is as follows:

$$\text{True sp.gr. } (60/60^\circ \text{ F.}) = \frac{141.5}{131.5 + \text{deg. A.P.I.}}$$

$$\text{or Deg. A.P.I.} = \frac{141.5}{\text{True sp.gr.}(60/60^\circ \text{ F.})} - 131.5.$$

The formula on which is based the U. S. Baumé scale for expressing the true specific gravity of liquids lighter than water (other than petroleum) in "degrees Baumé" is as follows:

$$\text{True sp.gr. } (60/60^\circ \text{ F.}) = \frac{140}{130 + \text{deg. Bé.}}$$

$$\text{or Deg. Bé.} = \frac{140}{\text{True sp.gr.}(60/60^\circ \text{ F.})} - 130.$$

The relation between the two scales at 60 deg. F. is:

Degrees A.P.I. = 1.010714 Deg. Bé. — 0.10714

Thus 10° Be. (140 mod.) corresponds to 10.0 A.P.I. (141.5 modulus)
30° Be. (140 mod.) corresponds to 30.2 A.P.I. (141.5 modulus)
50° Be. (140 mod.) corresponds to 50.4 A.P.I. (141.5 modulus)
70° Be. (140 mod.) corresponds to 70.6 A.P.I. (141.5 modulus)
90° Be. (140 mod.) corresponds to 90.8 A.P.I. (141.5 modulus)

[1] "The A.P.I. Scale for Reporting the Gravity of Liquid Petroleum Products," *Chem. & Met. Eng.*, vol. 26, No. 24, p. 1120, June 14, 1922.

Metaldehyde as a Fuel

An Interesting Account of the Manufacture and Properties of a New Solid Fuel Developed for Household Use by Swiss Electrochemists

By H. Danneel

MANY types of solid fuel have appeared on the market. At the outset soaps were used as the solidifying medium for the alcohol to which shellac, stearine, tallow and stearic acid were sometimes added and from which the oleic acid was eliminated so as to obtain better burning. Subsequently collodion and cellulose acetate were used for solidifying the spirit[1] and also the jel made from agar agar.[2] Large quantities of these and similar fuels were used during the European war and some little post-war demand for them has been established because, in spite of their defects, they are more convenient to use than is liquid alcohol. The chief fault with most forms of solidified spirit is found in the volatility of the alcohol, which necessitates the use of air-tight vessels. Otherwise evaporation would take place and the calorific value of the fuel would be impaired. The fact that solidified spirit liquefies when ignited renders it unsuitable for many purposes and the residual ash is sometimes considered an objectionable feature.

Apart from the above, paraformaldehyde and hexamethylenetetramine have been recommended as fuels. After the flame of the former has been extinguished it gives off vapors of formaldehyde, not easily forgotten by anyone who came too close to them. Hexa was scarcely more than an emergency product during the war, for the cost of the raw materials formaldehyde and ammonia is comparatively high. Its cost is further increased by a manufacturing loss amounting to almost one-half of the raw materials. The characteristics of hexamethylenetetramine as a fuel are for the most part satisfactory, if objection is not taken to the fact that it is soluble in water. Certain other materials have also been recommended as fuels but have not acquired industrial importance.

A new and rather promising solution of this problem appears to have been arrived at recently by a Swiss firm, the Usines Electriques de la Lonza of Basel, which is producing a fuel from metaldehyde, a substance to which, up to the present, only scientific importance was attached. Its manufacture on a commercial scale has been rendered possible through the synthetic production of acetaldehyde from calcium carbide.

Discovery and Properties of Metaldehyde

Metaldehyde was discovered by Liebig,[3] its existence confirmed by Fehling[4] and its properties were investigated by Kékulé and Zincke.[5] It is formed as a by-product when acetaldehyde is transformed into paraldehyde by the action of acids or salts. At ordinary temperature a solution of very small quantities of metaldehyde in paraldehyde is obtained but at low temperatures small quantities of solid metaldehyde are obtained in the shape of fine white needles which can be increased in size if the process is carried on slowly.

Metaldehyde does not melt under atmospheric pressure and starts to sublime without melting between 11[illegible] and 115 deg. C. In a closed tube it is said to melt at 160 deg. C. (Roozeboom 184 deg. C., Hollmann 16[illegible] deg. C., Smith and de Loeuw 246 deg. C.). Metaldehyde when impure, gradually volatilizes in the form of acetaldehyde when left in the open air, particularly during hot weather. In confined spaces it changes into paraldehyde. When chemically pure, it is a substance of practically permanent stability. Its molecular weight corresponds to the formula $(CH_3COH)_4$. The heat of combustion amounts to about 6,000 cal. per kg.

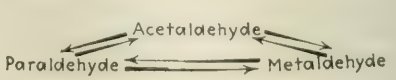
In the majority of solvents metaldehyde is but little soluble; for instance carbon bisulphide, acetone, glacial acetic acid and water. Acetaldehyde dissolves but 0.2 per cent at 19 deg. C., paraldehyde dissolves but 0.06 per cent at 12 deg., boiling alcohol 1.8 per cent, boiling ether 0.5 per cent and benzine at 23 deg. dissolves a maximum of 13.5 per cent.

Acetaldehyde-Metaldehyde-Paraldehyde Equilibr[illegible]

The interesting instance of three polymorphous substances, whose transformation into one another can be greatly accelerated by catalysts (pure acetaldehyde is known to keep for a long time without changing into paraldehyde), has invited investigations of the processes from a physical and chemical point of view. From these as well as from numerous tests made in connection with the commercial manufacture of metaldehyde, the following conclusions can be made:

1. If acetaldehyde is subjected to the action of catalysts at ordinary temperature, it polymerizes. The quantities of catalysts required are exceedingly small; 0.1 per cent and less has been found to suffice.

2. The polymerized substances formed are paraldehyde and metaldehyde and the reaction proceeds with a speed determined by the strength of the catalyst until an equilibrium is established, which equilibrium depends on the temperature but not on the nature of the catalyst. The reactions which lead to the equilibrium are three in number, that is to say—acetaldehyde ⇄ paraldehyde, acetaldehyde ⇄ metaldehyde, paraldehyde ⇄ metaldehyde—and might be illustrated by the schematic formula:



The reaction which starts from pure acetaldehyde to which has been added the necessary quantity of catalyzing agent leads at 15 deg. C. to a liquid mixture of the three substances in which paraldehyde predominates to the extent of about 92 per cent. Metaldehyde can clearly form to a very slight extent only, at [illegible]

[1] D. R. Pat. 184,721.
[2] Br. Pat. 24,146 (1901).
[3] *Ann.*, vol. 14, p. 141 (1835).
[4] *Ibid.*, vol. 27, p. 319 (1838).
[5] *Ibid.*, vol. 162, p. 145 (1872).

[6] R. Hollmann, *Z. Physik. Chem.*, vol. 43, p. 129 (1903). R. Sm[illegible] and H. L. de Loeuw, *ibid.*, vol. 77, p. 269 (1911).

vents in smaller quantities than are required for a aturated solution in paraldehyde (i.e. 0.06 per cent). n intermediate phases too, there are no visible signs f the formation of metaldehyde when the reaction roceeds at 15 deg., which proves that the quantity resent in these intermediate stages does not exceed hat which can be taken up by acetaldehyde, that is to ay 0.25 per cent.

3. At low temperatures the circumstances are different. The solubility of metaldehyde in acetaldehyde ecreases with the temperature, and by a judicious hoice of catalysts it can be brought about that temorarily more metaldehyde is formed than can be reained in solution by acetaldehyde or by paraldehyde, n which case metaldehyde would be precipitated as a olid body. The final equilibrium, however, would not n any way be altered, so that toward the end of the eaction the precipitated metaldehyde would again disappear. There are a number of substances which ppear relatively to accelerate the reaction. Acetaldeyde → metaldehyde to a greater extent than the imultaneous reaction acetaldehyde → paraldehyde. Only such substances, of course, are of value in conection with the manufacture of solid metaldehyde, nd among them are nearly all of the strong acids, particularly sulphuric acid and also a few salts. It is clear that the reaction product must not be left to itself too long and that the process has to be interrupted when the maximum quantity of metaldehyde as been formed, because otherwise it would practically disappear again.

Manufacturing Difficulties

In the course of manufacture a number of difficulies are met with, some of which it has not been found an easy matter to overcome. First of all, there is the selection of the best catalyst. A given substance can influence in different ways the three reactions which have to be considered. It can, for instance, accelerate reaction 1 and exert no influence on 2 and 3, or even retard them. It can accelerate all three reactions or two of them, leaving out the third one, so that from a mathematical point of view, 24 combinations are possible. Moreover, the effects of the catalyst are modified in various ways by the temperature. Cases are known where a catalyst does not act at a temperature below 10 deg. C., but exerts a very marked action at higher temperatures. A much stronger action in fact than might be expected from the temperature coefficient of the speed of reaction, which is generally assumed to be 1/5. Ultimately the solubility of metaldehyde in paraldehyde, acetaldehyde and mixtures of these two depends on the temperature and determines the precipitation of metaldehyde. Its dependence on the temperature, however, is not the same as that of the efficiency of the catalysts. When working at very low temperatures, there is also the risk of paraldehyde, which has a solidifying point of 12.5 deg. C., solidifying. Therefore it would appear that although metaldehyde is metastable at ordinary temperature, it has to be guarded during the course of manufacture against transformation into paraldehyde or acetaldehyde.

The regulation of the temperature during the manufacturing process is not a simple matter. The reaction is exothermic and in large reaction vessels the temperature can easily rise locally. Unless it is distributed at once a local acceleration takes place in the formation of paraldehyde, accompanied by further rises in the temperature, so that the reaction may assume the nature of an explosion. Within a few minutes the total contents of a large reaction vessel may be brought to the boiling point, an occurrence which has to be guarded against by all means, in view of the flammability of acetaldehyde.

Preparing It for the Market

When the maximum quantity of metaldehyde has been precipitated, the reaction product is treated in a hydro-extractor and freed from the liquid, which consists mainly of paraldehyde with small quantities of acetaldehyde. This liquid is transformed into acetaldehyde and again enters the process unless it is desired that it be worked up into pure paraldehyde.

Metaldehyde, such as it is obtained in the above process, is not suitable for consumption as a fuel. It consists of small needles, the size of which is inversely proportional to the speed of formation. When dry, it forms a voluminous powder which so readily ignites that its use would involve some risk in the household. It moreover develops a strong flame and burns away quickly, so that it is impossible to utilize fully its calorific value. By compressing it strongly into convenient shapes, it has been found possible[7] to render it suitable for the purpose in view. When so treated, metaldehyde does not ignite as quickly as alcohol, but requires a few tenths of a second's contact with the flame of a match.

Shaped metaldehyde exhibits peculiar symptoms when burning. It is not the metaldehyde itself which feeds the flame, but acetaldehyde which is formed from it by the heat radiated by the flame. The fuel, therefore, is surrounded by a zone of cool gas which prevents the flame from touching the fuel itself. This, together with the absorption of heat necessitated by the transformation of metaldehyde into acetaldehyde, keeps the fuel itself cool, so cool in fact that it is possible to extinguish the flame by the palm of the hand without risk of injury from burning. The transformation into acetaldehyde during the burning process regulates itself; as soon as volatilization becomes more intense the flame is removed from the solid block and there is less radiated heat and the volatilization is automatically checked. Compressed metaldehyde is characterized by its steady and uniform flame.

Why Impure Compound Is Most Satisfactory

The influence of the catalyst during the combustion process is more noticeable in connection with metaldehyde than it has been with any other kind of fuel. When metaldehyde such as comes from this process, that is to say in an impure condition, is pressed into shapes, the resulting fuel exhibits traces of the characteristic acetaldehyde smell, even when not exposed to heat. This indicates that a slow decomposition of metaldehyde is taking place. This smell becomes very marked during a few minutes after the flame has been extinguished, a thing that would not happen with pure metaldehyde. This is due to the action of minute particles of the catalysts adhering to the metaldehyde crystals. These impurities can scarcely be measured and probably amount to only a few millionths of a per cent, so that an elimination would be much more troublesome than other means to counteract the influence of the catalyst. Such means would consist in depriv-

[7] Metaldehyde compressed as fuel patented in 20 countries. Br. Pat. 144,589, Swiss Pat. 84,746, U. S. Pat. 1,407,101.

ing the catalyzing agent of its efficiency by neutralizing the acid and transforming, for instance, sulphuric acid into barium sulphate, hydrochloric acid into silver chloride, or by treating sulphuric acid with ammonia and transforming it into ammonium sulphate, which is inert. Another way would be to eliminate the liquid phase—a course which is facilitated by the fact that metaldehyde is neither hygroscopic nor soluble in water.

But supposing metaldehyde were entirely free from a catalyzing agent, such as could be obtained by sublimation in a vacuum, or recrystallization, or such as would be obtained by depriving the catalytic agent of its efficiency, the combustion would show new and undesirable phenomena. Such a pure product ignites only with difficulty and, in contrast with the impure product, the flame touches the fuel, which becomes hot, and when extinguished, clouds of sublimed metaldehyde can be noticed floating in the air in the shape of a fine fluff. Moreover, the sublimation would tend to clog delicate parts of a burner, such as the delicate regulating devices used in some applications.

It is evident, therefore, that for a metaldehyde fuel a catalyzing agent is required to influence the combustion process, while for the storage of the fuel it is not wanted and not even desirable. For that reason a means has been found to render the catalyst inert at temperatures below 30 to 40 deg. C., and at the same time allow its active properties to become evident at temperatures of 60 deg. and above. This temperature is produced by the heat radiated from the flame, and when the flame is extinguished and the temperature falls the catalyst again becomes inert. In that way it has been found possible practically to do away with the odor, which for that matter might have been disguised or modified by the addition of certain scenting materials. Furthermore, this is accomplished without interfering with the desirable effects on the combustion process.

Basel,
Switzerland.

Rapid Methods for Determining Endurance Limits

A report of progress from the British National Physical Laboratory (abstracted in *The Iron and Coal Trades Review* for June 30, 1922) notes that the method of predicting fatigue ranges of stress which has hitherto been employed at the laboratory has been by means of a series of tests on different specimens (usually six) at different ranges of stress, commencing with a range well above the fatigue limit so that fracture occurs after a comparatively short number of reversals, and then progressively diminishing the range of stress for the other specimens until fracture fails to occur with a number of reversals of the order of five to ten millions. It is then comparatively easy by means of plotting to predict the limiting range of stress. This method, although otherwise satisfactory, is slow and costly and several attempts have been made by workers in this field to predict the fatigue range of stress from a test on a single specimen of the material. One method is that due to Dr. J. H. Smith, who has found that by attaching an optical extensometer to a specimen under reversals of tensile stress, the stress-strain curve obtained, under gradually increasing range of stress, exhibits a "yield-point" characteristic similar to that found in static tests, and that the range of stress corresponding to this yield point is the true fatigue range of the material.

A calorimetric method has been devised by Mr. Stromeyer for use in alternating torsion tests. I this method the specimen under test is water-jacket and the temperature of the circulating water carefull observed. The torsional fatigue limit is determined b noting the stress at which a small but perceptible ris of temperature of the jacket water due to the heatin of the specimen by internal work takes place. In th experiments carried out during the year both of the methods were used simultaneously on the same specime under alternating tension, the chief modification bein that instead of using a water jacket the temperatu of the specimen was determined by a thermo-junctio Satisfactory agreement between the two methods ar the results of fatigue tests on the material by th ordinary Wöhler method have been obtained for the ca of a wide range of materials.

The method of "yield ranges" has also been extend to tests on specimens subject to reversals of bendi stress in the ordinary Wöhler fatigue testing machin A plane mirror is mounted on the end of the specim with its plane perpendicular to the axis of rotatio The changes in the slope of the plane of the mirr due to gradual increases of the load on the specime are observed by means of a source of light and a lo optical lever (40 yards in length). On plotting t results on a base of stress range a "yield point" c be detected at a stress range which is identified wi the fatigue range of the material. By means of the methods the time necessary to predict the limiting ran of stress has now been reduced to less than half an ho

Phosphorescence

Sir George Beilby, in his recent book on "Aggregati and Flow of Solids," describes a number of experimen going to show that certain types of phosphorescence a due to the molecular movement or displacement whi is produced by heat, by mechanically applied stresses by radiant energy. Certain other types of ph phorescence are distinguished by their appearance three stages, called by him primary, secondary and r vived phosphorescence. These can be explained as d to atomic changes in which chemical affinity is t controlling factor. Furthermore, a species of el trolysis occurs in solids exposed to the beta or catho rays; the products of electrolytic dissociation are ins lated or partly insulated from each other by the neut molecules as in a viscous electrolyte; and it is t breaking down of this insulation and the recombinati of the ions which cause revived phosphorescence.

Forging and Working Invar

Invar steel is very difficult to work mechanically b is an important alloy for certain classes of work whe very low coefficient of expansion is desired. In ord to see whether it could be worked successfully, fo small ingots of invar were prepared by the Metallurgi Division of the Bureau of Standards. The first attem at forging was unsuccessful, the ingot cracking a breaking under the forging press. The second attem was quite satisfactory as a result of very care handling during forging operations.

It was found necessary to give very light reductio and not allow the forging temperature to drop bel 1,000 deg. C. during the first reduction. This ingot w forged to a $\frac{3}{8}$-in. rod, and a portion of this was cut and machined to a $\frac{1}{4}$-in. rod. This has been cold dra with two intermediate annealings down to approximat $\frac{1}{16}$-in. wire.

Chemical Lead And the Causes of Its Technical Failure

An Analysis of the Effect of Various Impurities on Physical Properties and Technical Value of Chemical Lead

By Thomas French

DURING the last 50 years a considerable amount of research work has been devoted to "chemical lead." Although many facts with examples of faulty lead have been collected and many theories have been formed to account for the defects commonly occurring in lead, much still remains to be done, especially work of an academic nature. At the time Percy published his metallurgy of lead, in 1870, both the Pattinson and Parkes processes for the desilverization and purification of lead were in general use, and although the reasons underlying the separation of the various impurities in each case were not then so well established as they are now, the practical application of the processes was much the same as at the present day.

Parkes vs. Pattinson Process of Lead Refining

At all the large smelting works, desilverization by the Parkes process is almost universal on account of its lower cost, but there are still a few of the smaller smelting works in Europe that retain the Pattinson process because of the simplicity of its operation. Still more of the refiners of lead, not necessarily smelters, retain the Pattinson process in order to refine the lead to the grade required for the manufacture of white lead by the Old Dutch process, for which it is necessary to have a very highly refined lead, and in a lesser degree for the manufacture of red lead and litharge. Litharge for assayer's purposes, in which the silver has been reduced to a few grains per ton, is also made from lead that has been desilverized by the Pattinson process.

Effect of Addition of Bismuth to Purified Lead

There are certain elements that are not removed in refining lead by the Parkes process, notably bismuth, which unfortunately ranks as the most objectionable of all the impurities that occur in lead. Lead of "corroding" grade is generally required to contain not more than 0.05 per cent of bismuth. It is doubtful, however, if bismuth has the bad effect on white lead that is so often attributed to it. White lead of the best quality has been made by the Old Dutch process from an otherwise highly refined lead but containing more than 0.1 per cent bismuth, which was purposely added, with no observable bad effect or retardation of the corrosion. It is said, however, that the bismuth becomes concentrated in the residue of lead that remains after corrosion has stopped and that the grooves in the flat grinding stones quickly become filled with it, making grinding difficult. For other white lead processes such highly refined lead as is used for the Old Dutch and chamber methods is not necessary. For the manufacture of red lead and flake litharge, the bismuth content of the lead must be low, otherwise the color will be dirty and the flake litharge will not break down properly on weathering, resulting in a large proportion of hard lumps which must be sold at a less profitable price.

For concentrating sulphuric acid by means of lead pans there is not the slightest doubt that bismuth causes the acid to attack the lead at a very much lower temperature than when purified lead is used, and although it has by no means been definitely proved, the opinion is general that in "chamber" lead its presence is also very undesirable.

The cost of refining lead or desilverizing by the Pattinson process is somewhat more than by the Parkes process. This is unfortunate, as the Pattinson process removes bismuth from the lead and concentrates it in the uncrystallized portion containing the silver and other impurities. On the other hand, the Pattinson process removes copper very imperfectly, while the zinc used in the Parkes process has a great affinity for copper. For both processes the removal of copper is effected by a particular modification of the softening or improving process, previous to the desilverization. American lead is usually contaminated with bismuth to a much greater extent than European or Australian lead and were it not that the cost is more, the Pattinson process would be much more suited to the refining of American lead than the Parkes process. Should the demands of the user of lead become more exacting with regard to the presence of bismuth, it is possible that the American smelter may be forced to use a combination of the Parkes and Pattinson process. It is probable that the cost of the Pattinson process may be considerably reduced by a different and simpler arrangement of the plant than that of the Rozan and more modern modifications.

Variation in Analyses of the Same Lead by Different Men

There is very little information published as to the extent to which lead may be purified by either the Pattinson or Parkes process. It is generally understood that with the exception of bismuth, Parkes lead is purer than Pattinson and it is probably the case that for an equal removal of silver in an ordinary refined lead, Parkes lead is purer. There can be little question, however, that for extreme purification the Pattinson process is superior to the Parkes, judging mainly by the physical properties of the extremely refined leads.

It is a costly and by no means an easy matter to make a reliable analysis of a refined lead. When it is remembered that the total impurities comprising probably a dozen ingredients may amount to less than 20 mg. when 200 g. are used for analysis, the difficulty will be more readily appreciated. Some of the impurities, such as bismuth for instance, may be determined with a fair degree of accuracy. Silver by the cupellation method is held by many to be more accurate than by wet analysis. If each constituent could be gone after individually from a fresh solution of the lead there would be some chance of obtaining an accurate result, but when one after another of the constituents is determined in the same solution, with so many evaporations, the use of reagents which are by no means as pure as might be expected and with contamination by dust and the other things incidental to an analysis, the final result can be only approximately correct. It is,

in fact, quite common to obtain from different analysts analyses of the same sample of lead that have only the remotest likeness to one another. A. G. Betts, in his "Lead Refining by Electrolysis," gives examples of analyses of the same sample of lead, by three chemists, as follows:

PER CENT OF IMPURITIES

	Fe	Zn	Sb	Cu	As	Bi	Ag
A	0.00023	0.0004	0.0007	0.00043	0.00005	None	0.00003
	0.00032	.....	.....	0.00045	.....	....	.....
	0.00040	.....	.....	0.00045	.....	....	.....
B	0.0022	0.0079	0.0013	0.0013	0.0065	....	0.00016
C	0.0037	0.0042	0.0007	0.0012	0.0092	....	0.0003

Another example quoted by the same author of a sample analyzed by two analysts is as follows:

PER CENT IMPURITY

	Cu	Sb	Fe	Sn	Ag
A	0.0003	0.0060	0.0003	0.0049	0.0006
B	0.0020	0.0010	0.0046	0.0095	0.0006

In the latter instance it will be noticed that as regards copper, A's result is nearly 7 times less than B's; antimony, 6 times more; iron, about 15 times less, and tin about half as much, while silver, which was probably determined by dry assay, is the same in both cases.

An analysis of a refined lead, including a blank of the reagents used, usually requires about three weeks to perform. The difficulty, unreliability, time and expense of making an analysis of a refined lead are no doubt among the principal reasons for the small advance that has been made in our knowledge of the properties of lead.

Remarkably Consistent Properties of Lead From Different Refineries

It is remarkable how invariable the different well-known brands of lead on the market are as regards their physical properties. Australian "Brokenhills," Spanish "Pennaroya" and Perth Amboy leads each have their own characteristics which remain unchanged over a long period of years. Considering the variety and impurity of the ores from which the lead has been derived, the constancy of the refined lead must be admitted to be largely due to the particular method of treatment that the work lead has undergone as regards softening previous to desilverizing, method of desilverizing and subsequent refining. None of these leads is capable of resisting the action of 96 per cent sulphuric acid at the boiling point of the acid. Before that temperature is reached the lead is violently converted into sulphate of lead and sulphur is deposited, with the evolution of sulphurous acid and hydrogen. After subjecting these leads to further purification by the Pattinson process they are almost unaffected by the boiling acid, only a few bubbles of gas being observed and almost no conversion of the lead into sulphate after a considerable time. Usually, four crystallizations of the lead are sufficient to give this result and a further crystallization through another four pots makes little difference, although the physical properties of the lead are thereby improved.

Lead when refined to this degree solidifies in the mold into which it is cast with a highly colored surface characteristic of pure lead and with the crystals on the surface very well defined and in large aggregates. When a small sheet of this lead that has been cast into a mold and not rolled is subjected to the action of dilute nitric acid, these aggregates of crystals are slowly eaten around, the eutectic being eaten away more rapidly than the crystals. Lead has the power of dissolving oxide of lead when very hot. This oxide of lead is given up very completely when the lead is slowly cooled, but it may be that a minute quantity separates between the crystals and is attacked more readily by the acid.

Addition of Impurities to Refined Lead

If this highly refined lead, crystallized eight times, is alloyed with a small quantity of another metal to the amount of about 0.1 per cent, the action of the nitric acid is increased and a difference in the behavior of the metal added is discernible. That with antimony dissolves most rapidly and is accompanied by a black deposit; bismuth comes next, then copper. Arsenic and silver are very nearly equal to copper. Zinc, cadmium, tin and sodium are a little better than copper, and the alloy with aluminum is best of all.

When subjected to the action of strong sulphuric acid the alloy with bismuth is attacked when only moderately heated and if the heating is continued the lead is violently converted into sulphate. The alloy with silver and that with antimony come next and are violently attacked. Arsenic stands the action much better than silver and antimony. Cadmium, tin, aluminum, copper and sodium are about equal and still better, while zinc stands the action better than all the others.

Tests such as these on alloys of very pure lead with a very small quantity of another individual metal are, however, of little value for practical purposes, for when more than one metal in small quantity is added to the lead, the action of the acid appears to be quite different. The one metal apparently has an inhibitory or corrective effect on the other. Thus, when copper is present along with bismuth, it withstands the action of the acid very much better. This has been dealt with by D. W. Jones,[1] who gives the effect of the addition of various small amounts of copper to chemical lead. It should be remembered, however, that the chemical lead with which he experimented is of a much more impure quality than the highly refined lead referred to above.

Failure in Sulphuric Plants Often Due to Poor Management

The causes of failure due to defective lead are very varied. Lead used for chamber work may be quite satisfactory, while the same lead used in a concentrating pan may be worthless. For chamber work the sheet lead may have local defective parts which shorten its life, but usually the life of a chamber depends on the extent to which the production of acid is forced and on the management. Of two plants using exactly the same sheet lead for the construction of sulphuric acid chambers, one usually produced about four times as much sulphate of lead as the other.

The principal cause of the solution of the lead is generally considered to be the presence of an excessive quantity of nitric acid, in place of nitrogen trioxide and peroxide. If this is so, a pure lead should stand the action much better than an impure lead, but this deduction must be modified by the fact that the presence of air will accelerate the action, whereas the surface film of sulphate of lead that is formed will decrease it. Thinning of the sides of the chamber usually takes place near the top of the chamber and near the bottom. Sheets have been rolled thicker at the top and bottom for this reason, with good results. Pitting and roughening of the sheets is a very common defect and long irregular corroded channels

[1] *J. Soc. Chem. Ind.*, vol. 39, p. 221 T.

imilar to those often met with in lead pipes that have een lying underground, subject to electrolysis, are also ommon. Analysis of the lead in these cases gives little nformation as to the cause of corrosion. In any case, ne analysis of one part of a sheet of lead may be uite different from that of another part, for the im-urities in a block of cast lead are not disposed equally nroughout its mass. The end sheets rolled from the lock may be very different from the middle, as regards istribution of the impurities.

Behavior of Lead in Concentrating Pans

In concentration pans the acid is kept at a tempera-ure very little above 200 deg. C., while the melting oint of lead averages about 325 deg. C. Pans often ive way suddenly after a few days' use and sometimes nly after they have been in use for a long period. he contents of the pan suddenly become milky through ne formation of sulphate of lead and sulphur, accom-anied by a rise in temperature, and a large hole is apidly eaten through the pan. The addition of cold eak acid appears only to aggravate the action, prob-bly on account of the heat developed. Usually in such ases the cause will be found to be the presence in the ead of either bismuth or antimony.

William Beaumont Hart gives an example[2] of a an which he states was made of Pattinson lead hich had been crystallized three times, and contained, mong other impurities, a trace of antimony, 0.003 er cent bismuth and 0.0014 per cent copper. Five ays after starting the pan, without any known cause nd without evolution of gas, the pan started to leak. s contents became milky and a gradual slow action as observed. The remaining contents of the pan were nalyzed, showing the acid to have a specific gravity f 1.551 at 15 deg. C. and a strength of 63.8 per cent ulphuric acid. Among the impurities present in this cid there were bismuth 0.2247 per cent; zinc 0.0759 er cent; copper 0.0941 per cent; silver 0.0471 per cent, nd a trace of antimony. From the cubic capacity of ne cavities that had been eaten away he calculated nat the original lead at these parts must have had a ercentage composition as follows: Bismuth, 0.1250; opper, 0.0523; silver, 0.0262; zinc, 0.0422, and a trace f antimony. He remarks that it may happen that the ismuth accumulates at certain parts and may exhibit self in certain shapes in the sheet rolled or cast, the actured surface of which is sometimes covered with black coating, or the bismuth-lead alloy may exude rom the metal in fluid condition. Further investiga-on in this direction would probably lead to interesting esults.

Effect of Dirt and Oxide on Lead

It is well known that the presence of dirt and oxide f lead skimmings is responsible in many cases for the reakdown of sheet lead. Oxygen in lead may be re-ponsible for many failures, but Lunge and Schmidt, ho investigated this, concluded that the percentage of xygen in lead is very slight even in extreme cases and oes not seem to have any connection with its liability be acted on by acid. By a special method of analysis evised by them, they found that ordinary soft lead ontains an average of 0.0024 per cent of oxygen. They ade numerous attempts to increase the quantity of xygen artificially but never got beyond a maximum of 005 per cent. As this slight difference in percentage not connected with a perceptible difference in the action of sulphuric acid, the oxygen hypothesis, they say, must be abandoned.

It is presumed that by their reference to oxygen in lead they mean the compound of oxygen and lead. Metallic lead when red hot is capable of dissolving a very considerable quantity of oxide of lead, especially when melted under litharge. In this way at least 1 per cent of oxide, which contains ten times as much oxygen as was found by Lunge and Schmidt, may be introduced into lead. On slow cooling the whole of the dissolved oxide apparently separates and rises to the surface. When the cooling is rapid the oxide has not time to separate and is interpersed throughout the mass, but quite unalloyed with the lead. On hammering a small block of lead treated in this way, it shows innumerable cracks wherever the oxide has separated. If rolled it results in laminations of lead separated by films of litharge, in extreme cases so thick that it drops out when the lead is handled. Sheet lead and pipes have at times more of this entrapped oxide of lead than might be expected and there can be little doubt that to it is due the difference in the behavior of sheets rolled from the same brand of lead.

Process of Rolling Sheet Lead

In making sheets, the pigs of lead are loaded into a large cast-iron melting pot which is provided with a spout at the bottom for running off the melted lead. After the lead is melted and skimmed it is run into a mold placed at a lower level and forms a large block from 6 to 9 in. thick weighing 10 tons upwards. When cold enough it is lifted by means of a crane and transferred to the rolling mill. The rolls are slightly cambered and during the rolling the lead increases very slightly in width and elongates only in the direction of its length. After the block has been reduced considerably in thickness by the rolls it is cut into short lengths, the width of the rolls, and it is then usual to run each length through the rolls at right angles to the previous direction. When the sheet has become so much elongated that it is too long for the rolling table, it is doubled over and the rolling continued, a little chalk having been placed between the sheets to prevent them from adhering to one another. Finally the rough edges are cut off and the sheet is trimmed to the required size and made into rolls for the market.

When the lead is melted a considerable amount of granular scum, composed partly of dirt but mostly of oxide of lead, rises to the surface. Molten lead, like mercury, is very difficult to clean and by continued stirring it is always possible to bring a little more scum to the surface. In practice the lead is skimmed only once and occasionally a small lump of oxide, which may either have been adhering to the side of the pot, or trapped in the spout, passes into the mold and remains below the surface of the lead. Pieces of sheet lead that have failed from this cause are sometimes found with channels and streaks eaten away at right angles to one another when transverse rolling of the piece of lead has taken place. This has been proved by immersing a small lump of oxide in the middle of a block of lead. After rolling into a sheet and submitting to the action of acid for some time, a long channel was eaten away, similar to those which are commonly met with after the thin film of the metal which covered it has dissolved or worn away.

After the lead has been tapped from the melting pot into the mold it cools gradually or, if it is required

[2] *J. Soc. Chem. Ind.*, 1907, p. 504.

at once, the cooling is hastened by pouring water on it. The lead shrinks away from the mold and in the center it sinks, forming a large hollow in which usually the surface of the lead is continuous or unbroken. There are occasions, however, on which the lead has solidified too rapidly on the surface away from the center and in this case there will be found a mass of disrupted crystals in the hollow which penetrate the lead to a considerable depth. These crystals instantly acquire a film of suboxide. A freshly cut surface of lead welds together very thoroughly with pressure, but with the slightest oxidation film welding is impossible. When a sheet is rolled from a block such as this, there will be found in it a large part that will give unsatisfactory results in practice and especially if the sheet is subjected to vibration it will soon exhibit weakness.

Other Causes of Failure

Apart from the presence of impurities probably the chief cause of failure of sheet lead and pipes is due to admixture of oxide of lead, as previously mentioned. The lead in the melting pot is frequently made red hot and the surface of the lead then oxidizes with extreme rapidity and acquires a thick layer of flaky oxide of lead, which is dissolved by the lead near the surface. This lead saturated with oxide finds its way into the mold when sufficient time has not been allowed at a lower temperature for its separation. Although the lead in the mold crystallizes out free from the dissolved oxide, each crystal group is enveloped in oxide of lead. On rolling, these crystals cohere very imperfectly and give rise to the brittleness of the lead which is sometimes noticed in the lead boxes that are made to contain sulphuric acid for export. The small quantity of hydrogen evolved by the action of the acid on the lead gives sufficient pressure to form numerous cracks and the lead becomes so brittle that a slight blow causes it to break. The oxide is often observed when the sheet lead is scraped or cut by a sharp knife.

Failures of sheet lead sometimes occur for which the quality of the lead is not responsible, such as when lead is in contact with mortar, or when the sheets are subject to the vapors of acetic acid and carbonic acid gas. This latter condition sometimes exists when sheet lead is used on the roofs of bonded stores or distilleries. The lead in this case is gradually converted into white lead, as all the elements for the formation of the latter are present. There are numerous other isolated cases, some of which are easy to explain while in others only time and more data will afford a solution.

Chemical Specification for Cast-Iron Pipe

Although there has never been a general agreement between manufacturers' and users' associations on the correct chemical analysis of cast-iron pipe, discussions at a recent meeting of the American Water Works Association foreshadowed an agreement on sulphur limit at 0.10 or 0.12 per cent. At this meeting F. A. McInnes read an interesting paper on causes of failure, in which he remarked that analyses of metal from some of the pipe in the Boston waterworks that has been found broken or cracked during the past 20 years show some "horrible examples." Omitting extremes, the remaining analyses, particularly those in which the sulphur is abnormally high, warrant the conclusion that the quality of the iron was a contributing if not a direct factor in the failure of the pipe.

Cohesion

Rigidity is the outstanding characteristic of a solid, according to Sir George Beilby[1]. "During the past 20 years enormous strides have been made in the study of the ultimate structure of the atom, and in particular the experimental study of the disintegration of the radioactive elements has thrown an entirely new light on interatomic energy. This energy is now known to be of so high an order compared with the molecular forces previously known that many physicists have come to regard these latter as merely residual effects of the interatomic energy. However true this may be, the fact remains that in matter as we know it and as it affects our daily lives, cohesive force must always remain its most fundamental endowment." He describes experiments showing that filings of all metals, when small enough, adhere to each other or to flat surfaces with sufficient force to overcome gravitational attraction. Particles of zinc 0.033 mm. diameter and less will stick to the under side of a plate glass; of gold, 0.133 mm., silver 0.165 mm. and copper 0.099 mm.

"All the experimental researches on the properties of matter at low temperatures go to show that while the qualities of extension and mass which are common to matter in all its forms are unaltered by the removal of heat, the outstanding characteristic of the solid state, rigidity, becomes more and more pronounced as the absolute zero of temperature is approached. In other words, the physical properties which depend on cohesion show by their steady development as the absolute zero is approached that in a heatless universe cohesion would hold undisputed sway. In this universe the diverse properties of the majority of the elements as we know them would be entirely latent; the radioactive elements alone would continue by their disintegration to pass the product of their interatomic energy into a universe in which it would be dissipated and disappear entirely.

"With the advent of heat the all-powerful grip of cohesion is relaxed and the latent potentialities of matter begin to unfold. The waves of ether-borne energy, as they stir the responsive vibrations of the molecules, are to dead matter as the first breath of approaching spring is to the sleeping buds. As among the trees of the forest the response is more ready in some than in others, so among the elements, the lighter and more easily energized, like hydrogen and helium, are already far on in their development toward the ideal freedom of the gaseous state before the less responsive, like platinum and carbon, show any signs of stirring from their lethargy. In the more slowly energized elements we can study the earlier steps in this development, and I think we are now entitled to say that one of the first of these is the acquirement by the molecules of the power of automatic crystalline arrangement."

Fertilizer Used on Cotton

The Department of Agriculture has estimated that commercial fertilizer was used on almost exactly one third of this year's cotton acreage, or on about 11,500,000 acres. On the average 249 lb. of fertilizer was applied per acre and the total fertilizer used was about 1,429,000 tons. This had a total value of $42,121,000, or $29.48 per ton. This was equivalent to a cost of $3.69 for each acre on which fertilizer was used.

[1] "Aggregation and Flow of Solids," MacMillan Co.

New Vessel for the Absorption of Hydrochloric Acid*

A Discussion of the Principles Underlying the Absorption of Gases — The Presentation of a New Absorber and the Illustration of Its Use in Hydrochloric Acid Production

By Stephen L. Tyler
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THE absorption of hydrochloric acid gas in water at first sight seems to be a very simple proposition. The gas is highly soluble in water and it uld seem that simply bringing together the gas and e absorbent would readily result in complete absorpn.

The problem, however, is not quite as simple as it uld first appear. The solution of hydrochloric acid s in water is one which is highly exothermic and e solubility of the gas is inversely proportional to the mperature. As an example of this, it is possible at a mperature of 0 deg. C. to dissolve over 500 volnes of the gas in one volume of water, while at a temrature of 60 deg. C. less than 350 volumes of gas can dissolved in one volume of water and at a temperare of 110 deg. C. only about 160 volumes may be tained by one volume of water.

Conditions Favoring Absorption

The solution of hydrochloric acid gas in water is pendent upon the following conditions:

1. The temperature of the gas and the liquid.
2. The concentration of the gas in the gases to be scrubbed and the concentration of the acid liquid to be produced.
3. The time of contact between the gas and the liquid; the average distance between the gaseous particles and the liquid particles; the thickness of the liquid layer and its movement internal and as a whole.

Three general methods suggest themselves for bring- about intimate contact between gas and absorbing uid:

1. Spraying the liquid into the gas.
2. Bubbling the gas through the liquid.
3. Contact between liquid and gas by a distribution of the liquid over relatively large surfaces.

The first method mentioned above is not practical efficient in the case of hydrochloric acid because the high heat of solution and the difficulty of remov- the heat generated. By this first method only acid low strength can be obtained. The second method, ile reasonably satisfactory from the standpoint of ducing acid of good strength, is impractical from the chanical standpoint when the apparatus is designed the removal of heat because of the highly corrosive ure of the gas to be handled and the pressure encoun- ed. Thus we have left only the third method or the ect exposure of the liquid to the gas for the satisfactory production of a high strength hydrochloric acid.

Two Methods in Use at Present

At the present time two general methods are used bringing about this intimate contact between the soluble gas and the absorbing liquid. One of these methods employs stoneware vessels (tourills) so designed that a relatively large surface of liquid is exposed to the gas. These vessels are also designed for cooling. The second method uses the vertical tower with a suitable packing material over which the absorbing liquid is passed, thus exposing extremely large surfaces of absorbing liquid to the gas. This latter method is used extensively where gas concentrations are low.

The tourill type of plant is satisfactory for the production of the higher strengths of acid and the design of the apparatus is such as to allow of satisfactory cooling and surface exposure of the absorbing liquid to the gases. There is, however, the objection that this plant requires much floor space and necessitates many connections to maintain a circulation of both liquid and gas. The tower has been used extentively for the absorption of hydrochloric acid gas, but from this it is possible to produce only acids of low strength, as it is not practical to construct absorption towers with sufficient cooling to keep the tower temperature down to a point where high strength acid may be produced.

Principles Involved in the New Absorber

A new type of absorption vessel has recently been developed. The general design of this vessel is shown in Fig. 1. It will be seen that the vessel follows the general design of the S-bend, but has broadened body (3), which is flattened so as to give large surface with relatively small volume. There is a dam or weir (4) at one end of the lower surface which retains a certain quantity of liquid in the bottom of the vessel, thus making this a small reservoir. By following the S-bend principle, the pieces would be set up vertically one above the other, the socket (2) receiving the spigot (1) of the vessel following, thus making an absorption system which amounts to practically nothing more than a single conduit through which both the gases and liquid pass and which has pockets or reservoirs to retain a certain amount of the liquid. Thus the third method of bringing about the intimate contact between the gas and the absorbing liquid is used, but all of the

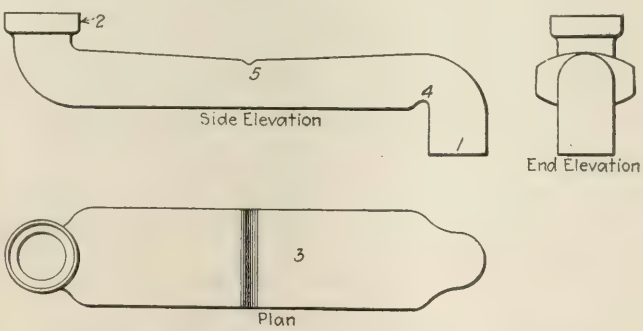


FIG. 1—GENERAL DESIGN OF ABSORPTION VESSEL

*Paper presented before the American Institute of Chemical ineers at Niagara Falls, Canada, June 21, 1922.

objections to the other types of apparatus have been removed by the elimination of small tube connections for maintaining the circulation of the absorbing liquid. These connections have been made generally of glass with rubber as the packing material and have been a very objectionable point, especially because of the fact that they were located necessarily below the level of the absorbing liquid and a leak was certain if breakage occurred or the packing deteriorated.

At the central portion of the roof of the vessel there is a low point (5) toward which the vessel slopes from either end. This sloping of the roof will deflect the gases downward upon the absorbing liquid and bring about very intimate contact. There will be a certain amount of liquid condensed out from the gases as well as some of the liquid run over from the absorption vessel immediately above, which will drip off at this point, making substantially a liquid curtain through which all of the gas must pass. This dropping of liquid on to the absorbing surface has the added advantage that it brings about a complete agitation of the absorbent and thus materially increases the absorption. In absorbing soluble gases in liquids, agitation of the absorbent will always increase the efficiency. There is

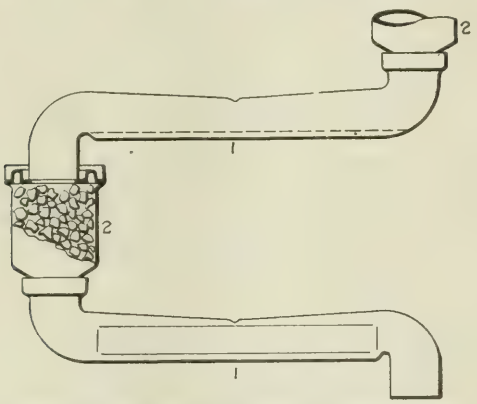


FIG. 2—APPARATUS WITH SMALL ABSORPTION TOWER INSERTED FOR LOW CONCENTRATION OF GAS

also further agitation when the absorbent flows from one vessel to the other, as there is a vertical drop of several inches.

With gases of higher concentration, surface exposure alone is better adapted for their absorption. Therefore the type of vessel just described, if used alone, is more suited to such gases as are generated from the pan side of a "salt-sulphuric" hydrochloric acid plant. In cases where the hydrochloric acid gas concentration is low the same type of absorption vessel may be set up in much the same manner but with interposed packed towers of larger section than the pipe connections themselves.

Modification of New Apparatus for Low Concentration Gas

A set-up showing these short towers is shown in Fig. 2. The packed tower (2) is placed between two absorption vessels (1). The objections already raised to the tower method of absorption in that it does not allow of the removal of the heat generated is overcome in this method of employing towers. The absorbent is thoroughly cooled in its travel through the intermediate absorption vessels.

Suggested Absorption System for Pan Gases

Fig. 3 shows a typical cooling and absorption system for hydrochloric acid produced from the gas generated

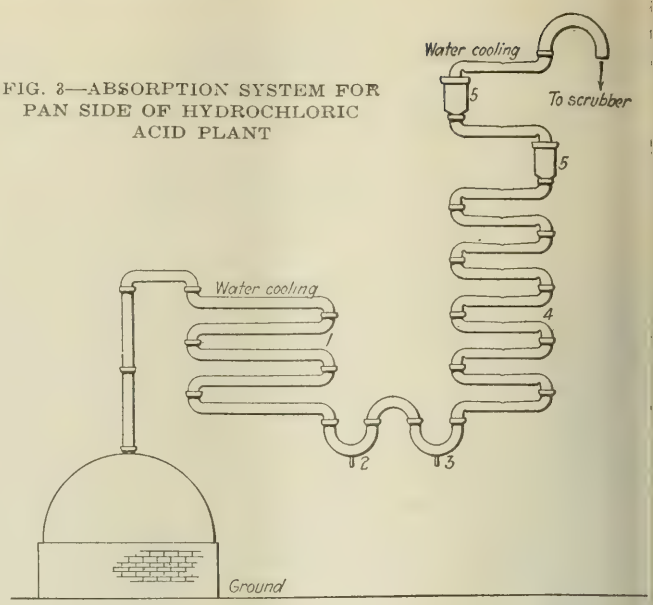


FIG. 3—ABSORPTION SYSTEM FOR PAN SIDE OF HYDROCHLORIC ACID PLANT

on the pan side of the pan and roaster type of plant. It will be noted that the gas first passes through a water-cooled condenser (1) which will remove much of the condensable vapors and lower the temperature of the gas. The condensate produced in this line runs off from a trap (2). The gas passes on through a second trap (3) and up into the absorption system (4). The absorption system operates on the reflux principle so that the strongest gas is in contact with the strongest acid. In the upper portion of this, where the gas concentrations are much lower, towers (5) are interposed between the absorption vessels so as to remove as much as possible of the soluble gas. The gases passing on through this upper portion of the absorption system are carried over to the final scrubbers. The acid produced in the absorption system is taken off from trap (3). The entire absorption system would be thoroughly water-cooled to prevent a rise in tempera

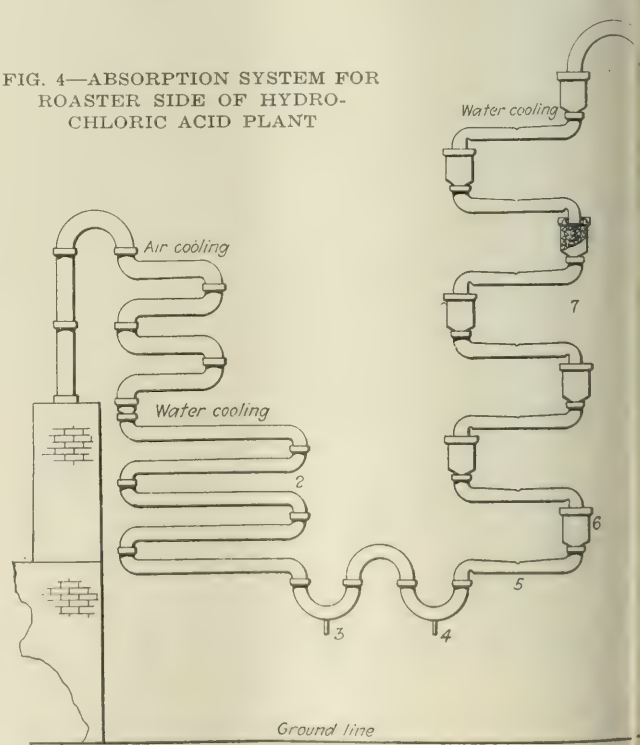


FIG. 4—ABSORPTION SYSTEM FOR ROASTER SIDE OF HYDROCHLORIC ACID PLANT

ture due to the absorption and to insure the production of acid of good strength.

System Modified for Absorption of Muffle Gases

Fig. 4 shows the general design of a cooling and absorption system for the hydrochloric acid gas produced on the roaster or muffle side of the plant. The gases leaving the muffle are first conducted through a series of S-bends (1) which are air-cooled only; then through a second series of S-bends which are water-cooled (2). In this latter set of condensers, the condensable vapors are removed and the gas is cooled. The condensate from both of these coolers is carried off through the trap (3). The gases pass forward through another trap piece (4) and up through the absorption system (7) which is composed entirely of absorption vessels (5) with intermediate towers (6). The exit gases from this absorption train are carried over to a scrubbing system which may consist of another absorption system similar to the one shown or may be a stoneware tower, depending considerably upon the ultimate use for the acid produced.

The type of hydrochloric acid absorption equipment with which this paper deals is designed to be made of fused silica. For such work as this, fused silica is especially well adapted inasmuch as it is insoluble in the acid and thus the product cannot be contaminated. The wall thickness of pieces made up of fused silica is much less than that obtained in any other ceramic material, thus tending toward increasing the efficiency of the cooling and consequently reducing the size of the plant. Such equipment is relatively light in weight so that light supports are ample.

Summary

In summing up the points brought out regarding the type of absorption equipment described, the following points are worth notice: Light weight; economy of floor space; complete agitation of absorbent; liquid curtain through which gas must pass; no joints below liquid level; no glass tube connections or rubber joints; thorough cooling of gas and liquid; intermediate towers give all advantages of tower absorption with none of the disadvantages; complete distribution of cooling water over large cooling surface.

Other uses for the absorption vessel are apparent but the following are possibly worth mentioning:

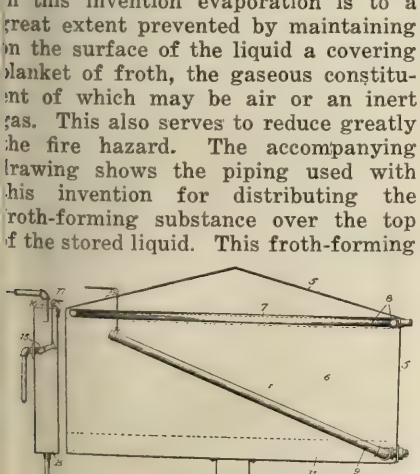
1. As absorber for soluble gases other than hydrochloric acid.
2. For bringing about reactions of gases upon solutions, emulsions or suspensions. An example of this would be some of the chlorination reactions. In this sort of work, the use of the intermediate tower should considerably increase the efficiency of the plant.
3. For the concentration of volatile liquids of boiling points approximately that of water.
4. For fractional distillation of liquid mixtures.
5. As condenser for such vapors as nitric acid where surface exposure to the hotter gases is desirable to insure uniformity of product. The large surface exposure as well as the intimate contact between the hotter still gases and the condensate produced when operating on the reflux principle would give an acid of very good quality and color.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Prevention of Evaporation of Stored Liquids.—Petroleum oils and other similar volatiles are often held in storage for considerable periods of time. The invention covered by this patent aims to prevent evaporation from oils and other similar liquids when so stored. In this invention evaporation is to a great extent prevented by maintaining on the surface of the liquid a covering blanket of froth, the gaseous constituent of which may be air or an inert gas. This also serves to reduce greatly the fire hazard. The accompanying drawing shows the piping used with this invention for distributing the froth-forming substance over the top of the stored liquid. This froth-forming substance can be obtained by dissolving a suitable amount of animal gelatine in water together with a small percentage of a soluble preservative agent as mercuric chloride. (1,415,351; Frank A. Howard, C. I. Robinson and James M. Jennings, assignors to Standard Oil Co. of N. J. May 9, 1922.)



Fertilizer and Process of Making Same.—Graham Edgar of Washington, D. C., has developed an improvement in fertilizer manufacture and assigned it to the government. It relates to the use of calcium cyanamide and tricalcium phosphate in the production of fertilizer containing both fixed nitrogen and phosphoric acid in available forms. It could not be done previously because calcium cyanamide is not effectively converted into urea when treated with acids in the presence of diluents and neutralizing substances such as calcium phosphates, except when the ratio is about 10 to 1. Also because the effective conversion of calcium cyanamide into urea in the presence of acid phosphates occurs only at temperatures of 70 or 80 deg. C. Under these conditions a considerable loss of available phosphoric acid occurs due to the transformation into soluble phosphates. This has limited the amount of calcium cyanamide used in fertilizer mixtures to about 6 per cent. Mr. Edgar's process develops the fact that it is necessary first to treat the calcium cyanamide with strong mineral acids in an amount substantially in excess of that necessary to neutralize the lime content and to maintain a substantial excess of mineral acid throughout the reaction and finally to allow the process to come to completion before adding such diluents and neutralizing substances as bone meal, phosphate rock and potassium carbonate. Urea is very much less decomposed in the presence of strong mineral acids than in the presence of diluents or weekly acidic substances, and therefore higher temperatures may be employed for the reaction as carried out above.

After the reaction has been completed, phosphate rock sufficient to neutralize the excess acid is added. By this process it is possible to produce from calcium cyanamide a fertilizer containing 50 per cent of the total nitrogen in the form of urea and in addition to raise the ratio of urea to phosphoric acid anhydride to one part of urea to three parts of phosphoric anhydride, and may even exceed this, reaching a point where the urea will exceed the amount of phosphoric anhydride present. (1,413,013; April 18, 1922.)

Varnish Composition. — A varnish composition for use as a solvent oil may be prepared from a mixture including approximately 50 per cent by weight of pure vegetable gum, tung oil and thinners, ½ per cent of pure camphor gum, ½ per cent of lavender oil and 49 per cent of naphtha. (1,413,628; H. W. and R. W. Summers, assignors to Detroit Universal Solvent Co.; April 25, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Chemical Foundation Defended in Senate

Underwood Upholds Motives and Conduct of Garvan's Organization—Decision Against Foundation Might Be Taken as Precedent and Result in Loss of Other Benefits to Industry

INFORMATION reaching Washington indicates that the chemists and chemical industries of the country have been stirred deeply by the action taken against the Chemical Foundation. The anxiety is not confined to those interested in the chemical industries, as it is feared that Americans may lose the advantages which came with the sale of other alien property.

Another week has passed without any information having been brought out which would cause any of the chemists to desert the Foundation. At the office of the Alien Property Custodian it is stated that the suit will be filed during the first week of August.

Under ordinary circumstances there would be no objection to the suit. It is realized that there are certain legal questions which must be settled, but there is objection to the apparent timing of the action so as to influence legislation. The situation is made worse in the eyes of chemists because it seems to be one of a succession of acts by the Administration which have hurt the chemical industry during the critical period in which it has been endeavoring to establish itself on a scale commensurate with the commercial importance of the country. Several arbitrary acts have been aimed at the Chemical Warfare Service. The State Department suddenly severed its relations with the Textile Alliance. The patent convention was renewed without the adoption of the safeguards which the chemical industry advocated. Then came the action against the Foundation. All of this, combined with the prospects for the defeat of the dye embargo, make the future of the American chemical industry exceedingly dark.

Underwood Defends Foundation

During an extended discussion of the Chemical Foundation matter in the Senate, the only defense of the Administration's course was that a suit against the Foundation is necessary in order to meet the suit which the Foundation brought to establish the status of the royalties paid into the U. S. Treasury. Senator Underwood spoke effectively in defense of the Foundation. It is probable that a further defense of the Foundation will be made in the near future on the floor of the Senate, by a prominent Republican member.

Senator Underwood prefaced his remarks with the explanation that it is advisable at this time to review the facts surrounding the matter. Before he had proceeded far in his speech he was upbraided by Senator Nelson of Minnesota, chairman of the Committee on the Judiciary, for making an elaborate argument in behalf of the sale of the German patents to the Chemical Foundation. "I am astonished," he said, "that the conservative Senator from Alabama should take a case of this kind out of the hands of the courts and attempt to try it in the Senate."

To this Senator Underwood retorted: "The reason why I make this statement is not a question of trying to interfere with the courts, but I know that this attack is coming from the German lawyers in this country who are trying to get back the property of their clients." He declared that it is a mistake for the government to take this action against the Chemical Foundation. If the government succeeds in having set aside the transfer of these chemical patents to the agency created for the benefit of the American people, what is to become of the patents, he demanded. "Are you going to give them back to Germany or where do they go?" asked the Senator. "If you give those chemical patents back to Germany they go to the German cartel, a trust in Germany."

No Fraud Apparent

Senator Underwood traced the history of the legislation under which alien property was seized. He pointed out that the Germans had taken out these patents for the purpose of stifling industry in America. "The spirit of our patent laws," he declared, "had been violated, and our hospitality abused when the Germans took out those patents here for the sole purpose of building up in Germany the great industrial and war machine with which they expected to subdue the world."

The fact that A. Mitchell Palmer submitted his entire plan for the sale of the patents to the Chemical Foundation to Congress 2 months before the action was taken is evidence, Senator Underwood declared, that there could have been no fraud intended.

"This report effectually disposes of the charge that there was a fraudulent conspiracy on the part of those in the Alien Property Custodian's office," continued Senator Underwood. "The charge has been repeatedly made that Mr. Garvan, as Alien Property Custodian, sold these patents to himself as president of the Chemical Foundation. It will be seen, however, from this report which was made before Mr. Garvan became Alien Property Custodian or had any thought of being appointed to that office, that the entire plan was devised and perfected and the sale made while Mr. Palmer was in office.

"It was Mr. Garvan's announced purpose then to resign his subordinate place in the Alien Property Custodian office and take the presidency of the Chemical Foundation without salary or compensation for expenses, but on March 4, 1919, Mr. Palmer was appointed Attorney-General, and President Wilson, with full knowledge of the entire Chemical Foundation matter made Mr. Garvan Alien Property Custodian. It is true that the actual assignment of the patents to the Chemical Foundation was not ready until April 10, 1919, and it was signed by Mr. Garvan as Alien Property Custodian, but as shown by Mr. Palmer's report, the entire matter had been concluded and consummated before Mr. Palmer went out of office, and the signing of the papers was a mere formality.

Aim to Prevent Monopoly

"Conspiracies to defraud are not committed in the open light of day. Conspiracies to defraud the government are never reported to Congress by the conspirators in advance. How could a

(Continued on page 229)

Senate Committee Splits on Muscle Shoals

As had been expected, the Senate Committee on Agriculture split in much the same manner over the Muscle Shoals proposition as did the Committee on Miltary Affairs of the House of Representatives. The Senate committee, like the House committee, was almost evenly divided for and against the acceptance of the Ford offer.

The situation differs from that in the House committee in that Chairman Norris, joined by Senators McNary of Oregon, Norbeck of South Dakota, McKinley of Illinois and Gooding of Idaho, recommends the incorporation of the Federal Chemical Corporation to operate the Muscle Shoals property for government account.

Senator Kendrick, of Wyoming, explained to the Senate that his only objection to the Ford offer is the fact that the lease period is for 100 years. He believes no lease of waterpower should exceed fifty years, the limit prescribed by the waterpower act.

American Ceramic Society to Visit Canadian Plants

lembers Will Be Busy for Week Inspecting the Numerous Industries of the Dominion

Detailed plans for the Canadian sumer meeting of the American Ceramic ociety emphasize the fact that the eek of Aug. 13 to 19 will offer unsual opportunities for the inspection a variety of ceramic plants under ost enjoyable circumstances.

The party will leave Rochester Sunay, Aug. 13, at 9:45 p.m. standard me, on the steamer Kingston, arrivg in Montreal Monday at 6:45 p.m.

INSPECTION TRIPS

Tuesday, Aug. 15, will be spent in ontreal. G. Percy Cole, of the Dominn Glass Co., will be in charge of the sits to Montreal Pottery; Trenton otteries; Dominion Glass Co.; Point . Charles Works (bottles on Owens achine); Delorimiert Works (punch mblers, chimneys, etc.); McGill Uniersity; Consumers Glass Co. (semiutomatic machine on bottles and mblers); Nation Brick Co. Ltd.; aprairie Works and Delson Junction orks; Thomas Davidson Manufacturg Co., Ltd. (enameled ware); Gurney oundry Co., Ville St. Laurent (stove ameling, three furnaces), and the nada Cement Company, Ltd.

Wednesday, Aug. 16, will be spent in uckingham, Ont., with N. B. Davis in arge. On arrival at Buckingham, at :20 a.m. the excursion will proceed motor to the Derry feldspar quares. This 10-mile drive is through one the most beautiful sections along the evre River. The return trip will be ade in time to leave Buckingham at p.m. for Ottawa.

A brief but crowded trip to Ottawa Thursday will be under a committee mposed of N. B. Davis, Howells echette, Joseph Keele and D. Merkley. lternative excursions have been arnged to the Parliament Buildings; ctoria National Museum; Ceramic aboratories, Department of Mines; per mills and Merkley's brick plant.

VERONA, KINGSTON AND TORONTO

The party will leave Ottawa at 10:40 n. arriving at Verona at 2:34 p.m. ere R. F. Segsworth and Everett wnsend will be in charge and the rty will be conveyed from Verona to e famous feldspar quarries of this strict. A real camp dinner, cooked d served by camp cooks, is to be joyed in the Verona wilds.

The party will leave Verona at 6:35 n. for Kingston, arriving at 7:35 p.m. ter a banquet by Kingston Council d a visit to the Frontenac Floor & ile Tile Co. the visitors will leave in ecial Pullman sleeper for Toronto, ere they will spend Friday.

The day in Toronto is being arranged M. F. Gibson, A. N. Cote and R. K. bertson. Their plans include visits Standard Sanitary Works; Dominn Glass Co.; Jefferson Glass Co.; eral brick and tile companies; Toronto University and Queens Museum. Friday night will be spent in Toronto, the party leaving the next morning for Hamilton, where visits will be made to the Dominion Glass Co.; Canadian Libbey-Owens Sheet Glass Co.; General Porcelain Co.; National Fire Proofing Co. and Canadian-Harts Products Co.

Business Library to Be Selected by Industrial Leaders

Two thousand business men, one hundred national leaders in each of twenty basic industries, are selecting a representative business library to be placed in the Hotel McAlpin, New York, and to include the ten most authoritative books on every branch of business and industry.

Bank presidents, railroad heads, insurance presidents, advertising executives, textile manufacturers, wholesale grocers, department store heads and engineers are helping L. M. Boomer, managing director of the hotel, to collect this library. The bibliography will be made available to chambers of commerce and other business organizations.

The library when completed will comprise the ten most authoritative books covering the fields of Insurance, Banking, Textiles, Groceries, Railroads, Shipping, Automobiles, Iron and Steel, Coal, Lumber, Grain, Rubber, Shoe and Leather, Department Stores, Clothing, Advertising, Printing, Paper, Accountancy, Credit, Sales Management, Publishing, Foreign Trade, Building, Heating and Ventilating and Furniture.

The method of selection is to analyze the lists received from the one hundred leaders in each industry and thus select the books which are mentioned the greatest number of times. The ten books in each field most often selected will be those included in the library. The lists will be re-submitted to a committee of experts for further voting if there is not sufficient unanimity of opinion.

I. C. C. Ruling on Cyanamid—Sulphur Rates Protested

Deciding the complaint of the American Cyanamid Co., the Interstate Commerce Commission hold that the rates on cyanamid from Suspension Bridge, N. Y., and Niagara Falls, Ontario, Canada, to San Francisco, Los Angeles and other Pacific coast destinations in California are unreasonable. It prescribes reeasonable factors beyond St. Louis not exceeding 81.5 cents per 100 pounds and effective Sept. 6.

The Texas Gulf Sulphur Co., has entered a complaint against the rates on sulphur from Jersey City, N. J., to Baltimore, Md., and from Baltimore to Brills, N. J., on the ground that the present rates are unreasonable.

Unreasonable rates on sulphuric acid from Grasselli and Brill to Seaboard, N. J. are alleged by the Seaboard Byproduct Coke Co. of Pittsburgh. The General Chemical Co., of New York, complains against unreasonable rates on sulphuric acid from Undercliff to Maywood, N. J.

Trade Board Drops Resale Price Cases

Forty Old Complaints Quashed Since Supreme Court Has Found Practice Illegal

The Federal Trade Commission has dismissed, without prejudice to its right to institute new proceedings, about forty complaints against as many nationally known business concerns which it had charged with maintaining resale prices similar to those in what was known as the Beech-Nut Packing case.

These cases involve resale price maintenance and were suspended by the Commission to await the determination of the Beech-Nut Packing case, which case was selected and advanced by the Commission as a test case. In the Beech-Nut case the Supreme Court upheld the position of the Commission with respect to resale price maintenance.

After the Beech-Nut decision the Commission considered its suspense calendar and concluded, in view of the Beech-Nut decision and the age of the cases on suspense, that the cases suspended should be dismissed without prejudice, as it appeared to the Commission that the Supreme Court had settled the law with respect to price maintenance, and to bring these forty cases to a conclusion would involve a large expenditure of time and money and would require the amendment of the complaints to bring them down to date, and rather than amend its complaints, which would require reinvestigation, the Commission dismissed them without prejudice.

At the same time the Commission instructed its chief examiner to institute a new inquiry with respect to each of the dismissed cases and if it appeared that violations of law were found to exist within the meaning of the Beech-Nut decision, to report the facts to the Commission for determination as to whether or not new complaints should issue.

CHEMICAL COMPANIES INCLUDED

The companies against which complaints were dismissed included: The General Chemical Co., American Thermos Bottle Co., De Miracle Chemical Co., Kryptok Sales Co., L. E. Waterman Co., H. L. Hildreth Co., Massachusetts Chocolate Co., Marinello Co. of Wisconsin, Marinello Co. of Illinois, Vortex Manufacturing Co., Curtis and Co. Manufacturing Co. and Curtis Pneumatic Machinery Co., William Waltke & Co., Crescent Manufacturing Co., Goodyear Tire & Rubber Co., The Procter & Gamble Co., The DeLaval Separator Co., Buffalo Specialty Co., American Graphophone Co., Columbia Graphophone Co., The Gates Rubber Co., J. E. Hunt & Co., Pennsylvania Salt Mfg. Co., Colgate & Co., The Sheets Elevator Co., The Vick Chemical Co., Colorado Milling & Elevator Co., United Electric Co., Hillerich & Bradsby Co., Klaxon Co., D. M. Ferry & Co., Tungsten Manufacturing Co. and the Domestic Engineering Co., Inc.

Plans for Chemical Exposition Include Features Which Insure Success

Four Hundred Exhibitors Signed to Date Including Many Novelties and New Features—Society Programs and Motion Pictures Will Add to Activity

WITH over four hundred exhibitors signed up for booths at the Chemical Exposition, the success of the annual "big show" is assured. The Exposition this year will be the eighth held in New York. It has been purposely scheduled to occupy the week between the American Chemical Society meeting in Pittsburgh and that of the American Electrochemical Society in Montreal so that the month of September will be a busy one in chemical circles.

The Exposition will open on Monday, Sept. 11, at the Grand Central Palace, New York, and continue through the entire week. The exhibitors include most of the firms that have taken space in previous years and a number of companies that will exhibit for the first time. To date, five technical societies have definitely scheduled meetings to be held in the auditorium at the Exposition. Motion pictures dealing with varied phases of chemistry and engineering have been arranged for evening exhibition through the week. All in all, the 1922 edition of the Chemical Exposition offers enough of interest to the profession to occupy several days of one's time at the Grand Central Palace.

Exhibits and Exhibitors

Every branch of the chemical and chemical equipment industries will be represented among the exhibitors, as well as numerous allied houses. The chemical products which will be on display will include all varieties manufactured in the United States—coal-tar medicinals and dyestuffs, technical chemicals for the rubber, leather, paper, textile, paint, and other consuming trades. In the apparatus and machinery branches, the exhibits will take in every phase of chemical plant and laboratory equipment.

A number of new devices, developed during the past four years since the termination of war-time activity and completed since the 1921 Exposition, will be displayed for the first time this year. Many improvements on machinery long standard for industrial operations will be shown for the first time. A great many of the machines and instruments will be seen in actual operation. Something new in a special high capacity evaporator lead pump for handling phosphoric acid under pressure, a new adaptation of the hard rubber pump in hydrochloric acid loading, a recent development on a balanced automatic control valve and in a direct reading resistance thermometer, new ideas in pyrometers, developments of the past year in butyl alcohol derivatives for solvent purposes, recent developments in the use of chlorine bleach liquor in the paper industry in place of bleaching powder, new dust controlling and humidifying equipment, new ideas in loading machinery for trucks, new departures in all types of containers, steel, fiber, wood, and glass —new ideas in all branches of the industry will be on display. One of the well-known associations will display a wall chart on which will be listed every manufacturer in the United States of ordinary quicklime with a full chemical and physical description of each brand now on the market.

Several special sections are being planned. One will be given over to photographic materials, supplies and microscopes, in connection with the exhibit of the Technical Photographic and Microscopical Society. Another special section will be devoted to a fuel economy display which will include the products and services of nearly 100 firms. Another section will be given over to exhibits showing fire and dust explosion prevention in mills, industrial plants, grain elevators, mines and factories. This exhibit is being arranged by the Bureau of Chemistry and the Bureau of Mines. There will be shown fire extinguishing apparatus of the most modern kinds. Another novelty will be the container section, showing shipping containers of all kinds and in which packaging, labeling, package handling and shipping machinery will be exhibited.

Society Meetings

It is estimated that 100,000 persons will visit the Exposition this year from all parts of the country. Several of the societies have taken advantage of this congregating by scheduling meetings in connection with the show. Each afternoon the program will be given over to a series of events to be arranged by one of the scientific or business associations of the chemical industry, according to the plans which have been tentatively outlined. The Technical Association of the Pulp and Paper Industry, the Synthetic Organic Chemical Manufacturers Association, the American Ceramic Society, the Salesmen's Association of the American Chemical Industry, and the Technical Photographic and Microscopical Society have arranged to take care of the program for one afternoon each. The standardization program with its numerous different phases will also fill an afternoon session. The evening sessions will be given over exclusively to motion pictures, a number of which will be accompanied by lectures on various developments in the chemical and allied industries. All meetings will be held in a special auditorium in the Grand Central Palace provided for the purpose by the Exposition management.

T. A. P. P. I. Program

The Technical Association of the Pulp and Paper Industry has about completed its program. The Association is introducing a new idea in holding this particular type of meeting

VIEW OF MAIN FLOOR OF CHEMICAL EXPOSITION

The regular technical meetings o T. A. P. P. I. were formerly held eac year in connection with the Expositio but the meeting this year is of a speci nature. It is intended especially as a opportunity for manufacturers equipment applicable to the paper i dustry to describe their products t representatives of the industry and o the other hand, for the operating me to learn of the advantages offered b the latest developments in the equi ment field. Each speaker will prese an idea concerning the product of h company, not with the object of hypn tizing his audience into a buying org

(*Continued on page* 230)

Metz, in Germany, Voices Opposition to Dye Tariff

eclares Former Enemy Plants Can Never Supplant New Industry in the U. S.

Herman A. Metz, head of Metz & ., importers and manufacturers of es and synthetic chemicals, has cabled om Germany a correction of state- ents attributed to him on the dyes riff.

"It is true," said Colonel Metz, "that e are importing only about 10 per cent our dye requirements and it is true at German dye plants as well as other dustrial enterprises based on a dollar lculation are worth only about 10 per nt of their pre-war capital, despite the rge increases of capital stock issued many of them. I was much amused the comments made by a 'prominent ctor.' If these 'prominent factors' and yestuff authorities' only had the nerve put their names to their statements would soon know which of them were id propagandists or publicity agents d which really knew what they were lking about.

Depreciation of Mark Explains Huge Dividends

"Any primary school boy can figure t the present conditions. Before the ar the three largest dye and chemical hey always forget the chemical part) ants had a capital of 54,000,000 gold arks each. That equals about $12,- 0,000 each, for three of the plants ne, as the rest were smaller. To be rth the same amount in dollars (and rtainly buildings, land, plants and ocesses are as good as ever in pro- rtion) each of these three plants, tting the mark at 400 to a dollar, ould have a capital of 5,000,000,000 arks, or 15,000,000,000 for the three rgest. If, in view of the actual fig- es, you can work out a shrinkage in lue of less than 80 or 90 per cent I uld like to see it. And in figuring e 'exorbitant dividends' of 20 or 30 r cent, we must bear in mind that ey also are paid in paper marks, and at where formerly four marks were rth one dollar, now it takes over 400 buy one dollar or one dollar's worth goods, and then you get from one- ird to two-thirds the amount of goods u formerly got for a dollar.

Labor a Small Factor

"Of course labor, even at 30 (or 50 arks an hour, which it may soon be) cheap compared with the United ates. But bear in mind the fact that or is only about 10 per cent of the st of dyes and chemicals, while benzol d the main coal tar derivatives are expensive in Germany as in the ited States and the same are being ught in America, while coal, which w is largely bought in England, since ance takes the German coal, is as h or higher. You get a different nt of the whole situation.

"I have not changed my views one bit and I still insist that we must have a healthy chemical industry in the United States and want sufficient tariff to give it to us; but I want to get it by honest, above-board means and not under false pretences."

Arsenic Tariff Burden Discussed in Senate

Charges that the recent duty of 2 cents per pound on arsenic adopted by the Senate in the revised tariff bill will subject the cotton growers to a tax of $18,000,000 were made in a Senate debate on the cotton schedule by Senator Smith of South Carolina. Senator Robinson, of Arkansas, also opposed the duty on the same score while Senator Smoot, of Utah, for the Finance Committee, denied that the duty would impose such a tax. He said that based on last year's imports the duty would not exceed $100,000.

Chemical Foundation Defended

(*Continued from page* 226)

conspiracy be successfully charged here in view of the fact that the Alien Property Custodian, before the final act which transferred the property, made a full and complete report of his plans and purposes and the reasons therefor to the Congress of the United States, to which wide publicity was given at the time? If the Chemical Foundation had been a strictly private institution for profit, engaged in the manufacture of chemicals, the sale to it for $250,000 would have been properly subject to attack, for it would have given for a trifling consideration a monopoly in the production of chemicals. But it was just to avoid this kind of situation that the Chemical Foundation was formed."

Trustees Control Foundation

The Senator brought out the point that neither Mr. Garvan nor the Foundation stockholders are the real controlling factors in the organization. The names of the men to whom the power is given to vote the stock and to control the corporation are as follows: George L. Ingraham, former Chief Justice of the Appellate Division of the Supreme Court of New York; Otto T. Bannard, president of the New York Trust Co.; Cleveland H. Dodge; Benjamin Griswold, Jr., head of the firm of Alexander Brown & Sons, bankers, of Baltimore, and Ralph Stone, president of the Detroit Trust Co. All of them are men whose character and standing may not be questioned by anybody in the United States. They have the voting power of the stock in their hands as trustees and control in that way the Chemical Foundation for the benefit not of the stockholders, because the stockholders merely made a 6 per cent loan, but they control it in order that there may not be a monopoly created of these patents and that anyone in the United States who is willing to pay a reasonable royalty may use the patents.

Senator Wadsworth, of New York, the chairman of the important Committee on Military Affairs, made the following statement in regard to the Chemical Foundation to the Washington correspondent of *Chemical & Metallurgical Engineering:*

"The motives of Mr. Garvan and of those associated with him in the formation of the Chemical Foundation were good and patriotic. There is no reason for attacking these men. They are sincere and have a most worthy objective in attempting to preserve and to build up a domestic chemical industry without profit or emolument for themselves.

"I have no criticism for the action of the Administration but I am very sorry that, as an incident to this legal action, the motives of the men carrying on this work have been attacked. The Chemical Foundation has performed a very valuable function. I regret the attacks on the character of the Foundation, but it should be allowed without prejudice to establish its legal right to live."

Attempt to Adopt Uniform Standard for Alcohol Determinations

At the last meeting of the Association of Official Agricultural Chemists, criticism was made of the A. O. A. C. and U. S. P. alcohol tables. The sentiment appeared to be in favor of the A. O. A. C. tables. The chairman of the committee to co-operate with the U. S. Pharmacopœial committee of revision, appointed at the last meeting, has discussed the question considerably with the conviction that a conclusion is not so easily arrived at. The committee itself is divided; two are in favor of the A. O. A. C. alcohol tables and two in favor of the U. S. P. alcohol tables.

In view of the unsatisfactory outcome so far, the chairman is submitting the matter to the A. O. A. C. membership for discussion, criticism and a vote.

It is conceded that the most convenient temperature for making routine observations is the laboratory temperature, but this temperature varies considerably from time to time and in different sections of the country. The A. O. A. C. tables are based on the Bureau of Standards table 20 deg./4 deg. and represent true specific gravities, whereas the U. S. P. tables are based on the Bureau of Standards tables 15.56 deg./15.56 deg., and are apparent specific gravities, barometer at 760 mm. with 50 per cent air saturation. The Bureau of Standards has not committed itself to any temperatures for alcohol tables or for determining specific gravities of alcoholic mixtures. The Standards Bureau has adopted 20 deg. as the temperature for standardizing apparatus. 20 deg./4 deg. is considered the more scientific, but 15.56 deg. is more largely used in the industries and by industrial chemists and 60 deg. F./60 deg. F. is written into the internal revenue law dealing with alcohol products. The Gauger's Manual tables are also based on this temperature.

Mining Engineers Honored by French Government

A. S. Dwight and C. F. Rand Decorated for Distinguished Services to Their Country and Profession

For distinguished service during the war, Col. Arthur S. Dwight, president of the American Institute of Mining and Metallurgical Engineers, and Charles F. Rand, chairman of the Engineering Foundation, were decorated with the Croix de Chevalier de la Legion d'Honneur by the French Government on July 20. The decorations were conferred by Consul General Gaston Liebert at a luncheon given in his honor at the Engineers' Club, New York City, and attended by engineering leaders from many parts of the country, including representatives of the national organizations of civil, mining, mechanical and electrical engineers and of the Federated American Engineering Societies.

In presenting the decorations, Consul General Liebert extolled Col. Dwight and Mr. Rand as personifying the spirit and service of the American engineer, which, he asserted, was a powerful factor in the victory over Germany. M. Liebert said that there was a growing friendliness between the United States and France. The two countries, he declared, have come to understand each other better since the Genoa and the Hague Conferences. The general Franco-American situation, he thought, has greatly improved since the Disarmament Conference in Washington.

Col. Dwight and Mr. Rand rank among the leaders of American engineering. Both have previously been honored by foreign governments. Col. Dwight aided in recruiting and training the Eleventh Engineers, the first unit of the A.E.F. in action, thrilling the nation on November 30, 1917, when it went to the assistance of Haig with pick and shovel during the German drive for the Channel ports. Col. Dwight served twenty-two months overseas, receiving the D.S.O. from the British, and being cited by General Pershing. He is a former alumni trustee of Columbia University, where he was graduated from the School of Mines, in 1885.

Mr. Rand is internationally known as the head of large mining properties in this country and Cuba. He discovered the great soft iron ore deposits of the north Cuban coast and has been active in Cuban railroad building. In 1913, Mr. Rand was decorated by King Alfonso of Spain with the Grand Cross of Knight Commander of the Order of Isabella Catolica for distinguished services to Spain and to mining. He is an honorary member of the British Iron and Steel Institute, of which the only other honorary members are the Prince of Wales, the King of the Belgians, Dr. Richard Akerman and Baron Gustaf Tamm. Mr. Rand is a director and past president of the American Institute of Mining and Metallurgical Engineers and as the head of the Engineering Foundation is active in promoting industrial research in America.

Plans for Chemical Exposition

(*Continued from page* 228)

but with the idea of acquainting his auditors with the merits of his product and its proper application so that the latter can judge whether or not they are taking best advantage of the production aids which the equipment manufacturers are devoloping. The program is as follows:

W. C. Edge of Paul B. Huyette Co., "Safety and Efficiency Appliances for the Boiler Plant."

E. J. Trimbey of the Trimbey Machine Works, "Trimbey & Tibbitts Proportioning and Metering System for Paper Stock."

George L. Dickey, Industrial Filtration Corporation, "Rotary Filters for Washing of Paper Pulp and for Filtering and Washing Caustic Lime Mud." (Illustrated.)

H. A. Morrison, Oliver Continuous Filter Co., "Efficiencies and Economies in Washing Black Liquor from Digested Soda and Sulphate Stock."

L. D. Mills, The Merrill Co., "The Merco Nordstrom Plug Valve."

H. S. Thayer, Atlas Electric Devices Co., "Testing Colored Materials for Fastness-to-light."

A. E. Campbell, The Schaeffer & Budenberg Mfg. Co.., "Instruments for Promoting Efficiency in the Paper Mill."

H. G. Bean, The Bristol Co., "Application of Recording Instruments in Pulp and Paper Industry."

C. C. Phelps, Uehling Instrument Co., "The CO_2 Record of Combustion Efficiency."

Harry Carlson, Sandvik Steel, Inc., "Steel Belts and Their Application to the Solution of Conveying Problems."

H. Austin, Ernest Scott & Co., "Scott Evaporator as Used in the Pulp Mill for Recovering Soda from Spent Liquors."

L. G. Chase, Yarnell-Waring Co., "The V-Notch Meter and its Application to the Paper Mill."

W. D. Mount, Glamorgan Pipe & Foundry Co., "Continuous Causticizing with Lime Recovery and Reuse."

Jerome D. Stein, Grinnell Co., "The Grinnell Dryer Applied to Wall-Paper and Coated Paper."

Hoover to Address Salesmen

The Salesmen's Association of the Chemical Industry has announced that Herbert Hoover will address its meeting at the Exposition. Mr. Hoover will talk on "Standardization, and What It Can Do for the American Chemical Industry." Wayne B. Wheeler, general counsel for the Anti-Saloon League and considered one of the foremost authorities in the United States on alcohol and prohibition legislation, and also active in the rigid enforcement of the Volstead act, will also address the assemblage on "The Attitude of the Anti-Saloon League Toward Industrial Alcohol."

Symposium on Standardization

On the "Standardization" program, tentative arrangements have secured the following speakers: W. D. Collins, United States Geological Survey, on "Moderation in Standardization"; N. F. Harriman, United States Bureau of Standards, on "Standardized Testing Apparatus"; I. G. Jennings, Glass Container Association, on "Discussion of the Reasons for the Varieties of Shapes and Sizes"; J. M. Roberts, secretary of the Apparatus Manufacturers' Association of the United States on "What Has Been Accomplished in the Standardization of Scientific Apparatus"; Ross C. Purdy, secretary of the American Ceramic Society and chairman of the committee on refractories of the American Society for Testing Materials, on "Standardization of Fire Clays and Refractories" Emerson P. Poste, Elyria Enameled Products Co., on "Standardization of Enameled Wares for Chemical Purposes." Other details of the program have not as yet been arranged and will be announced later, when the complete list of speakers is assured.

Motion Picture Program

An unusually interesting array of motion pictures will be shown evening at the Exposition. The subjects covered are timely and diversified and it will be impossible to visit the Grand Central Palace in the evening without having opportunity to see a film that will be of interest to technical men in general.

One of the features of the evening programs will be an illustrated address by David Wesson on "The Romance of Cotton."

The complete program of films to be shown follows:

"Recovering Values from Fume and Smoke," by courtesy of the U. S Bureau of Mines and the Research Corporation.

"Inspiration: One of the World's Great Copper Mines," by courtesy of the U. S. Bureau of Mines.

"The Story of Sulphur," by courtesy of the U. S. Bureau of Mines and the Texas Gulf Sulphur Co.

"Mexican Petroleum," by courtesy of the U. S. Bureau of Mines.

"The Story of Heavy Excavating Machinery," by courtesy of the U. S. Bureau of Mines.

"The Story of Abrasives," by courtesy of the U. S. Bureau of Mines and The Carborundum Co.

"The Story of Air Reduction."

"The Story of Natural Gas."

"The Story of Asbestos," by courtesy of Johns-Manville, Inc.

"Fire Fighting with Foamite Firefoam," by courtesy Foamite Firefoam Co.

"The Manufacture of Newsprint Paper at the Spanish River Pulp & Paper Co. Mills in Ontario," by courtesy of the G. H. Mead Co.

"Nickel and Copper Mining, Smelting, and Refining," by courtesy of the International Nickel Co.

"Prospecting for Gold in Northern Ontario" and "Assaying for Gold in Northern Ontario," by courtesy of the Ontario Department of Mines.

Franklin Medal Presented to English Scientist

Sir Joseph J. Thomson, Master of inity College, Cambridge, was pre-nted with the Franklin Medal by the ranklin Institute on July 26, in Lon-n, for his "signal and eminent rvice in science."

The presentation was made by the arl of Balfour, who referred to Sir seph as one of the greatest pioneers an age prolific in marvels and iracles of scientific discoveries and hievements.

In replying, Sir Joseph said he was ad if he had contributed to the otherhood of science between Great ritain and America. He reviewed ranklin's epoch-making achievements. ranklin had attained his position nong the immortals in science by a ief six years of work, and in spite of e fact that he had to the end of his fe no knowledge of mathematics. ranklin was one of the most daring adventurers in speculative science. was his speculative contributions at had proved most valuable.

Those attending the presentation in-uded Dr. Ellwood Hendrick, Consult-g Editor of *Chem. and Met.;* Prof. T. Goodstead of Berkeley, Cal., and rofessor W. G. MacCallum of Balti-ore.

ennessee Coal, Iron and R.R. Co. Announces Expansion

Following closely its announcement the immediate construction of a odern 10- and 12-in. merchant bar ill at Fairfield, the Tennessee Coal, on & R.R. Co. announces that it will mediately construct a steel foundry the plant of the Chickasaw Ship-ilding & Car Co. at Fairfield and re-odel the Ensley foundry. The official nouncement of George Gordon Craw-rd, president of the Tennessee com-ny, follows:

"A modern steel foundry will be con-ructed at the Fairfield works of the ickasaw Shipbuilding & Car Co. and ien this is completed the Tennessee al, Iron & R.R. Co. will remodel the undry at the Ensley works to im-ove facilities for manufacturing in-t molds and iron castings."

Personal

J. M. Cobb, connected with the United ates Bureau of Mines, is directing a urse of first aid instruction for em-oyees at the plant of the American ricultural Chemical Co., Pierce, Fla. ie series of lessons was commenced July 10.

Colonel Arthur S. Dwight, presi-nt of the American Institute of ining and Metallurgical Engineering, d Charles F. Rand, chairman of the gineering Foundation, were deco-ted July 20 with the Croix de Cheva-r de la Legion d'Honneur by the ench Government, for distinguished vice during the war.

J. M. Gillet, formerly in the chemical engineering department of the Goodyear Tire & Rubber Co., is now chemical engineer with the Lamberson Japanning Co., Chicago, Ill.

A. A. Holmes has recently severed his connection with the E. B. Badger & Sons Co. and has been appointed sales manager for the American Trona Corporation, with headquarters in New York City.

Ulric J. Lebourveau of Stamford, Conn., recently resigned from the Atlas Powder Co. after 7 years of continuous service. During the last 5 years he has been connected with the research division on experimental and development work. Mr. Lebourveau has not yet made any definite plans for the future.

Dr. R. B. Moore, chief technologist at the Bureau of Mines, has returned from a business visit to Europe.

Sloan S. Sherrill, formerly plant engineer for the Calumet Chemical Co. of Joliet, Ill., a subsidiary of the Calumet Baking Powder Co. of Chicago, severed his connection with that company to accept a position with the Universal Oil Products Co. of Chicago, as mechanical engineer on its operating staff. Before his connection with the Calumet Chemical Co. he was on the engineering staff of the Chemical Construction Co. of Charlotte, N. C.

Linus S. Sterritt, general manager of the United Paper Board Co., Lockport, N. Y., has resigned, to become manager of the plant of the Eddy Paper Co., Three Rivers, Mich.

Robert T. Stokes, formerly assistant editor of the *Journal of Industrial and Engineering Chemistry,* is now secretary of the Biscuit & Cracker Manufacturers' Association, New York City. He succeeds the late Edward Griswold.

Obituary

T. J. Menten, vice-president of the Schaeffer & Budenberg Co. and the American Steam Gauge Co., died on July 9 after a brief illness. Mr. Menten was prominent for many years in the field of recording instrument manufacturers.

William Benjamin Smith, chemical engineer and inventor, died on July 19 at Washington, D. C. He invented the first grain reaper used in Georgia, and the Smith American car axle journal bearing. He made commercially profitable the use of potash from feldspar for agricultural purposes. He recently completed tests of an insecticide fertilizer which has been used in the South against the boll weevil.

The death, on July 22, of Dr. Jokichi Takamine robbed the chemical industry of one of its most brilliant leaders. But to his native country, Japan, and to his adopted country, the United States, the loss is of even greater significance, for Dr. Takamine did much to further diplomatic, as well as scientific, relations between these nations. In fact, the illness which resulted in his death may be traced directly to his distinguished service in support of the late Disarmament Conference and to his activities in welcoming the delegates of the Japanese Business Men's Mission and Baron Shibusawa's party.

Dr. Takamine was perhaps best known for his pioneer work in the field of biological and pharmaceutical chemistry. His discovery in 1900 of adrenalin, which he isolated from the glands of sheep, gave us the foundation for bloodless surgery and made possible many difficult operations on the eye, ear, nose and throat. The diastatic enzyme, takadiastase, which bears its discoverer's name, is a remedy known to physicians and chemists all over the world. These two products formed the basis for the important pharmaceutical corporations which were established by Dr. Takamine in the United States and in Japan. Among these are the Takamine Ferment Co., International Takamine Ferment Co., Takamine Laboratory, Inc., and Takamine, Inc., in this country and Sankro & Co., Ltd., in Tokyo. In addition he maintained a chemical and physical research laboratory at Tokyo and a private laboratory at Clifton, N. J.

Dr. Takamine was born on Nov. 3, 1854, the first son of a physician to the Prince of Kaga. He first took up the study of medicine at Osaka, but in 1879 was graduated in chemical engineering from the Imperial University of Japan at Tokyo. The Japanese Government sent the young chemist to study at the University of Glasgow and the Andersonian University at Glasgow. Returning home after 3 years, he was appointed chemist of the Imperial Department of Agriculture and Commerce, which position he held until 1884, when he was sent to New Orleans as a commissioner to the Cotton Centennial Exposition.

In 1885 he married a New Orleans girl, Miss Caroline Hitch, and returned to Japan, where he erected the first superphosphate works at Tokyo. He came again to the United States in 1890 and began the research work that won him his enviable position as a commercial chemist. Following the organization of the different companies to manufacture and distribute his products in the United States, he became interested in introducing a number of useful chemical industries into his native country. Thus he is accredited with having established several Japanese alkali and soda works, fertilizer plants, and dye, chemical and aluminum factories.

Dr. Takamine founded the Nippon Club of New York, the Japan-America Society and the Chemical and Physical Research Society of Japan. He was a member of the Lotos, Chemists', Drug and Chemical and the New York Athletic clubs, the American Chemical Society, the American Institute of Chemical Engineers, the Royal Society of London and the Franklin Institute of Philadelphia.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Business Revival Awaits Strike Settlement

Continued Improvement in Fundamental Business Conditions Is Threatened by Labor Troubles in Mines and Shops—Otherwise the Industrial Situation Is Promising

THE present industrial situation is fraught with difficulties which completely overshadow the importance of recent progress being made toward business improvement. Current developments appear insignificant in comparison with the serious consequences which may follow the present crisis in the coal mines and on the railroads. A crucial stage has been reached in this situation and unless the turn is for the better much of the present tide of business revival will have been stemmed.

The coal miners' and railway shopmen's strikes are beginning to pinch some of our largest and most important industries. Serious effects are being felt by the producers of steel and metal products, many of whom are curtailing their production in order to husband their dwindling supplies of coal. The banking of fifteen blast furnaces and increasing irregularities in steel production are among the early symptoms to be reported. There is scarcely a steel plant, however, that can look forward to more than a 30 days' supply of fuel. The glass and clay products and several other industries are being forced to balance production with their coal piles.

It is an unfortunate commentary on the situation that even without the railway complications, the problem of handling the amount of coal needed for next winter will tax railroad capacity to its limit. It may be safely predicted that if the government's plans do not shortly result in coal production and expeditious transportation, all business will be embarassed and industrial revival will suffer a serious setback.

Unemployment No Longer a Factor

It should be recognized, however, that notwithstanding these labor difficulties there has been a consistent and general improvement in fundamental business conditions. Unemployment, except for the voluntary kind, is no longer a factor in the situation. In fact certain industries, notably iron and steel, automobile, construction and farming, have reported actual labor shortages. The U. S. Employment Service made a survey in July embracing 355 principal industrial centers, and a predominating proportion of these reported improvement. Of 65 leading cities, 52 had more workers employed July 1 than on June 1. There were but 13 decreases and these were all in centers affected by either the textile or the coal strike. In 8 of 12 major manufacturing industries there were increases in the number of persons employed. The largest, 32.1 per cent, was for iron and steel; car building and repairing with an increase of 30.5 per cent was a close second, while the automobile manufacturers reporte an increase of 21.2 per cent.

Were it not for the coal strike th railroads would be handling a volum of freight traffic larger than for an year since 1920. From the low poi of 706,713 cars for the week of Apr 15, revenue freight loadings increase to 877,856 cars for the week of Ju 24—the highest for the year. For t week ended July 15 car loadings we 860,907, which represents an increa of 86,023 cars over the correspondi week of 1921. This also shows th during its second week the shopme strike had no noticeable effect freight movement.

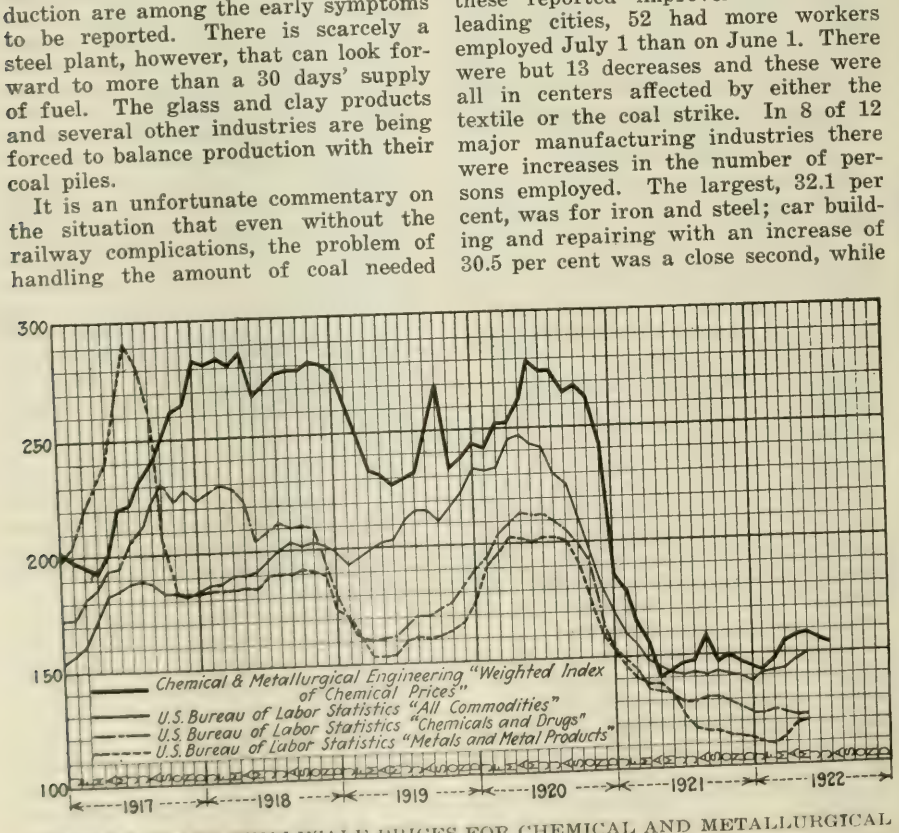
Business failures, which in Januar 1922, had attained a new high reco of liabilities, $115,301,371, have sin fallen, and for June were $38,412,7 This is the smallest for any mon since October, 1920.

Stocks and Exchanges

The financial situation continues be favorable, with an abundance money available at low rates of inte est. Security values after a slight r cession during June have begun mo ing up again. This upward trend representative railroad and industr stocks is shown in the following co pilation of *Wall Street Journal* av ages, which has been made by the I ing National Bank:

	20 Railroads	In ti
Highest for 1919 (May)	$91.13 (Nov.)	$11
Highest for 1920 (Nov.)	85.38 (Jan.)	10
Highest for 1921 (Jan. 15)	77.56 (Dec. 15)	8
Lowest for 1921 (June 20)	65.52 (Aug. 24)	6
Highest for 1922 (July 6)	87.58 (May 29)	9
Lowest for 1922 (Jan. 9)	73.43 (Jan. 10)	7
Previous low	64.30	6
January 3, 1922	73.48	7
June 1, 1922	85.23	9
June 12, 1922	81.81	9
July 1, 1922	84.45	9
July 17, 1922	86.55	9
July 22, 1922	86.41	9
July 27, 1922	87.63	9

The foreign exchange market b been erratic during the past mon



THE TREND OF WHOLESALE PRICES FOR CHEMICAL AND METALLURGICAL PRODUCTS, 1917-1922

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	153.56
Last week	153.58
August, 1921	158
August, 1920	264
April, 1918 (high)	286
April, 1921 (low)	140

Included in this index are acetic citric, hydrochloric, nitric and sul phuric acids, ethyl and methyl alco hols, ammonia, ammonium sulphate barium chloride, bleaching powder borax, caustic potash, caustic soda copper sulphate, formaldehyde, glyc erine, potassium carbonate, salt cak soda ash, sulphur, benzene, anilin cottonseed and linseed oils.

but except for the German mark, the principal foreign currencies ended the month in a better condition than on June 30. Almost complete demoralization of the Berlin exchange on July 7 forced the value of the mark down to $0.0018¾, a new low level for all time. Following the French negotiations with Great Britain and the possibilities of lowered reparations and a 2-year moratorium, the value of the mark rose to 23c. per 100 on July 12. This level was not long maintained, however, and on July 26 the mark again fell to $0.0019.

Price Trends

Because of seasonal variations and the effects of temporary market conditions, a single month is often too short a time to compare the trend of commodity prices. The Federal Reserve Board's index number based on 100 representative commodities increased from 158 in May to 162 for June. The extent of this improvement is more evident, however, when this index is compared with its value for Jan. 1, which was 142. The Department of Labor "all commodity" index was 150 for June, 1922, as compared with 138 for January. Since the first of the year the index for metals and metal products has increased from 112 to 120, while chemicals and drugs have declined from 124 to 122.

This magazine's weighted index of chemical prices has fallen steadily during July. It averaged 155.61 for the month, as compared with 157.48 for June. The rise from 143.30 on Jan. 1, 1922, to 160.49 on May 24 was apparently too rapid to be of healthy significance and many important commodities have since receded from the temporary peak reached during May. This applies particularly to cottonseed and linseed oils, sulphuric acid, caustic soda, soda ash and barium chloride. Two factors which have contributed to lower prices during the past month are the freight rate reductions which took effect July 1 and the seasonal slackening of demand, which is usually associated with the summer months.

Situation in Individual Industries

Iron and Steel—The situation is reflected somewhat differently in the various chemically controlled industries. Reference has been made to the coal strike's effects on the iron and steel industries, which are already curtailing production. During the month of June, however, some increase was noted. The output of pig iron increased 2½ per cent over May. The unfilled orders of the U. S. Steel Corporation on June 30 showed a considerable gain over the previous month, amounting to 5,635,531 tons on June 30, as against 5,254,228 tons on May 31.

Paper—Total newsprint production during June was 127,230 net tons, but in June, 1921, it amounted to only 86,770. This is equivalent to a gain of 47 per cent. The total for the first 6 months of 1922 is 690,142 tons, as compared with 615,448 tons for the corresponding half of last year. This production is the highest in 5 years, with the exception of 1920.

Automobile—The automobile industry continues to set production records. The June output of passenger cars was 261,963, as compared with 231,724 in May. The steady improvement in the production of trucks, from 23,803 in May to 25,916 in June, may be interpreted as a very favorable index of general business conditions. The month of July is expected to show some seasonal decrease in this industry, but it is estimated that the total yearly output of passenger cars and trucks will be 2,000,000 for 1922, as against 1,668,000 in 1921 and 2,205,197 in the record year 1920.

Petroleum—The petroleum industry has ridden to a fall. May and June productions were but slightly below the record set last March in spite of the fact that consumption of all products except gasoline was unusually low and tremendous oil stocks were piling up. The result has been one price cut after another. Mid-Continent crude had a second cut last week of 25c., bringing it down to $1.50, while crude Pennsylvania oil is selling for $3 a barrel.

Construction—The building boom, which has been gathering momentum in the past 6 months, has resulted in more than doubling the volume of construction completed during the first half of last year. The paint and varnish, structural steel and glass industries have been favorably affected by the increased demand and slightly higher prices for construction materials. The cement industry, stimulated by the demands for both construction and highway programs, has been proceeding at capacity production.

Glycerine Prospects

In the July number of the *Buyers' Bulletin*, issued by Roger Babson's statistical organization, the following interesting comment is made on the glycerine situation:

"For many months the statistical position of glycerine has forced prices to a comparatively low basis. Since 1919 stocks have ruled abnormally large and general business conditions have failed to readjust the situation. Production this year is practically the highest on record and while consumption has also extended upward, an over-supply still exists.

"It will take some time, under present conditions, to reduce current stocks to a level that will justify a broad recovery in price. From an international standpoint the volume of imports is counteracted by exports. This does not mean that a further reaction in price is warranted. A recovery of 7 per cent has already taken place since the low of 1921. Still prices are 27 per cent under the 10-year average prior to 1913. We consider the abnormal situation about discounted by the present range of prices. The next broad movement, although it will not materialize in the immediate future, will be upward and not downward."

The Chemical Market During July

Chemical and allied products showed very few important price changes in the New York market during the past month, due perhaps to the seasonable dullness of the summer months. The railroad situation, the coal strike and tariff uncertainties have greatly retarded possible improvement in business. The export market in alkalis has been somewhat of a disappointment to leading factors, who were of the opinion that prices would be much higher than present levels. Financial difficulties in Germany and the fluctuating exchanges are said to be the direct causes for the declining market.

Sharp Cut in Formaldehyde a Feature

A feature of special interest was the sharp cut in the price of formaldehyde. During the month manufacturers, eager for passing business, quoted prices as low as 7¼c. per lb., the lowest level recorded since the war. During the latter part of July, however, producers were pressed for deliveries and prices were brought back to 8@8¼c. per lb. Prussiate of soda, barium chloride, caustic potash and potash alum have recorded slight decreases during the interval, due to increasing stocks and lack of interest from consumers. In contrast with these declines there was a significant advance in white powdered arsenic. Insecticide manufacturers have reported a phenomenal demand and spot material has become very scarce. Prices were advanced from 7c. to 7⅞c. per lb. Oxalic acid was another item that showed considerable strength during the month. Producers announced an advance at the works from 14c. to 14½c. per lb. early in the month and quotations have held very steady throughout the interval, with consumers buying in moderate quantities.

Calcium Acetate Prices Increased

Calcium acetate prices were increased on two occasions during July owing to the decreased spot supplies and the increasing demand. The first advance was from $1.75 to $2 per 100 lb. The following week another advance of 35c. per 100 lb. was announced, bringing the spot market to $2.35 per 100 lb. Acetone and all grades of acetic acid were advanced to correspond with the lime acetate market. Sulphate of ammonia, copper sulphate, acetate of soda and prussiate of potash have shown considerable strength, with fractional advances recorded among first hands.

It may be stated in general that the markets during July revealed few surprises to the professional trader. Nor is there any reason to believe that the coming months will bring about any disastrous results, but, on the contrary, producers are very optimistic about the fall season and are looking forward to a resumption of real business with the industries that consume chemicals and related materials.

The New York Market

NEW YORK, July 31, 1922.

The chemical market during the past week continued along the same quiet lines in evidence during the preceding week. Trading in most instances was for immediate consumption, with the general tone extremely conservative. There were a few important price changes, foremost among which was the decrease noted in caustic soda for export. Trading has shown a decided improvement since the last decline and leading producers are looking forward to a much firmer market in the near future. Oxalic acid was reported fractionally higher at the works. White powdered arsenic continued firm, with only odd lots available. Acetate of soda was decidedly strong and buyers found some difficulty in getting any round quantities. All grades of acetic acid recorded advances to correspond with the recent rise in calcium acetate. Copper sulphate continued very firm. Insecticide dealers have been in this market for large tonnages and no let-up is in sight for the next few weeks. Cyanide of potash has been very scarce of late and prices showed an advance from 50@55c. per lb. The spot market is very firm.

GENERAL AND SPECIAL CHEMICALS

Ammonium Sulphate—Restricted production has kept this item rather short on spot, with the demand much greater than the supply. It is doubtful if better than $3.55 per 100 lb. could be done for double bags, f.a.s. N. Y.

Arsenic — Leading factors quote the market very firm at 7½c. per lb., prompt shipment. There have been a few odd lot sales among second hands at 7¾@8c. per lb. The demand is brisk.

Acetic Acid—Higher prices for calcium acetate have caused an advance in all grades of this acid. The 28 per cent is quoted at $2.60 per 100 lb., with the 56 per cent at $5.25 per 100 lb. Glacial acetic is held around 11c. per lb. in barrel lots. Demand is moderate.

Acetone—Prices for acetone were advanced by makers in order to correspond to the increase on acetate of lime. Chemically pure acetone is selling at 13@13½c. per lb. for carlots, with smaller quantities at 14@15c. The general market is firm.

Bichromate of Soda — Some small transactions were recorded at 7c. per lb., with quantity lots down to 6¾c. Trading was only moderate with the call mostly for contract shipments.

Bicarbonate of Soda — Producers quote the market around $1.75 per 100 lb., in barrels. The general tone of the market is steady, considering the time of the season.

Caustic Soda — There was another decline in this product to $3.50 per 100 lb. f.a.s. The demand was much better from the Orient and various European centers. Contract prices are nominally unchanged.

Copper Sulphate — There was a healthy tone to this market, especially from the insecticide industry. Dealers quote 6½@6¾c. per lb. for limited quantities on spot.

Formaldehyde—Producers have withdrawn from the market and goods previously quoted down to 7½c. per lb. could not be located in any quarters. Second hands quote the spot market at 8@8½c. per lb. Demand is moderate.

Muriate of Potash — Following increased importations there has been a slight decrease in this item from $33.50 per ton to $33. There were some larger sales reported fractionally lower than this but the general range is from $33@$33.50 per ton.

Prussiate of Soda—Trading has been rather dull during the interval and prices ranged around 20½c. per lb. for spot goods. Shipments from abroad were quoted from 19½@20c. per lb. c.i.f., duty paid.

Oxalic Acid — Spot quotations were held at 15¼@15½c. per lb. The best price heard at the works was 14½c. per lb. Demand is much better, with consumers showing more interest in spot goods.

WAXES

Beeswax—The market for African crude was rather steady both here and abroad. Offerings in several directions were limited, with spot quotations around 24@25c. per lb. Brazilian crude held at 28@29c. per lb.

Candelilla Wax—There were only a few offerings on spot at 40c. per lb. The demand far exceeds the limited supply.

Carnauba Wax—Prices in all grades have undergone little change. Shipments have increased notably of late, but prices were somewhat steady during the week. No. 3 North Country held at 16½@17c. per lb. No. 2 was quoted at 22@24c. per lb.

Japan Wax — The market did not show any signs of live trading and prices remained unsteady at 16½@17c. per lb. Forward business was transacted at 15c. per lb., in large lots.

Montan Wax—Prices were not very strong in this item. Spot material is in liberal supply with competition very keen. The market closed at 3¾@4c. per lb.

Paraffine Wax—There was little demand during the past week, but prices remained steady. Crude scale of 122-124 deg. melting point was held at 2½@2¾c. per lb., for carload quantities.

The Chicago Market

CHICAGO, July 25, 1922.

There was a little more life to the chemical market during the past week and buyers appeared to be interested in larger quantities. The rail strike probably had considerable to do with this, as supplies from the East were coming in slower than usual. The tone of the market is firm, with only a very few declines to be noted. Higher prices in the spot market were predicted unless there is an early settlement of the coal and rail strikes. Imported material is as firm as domestic in this market and no heavy stocks of either could be located.

GENERAL CHEMICALS

Caustic soda was a trifle easier on spot and supplies were available at $3.80 per 100 lb. for the 76 per cent solid and $4.35 for the ground. *Caustic potash* was firmer, with most holders asking 6¾@6¾c. per lb. for the imported 88-92 per cent material. *Soda ash* was unchanged at $2.20@$2.30 per 100 lb. for the 58 per cent material in cooperage.

Alums were unchanged both as to price and demand. *Ammonia alum* was available in second hands at 3¾@4¼c. per lb. for the lump and 4¼@4¾c. for the ground. *Potash alum* moved in a fair volume at 4½@5c. per lb. for the iron-free lump and 5½@6c. for the U.S.P. powdered. *Sal ammoniac* was quiet, with open quotations unchanged at 7¾@8c. per lb. for the white granular. It is possible that the lower figure could have been shaded fractionally with a fair-sized inquiry. *Copper sulphate* displayed no signs of weakness, and quotations were firm at 6½@7c. per lb. *Carbon bisulphide* was in good demand and supplies were more plentiful at 7@7½c. per lb. *Carbon tetrachloride* was reported as moving in a fair way at 10@10½c. per lb. for the large drums. *Formaldehyde* was somewhat more active, although the price was unchanged at 9c. per lb. for single-barrel lots. *Glycerine* was firmer and refiners were asking 16c. per lb. for the c.p. material in large drums. *Red phosphorus* was available at slightly lower prices from second hands, who apparently had all the business at 25@26c. per lb. for single-case lots.

No improvement was to be noted in *bichromates*. *Potasium bichromate* was quoted at 11c. per lb. in single-cask lots and *sodium bichromate* at 8½@9c. in similar quantities. *Red prussiate of potash* continued exceedingly scarce with only small lots available at 90c.@$1 per lb. The yellow salt was in about the same position as before and was offered at 32@35c. per lb. *Potash permanganate* lacked quotable change and the U.S.P. small crystals were available at 15½@16c. per lb. *Hypo* was reported to be moving in the usual consuming channels at $3.85 per 100 lb. for the pea crystals in barrels.

LINSEED OIL

The movement of *linseed oil* was rather slow during the past few days and the market was reported as weaker. The boiled oil was quoted late today at 95c. per gal. in 5-drum lots, with similar lots of the raw at 93c.

NAVAL STORES

Turpentine, like linseed oil, has been moving only in a small volume during the past few days, with the tendency of the market downward. Five-drum lots were quoted today at $1.22½ per gal. *Rosin* was in better demand and the WG grade was offered in less than carlots at $8.75 per 280 lb.

The Iron and Steel Market

PITTSBURGH, July 28, 1922.

The combination of the railroad rike begun 4 weeks ago and the coal rike begun 4 months ago is the dom- ant factor not only in the iron and eel trade but in industry generally. al supplies, which increased during e first 3 months of the coal strike, ve decreased sharply since transpor- tion difficulties arose.

It is now much more than a matter whether pig iron and steel can be oduced. It is a question also of ether the pig iron and steel can be nsumed. Thus far there is little if y indication that industrial opera- ns have been slowed down at any int through lack of steel, but it seems ogether probable that there will be slowing down in steel consumption, rough insufficiency of transportation d of coal supply.

STEEL INGOT PRODUCTION

Steel ingot production reached its aximum rate toward the close of ne, having increased rapidly in the st 3 months of the year and slowly ereafter. There has since been a de- ease, and by this time the decrease ay amount to between 5 and 10 per nt. The influence of diminished coal pply is felt first at byproduct coke ens, rather than in coal for heating d rolling steel. Some byproduct ovens were running on a hand-to-mouth basis, others had small stocks, none probably sufficient for 30 days' opera- tion. The banking and blowing out of blast furnaces comes more promptly at some points than at others, being es- pecially noticed in eastern Pennsylvania and in the Mahoning and Shenango Valleys. Unless conditions change promptly and radically for the better many more furnaces will have to stop.

The effect of the new situation upon the steel market has been for buyers and sellers to cease considering late de- liveries at all, and to increase the pres- sure to buy small lots for early ship- ment, as a result of which delivery premiums have increased in some cases. Basis prices, for extended de- livery, are not greatly affected, except that mills are somewhat stiffer in their views, finding that with restricted pro- duction the tonnage they had on books will keep them occupied a longer time than they estimated a month ago. The minimum price on bars, shapes and plates is now 1.70c. instead of 1.60c., this being for indefinite delivery, on orders that prove attractive to mills. Former prices of 2.40c. on blue an- nealed sheets, 3.15c. on black, and 4.15c. on galvanized sheets are not entirely lost, but it is very difficult to make pur- chases except at $2@$3 a ton higher.

Offerings of Connellsville coke are lighter and prices are higher, being quotable at $13.50@$14 for furnace coke and at $14.50@$15 for foundry coke. Blast furnaces disappeared from the market long ago, and most other consumers, except foundries, have since disappeared, while foundries are buy- ing but little in proportion to their normal requirements. As a matter of fact, the quotations on the respective grades may be taken to mean that coke offered as "foundry" grade is more or less of that grade, while coke sold as "furnace" coke is for foundry use, but is not at all guaranteed as to grade.

Connellsville steam coal has sold up to $8.50 and Westmoreland County gas coal up to $9.50, but how much of the coal recently bought and sold will get through, now that the priority system is established on the railroads, is a question.

PIG IRON PRICES

Production of merchant pig iron has dwindled to almost insignificant pro- portions, as has inquiry. Any forced purchases would no doubt cause sharp advances in market prices, but con- sumers seem indisposed to bid for the limited quantities of pig iron in exis- tence or likely to be made in the next few weeks. On the basis of last sales the market is quotable at $25 for besse- mer, $24 for basic, $27 for malleable and $25 for foundry, f.o.b. valley fur- naces, but these prices are largely nom- inal, it being uncertain whether any business could be done at such prices.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
tic anhydride	lb.	..... –	$0.38 – $0.40
tone	lb.	$0.13½ – $0.13¾	.14 – .14½
d, acetic, 28 per cent	100 lbs.	2.60 – 2.65	2.70 – 3.25
cetic, 56 per cent	100 lbs.	5.25 – 5.35	5.40 – 5.75
cetic, glacial, 99½ per cent, carboys,	100 lbs.	11.00 – 11.25	11.30 – 11.50
oric, crystals	lb.	.11 – .11½	.11¾ – .12
oric, powder	lb.	.11 – .11½	.11¾ – .12½
itric	lb.	..... –	44½ – .45
ydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
ydrofluoric, 52 per cent	lb.	.11 – .11½	.11¼ – .12
actic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
actic, 22 per cent tech	lb.	.04 – .04¼	.04½ – .05
olybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
uriatic, 20 deg (see hydrochloric)		..... –	..... – .....
itric, 40 deg	lb.	.06 – .06½	.06¾ – .07
itric, 42 deg	lb.	.06½ – .06¾	.07 – .07½
xalic, crystals	lb.	.15¼ – .15½	.15¾ – .16
hosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
icric	lb.	.20 – .22	.23 – .27
yrogallic, resublimed	lb.	..... –	1.65 – 1.75
lphuric, 60 deg., tank cars	ton	9.50 – 10.00	..... – .....
lphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
lphuric, 66 deg., tank cars	ton	15.00 – 16.00	..... – .....
lphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
lphuric, 66 deg., carboys	ton	..... –	..... – .....
lphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
lphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
lphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
nnic, U. S. P.	lb.	..... –	60 – .75
nnic (tech.)	lb.	.40 – .45	.46 – .50
rtaric, imp orted crystals	lb.	..... –	.28½ – .29
rtaric acid, imported, powdered	lb.	..... –	.29 – .30
rtaric acid, domestic	lb.	..... –	..... – .30
ngstic, per lb. of WO	lb.	..... –	1.00 – 1.10
hol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
hol, methyl (see methanol)		..... –	..... – .....
hol, denatured, 188 proof No. 1	gal.	..... –	.31 – .33
hol, denatured, 188 proof No. 5	gal.	..... –	.31 – .33
n, ammonia, lump	lb.	.03¼ – .03½	.03¾ – .04
n, potash, lump	lb.	.03 – .03¼	.03½ – .04
n, chrome lump	lb.	.05 – .05¼	.05½ – .06
ninum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
ninum sulphate, iron free	lb.	.02¼ – .02½	.03 – .03½
a ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07½	.07½ – .08
monia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
monium carbonate, powder	lb.	.08¼ – .08½	.08¾ – .09
monium nitrate	lb.	.06 – .06½	.06¾ – .07½
lacetate tech	gal.	..... –	2.00 – 2.25
nic, white, powdered	lb.	.07¾ – .08	.08¼ – .08½
nic, red, powdered	lb.	.12 – .12½	.12½ – .13
um carbonate	ton	61.00 – 63.00	64.00 – 68.00
um chloride	ton	90.00 – 93.00	94.00 – 105.00

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2.50
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05¼ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2.40	2.45 – 2.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.80 – .83
Carbon bisulphide	lb.	.06½ – .06¾	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6.60	6.65 – 7.00
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.08 – .08¼	.08½ – .09
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth–imported powdered–net	ton	30.00 – 32.00	..... – .....
Fusel oil, ref	gal.	..... –	2.25 – 2.65
Fusel oil, crude	gal.	..... –	1.45 – 1.50
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.15½ – .15¾
Iodine, resublimed	lb.	..... –	4.20 – 4.25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate	lb.	..... –	.09½ – .11½
Lead arsenate, powd	lb.	.13 – .13½	.13¾ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07¾ – .08	.08¼ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07½
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.11 – .11½

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.09½ – .09¾	.10 – .10⅛
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07½ – .08
Potassium cyanide	lb	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06½ – .06⅔	.07 – .08
Potassium permanganate	lb.	.14 – .14¾	.14½ – .15
Potassium prussiate, red	lb.	.....	.90 – .95
Potassium prussiate, yellow	lb.	.31½ – .32	.32¼ – .32½
Rochelle salts (see sodium potas. tartrate)		.....	..... – .....
Salammoniac, white, granular	lb.	.06¾ – .07	.07¼ – .08
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	19.00 –22.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06½ – .06¾	.07 – .07¼
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.06¾ – .07	.07¼ – .07½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04⅔ – .05¼
Sodium chlorate	lb.	.06¼ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.21 – .22	.22½ – .25
Sodium fluoride	lb.	.09½ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.55	3.60 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .03	.03½ – .03⅔
Sodium nitrite	lb.	.08 – .08¼	.08½ – .09
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.20½ – .21	.21¼ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04¼	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	..... – .....
Talc—domestic powdered	ton	18 00 –25 00	..... – .....
Tin bichloride	lb.	.09 – .09¼	.09½ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.06 – .06¼	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.65 — .67
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Dipnenylamine	lb.	.55 — .58
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.85 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06¼ — .07
Naphthalene, balls	lb.	.07¼ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	$0.15 — $0.17
N-W acid	lb.	1.15 — 1.30
Ortho-amidophenol	lb.	2.15 — 2.25
Ortho-dichlor-benzene	lb.	2.15 — .20
Ortho-nitro-phenol	lb.	.70 — .75
Ortho-nitro-toluene	lb.	.10 — .13
Ortho-toluidine	lb.	.14 — .18
Para-amidophenol, base	lb.	1.30 — 1.35
Para-amidophenol, HCl	lb.	1.35 — 1.40
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .80
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.90 — 1.00
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.15 — .15
Pyridine	gal.	1.75 — 2.75
Resorcinol, technical	lb.	1.30 — 1.35
Resorcinol, pure	lb.	1.75 — 1.80
R-salt	lb.	.60 — .70
Salicylic acid, tech., in bbls.	lb.	.23 — .24
Salicylic acid, U. S. P.	lb.	.25 — .26
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.27 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .18
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	gal.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — .....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — .....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.20 — $0.21
Beeswax, refined, dark	lb.	.30 — .32
Beeswax, refined, light	lb.	.34 — .35
Beeswax, pure white	lb.	.38 — .42
Candellila, wax	lb.	.40 — .42
Carnauba, No. 1	lb.	.40 — .42
Carnauba No. 2, North Country	lb.	.22 — .24
Carnauba, No. 3, North Country	lb.	.16½ — .16¾
Japan	lb.	.16½ — .17
Montan, crude	lb.	.03¾ — .04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04¼ — .....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02¾ — .....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¾ — .03¾
Paraffine waxes, refined, 125 m.p.	lb.	.03½ — .03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ — .04½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05½
Stearic acid, single pressed	lb.	.09 — .09½
Stearic acid, double pressed	lb.	.09½ — .09½
Stearic acid, triple pressed	lb.	.10½ — .10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.65	— $6.10
Rosin E-I	280 lb.	6.10	— 6.55
Rosin K-N	280 lb.	6.65	— 7.75
Rosin W. G.-W. W.	280 lb.	7.85	— 8.40
Wood rosin, bbl.	280 lb.	6.25	— .....
Spirits of turpentine	gal.	1.22	— 1.23
Wood turpentine, steam dist.	gal.	.85	— .....
Wood turpentine, dest. dist.	gal.	.70	— .70
Pine tar pitch, bbl.	200 lb.	.....	— 6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	— 9.50
Retort tar, bbl.	500 lb.		— 9.00
Rosin oil, first run	gal.	.36	— .....
Rosin oil, second run	gal.	.38	— .....
Rosin oil, third run	gal.	.46	— .....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist.	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.40
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref.	gal.		.55

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55	— 3.60
Blood, dried, f.o.b., N. Y.	unit	4.50	— .....
Bone, 3 and 50, ground, raw	ton	37.00	— 39.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10	— 3.20
Nitrate of soda	100 lb.	2.55	— 2.60
Tankage, high grade, f.o.b. Chicago	unit	3.50	— 3.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50	— 4.00
Tennessee, 78-80%	ton	7.00	— 8.00
Potassium muriate, 80%	ton	33.00	— 33.50
Potassium sulphate	unit	1.00	— .....

Crude Rubber

Para—Upriver fine	lb.	$0.19	— .19
Upriver coarse	lb.	.13½	— .13
Upriver caucho ball	lb.	.13½	— .13
Plantation—First latex crepe	lb.	.14½	— .15
Ribbed smoked sheets	lb.	.14½	— .15
Brown crepe, thin, clean	lb.	.13½	— .....
Amber crepe No. 1	lb.	.14	— .....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

astor oil, No. 3, in bbls	lb.	$0.11 —	$0.11½
astor oil, AA, in bbls	lb.	.12 —	.12½
ina wood oil, in bbls	lb.	.12½ —	.12¾
oconut oil, Ceylon grade, in bbls	lb.	.08½ —	.08¾
oconut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
rn oil, crude, in bbls	lb.	.11 —	.11¼
ttonseed oil, crude (f. o. b. mill)	lb.	.09 —	.09¼
ttonseed oil, summer yellow	lb.	.11 —	.11¼
ttonseed oil, winter yellow	lb.	.12 —	.12½
nseed oil, raw, car lots (domestic)	gal.	.89 —	.90
nseed oil, raw, tank cars (domestic)	gal.	.84 —	.85
nseed oil, boiled, in 5-bbl lots (domestic)	gal.	.92 —	.93
ive oil, denatured	gal.	1.15 —	1.17
lm, Lagos	lb.	.07 —	.07¼
lm, Niger	lb.	.06½ —	.06¾
anut oil, crude, tank cars (f.o.b. mill)	lb.	.09¼ —	.09¾
anut oil, refined, in bbls	lb.	.12½ —	.12¾
peseed oil, refined in bbls	gal.	.82 —	.83
peseed oil, blown, in bbls	gal.	.88 —	.89
ya bean oil (Manchurian), in bbls. N. Y.	lb.	.11¾ —	....
ya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¾ —	....

FISH

ght pressed menhaden	gal.	$0.51 —	....
llow bleached menhaden	gal.	.53 —	.54
hite bleached menhaden	gal.	.55 —	.56
own menhaden	gal.	.61 —	....
hale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

bestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700.00	$750.00
bestos, shingle stock, f.o.b., Quebec, Canada	short ton	75.00	—110.00
bestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00	— 17.00
rytes, ground, white, f.o.b. mills	net ton	17.00	— 23.00
rytes, ground, off color f.o.b. mills	net ton	13.00	— 21.00
rytes, floated, f.o.b. St. Louis	net ton	23.00	— 24 00
rytes, crude f.o.b. mines	net ton	8.00	— 9.00
sein	lb.	.10½	— .13
ina clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	— 8.00
ina clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	— 9.00
ina clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	— 20.00
ina clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
ina clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00	— 20.00
ina clay (kaolin), imported, lump	net ton	16.00	— 20.00
ina clay (kaolin), imported, powdered	net ton	30.00	— 35.00
dspar, No. 1 p ottery grade	lon g ton	6.50	— 6.75
dspar, No. 2 pottery grade	long ton	5.75	— 5.90
dspar, No. 1 soap grade	long ton	7.00	— 7.50
dspar, No. 1 Canadian, for mill	long ton	21.00	— 22.00
aphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05	— .05½
aphite, Ceylon chip	lb.	.04	— .04½
aphite, high grade amorphous crude	ton	35.00	— 50.00
selguhr, f.o.b. mines, Cal	per ton	40.00	— ....
selguhr, f.o.b. N. Y	per ton	50.00	— 55.00
gnesite, calcined (powdered)	per ton	8.00	— 12.00
mice stone, imported	lb.	.03	— .05
mice stone, domestic, lump	lb.	.05	— .05½
mice stone, domestic, ground	lb.	.06	— .07
llac, orange fine	lb.	.78	— .79
llac, orange superfine	lb.	.80	— .81
llac, A. C. garnet	lb.	.66	— .67
llac, T. N	lb.	.75	— .76
ca, glass sand, f.o.b. Indiana	per ton	1.50	— 2.50
ca, sand blast material, f.o.b. Indiana	per ton	2 50	— 5.00
ca, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00	— 16.00
ca, building sand, f.o.b. Pa	per ton	2.00	— 2.75
apstone	ton	12.00	— 15.00
lc, 200 mesh, f.o.b. Vermont	ton	7.00	— 12.00
lc, 200 mesh, f.o.b. Georgia	ton	7 50	— 12.00
lc, 200 mesh, f.o.b. Los Angeles	ton	16.00	— 20.00

Refractories

uxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00
rome brick, f.o.b. Eastern shipping points	net ton	40–42
rome cement, 40-50% Cr_2O_3	net ton	24–32
rome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
eclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	28–35
eclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–28
gnesite brick, 9-in. straight (f.o.b. works)	net ton	56
gnesite brick, 9-in. arches, wedges and keys	net ton	70
gnesite brick, soaps and splits	net ton	90
ca brick, 9-in. sizes, f.o.b. Chicago district	1,000	33–35
ca brick, 9-in. sizes, f.o.b. Birmingham district	1,000	35–40
ca brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	31–33
con carbide refractory brick, 9-in	1,000	1100.00

Ferro-Alloys

rrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
rochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
rochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
romanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
romanganese, 78-82% Mn, German	gross ton	67.00 —	67.50
egeleisen, 19-21% Mn	gross ton	36.00 —	....
romolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
rosilicon, 10-15%	gross ton	38.00 —	40.00
rosilicon, 50%	gross ton	58.00 —	60.00
rosilicon 75%	gross ton	115.00 —	120.00
rotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
ro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
rovanadium, 30-40% per lb. of contained V	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	19.00 —	21.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	18 00 —	21.00
Coke, foundry, f.o.b. ovens	net ton	13.50 —	....
Coke, furnace, f.o.b. ovens	net ton	13.00 —	....
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19 00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01¼ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.29½ —	30
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.50 —	....
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13¼
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	3.25 —	3.50
Uranium oxide (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13¼

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.875–14 00
Aluminum, 98 to 99 per cent	18.00–19.00
Antimony, wholesale lots, Chinese and Japanese	5 25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32 00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	32.50
Lead, New York, spot	5.75
Lead, E. St. Louis, spot	5.375– 5.40
Zinc, spot, New York	6.25 – 6.30
Zinc, spot, E. St. Louis	5.925

OTHER METALS

Silver (commercial)	oz.	$0.69¾
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.10
Platinum	oz.	90.00
Iridium	oz.	170.00@175.00
Palladium	oz.	55.00@ 60.00
Mercury	75 lb.	55.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.25
Copper bottoms	27.75
Copper rods	19.25
High brass wire	16.75
High brass rods	14.25
Low brass wire	18.25
Low brass rods	18.75
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	20 75
Seamless high brass tubing	18.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	10.25@10.50
Copper, heavy and wire	10.00@10.25
Copper, light and bottoms	7.75@ 8.25
Lead, heavy	3.90@ 4.15
Lead, tea	2½–2¾
Brass, heavy	4.50@ 4.75
Brass, light	4.00@ 4.25
No. 1 yellow brass turnings	4.00@ 4.25
Zinc	2.00@ 2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.70	$2.70
Soft steel bars	2.60	2.60
Soft steel bar shapes	2.60	2.60
Soft steel bands	3.10	3.20
Plates, ¼ to 1 in. thick	2.70	2 70

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

LEATHER—The Charles S. Walton Co., Philadelphia, Pa., tanner of sole and belting leathers, has placed its tannery at Curtis Bay, Baltimore, Md., on a full capacity basis, with regular working force.

The General Leather Co., Frelinghuysen Ave., Newark, N. J., specializing in automobile leathers, is developing maximum capacity at its plant. The company has recently placed its new addition in service, giving the plant a capacity of 1,200 salted hides per day.

The Greiss-Pfleger Tanning Co., Cincinnati, O., has increased production at its tanneries at Chicago and Waukegan, Ill. The June shipments from the plants were the largest in the history of the company.

A number of leather tanneries at Newark, N. J., are advancing operations to a close to normal basis, including Straus & Sons, and the Fr[illegible]d Brothers Leather Co. Imitation leather (cau[illegible]mpanies in this section also are wor[illegible]ntracts. [illegible]an advanced production schedule. [illegible]ide (caus[illegible]

CERAMIC—The C[illegible]kling-Armstrong Terra Cotta Co., Philadelphia, Pa., has adopted a capacity operating basis at its plant, and a number of departments are now running on an overtime schedule.

The National Fireproofing Co. is maintaining active production at its plant at Port Murray, N. J., giving employment to a large working force.

IRON AND STEEL — The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has resumed operations at another blast furnace, making a nine-furnace base for the company, six producing basic iron, two running on foundry pig, and one on ferromanganese.

The Eastern Steel Co., Pottsville, Pa., has blown in two blast furnaces at its local plant, following an idle period of many months. Every department of the works is now in service, and operations will be increased in different branches at an early date.

The United States Steel Corp., New York, has advanced production at its different mills to a 76 per cent of normal operating basis.

The Carnegie Steel Co. is operating its six blast furnaces at Youngstown, Ohio, at full capacity on large merchant bar.

The coal strike and railroad strike have caused the suspension of a number of blast furnaces, heretofore running at capacity up to about a week ago. These include two bessemer furnaces of the Republic Steel Co. and one furnace of the Trumbull-Cliffs Iron Co., both in the Youngstown, O., district. The Briar Hill Steel Co., in the same section, has banked one of its furnaces. The Bethlehem Steel Co. has placed three of its furnaces out of blast, two being at the Bethlehem, Pa., works, and the other at Steelton, Pa. At Cleveland, O., the McKinney Steel Co. has banked one of its furnaces.

The Youngstown Sheet & Tube Co., Youngstown, O., is now running at close to 80 per cent of normal.

METALS — The Cerro de Pasco Copper Corp., New York, will soon place its new smelting plant at Oraya, Peru, in operation. The plant will run on a basis of 2,500 tons of ore per day, the ore being estimated to average from 5 to 6 per cent of copper.

The Bartlesville Zinc Co., Bartlesville, Okla., is increasing production at its plant at Blackwell, Okla. The wages of employees have been advanced 50 cents a day, making an increase of over one dollar a day since the company reopened its plant a few months ago.

The Calumet & Hecla Copper Co., Calumet, Mich., is operating on a production basis of about 4,000,000 lb., refined, per month; of this amount, about 1,500,000 lb. is being secured from the reclamation plant.

PAPER — The United Paper Board Co., Lockport, N. Y., is running on a capacity basis at its local mill. A general increase of 10 per cent has been made in wage schedules.

The International Paper Co. has increased operations to four machines at its plant at Three Rivers, Que., with output totaling 240 tons per day.

MISCELLANEOUS — The United States Guano Co., Standard Wholesale Phosphate Co., Union Acid Works, Standard Guano Co. and the Standard Acid Works, all of Baltimore, Md., and operated under one management, manufacturing fertilizer products, are increasing production at their plants. Extensions are under way to utilize the escaping gases for chemical reclamation.

The Chattanooga Coke & Gas Co., Chattanooga, Tenn., is arranging for the early resumption of operations at a portion of its plant.

Tire production at Akron, O., is now running close to 105,000 tires a day at all plants combined, which are giving employment to about 50,000 men and women.

The Midwest Castings Co., Middletown, O., is arranging for the immediate resumption of operations, following a shut-down for close to a year past.

Owing to fuel shortage, the American Sheet & Tin Plate Co., Youngstown, O., has closed 26 mills at its Farrell, Pa., works. The suspension is temporary.

The Three Rivers Glass Co., Three Rivers, Tex., will soon commence production at its new local plant. The building has been completed and machinery installation is under way. H. S. Warwick is manager.

The Whitall-Tatem Co., Millville, N. J., has placed two of its glass factories out of blast, and will commence immediate repairs to the furnaces and other plant departments. Resumption is planned early in the fall.

Construction and Operation

Arkansas

VAN BUREN—J. H. Hansel, Ozark, Ark., is organizing a company to establish a local plant for the manufacture of brick and other burned clay products. A site is being selected.

California

MARTINEZ—The Shell Oil Co., 343 Sansom St., San Francisco, has plans under way for the installation of a new still and other equipment at its local refinery, estimated to cost about $150,000.

OAKLAND—The Fornercrete Aggregate Co., manufacturer of cement specialties, colors, etc., for exterior construction, has leased property on Clement St., near High St., totaling about 30,000 sq.ft., as a site for the erection of a new plant. Plans will be prepared at once. E. K. Forner is president. The Industrial Department of the local Chamber of Commerce is interested in the project.

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg., San Francisco, has acquired a tract of property in the harbor section, formerly occupied by the Chandler Shipbuilding Co., totaling about 10 acres of land, as a site for the erection of a new refining plant. It is estimated to cost close to $1,000,000, including machinery, and will handle the deposits from the company's property in Death Valley, Cal.

SACRAMENTO—The Pacific Gas & Electric Co., 445 Sutter St., San Francisco, will make extensions and improvements in its local artifical gas plant to cost about $150,000, including equipment.

IRVINGTON—The Panama Soap Co., San Diego, is negotiating with the city trustees for a suitable site for the erection of a new local plant for the manufacture of soaps and kindred products. It is proposed to remove the present works from San Diego, and discontinue operations entirely at this latter location.

SAN DIEGO—The Vitrified Products Corp. has purchased property in the Oldtown district, and plans for the erection of a new plant for the manufacture of shale brick. The equipment installation will provide for automatic operation, without handling after production has been commenced.

SANTA CLARA—The Concrete Lumber Co. is negotiating with the local Chamber of Commerce for a suitable site for the erection of a new plant. The company is now located at Los Angeles.

Colorado

TELLURIDE—The Tomboy Mine & Milling Co. has tentative plans under consideration for the rebuilding of the portion of its plant destroyed by fire, July 8, with loss estimated at about $50,000, including equipment.

Connecticut

MERIDEN — The Tredennick Paint Co., South Colony St., has commenced the erection of a new 1-story plant addition.

Illinois

JOLIET—The Illinois Wall Paper Co., a subsidiary of the York Card & Paper Co., York, Pa., is completing plans and will soon take bids for the erection of a new 1-story plant on Logan St., 100x300 ft., estimated to cost about $85,000. R. G. Hoen, 417 National Bank Bldg., Joliet, is architect. Robert D. McCoy is president.

Indiana

INDIANAPOLIS—The Beveridge Paper Co., Pearl St., has plans under way for the erection of a new building at its local plant. H. L. Beveridge is president.

JEFFERSONVILLE—The Louisville Cement Co., Louisville, Ky., has tentative plans under consideration for the rebuilding of the portion of its manufacturing plant at Speeds, near Jeffersonville, destroyed by fire, July 13, with loss estimated in excess of $300,000, including equipment.

Louisiana

NEW ORLEANS—The Chalmette Petroleum Corp., recently organized, has acquiired the plant and property of the Chalmette Oil Refining Co. and the Louisiana Oil Exporting Co., and will consolidate the interests. Plans are under way for extensions in the oil refining plant for considerable increase in capacity. The new company will operate with a capital of $1,000,000.

LAFAYETTE—The Guidry Brick Co. is planning for extensions to double, approximately, the present plant capacity. A. Guidry heads the company.

Maryland

BALTIMORE—The United States Asphalt Refining Co., has filed plans for the erection of a 1-story building, 33x70 ft., at North and 4th Aves.

Massachusetts

AMHERST—The Amherst Agricultural College has awarded a contract to George S. Allen, Amherst, for the erection of its proposed new 3-story and basement chemical laboratory, 94x195 ft., estimated to cost about $300,000, including equipment. Ritchie, Parsons & Taylor, 15 Ashburton Place, Boston, are architects.

Michigan

DETROIT—Porath Brothers are considering preliminary plans for the rebuilding of the portion of their brick and clay products manufacturing plant, destroyed by fire July 9, with loss approximately $50,000, including equipment.

MOUNT PLEASANT—The National Portland Cement Co. has excavation work under way for the initial buildings at its new plant at Coldwater Lake, and will commence foundations and superstructure at an early date. The main mill will be 2-story, and will be supplemented with number of other buildings, including power plant, etc. The entire plant will cost about $500,000, including machinery. A. E. Gorham, 119 South Normal St., Mount Pleasant, is president.

Mississippi

HATTIESBURG—The Hattiesburg Pine Oil Co., recently organized with a capital of $425,000, has plans under way for the erection of a new plant on local site for the manufacture of pine oil, turpentine and kindred products. The mill is estimated to cost in excess of $75,000, with machinery. The company is headed by M. D. King and Paul S. West, both of Hattiesburg.

Missouri

ELVINS—The St. Louis Smelting & Refining Co., 722 Chestnut St., St. Louis, h

plans completed for the establishment of a local plant, in connection with extensive property developments on a tract of 650 acres. The project is estimated to cost close to $500,000, including machinery.

ST. LOUIS—Benjamin Moore & Co., Inc., manufacturer of paints, varnishes, etc., is reported to be planning for the immediate rebuilding of the portion of its plant on South Second Street, destroyed by fire, July 8. A number of plant buildings and equipment were damaged. An official estimate of loss has not been announced.

KANSAS CITY—The Acme White Lead Co., Detroit, Mich., will commence work at once on remodeling and improving its local plant building at 15th and Grand Sts. The Bliss Building Co., 402 Mutual Bldg., Kansas City, has the construction contract.

New Jersey

ELIZABETH—The Atlantic Tar & Chemical Works, Ltd., Rayway, Elizabeth, manufacturer of coal tar products and other chemical specialties, has plans in progress for enlargements in its plant for considerable increase in capacity. Additional equipment will be installed. To carry out the expansion, the company has arranged for a bond issue of $500,000, the larger part of the proceeds to be used for such purpose. George C Lewis is president, and David Viener, vice-president and general manager.

NEWARK—Walter G. Jacobs, 9 Campbell St., operating a foundry for the manufacture of iron and other metal castings, has commenced the erection of a new 3-story plant at 63-73 Warren St., estimated to cost in excess of $75,000. Contract for the building has been let to the American Concrete Steel Co., Essex Bldg.

BLOOMFIELD—The Standard Oil Co. of New Jersey, 31 Clinton St., Newark, has filed plans for the construction of a new distributing plant and substation in the Silver Lake district, estimated to cost about $42,000.

PERTH AMBOY—The American Smelting & Refining Co., 120 Broadway, New York, has work under way on improvements at its local copper-refining plant, and expects to have the unit ready for service early in October.

New Mexico

TUCUMCARI—The Pecos Co. is perfecting plans for the completion of its local oil refinery, and will proceed with the work at an early date. The construction has been held in abeyance for a number of months past. The plant will be placed in service immediately upon completion.

CARRIZOZO—The Helen Rae Mining Co., will make a number of improvements in the mill at its local gold mining properties. The plant has been closed temporarily for this purpose; the machinery will be repaired.

New York

GOWANDA—The Eastern Tanners' Glue Co., has plans under way for the erection of a new plant on Palmer St. Richard Wilhelm is president.

NEW YORK—The Nevada Consolidated Copper Co., 25 Broad St., will soon commence the rebuilding of the concentrating plant at its properties, recently destroyed by fire with loss approximating $1,500,000, including machinery. The plant had a capacity of about 12,000 tons, and the new unit is expected to be of like size. The smelting plant at the property was not damaged by the fire and will be continued in operation.

Oklahoma

TULSA—The Phillips Petroleum Co., Bartlesville, Okla., has plans under way for the erection of a new gasoline absorption plant on site selected at DeNoya, near Tulsa. The plant is estimated to cost about $500,000, including compressors, pumps and other operating machinery, and will be one of the largest plants of this character ever built.

OKLAHOMA CITY—The City Commission has approved plans as prepared for a new water-purification plant at the municipal waterworks, and expects to call for bids at an early date. The city engineer is in charge.

Oregon

WILLIAMINA—The Oregon Face Brick Co., 204 Henry Bldg., Portland, has acquired a brick manufacturing plant at Wilamina, and will place the works in operation at once. A number of improvements will be made. Local clay deposits have also been purchased for raw material supply. Robert Shelley is president.

Pennsylvania

PHILADELPHIA—The Gilbert Spruance Co., 312 North 3rd St. manufacturer of paints, varnishes, etc., has awarded a contract to Harry Gill, Jr., 2515 Germantown Ave., for the erection of a 2-story factory addition, 70x138 ft., at Richmond and Tioga Sts., estimated to cost about $47,000.

MCKEES ROCKS—The Chesebrough Mfg. Co., 17 State St., New York, a subsidiary of the Standard Oil Co., manufacturer of vaseline and byproducts, is completing plans for the first unit of its proposed new local plant, and will call for bids at an early date. It will be 2 and 3 story, and is estimated to cost close to $500,000, including machinery. Other plant units will be built at a later date. The company recently acquired a tract of about 14 acres of land near McKees Rocks for the works. The Hunting-Davis Co., Century Bldg., Pittsburgh, is architect and engineer.

PITTSBURGH—The Watson Paint & Glass Co., 101 Wood St., has purchased from E. A. Campbell the factory of the Eagle Paint & Varnish Co., Galveston Ave., recently acquired by the latter. It is planning to occupy the property for extensions in its present works.

PITTSBURGH—The Atlantic Refining Co., Butler and 56th Sts., is considering preliminary plans for extensions in its local refining plant. Headquarters of the company are at 3144 Passyunk Ave., Philadelphia.

LOCK HAVEN—The General Refractories Co., Oliver Bldg., Pittsburgh, has purchased the local plant and property of the Hayes Run Fire Brick Co., Orviston, near Lock Haven, and will continue operations at the plant as heretofore. The company will be merged with the parent organization, which also recently acquired the plant and property of the Pennsylvania Fire Brick Co., Beech Creek, Pa.

South Carolina

PAMPLICO—The Consumers' Oil Co., is reported to be planning for the rebuilding of the portion of its plant, recently destroyed by fire.

Texas

STAMFORD—The Rule-Jayton Cotton Oil Co., has acquired local property, totaling about 20 acres, for the erection of a new cotton oil mill. Plans for the structure are under way. It is estimated to cost close to $150,000, including equipment. The mill will have an initial capacity of about 125 tons per day.

CHILDRESS—The City Council will commence the immediate construction of the proposed new filtration plant at the municipal waterworks, estimated to cost about $30,000.

EL CAMPO—The plant and property of the El Campo Oil Mill Co., has been acquired by H. E. Wilson, Wharton, Tex., and associates. The new owners will organize a company to operate the plant, and will make a number of improvements in building and equipment. It is expected to have the mill in regular service at an early date.

BEAUMONT—A portion of the local distillate plant of the Magnolia Petroleum Co., including storage tanks, etc., was destroyed by fire, July 15, with loss estimated at about $1,500,000, including equipment and sock.

Washington

CAMAS—The Crown Wilmette Paper Co., is reported to be planning for the erection of an addition to its plant on adjoining property, recently acquired.

West Virginia

GRAFTON—George W. Bowers, Mannington, W. Va., is perfecting plans for the organization of a new company and the establishment of a local plant for the manufacture of pottery products. A site will be secured at an early date.

Canada

ASBESTOS, QUE.—The Johns-Manville Co., Madison Avenue and 41st St., New York, manufacturer of asbestos products, has acquired property here and plans for the erection of a large Canadian branch plant. The proposed works will consist of a number of buildings, including power plant, etc., and will be equipped to give employment to about 300 persons. The plant is estimated to cost close to $1,000,000. The company has also purchased the mining properties of the Bennett-Martin Co., at Thetford Mines, Que., in the same vicinity, and will use as a source of raw material. It is expected to have the initial plant unit ready for operation early in 1922. T. F. Manville is president.

Capital Increases, Etc.

THE BUFFALO COLD DRAWN STEEL CO., INC., Buffalo, N. Y., has filed notice of increase in capital from $2,000,000 to $3,500,000.

THE KOENITZER TANNING CO., Saginaw, Mich., has filed notice of decrease in capital from $325,000 to $100,000.

THE BULLET PROOF & NON-SHATTERABLE GLASS CORP., recently organized under New York laws, has filed notice to operate in New Jersey for the manufacture of special glass products. The company is represented by Edward S. Bock, 45 South Spring St., Elizabeth, N. J.

THE BOSTON LEATHER & FINDING CO., Bridgeport, Conn., has filed notice of increase in capital from $20,000 to $50,000.

THE YORKTOWN OIL & MFG. CO., Yorktown, Tex., has filed notice of increase in capital from $50,000 to $100,000.

THE BARAGUA SUGAR CO., 25 Broad St., New York, N. Y., operating a sugar refinery in Camaguey Province, Cuba, is disposing of a bond issue of $4,500,000, a portion of the proceeds to be used for general expansion. Edwin F. Atkins is president of the Punta Alegre Sugar Co., the parent organization.

THE NITRO PRODUCTS CO., Saginaw, Mich., has filed notice of reduction in capital stock from $200,000 to $20,000.

THE CONSTANTIN REFINING CO., Tulsa, Okla., has arranged for a bond issue of $720,000, a portion of the proceeds to be used for general expansion.

THE MUTUAL OIL CO., Denver, Col., will increase its capital stock from $15,000,000 to $30,000,000, a portion of the proceeds to be used for expansion, including the purchase of additional oil properties and refineries.

THE NIAGARA FELT & PAPER CO., Little Falls, N. Y., has filed notice of increase in capital from $60,000 to $200,000.

THE ILLINOIS-KANSAS OIL & GAS CO., Tulsa, Okla., has filed notice of increase in capital from $500,000 to $1,000,000.

THE FIBERBILT SPECIALTIES, INC., 427 Broadway, New York, N. Y., has filed a petition in bankruptcy. Edward McDonald has been appointed receiver.

THE DETROIT EMERY WHEEL CO., Detroit, Mich., has filed notice of dissolution under state laws.

New Companies

THE SUNSET RUBBER CO., Everett, Wash., has been incorporated with a capital of $150,000, to manufacture rubber specialties. The incorporators are C. E. Powley and W. A. McCloud, both of Everett.

THE WOODBRIDGE PRODUCTS CO., 123 Main St., Woodbridge, N. J., has filed notice of organization to manufacture lubricants, soaps, etc. The company is headed by George M. Anderson and LeRoy F. Kendall.

THE R. T. CLARK OIL CORP., Natchez, Miss., has been incorporated with a capital of $2,000,000, to manufacture petroleum products. The incorporators are R. T. Clark, Natchez; L. S. McFadden and R. L. Cheshire, both of Monticello, Ark.

THE SHINGLE-GIBB LEATHER CO., Philadelphia, is being organized by Lester H. Shingle, Walton and Thomas B. Gibb, 503 Chestnut St., to manufacture leather products. Application for a state charter will be made at once. The last noted incorporator represents the company.

THE EASLEY OIL CO., Pittsburgh, Pa., is being organized by Edwin A. Easley, S. A. Doherty and F. B. Carraher to manufacture oil products. Application for a state charter will be made on July 24. The company is represented by James F. Coyle, 1513 Berger Bldg., Pittsburgh.

THE ASPHALT ROOFING PRODUCTS CO., care of the Colonial Charter Co., Ford Bldg., representative, has been incorporated under state laws with a capital of $25,000, to manufacture prepared roofing specialties.

THE MOUND CITY LINSEED OIL CO., St. Louis, Mo., has been incorporated with a capital of $5,000, to manufacture linseed oil products. The incorporators are W. H. Wilkins, G. S. Sturges and J. J. Rufile, all of St. Louis.

THE PETROLEUM CORP., Wichita Falls, Tex., has been incorporated with a capital of $75,000, to manufacture petroleum products. The incorporators are F. W. Fischer, S. I. Carter and D. E. Ducas, all of Wichita Falls.

THE ENAMELART FINISHING CO., New York, N. Y., has been incorporated with

a capital of $10,000, to operate an enameling works. The incorporators are F. E. Pearson, G. S. Nobles and L. J. Schneider, 116 West 90th St., New York.

THE BROWN CLAY PRODUCTS Co., Canton, Ohio, has been chartered under state laws to manufacture brick and other burned clay products. The incorporators are Ira E. Brown and O. E. Smith, both of Canton.

THE AETNA EXTERMINATORS, INC., 3407 North Halsted St., Chicago, Ill., has been chartered under state laws to manufacture chemical products, insect powders, etc. The incorporators are A. U. Forman, Hulda Almert and Andrew H. Almert.

THE GUY STEEL CASTINGS Co., West Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture steel and other metal castings. The incorporators are George B. Kinghorn, Southington, Conn.; J. E. Sinnott, Hartford, Conn., and W. R. Bennett, 249 Fairfield Ave., Hartford. The last noted represents the company.

THE PEERLESS OIL Co., Mannington, W. Va., has been incorporated with a capital of $700,000, to manufacture petroleum products. The incorporators are Jesse Shimp, E. B. Koen, both of Mannington and James A. Meredith, Fairmont, W. Va.

THE DE COTIIS CHEMICAL & COLOR Co., Pittsburgh, Pa., is being organized by A. De Cotiis, Roy Rhea and C. Schoemer, to manufacture paints, colors, chemicals, etc. Application for a state charter will be made on August 8. The company is represented by Duff, Marshall & Davis, 408 Union Arcade Bldg., Pittsburgh.

THE HARVARD CHEMICAL Co., Boston, Mass., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by John J. Palladino, 22 Dartmouth St., Boston.

INTERNATIONAL INKS, INC., Trenton, N. J., care of the Corporation Bureau of New Jersey, 33 West State St., Trenton, representative, has been incorporated with a capital of $1,000,000, to manufacture inks of various kinds, colors, etc.

D. D. JOHNSON & Co., LTD., 138 South Schuyler Ave., Kankakee, Ill., has been incorporated with a capital of $50,000, to manufacture chemical fungicides and other chemical specialties. The incorporators are David D. Johnson, C. H. Rumley and Lee E. Horton.

THE SHOPE BRICK Co., South Bend, Ind., has been incorporated with a capital of $25,000, to manufacture brick and kindred products. The incorporators are George J. Hoffman, Clem C. Whiteman and Richard Johnson, all of South Bend.

THE INTERNATIONAL PETROLEUM PRODUCERS, INC., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with capital of $1,000,000, to manufacture petroleum products.

THE BUMET RUBBER Co., East Orange, N. J., care of the New Jersey Registration & Trust Co., 525 Main St., East Orange, has been incorporated under state laws with a capital of $50,000, to manufacture rubber products.

THE CRAGEN OIL & REFINING Co., 24 North Main St., East St. Louis, Ill., has been chartered under state laws to manufacture refined oil products. The incorporators are Edward L. Cragen, Daniel T. Garber and Joseph A. Troy, Jr., all of East St. Louis.

THE GARDAPLANT CHEMICAL Co., St. Joseph, Mo., has been incorporated with a capital of $30,000, to manufacture chemicals and chemical byproducts. The incorporators are Glen Snyder, Henry Lake and C. J. Griswold, all of St. Joseph.

THE HERBINE CHEMICAL Co., New York, N. Y., care of Lieberman & Siegel, 51 Chambers St., representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are N. M. Goldstein, S. Brown and M. Herbst.

THE NEW JERSEY LEATHER CLOTH Co., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture imitation leather products. The incorporators are Jacob Wallman, L. M. and Fred Scherer, 132 Paris St., Newark.

THE SOUTHWESTERN PRODUCTS Co., St. Louis, Mo., has been incorporated with a capital of $25,000, to manufacture soaps and kindred products. The incorporators are C. B. Brockett, H. W. Jameson and O. M. Charleville, all of St. Louis.

THE FIBRE BOARD & CASE Co., 326 West Madison St., Chicago, Ill., has been incorporated with a capital of $20,000, to manufacture fiber products. The incorporators are Dale S. Johnson, Thomas W. Reilly and Eugene D. Billings.

THE FEATHERED PAINT Co., New York, N. Y., care of L. A. Jackson, 220 West 42nd St., representative, has been incorporated with a capital of $5,000, to manufacture paints, varnishes, etc. The incorporators are H. R. Epstein and A. P. Boyd.

THE LARRY-HINDS Co., 240 Poplar St., Memphis, Tenn., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are W. R. Larry, and M. F. Hinds.

THE HARTEL BRASS & NICKEL WORKS, 270 New York Ave., Union Hill, N. J., has filed notice of organization to manufacture brass, bronze, nickel and other metal products. The company is headed by Otto Hartel.

THE SUPERIOR CHEMICAL PRODUCTS Co., 303 West Chicago Ave., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are Douglas G. and H. J. Logan, and Claude H. Pratt.

THE STERLING ELECTRIC STEEL CASTING Co., Falling Springs Ave., Centerville, Ill., has been chartered under state laws to manufacture steel and other metal castings. The incorporators are Claude L. Harrell and George F. Baker.

THE HAWTHORNE CHEMICAL Co., Hawthorne, N. J., care of George A. McCausland, Hawthorne, representative, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are William Van Eerde and Jacob C. Bachman, both of Hawthorne.

THE PAYNTER CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $300,000, to manufacture automobile tires and other rubber products.

Industrial Notes

The Pittsburgh Testing Laboratory, Pittsburgh, Pa., announces the appointment of Harry M. Wey, as manager of the Chicago district, with an office located at 1560 Monadnock Block.

The Pennsylvania Pump and Compressor Co., Easton, Pa., announces the recent opening of a district office at 105 West Monroe Street, Chicago, Ill. H. M. Montgomery is in charge.

Samuel P. Sadtler & Son, Inc., consulting and analytical chemists, Philadelphia, Pa., announce that on July 1, Dr. Elbert C. Lathrop severed his connection with the duPont Co. and joined the Sadtler organization as vice-president and treasurer. Dr. Lathrop, a graduate of Depauw University, Indiana, 1907, was for nine years connected with the laboratory of Soil Fertility Investigations of the Bureau of Plant Industry, U. S. Department of Agriculture, where he carried out some very important research on the organic matter of soils for which, incidentally, he was awarded the Longstreth Medal by the Franklin Institute of Philadelphia in 1912.

The Gasoline Recovery Corp. announces that its engineering and sales departments have opened offices at 402 Janet Building, Charleston, W. Va., in charge of E. M. Burdette, vice-president and C. L. Voress, general manager.

The California Master Products Corp., Los Angeles, Cal., producers of white bentonite, calcined magnesite, and other nonmetallic minerals, have just completed an addition to their plant to provide warehouse facilities and allow the installation of a new Raymond 5-roller mill of latest design. F. A. Kaufman is manager.

W. Woodward Williams has been appointed vice-president of the Titan Iron and Steel Co., mechanically puddled wrought iron, Newark, N. J. Mr. Williams graduated from Harvard University in 1905. After six years in the mills of the Carnegie Steel Co. at Pittsburgh, Duquesne and Youngstown, he entered the sales department of the Bowne-Fuller Co., Cleveland, and was later appointed manager of its Pittsburgh office. In January, 1914, he became general manager of sales of the A. M. Byers Co., Pittsburgh, and subsequently was made its general manager. In August, 1919, he became general manager of the Reading Iron Co., and afterward was elected vice-president, in charge of sales and operations. In September, 1920, he became associated with the Pittsburgh Gage & Supply Co., the largest jobber of wrought iron pipe in the United States, resigning the vice-presidency on May 31, 1922, and entering immediately upon his present office of vice-president of the Titan Iron & Steel Co., Inc.

The Wilson Welder & Metals Co., Inc., 132 King Street, New York, N. Y., recently appointed the King-Knight Co., Underwood Building, San Francisco, Cal., exclusive representatives in central and northern California for Wilson plastic-arc welding ma chines and Wilson "Color-Tipt" metals.

The Kelley Island Lime and Transpor Co. has elected John A. Kling of Cleve land, Ohio, chairman of the board an George R. Johnson, of Buffalo, N. Y., presi dent. Other officials elected include: E. W Oglebay, first vice-president, F. A. Beck with, second vice-president; G. J. Whelar third vice-president and general manager F. W. Ohlemacher, fourth vice-presiden and C. A. McMorris, secretary and treas urer with F. W. Kohl as assistant secretar and assistant treasurer.

The Medart Patent Pulley Co., with ger eral offices and works in St. Louis, Mo., ha changed its name to The Medart Company.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., announce a numbe of recent changes and transfers affectin several different departments as well a some of the district offices. T. A. McDowe has been appointed executive assistant t the manager of the supply departmen which was recently reorganized. Carl Schluederberg, assistant to manager of th supply department, will hereafter devote a of his time to the foreign supply and mer chandising business. W. C. Koehler ha been appointed to succeed T. A. McDowe as manager of the cost and developmer section. M. H. Scott has been appointe chief clerk of the supply department. Pa H. Smith, manager of the power divisio of the Atlanta office, has resigned to ac cept a position with the Brooklyn Ediso Co. He has been succeeded by Thoma Fuller, who is now manager of both th power and supply divisions of the Atlant office. W. T. Blackwell has been appointe manager of the interior lighting section the merchandising department with hea quarters at South Bend, Ind. A. G. Crocke has been appointed manager of the powe division of the Detroit office and R. Cobban has been made branch manager the Butte office. W. W. Spangler has bee appointed assistant manager of syndicat operations. Important changes have als been made in the power sales departmen The changes include the promotions three managers and the creation of tw new managerships in the Power Depart ment and are effective immediately. L. Bullington, who has been assistant to th manager of the power department for th past several years, has been made assistar manager and will have charge of the ger eral work of the power department. Charl F. Lloyd, formerly manager of the sub station section, has been made manager the electric division and R. E. Carother formerly manager of the turbine sectio has been appointed manager of the steat division. The vacancies caused by the pro motions of Mr. Lloyd and Mr. Carother have been filled by the elevation of Bruc H. Lytle and D. O. Tylee, the former b coming manager of the substation sectio and the latter manager of the turbine se tion.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold summer excursion meeting to Rochester Montreal, Ottawa, Kingston, Toronto, Ham ilton, Niagara Falls and Buffalo, Aug. 13-1

AMERICAN CHEMICAL SOCIETY will hol its fall meeting in Pittsburgh, Pa., Sept. to 9.

AMERICAN ELECTROCHEMICAL SOCIETY wi hold its fall meeting in Montreal, Sept. 2 22 and 23. Headquarters will be at th Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold it annual convention and exhibition at Atlar tic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AN METALLURGICAL ENGINEERS will hold it 126th meeting at San Francisco, Calif., Sep 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATIN will hold its International Steel Expositio and Convention in the General Motor Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF TH NATIONAL SAFETY COUNCIL will be held i Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL IN DUSTRIES (EIGHTH) will be held in Ne York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AN MECHANICAL ENGINEERING will be held a the Grand Central Palace Dec. 7-13, wit the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has dis continued meetings for the summer, bu will resume them in October.

THE SOCIETY OF INDUSTRIAL ENGINEER will hold its next national convention an exhibitions of labor-saving equipment a the Hotel McAlpin, New York, Oct. 18, 1 and 20.

CHEMICAL & METALLURGICAL ENGINEERING

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Assistant Editors

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Finis to Ford's Offer For Muscle Shoals

COMMITTEES in both houses in Congress have done well to reject Mr. FORD'S offer for Muscle Shoals. The attack was concentrated on his offer of the small sum of $5,000,000 for the nitrate plants and a demand that the power project be leased to him for a term of 100 years. As we have pointed out repeatedly in these columns, these two items of the Ford offer were sufficient to cause its rejection.

It is seldom that a Congressional committee gets as deeply into the details of a technical subject as the Senate Committee on Agriculture and Forestry delved into the intricacies of the Ford plan. The report by Senator NORRIS analyzed the situation in great detail. Not only does he show the impossibility of favoring Mr. FORD with a 100-year lease while other lessees under the federal water power act are limited to 50 years, but he proves quite conclusively that the $5,000,000 offered for the nitrate plants could be recouped almost immediately from the sale of the government's equity in the Gorgas steam plant and of surplus property which was never used and which is not necessary to the operation of the plants. Further, he analyzes the financial phases of FORD'S offer and shows that not only would the government not be reimbursed for the principal sums advanced but would receive less than 3 per cent interest on the money required to complete the great Muscle Shoals power project.

The Ford offer and all others having been rejected, Mr. NORRIS comes forward with a plan of his own which reverts to the original scheme of operation by a government owned and controlled corporation. As we intimated some weeks ago, this completes the cycle of proposals for the disposition of Muscle Shoals and brings us back to the original starting point. Mr. NORRIS proposes that his government corporation shall complete the power project and operate the nitrate plants for the production of fertilizer. He will be sure to meet much opposition from those who object to putting the government into business, despite his plea that it is just as proper for the government to operate power and nitrate plants as it is to maintain battleships and perform all the functions necessary to keep government property in repair. The majority of his own committee is opposed to the measure and it is not likely to receive serious consideration at this session of Congress.

Speaking for the minority of the committee that favors the Ford offer, Senator LADD has prepared a report in which he draws the deadly parallel between the features of FORD'S proposal and Senator NORRIS' plan for government ownership and operation. His principal argument in support of Mr. FORD is that acceptance of his proposal will terminate the heavy expense under which the government now labors in the maintenance of Muscle Shoals and will, in addition, benefit the agricultural industry of the country by industrial research in the production of fertilizers. These advantages, coupled with a vision of the great industrial developments that Mr. FORD will bring about at Muscle Shoals, constitute in the minds of Senator LADD and his colleagues a sufficient reason for letting Mr. FORD have the project on his own terms. Senator LADD sees no reason for quibbling over such details as a 100-year lease and the small price to be paid for the nitrate plants. In short, the burden of the minority report is that the Ford offer should be accepted in spite of its obvious shortcomings because it is the only offer that has been made for the power project and nitrate plants as a whole. Leaving government ownership and operation out of the question, the minority report does not successfully meet the objections to FORD'S plan.

The Seniority Snag In the Railroad Strike

ONE of the unfortunate features of any strike is that the original issues may soon be lost to sight while extraneous matters assume unwonted importance. That is precisely the situation in the railroad strike and is the present cause of practically all the controversy going on among the government, the railway executives and the striking shop crafts.

But if the matter of seniority is extraneous to the original purposes of the strike, it has nevertheless become the one clear-cut issue. It is the one point in the settlement of which a definite principle is involved. The other matters are of a kind subject to compromise, but when the President asks the railway executives to agree that all striking employees shall "be returned to work and to their former positions with seniority and other rights unimpaired" he is asking them to violate a principle on which, in our judgment, there should be no yielding.

Neither the railway executives nor the striking shopmen can come before the public with clean hands as far as their compliance with decisions of the Railroad Labor Board is concerned. Both are guilty of ignoring the authority of this government agency and are justly subject to public censure. But the seniority issue was created by the strikers and not by the executives, and the decision of the executives not to restore the strikers to their jobs with seniority and other rights unimpaired was made for them officially by the Railroad Labor Board. In other words, the successive steps by which restoration with seniority rights has become the principal issue of the strike show clearly that the executives are in a very strong position in refusing to accept the President's proposal. It requires little stretch of the imagination to foresee the consequences

of accepting the government's conditions for calling off the strike. If strikers are to be permitted to disrupt transportation and industry and threaten the welfare of the country and then, after having caused untold inconvenience, loss and damage, return unpunished to their jobs as though coming back from a brief holiday, neither the railway executives nor the Railroad Labor Board nor any other agency will be able to settle future strikes by filling the strikers' places with new workers. If the executives are now required to tear up as a scrap of paper their promises to protect and reward faithful employees and new employees, then they will indeed do violence to every principle involved in the matter and work a gross injustice on the men who made it possible to continue transportation service in spite of the strikers. Regardless of the merits of the original points in controversy, there should be no yielding by the railway executives on the seniority issue.

Quack, Quack!

SCARCELY a week passes without the receipt of printed matter describing some marvelous liquid or powder which will turn merchant bar into finest tool steel, which will double the mileage of a Cadillac if two drops of the stuff are placed in the carburetor, which will convert the purchasable variety of grape juice into extra dry champagne over night, or which will cure warts, corns, sprains, abrasions, cancer and falling hair. Later in the fall we expect to get some more literature advocating the use of some other stuff, "the result of extensive and exhaustive research, experiments, tests and demonstrations by scientists," which will make the mixture of slate and culm to be sold this winter burn like the cleanest anthracite.

That all of these varieties of "Nulife" are sold in large quantity is sure: so many new ones are constantly appearing. And doubtless they are often sold to men who pride themselves with knowing something about their business. A fair share of the purchasers must also be those who have never been victimized before and who must learn from experience, and in no other way, that there is no virtue in nostrums. Furthermore, it is a standing demonstration of the salesman's premise that it is more important to know the psychology of the buyer than anything about his real needs or the nature of the article offered for sale.

Chemical analysis would in most cases show that the largest portion of "Nulife"—and we offer our apology if this pet word meaning all kinds of quack remedies has been previously appropriated—might be water, sand, charcoal, fuel oil or some such cheap ingredient. But not everybody has the opportunity nor the desire for analyzing "Nulife" and finding out whether he could not make it up for himself for about one-tenth the selling price of the "secret composition." Those who have such opportunities ordinarily have wholesome respect for law, and become instantly suspicious of lurid claims, knowing that in the struggle with Mother Nature you can't get something for nothing.

But it would be just as well to spread the word about. There now seems to be a flood of substances on the market by which "wrought iron or bessemer steel of low grade is converted into the equivalent of costly crucible steel as far as physical properties are concerned." A rule-of-thumb or thoughtless heat-treater might easily believe it, remembering the changes he can make in a piece of really high-grade steel by heating and cooling. But he must be warned by more intelligent friends that the metal he has in hand did not appear by merely waving a wand and muttering cabalistic words. It is the result of most extreme care on the part of a hundred men throughout a dozen difficult operations, from the selection of ore and raw materials through steel making, casting, rolling, annealing and inspection. If he will think a little he will agree that all this infinite care, wrapped up in a little piece of flawless metal, cannot be replaced by daubing some dope on some junk and following the printed directions.

Thirty years ago the late Dr. HENRY M. HOWE was encountering these same ideas, and what he said is very much to the point: "You cannot make a bad beefsteak good by the cooking; you can cook it better or worse, and it will be worse or less bad beefsteak, but always bad. On the other hand, you can easily spoil a good beefsteak by bad cooking. Now, just as cooking is to food, so is heat-treatment to steel."

When you dine at LUNG TONG'S chop house in Jaurez, you use a liberal amount of chili sauce and red pepper, and for a very good reason; but at the Waldorf you do not need to drown one of OSCAR'S patties in mustard to make it tasty.

Universities Must Compete With Industry for Leaders

EVERY so often we publish in our personal column a note to the effect that Prof. BLANK has resigned his professorship in the X. Y. Z. University to accept a position in chemical industry. The receipt of another announcement of this kind, soon to be published, was coincident with that of a letter deploring the fact that such a man could not be saved for educational work.

Technical schools must supply trained men to industries and in addition must build up research in the fundmentals of science. This is no mean task. It should enlist the best talent and genius which the country can produce, and yet these announcements continue to come to us of a brilliant young professor entering industrial work. What is wrong? Surely no one will blame the young man, full of enthusiasm, ideas and red blood; eager for the prizes which industry is able to offer. His ambition is the motive power of this country. On the other hand, one cannot blame industry for trying to get men who have developed qualities of scientific leadership.

The problem, then, must be solved in some other way. Young men entering educational work find much that is attractive. The opportunity for real service is a repaying thing. The life, removed from the fret and nag of competition, has charm. The opportunity to do constructive research is appealing. But once the full professorship is attained—and this usually comes early in life—there is no further promotion. No opportunity is presented for achievement comparable to that offered by other professions—law, medicine, even the ministry. What more, then, is needed to keep men of promise and achievement in educational work?

A correspondent who desires to be nameless and for whose opinion we have the highest regard has presented a suggestion which is constructive and sane. He recognizes at once the futility of trying to persuade industry to refrain from tempting such men. Quite rightly he says: "Initiative and leadership are not fostered by neglect and lack of appreciation." He

nedy is to create an incentive to remain in teaching. the prizes be sufficiently alluring to attract the man h initiative and leadership. Compete with industry such men! And the method? Establish a number foundations paying salaries of $25,000 and over—y limited in number so that a comparatively small cent could ever hope to attain the goal. Such prizes uld serve as real incentives to hold men in educa-nal work.

Our correspondent continues by discussing some of restrictions. Such foundations should be reserved men of unusual accomplishment and need not be ed because there happens to be a vacancy. They uld not be pensions and should be held only during productive period. One should be reserved for h of the great fields of educational work—pre-inence in teaching or in research.

This idea is fundamentally sound. Great men appear ere there is great opportunity. If we would keep eat men in educational work we must create great portunity. Nor is this derogatory to the able men eady engaged in educational work. Thank heaven for se that stay, even though their reward is not much tter than that of the vast majority of mediocre men o clog the profession, impart facts and leave the dent lethargic and dispirited. But there is still the ceptional man to provide for, and we suggest that se in authority in our leading universities take the itiative in establishing foundations that will yield laries commensurate with those of industry. Com-tition will get and hold the best men.

mmodity Prices and Business Confidence

T IS rather an interesting point that in the past 10 years we have escaped a "panic" on two or three oc-sions when one was expected. There was rather a despread belief late in 1912 and in the fore part of 13 that a panic was due at about the middle of the ter year. No panic occurred. Perhaps the inception the World War might have been counted on for a nic, but there was none. While it was not the general w, there was a feeling in some quarters that the ling of the war would be followed by rather serious ancial troubles, but we had nothing of the sort.

The experience referred to was not the experience in e previous history of the United States. There had en numerous panics, and they had, of course, been nexpected, for the panic that is seriously expected can rcely happen, because men provide against the con-ion. Individually they set their houses in order.

Remarks are now being made here and there that the undations for a panic are being laid, hope being ex-ssed that things will not really go so far as to make uble. The reference is not to a financial panic, for it now generally accepted that under the Federal Re-ve system a financial or money panic is practically possible. What is thought of is a sort of "buyers' nic," which would cause buyers suddenly to cease ying, thus precipitating industrial depression.

The trends of the times need to be studied carefully, by them one should be able to determine whither are moving. It is a matter of advancing prices, but upward trends in prices are not provocative of panic. e causes and circumstances are to be considered. If rice has been lower than it should be in relation to easonable cost of production with an efficient opera-tion, an advance is healthy. The advance removes ground for doubt and makes the seller prosperous, and prosperity spreads.

One of the tests that may usually be applied is the test of whether the thing that advances is being pro-duced economically and efficiently. That uncovers the cause of the present doubt, the fear that there may be a "buyers' panic." The principal uneasiness at present is due to the fact that some workmen are being paid higher wages than the economic conditions of the coun-try would warrant for all workmen. Furthermore, these workers are not doing a fair day's work. That there are such cases in the building trades is well known. Common labor is being paid approximately 50 cents an hour in some districts. That is too high rela-tive to wages in general, since it would be impossible to establish $1,200 a year—which is what 50 cents an hour amounts to—as a minimum wage, with gradations upward according to the relative value of the services rendered. The wages would exceed the national income —i.e., the goods are not available for spending so much.

It need not necessarily impair the general economic fabric, however, if the high costs are sufficiently limited in extent. If we see many things coming to be produced under disadvantageous conditions, or at unfair cost, we shall then have reason to fear a reaction.

Production Efficiency In the Chemical Industries

EVER since business began to work back to normal conditions following the disruption caused by the war, it has been borne in upon the wise executive that he would best be able to meet competition and conduct his business profitably by giving attention first to the efficiency of his production methods. This fact was emphasized in a most striking manner by a survey of waste elimination conducted by the Federated American Engineering Societies. It has also been stressed less strikingly in the public utterances of business leaders and in the programs of industrial and technical societies.

But what are the factors that influence production efficiency? Waste is but one of them, and while it may have been true that the elimination of waste in all its forms offered many of our industries the quickest route to profitable operation, there are other equally impor-tant elements that must still be given the closest attention if production is to be made on the most effi-cient basis. Some of these factors are mechanical in their nature and some economic, while others fall into the broad classification of human relations. The theme is a large one and obviously cannot be covered in detail short of several large volumes. We shall attempt, how-ever, in our forthcoming Chemical Exposition issue, Aug. 30, to cover the essentials of the subject in a series of articles that have been contributed by recog-nized leaders and specialists. More than a score of topics will be treated, ranging from the mechanical problems of material handling and automatic control, through the economic subjects of cost accounting, the business cycle and problems of administration, to the human elements of the selection and training of work-ers, the preservation of their health and happiness, and their relations with their employers. The issue has been in preparation for several months and we believe its excellence is such as to deserve special commenda-tion, in advance, to our readers.

Readers' Views and Comments

An Outline of the Uses of Lime

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to D. M. Liddell's further discussion of "An Outline of the Uses of Lime" appearing in the July 19 number of *Chemical & Metallurgical Engineering*, I wish to point out that in writing that article I did not consider lime as being CaO. I believe it is quite generally agreed now that lime is not CaO. A very satisfactory definition for lime is that given by S. V. Peppel, published in Bulletin 4 of the Geological Survey of Ohio, which is as follows: "Lime is the material obtained by the calcination of a stone in which carbonate of calcium is a predominating ingredient." It follows from this definition that a dolomitic limestone calcined either partly or wholly would be considered lime, and that is the sense in which the term was used in the above-mentioned article.

The chemical reaction referred to was that between the magnesium oxide in the lime and the magnesium chloride in solution.

As to the question as to whether or not the use referred to is a use of limestone or lime, I think there could be no question that it is a case of using both. It can be considered a lime product, however, because it can be made from lime by proper chemical treatment.

NATIONAL LIME ASSOCIATION.
M. E. HOLMES,
Manager, Chemical Department.

Washington, D. C.

Should Engineers Be Licensed?

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your invitation for comments on the effect upon chemical engineers of laws requiring engineers to be licensed leads me to point out that many of these laws do not recognize the fundamental difference between much of the work of civil engineers and that of the other major branches of engineering. A large percentage of civil engineers are engaged on public works, either on salary or as consultants, and the apparent purpose of many license laws is to require a proof of fitness of men in responsible positions in such work. With the great mass of mechanical, electrical, chemical and mining engineers, the condition of their work is different, for they are the technical elements of groups having financial, legal, executive and sales elements in order to function properly in meeting legitimate business and industrial conditions. It is the group and not the individual which has become the natural unit in these fields of engineering. For example, a central station company does not go to an individual for information about large turbo-generators, but to the groups, or companies, designing and building them.

The condition that will exist in New Jersey after April 8, 1923, unless the license law is repealed which becomes effective then, serves to illustrate the dangers of license legislation to most engineers. After that date no person may practice or offer to practice professional engineering in that state, unless licensed, for more than 30 days in any calendar year, without incurring danger of being fined $100 to $500 or being imprisoned for not over 3 months or both. "Professiona engineering," the law says, "means the practice of th professional engineer who through technical knowledg gained by education and experience in one or mor branches of that profession initiates, investigates, plan and directs the application of the resources of nature t the use and convenience of man; and who represent himself or herself to be such an engineer through th use of the term engineer with or without qualifyin adjectives, or through the use of some other title imply ing that he or she is an engineer."

There is no provision by which an industrial o engineering company may perform professional er gineering work in the state except upon its ow premises. It cannot give engineering advice in its ow name, representing the combined knowledge and judg ment of its specialists; all the prestige and good wi inherent in that name is wiped out. It must give thi advice in the name of some individual, if at all, whic is plainly contrary to sound public policy and good ec nomics. A few instances will show what the effect o such a law upon the chemical industry will be.

Assume that a gas company in New Jersey wishes t build a large addition to its works and prefers as result of experience to turn the design and constructio over to some company specializing in such work. Unde the law this cannot be done; only individuals can b licensed in New Jersey and there is no provision fo companies practicing through them.

A New Jersey textile mill finds that its dye work must be reconstructed and enlarged. Its plant enginee is able to design the structures and plan the general lay out, but he wishes the help of dye makers and equip ment builders in laying out the details. The only wa these companies can co-operate is in the name of th individuals they delegate, whereas the textile compan wishes the co-operation in name as well as in fact o the employers of these men, as it is company knowledg and guarantees and not individual opinions withou guarantees which it is looking for.

A company having mills in several New Jersey citie finds that the drums of one of its boilers are becomin pitted inside. For years it has referred such trouble to the boiler builder, which has one of its works in th state, where it maintains an organization of engineer and chemists engaged exclusively in studying operatin troubles with boilers. But under the new license law all this valuable information is sealed up and can b utilized, if at all, only by a roundabout process.

The New Jersey license law is the most narrow an inelastic yet passed. It compares with the Pennsylvani law about as sulphuric acid and milk. The Pennsylvani law has been in effect but a short time, yet a suit t test its constitutionality has already been brought When the industries of New Jersey find out what th license law of their state does to them, if it is impar tially enforced and not used merely for oppression o companies out of favor politically, it seems reasonabl to expect a vigorous uprising against such legislation a well as a resort to the courts. JOHN M. GOODELL.

Upper Montclair, N. J.

The Proper Status of the Engineering Profession

By R. A. Hart
Senior Drainage Engineer, U. S. Department of Agriculture
In Collaboration With
H. W. Clark and S. A. Roberts*

The Ideals Toward Which Individual Engineers Must Strive if Their Profession Is Ultimately to Take Its Place on the Same High Plane as the Other Professions Are Set Forth and the Shortcomings of the Present Day Engineer Critically Examined

THE STATUS of a profession can be measured only by the standing and standards of the individuals who represent it. The measure, of ecessity, must be composite, with due regard both for ie highest and the lowest factor, but especially for ie mean of the general body of factors.

Were we to measure our profession by its most nowned exponents we could justly feel that a proper atus already has been attained, one not surpassed any other profession. Unfortunately, however, this not proper nor possible and we must regard the atus of such exponents as more or less individual but establishing, none the less, a status that is attainable id must be attained by the profession.

Engineering a Learned Profession

When the proper status is attained the engineering ofession will be truly a learned profession.

This means that engineers will acquire a broad liberal ucation second neither to that of medical men nor the representatives of the bar. Most engineers alize already that the purpose of obtaining an educaon is to enable one to live—not merely to make a ing—to fit one to enjoy the more durable satisfactions life, and that a rigid technical education, however orough and comprehensive, leaves much to be desired. ngineers will be better grounded in the humanities, ey will have a better command of the mother tongue d they will be able the better to express themselves d impress their thoughts upon others whether in all or in large groups. They will know more of e history of mankind, more of the fundamentals of litical economy, of sociology and of psychology, for ey will realize more fully than now that engineering s to do not only with material resources and sources power but with man himself, both as a factor in proction and as the fundamental motive of inspiration r the whole engineering process.

Needless to say, the purely technical education will t be neglected in the search for broader culture. deed, the scientific and technical phase will be insified, but at the same time broadened. Due to the pid evolution of the profession in America during e past half century, the educational system has been mpelled to readjust itself from time to time, being ayed first in one direction by a doctrine of practical ining that would have made a trade school of the llege, then in the other direction by a doctrine of ltural development that would have ignored the ilitarian aspect to a harmful degree. Our present stem is a compromise that provides for too much ecialization on the part of the engineering student. e engineering undergraduate education of the future ll provide for a more thorough grounding in the ndamentals of science and of engineering unmodified adjectives. Specialization will await the period of post-graduate study or the development under conditions of actual practice. Newly-fledged engineers, unless they have had the wisdom to interpolate practical experience between their years of technical study, will be of less value to employers for a period, but eventually they will be worth more to employers or clients, to civilization and to themselves.

Finally, the engineer of the future will reach a higher aesthetic development. He will come to appreciate and enjoy the finer things of life and he will not feel out of place in association with those whose lives touch these things more intimately.

When the proper status is attained, engineering will be recognized as a learned profession by engineers themselves, by the members of the other learned professions, by the law, and by laymen generally.

It has been but two generations since engineers were generally regarded as nothing more than high-grade mechanics. Engineers did not take particular exception to this classification and even today there are engineers whose perspectives do not define a higher status. Such engineers, admittedly, constitute a small minority, but there is a much larger proportion of the membership of the profession whose attitude toward culture in general, particularly toward the necessity for a proper regard for accuracy, effectiveness and clarity, not to say beauty, in the spoken and written word, constitutes a depressing factor in the struggle to advance the status of the profession. Many engineers have no more realization of the seriousness of their deficiencies in liberal education at the close of their college careers than they had of the desirability of such education at the beginning of their technical education, and as a consequence make no attempt to correct the deficiencies by personal effort after entering practice. Many others, realizing their deficiencies, conclude that it is too late to apply a remedy. Most engineers sincerely believe that their professional work leaves no time for perusal of anything but technical matter, newspapers and general periodicals; others find no time even to continue their technical development save through experience.

Recognition Must Be Sought

It may be said that the engineering profession has already been admitted to the honored company of the learned professions by the consent and acknowledgment of the membership thereof. It is realized that an engineer must have had a training equivalent to that of a doctor or a lawyer, for example, and that the nature of his subject matter is such as to require commensurate mental equipment, but the impression is firm that the training is special, highly technical and narrow and the recognition of the profession as a learned profession involves a mental reservation. One of our goals must be to eliminate this reservation.

From the legal standpoint, the engineer has been in a peculiar position. He has had the protection neither of the mechanics or material man's lien, with respect

*Messrs. Hart, Clark and Roberts were members of a committee the Engineering Council of Utah which prepared this article.

to remuneration for services rendered, nor that afforded to the members of most of the other professions through examinations for the bar, license laws and certification. The engineer has occupied a twilight zone in which he has been left at the mercy of his employer or client on the one hand and of the pseudo-engineer on the other. When the proper status is attained the engineer will have ample legal protection.

In America particularly, the laity has not accorded the profession the rank acknowledged even by the other professions and great effort must be expended before the proper recognition is secured. In France, the engineer is a gentleman and a scholar and is recognized as such. In England the engineer is frequently of the aristocracy. Even in Mexico there is no possibility of confusing the engineer with the driver of a locomotive as the one is called *inginerio* and the other *maquinista.* When the proper status is attained the layman will distinguish the engineer from the engine-driver, he will discover in the civil engineer more than the runner of lines and the driver of stakes; he will requisition the services of the engineer more and more, and he will retain the engineer on the basis of ability and service, not on the false basis of relative price. He will come to recognize the time element as non-essential and that the element of service or of opinion is paramount.

Development of a High Professional Sense

When the proper status of the engineering profession is attained it will be found that engineers generally have developed a high professional sense controlling their individual relations with the public, their individual relations with each other and their collective activities.

Engineering is essentially honest. It deals with immutable laws and the engineer discovers very early in his career that he cannot go counter to these laws and succeed. Whatever his natural inclination may be, he gets into honest habits. By the time he reaches the status where his opinion rather than his services is in demand, he has developed a very jealous regard for his reputation and this serves as a further protection. He finds that he is a dispenser of justice. He is not an advocate for either party in a controversy but his duty it is to expose the truth. It appears that engineers in general have come nearer attaining the proper status in this than in any other phase of the question. It is not to be denied, however, that there are men in the profession who fail to rise to the standard now established—men who will sell a favorable opinion for a fee; men who will advocate a wrong cause; men who will permit their judgments to be warped for a consideration or, perhaps, by insidious suggestion.

Curiously enough, while engineers in general have established a very high standard with respect to their fiduciary relationship, the same high professional sense does not apply to their relations one with another. This is largely due to the fact that engineers are more or less individualistic and the rapid economic development, particularly in America, has resulted in a keen competition in achievement which was worthy and beneficent but which, under conditions of stress evolved into a keen competition for work to do, and this latter competition has produced some very unworthy aspects. This is, no doubt, a passing phase and in the interest of the advancement of the status of the profession it should be firmly kept in mind that every injury done by word or act to a member of the profession is an injury to the profession and therefore to the instigator himself. The first electrical engineer said, "We must all hang together or assuredly we shall all hang separately."

The ethics of the engineering profession as yet are unwritten and this may be the reason why they are often ignored by engineers in their dealings one with another. Whether or not it is a reason, it is not an excuse, since there is a written code of ethics, available to every engineer, that covers the situation. The code comprises only eighteen words and may easily be memorized. It is as follows: "Therefore all things whatsoever ye would that men should do to you, do ye even so to them."

Engineers are beginning to act collectively. If the proper status of the profession is to be attained speedily such collective activity must be on a high plane. There must be nothing that savors of trade unionism. Every endeavor to advance the status of the profession must be of the highest order. Engineers must adopt an absolutely unbiased attitude with respect to the adjustment of the differences between capital and labor. In the matter of the promotion of legislation, engineers must operate with an eye single to the good of all and not serve one class or interest to the detriment of another.

When engineering attains the proper status there will be more business in engineering and more engineering in business. It is said, perhaps justly, that engineers do not possess a high commercial sense; indeed, many lack even the element of good common sense. Commercialism is distasteful to most engineers. This is not an uncommon characteristic of professional men generally, but with engineers particularly it is essential that economics shall have a full measure of regard. Engineers are notoriously poor salesmen, even of their own services. If engineers are to measure up to their opportunities they must develop the commercial instinct to an extent where they can sell ideas in the first place and then properly direct the application of the idea to the end that the product shall fill an economic want in an economical manner. Engineers must come to realize that the most effective instrument of engineering is the almighty dollar and that it is fully as essential to know the powers, purposes and limitations of this instrument and how to use it effectively and efficiently as that of any other or all other instruments of the profession.

Broader Power and Authority Involved

It seems almost unnecessary to say that the men in this world who are doing the things should have most to say about *what* is to be done, *when* it is to be done and *how* it is to be done. The fact remains, however, that engineers do not have a sufficiently effective voice in these matters. Generally the broader plans are laid, the organizations are effected, the policies adopted, the ends to be attained decided and perhaps even the financing arranged before the engineer is called upon to produce results. Somehow, handicapped and circumscribed as he is, he generally produces the result. How much better would it be for all were the engineer to play an important if not dominant part in the general plans and their collateral phases.

Great administrators have come to lean very heavily on their engineers and this is gratifying so far as it goes, but the question naturally arises, Why should the organization be such that the head must lean on the

lieutenant? Evidently the engineer is able not only to stand alone but to bear up under the weight of his chief. If the engineer suffers a deficiency that justly condemns him to the secondary position, let him correct that deficiency and the whole organization will profit by the readjustment.

But while great administrators have had the wisdom to lean heavily upon their engineers it may be said, in general, that administrators of smaller caliber and boards of directors generally fail to do so. They are more inclined to lean upon their attorneys for counsel in matters of administration and finance. This is entirely proper to the extent of the legal aspects, but when it comes to the more or less practical aspects it is unfair to the attorney to require his advice, as he is unfitted usually, both by temperament and training, to give the most competent guidance and his legal reputation itself may suffer without warrant in the event of his practical adhortation being erroneous.

The accountant and the banker come in for a due share of consideration by administrators and boards of directors in matters of administration and finance, but here again there is a tendency to fail to recognize limitations. The good banker is the conservative banker. For him to lead would be fatal to the financial structure. He must go only so far as he is compelled. He is the governor on the engine of material progress, not the actuating power. The accountant deals with things as they are and it is his duty rather to proscribe than to initiate. The attorney has his being in precedent. He deals with a system of rules of action that are but the crystallization of public opinion. Crystallization involves a time element and it follows naturally that the law ever lags and never leads in the progress of the race. The attorney must ever look backward and yet backward. His thinking is *a posteriori* in consequence.

The engineer by nature and training and experience is fitted best to bring in the element of vision so necessary to progress. Progressive by nature, grounded in the immutable laws of science, experienced in their practical adaptation and application, possessed of a constructive imagination, gifted with a sense of values and proportions, trained in *a priori* reasoning, urged on by the highest traditions of his profession and blessed with a reasonable assurance, the engineer is destined to lead humanity in its upward and onward progression.

Activity in Public Affairs

When the engineering profession attains the proper status, engineers in general will play a more important rôle in the drama of public affairs. There will be an increased voluntary activity and there will be a greater call to service.

It is said that most engineers do not bother even to vote. Certainly they are much less active in political matters than is excusable. It is the exception to find an engineer rendering his voluntary service in a strictly public capacity. He prefers to be a doer and to leave the talking to those who cannot do. Experience has shown this to be disastrous both to the engineers and to society. Some of the reasons for this aversion have been referred to. They will disappear with broader culture. There is an element of inertia involved, however and this must be overcome by individual and collective effort.

The voluntary intensified activity will be accompanied by a call to service on boards, commissions and in governmental affairs generally. It will become a custom if not a law that at least one member of every board or commission touching the public in any practical manner will be an engineer and that boards and commissions having to do with engineering matters strictly will be composed of engineers. The spectacle of the highway commission of a great commonwealth, a commission dealing entirely with engineering problems in the broadest sense, being made up of non-engineers will not be witnessed.

The minds and talents of engineers will be brought to bear upon the solution of the perplexing problems of civilization that have so far defied the best efforts of politicians, legislators and statesmen and if past performance by engineers in other matters be employed as a safe guide, we may confidently expect the same satisfactory results.

Compensation

The compensation of the engineer is twofold and is both direct and indirect. The direct compensation is the satisfaction which comes to him from doing something worth while and from successful accomplishment. Such compensation is limited only by the degree of his enthusiasm in his work, by the sincerity of his desire for rendering service and by the integrity of his application to his task. Thus the control is largely in his own hands.

But the engineer is one of those happy mortals who receive pay for doing what they like to do. Such pay constitutes the indirect compensation of the engineer and it is essential that it be sufficient in amount so that the engineer may live a well-rounded life in order to continue his service to mankind. It is this indirect compensation to which we refer when we say that the engineer is undercompensated. When the proper status of the profession is attained there will be no criticism to offer on the score of compensation.

A consideration of proper compensation for engineers involves a question of nature as well as of amount. A young engineer is valuable particularly for his services and there is some justification for the employment of a time basis in connection with compensation. The mature engineer, on the other hand, is valuable largely for his opinion based on experience and his judgment, which involves mental quality and caliber. In neither of these does the time element function. A right opinion is valuable regardless of whether it is rendered instantaneously or as a result of much calculation and consideration.

The time unit serves fairly well for the activities that involve manual operations. It fails utterly in the case of the service rendered by mature engineers. The value of the service rendered is the only satisfactory measure of his compensation. Many examples might be given to illustrate the fact that a good engineer saves at least the cost of his fee on each project.

Effort should be directed more toward a change in the nature and the basis for engineering compensation than toward advance in rates and classification. The one goes hand in hand with the whole movement to advance the status of the profession, while the other runs counter to it and may operate to its detriment. Proper compensation will follow as a matter of course when the proper status has been attained.

Summing up then, it has been shown that when the proper status of the engineering profession has been

attained, the profession will be truly a learned profession and universally will be recognized as such. Engineers will acquire a broader culture and a higher refinement. Their undergraduate scientific training will be broader and specialization will await the postgraduate period. Engineers will have a better legal status than now and they will develop a higher professional sense in connection with their individual relations with the public, their individual relations one with another and their collective activities. They will find it necessary to develop a higher commercial sense and to become much more active in public matters. The question of compensation will adjust itself to the status.

Determination of Gases in Metals

By Harold Lester Simons

(Contribution from the laboratories of the Magna Metal Corporation.)

A VERY common source of trouble in metallurgical work is that the resultant product is "gassy." Naturally, before any remedy may be applied, it is necessary to know just what gas is causing the trouble; and, furthermore, it is desirable to be able to ascertain the nature and quantity of gas in any given sample of material in order to determine the efficacy of the treatment resorted to in an attempt to remove it.

It is obvious that even under the best of conditions for analysis (and correspondingly worst condition of material) the amount of gas present must be very small indeed—a fact which any proposed method must take into account.

Hempel[1] advocates the use of a hollow mercury-filled drill in which the gas is collected. This procedure has the objection that a small amount of air is always obtained with the gas sought, this being likely to result in some confusion. Furthermore, although cast iron does not amalgamate with mercury, most other metals do. This will obviously render the procedure difficult.

Ryder[2] has evolved a method which is apparently an excellent one; but it involves employing the metal in filament form and is, therefore, unsuitable if the original material is in somewhat large pieces.

The fact that mercury does amalgamate with most metals suggests that, by means of a somewhat large quantity thereof, a solution of the metal in question may be formed and the liberated gas pumped off. Accordingly, the apparatus illustrated diagramatically in the accompanying figure was constructed and has been employed most usefully in connection with work in this laboratory.

A is a 200-c.c. round-bottom pyrex flask with walls about 1 to 1.5 mm. thick and top flared. The flare is used as a mercury seal where it makes joint with a ground-in stopper of ordinary soft glass. *B* is a tube which slants downward and meets the stopcock *C*. (Incidentally, all stopcocks and joints are mercury sealed.) *D* is made of capillary tubing which extends almost to the bottom of flask *E*, which is filled with purified mercury which has been boiled for some time in order to free the flask from air. *F* is a water-cooled condenser which may, however, be replaced by a long glass tube if desired. *G* is another mercury-sealed stopcock and *J* is a Geissler tube for spectral examination of the gas. It is connected to the apparatus by a bent and bulbed tube in order to catch any stray drops of

[1] "Methods of Gas Analysis," by Hempel (trans. by Dennis) (1912), p. 18 ff.

[2] *J. Am. Chem. Soc.*, vol. 40, p. 1656 (1918).

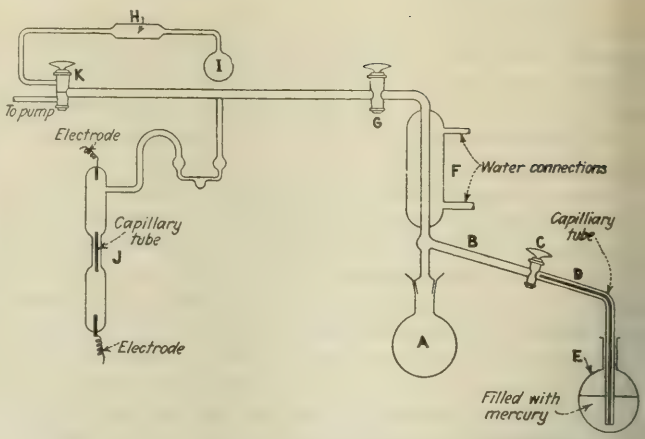


FIG. 1—SKETCH OF APPARATUS FOR RECOVERING GAS FROM METAL

mercury. *K* is a two-way mercury-sealed stopcock which leads on the one hand to a Toeppler pump and on the other to *I* (a source of pure oxygen), which is a bulb filled with pure potassium permanganate covered with glass wool. *H* is merely another bulb filled with phosphorus pentoxide to dry the oxygen.

In practice the apparatus is flooded with pure dry oxygen (obtained by heating *I*) and exhausted by means of the pump. *C* is then opened very slowly and mercury permitted to rise until it reaches the middle of tube *B*. Dry oxygen is then admitted to the system, after which *A* is removed and the metal samples inserted. As much as 75 g. of certain high-magnesium alloys in pieces about 2 x ½ in. have been used.

A is again fastened on and mercury placed in the seal. The complete system is now evacuated to about 1 mm., when it is again flooded with oxygen. The pumping is now continued until a spark refuses to pass in *J*, save with the greatest difficulty. Even then no spectral lines should be observable. It may be remarked in this connection that hydrogen (and nitrogen) lines are rather persistent and serve as a good criterion of complete evacuation. Since the current from an induction coil is not a pure sine function, one electrode of the Geissler tube remains colder than the other and retains more adsorbed gas. Therefore it is best to reverse the electrical connections frequently.

Stopcock *G* is now closed and mercury permitted to run in slowly by opening *C*. The rate at which this is done will depend upon the metal under examination. It is desirable to warm the flask with a bunsen flame. If the metal dissolves with difficulty or is present in large quantity, flask *A* is filled about two-thirds with mercury and stopcock *C* closed. The temperature may now be readily raised to the boiling point of mercury under atmospheric pressure. This elevated temperature greatly facilitates solution.

The flask and its contents are now permitted to become fairly cool before proceeding further—for if this is not done, the mercury will vaporize so rapidly that it will condense in all parts of the apparatus. Now open stopcock *G* slightly (*C* and *K* must be closed) and then shut it. Examine the gases spectrally at this time. A glass tube of about 25 c.c. capacity with stopcock at its upper end is now placed over the mercury sealed exit tube of the Toeppler pump. The tube and stopcock are completely filled with mercury by suction and supported in this position.

Everything is now in readiness to collect the gas by operating the pump after making connection through

It is well to examine the gas spectrally at inter-ls in order to note any change in its nature. This amination also serves to detect a leak. Gentle boil-g serves to render easy the liberation of the entire antity of the gas, which after collection can be ex-nined by the ordinary methods of gas analysis.

As the work performed at this laboratory is of a ry specialized nature, no advantage would be had by blishing results of isolated analyses. Many tests have dicated, however, that consistent results can be ob-ined by the method. For instance, a certain high-agnesium alloy, purposely made rather gassy, con-ined 0.083 c.c. gas per gram, which proved to be actically pure hydrogen by chemical analysis, although e spectroscope showed a trace of argon. Duplicate mples showed substantial agreement.

The author wishes to express his gratitude to Prof. ston Stevenson of the College of the City of New ork for his invaluable assistance and for the use of ivate apparatus in carrying out this procedure.

He also desires to extend his thanks to Andrew C. icksen of these laboratories for his most valuable sistance in parts of this work.

Paper From Southern Spruce-Pine

EXPERIMENTS recently conducted with the variety of wood known in the South as Southern spruce-pine e said to have demonstrated the value of the timber as pulp wood for paper manufacture. Exhaustive sur-ys are now being conducted to determine the amount timber available for newsprint manufacture and ans are being prepared for the erection of a paper ll on the Warrior River in Alabama, near Birming-m.

There are hundreds of square miles of the spruce-pine vering the hills and ridges throughout the northern d northwestern section of Alabama. The trees grow ong the banks of the river down to the water's edge, d stretch for miles along the banks of the stream. is estimated that there is enough timber standing supply one or more large paper mills for 100 years. is said that the trees reach the proper size for paper-aking in about eighteen years. The trees grow to considerable height; there is almost a total absence of art and only a trace of rosin. The fiber is almost entical with that of Canadian spruce and a cord of e Alabama wood makes a ton of paper pulp, the yield ing the same as with the ordinary spruce.

The proximity of the pine forests to the Warrior ver means easy, quick and cheap transportation of e logs to the proposed mill, as well as a 20 per cent ving in freight to purchasers of the finished paper, e to the fact that the combination water-rail freight te is considerably less than the all-rail rate. Experts clare that the wood can be delivered to the river at e-fourth the cost of delivering logs from the Canadian rests to the Northern paper mills.

The Southern spruce-pine has heretofore been con-dered a worthless product. Unfit for lumber and of fibrous nature, it decays quickly and has found no actical use in the South. The foliage is very short d contains many cones. The bark is unusually thin, d of much lighter color than that of the regular llow pine used for lumber. The trees grow only on e hills and knolls, being rarely found in the valley southern Alabama nor where there is a surplus of isture. Preliminary surveys indicate that the yield

CROSS-SECTION OF MATURE LOG OF SOUTHERN SPRUCE-PINE

in the territory along the Warrior River will average from 10 to 20 cords per acre. It is believed that the present supply is sufficient to last a fair-sized mill for fifty years, but in view of the rapid growth of this species of tree the supply might be said to be practically inexhaustible. An interesting experiment to demonstrate the practicability of using this species of spruce for newsprint was recently conducted by the publishers of the Birmingham *Age-Herald*. A recent issue of this paper was printed entirely on stock manufactured from the Alabama wood. The timber was cut along the Warrior River, shipped to Niagara Falls and converted into print. The report from the mill which handled the wood was to the effect that it grinds as easily and has as good fiber as Canadian spruce.

The weight of the paper is 32 lb., and the breaking strength 11 lb. per square inch, thus conforming with standard specifications for newsprint.

Electric Pig Iron in Sweden

The Engineer for July 7, 1922, contains an unsigned article on "Electric Smelting of Pig Iron in Sweden," commenting on a late test of a pig-iron furnace of the conventional type. The furnace has a height of 13.7 m. over all, 38 cu.m. capacity, and produces 23 tons of pig iron per day. In the official test, one metric ton of pig required 1,749 kw.-hr. (theoretical 1,301; efficiency therefore being 74.4 per cent). Magnetic ore containing 67.3 per cent iron was used, P 0.006 and S 0.004.

It is pointed out that the exceptional purity of the Swedish ores (the average of the whole country's reserves is 60 per cent Fe) and the resulting slag volume (15 per cent of the iron produced) are great factors leading to the success of electric smelting. If the charge contains any considerable amount of sulphur, the sulphur in the pig iron is regulated with extreme difficulty —it varies with the temperature of the hearth and returns to normal very slowly. Another controlling factor is the cost of electric power and charcoal versus coke.

Quality Control in Cement Manufacture*

By Richard K. Meade
Consulting Engineer, Baltimore, Md.

An Analysis of the Crucial Points of Portland Cement Manufacture and a Discussion of the Kind of Control Necessary at These Points to Produce Cement of High Quality

CONTRARY to the general belief, the question of the quality of cement is more often a mechanical than a chemical problem, or rather perhaps one of the relation of the mechanics of the process to the chemical composition of the product. The connection between the chemical composition of cement and its physical properties is now so well understood that there are few instances where the poor quality of the cement is due to a lack of knowledge of what the chemical composition of this should be. Generally speaking, poor quality is due to circumstances which interfere with the attainment of the ideal composition by the chemist. In speaking of composition in this paper the term is not limited to the mere analysis of the cement, but includes the proper combination of the elements to form the so-called cement clinker.

Problems of Manufacturing Good Clinker

The problem of manufacturing good clinker in laboratory quantities is extremely simple. It is merely necessary to grind finely a properly proportioned mixture of argillaceous and calcareous substances and then to ignite the mixture to the point of incipient vitrification for a sufficient time to allow proper chemical combination of the elements composing the mix. All the details of the process are well understood by cement chemists—the proper relation to be had between the argillaceous and calcareous elements, the fineness necessary to secure intimate contact and the degree of burning to promote combination are all matters of common knowledge in the industry. When it comes to handling large quantities of natural materials and to manufacturing cement economically, however, the problem is vastly complicated. To begin with the raw materials, these generally vary considerably in chemical composition in different parts of the deposit and the method of accurately sampling and proportioning these materials is one of the most troublesome problems with which the cement manufacturer has to contend. The question of the degree of grinding is generally limited by the mechanical equipment provided and is always influenced by the question of economy. The problem of burning is much simpler than the other two and is usually merely one of securing experienced and conscientious kiln attendants.

These three primary operations of cement manufacture bear a general relation to each other. Some years ago the writer called attention to the fact that, assuming the chemical composition to be correct, there is a very definite relation between the fineness of the materials, the temperature of burning and the time at which the materials are subjected to this temperature. This relation can be best illustrated by means of a mathematical formula thus

$$F \times D \times T = C$$

In which F represents the fineness, D the temperature, T the time, and C clinker (a constant quantity). It will be seen that if C is a fixed quantity the others can vary among themselves and still equal C. Thus with a coarsely ground mixture, the time or temperature of burning, one or possibly both, must be increased to secure proper combination. Similarly if the time in the kiln is short this must be made up for by higher temperature or finer grinding.

If the fact that the composition of the mixture of argillaceous and calcareous substance can vary is considered, another variable is added to the equation. It is, of course, well known that it is much easier to burn low-lime cement than high-lime cement, in which case coarser grinding satisfies. In actual practice, the details of cement manufacture, therefore, are a general compromise to suit local conditions between chemical composition, fineness of grinding and degree of burning.

Fine grinding and harder burning as indicated above will tend to correct faulty composition in some instances. The importance of fine grinding of the raw materials and of proper burning are, of course, better understood and when these are the cause of poor quality the remedy is evident.

Absolute Chemical Control Necessary

My own experience indicates that the problem of making cement of uniform high quality is largely one of *absolute* control of the chemical composition of the mixture fed to the kilns. Occasionally the raw grinding or burning equipment is insufficient, but for the most part the failure to control the chemical composition of the mix has been responsible for the irregular quality of the product.

Chemical analysis of the cement does not always show the trouble, particularly when this analysis is confined to a sample representing a large quantity of cement, such as a bin of several thousand barrels or a day's run—because such a bin of cement may be the average of several hours of very high-limed and consequently unsound cement mixed with several hours of low-limed cement; the average of the two being often near the desired chemical composition but the physical properties of the resulting cement retaining something of the undesirable characteristics of both the high-limed and low-limed clinker.

Such a result is quite apt to occur in the dry process where chemical control is generally a matter of examination of a mixture already made rather than of two materials about to be mixed. It is, of course, well known to most cement manufacturers that the routine tests of the dry-mill laboratory are post mortems rather than diagnoses. They are of no value so far as correcting the composition of the particular lot of raw material under examination is concerned, but serve as a guide to the making of succeeding lots.

By far the larger number of mills, both wet and dry make their mix by means of what are, in the vernacular

*Paper read before the Portland Cement Association at Atlantic City, June 27, 1922.

the industry, known as "readings." That is, samples the mix are drawn from the grinding mills at stated tervals of time and in these samples the carbonate of me is determined. If this is found to vary from the sired standard, no correction can as a rule be made that portion of the mix which has already been pre-ared, and the test serves principally as a guide to the roportioning of succeeding lots, etc. When the mix is ntrolled by such a process, the chemist finding his ixture too high or too low in lime (as shown by the ading) decreases or increases his limestone to cor-ct his proportions. In the dry process this often has ie effect of sending his composition to the opposite xtreme, with the result that while his low-lime and igh-lime clinker will average properly very little of it *per se* of correct composition.

In the wet process, however, an opportunity is gen-rally given to mix the whole lot of ground material y combining the contents of several slurry basins in ie large kiln feed basin and in this way the averaging done before the kiln is reached and hence the clinker of correct composition.

At many dry-process cement plants, the question of hemical control is largely one of good judgment on ie part of the chemist rather than of chemical test. or example, let us cite the case where a limestone and hale plant is supplied with rock by one large steam hovel. The shale is regular but the various strata of mestone differ much in chemical composition. Added o this variation is also the fact that 3 or 4 ft. of clay verlying the limestone is not stripped from the latter ut is blasted down with it. Deep well drills are used nd the shots are large, each representing several nonths' supply of stone. All stone is sent direct from ie shovel through crushers into a relatively small torage bin and the mix is controlled entirely by "read-ngs" taken from the tube mill discharge. Let us sup-ose, as frequently happens, the shovel is working in ie morning on clean limestone comparatively free from tripping. At noon, it encounters a limestone mixed vith stripping and by night it has worked through the tripping and is back on the clean stone. What happens o the mix is this: Some time during the afternoon the ample drawn from the tube mill shows the mix to be verclayed and the chemist accordingly decreases the hale. The orders to make this change probably reach he raw mill about the time the shovel reaches clean tone again with the result that the next sample drawn rom the tube mill will show the mix over-limed. At his mill, the mix would generally be wrong but for the isual inspection and good judgment of the chemist. This condition is by no means unusual and while prob-bly not existing often in such exaggerated form, does ccur in a more or less modified form at many mills.

Superiority of American Cement Evident

In my opinion, it is everlastingly to the credit of the American cement chemist that he can make cement *uperior* to any in the world with the crude methods ften supplied him. He may not be as "long" on theory s his English and German confrères, but for the exer-ise of good, hard common sense and rare judgment he as them both, to use a slang expression, "backed off he map."

So far as quarrying methods are concerned, the steam hovel and the deep-well drill are likely to stay, and it s also in most instances more economical to include the verburden in the blast rather than to strip. At the same time, it is evident that these three improvements in quarry efficiency have increased materially in most instances the difficulty of securing a uniform mix. The big blast throws down the entire vertical face of the quarry in one jumbled heap. If it served also to mix the various beds intimately it would be of advantage. Unfortunately the opposite is generally true and the beds remain almost as separate, but not as easily segregated after the stone is blasted down as when in the position left by nature. In the case of the old method of quarrying by means of 16- to 20-ft. benches, the beds were usually blasted down in some sort of order and could be quarried uniformly. The steam shovels also confine the stone supplied the mill to that obtainable from one or two points in the quarry, while with hand loading the stone can be obtained from almost the entire area of the quarry.

Lack of Uniform Overburden Presents Problem

If the overburden could be intimately mixed with the stone there would generally be no objection to its being blasted down with the stone. Unfortunately this result cannot often be obtained and the overburden usually lies over part of the rock only.

With these new conditions occurring in the quarry, provision must be made at the mill to take care of the irregular supply of stone and clay sent to the mill by the shovels. The influence of occasional variations in the composition of the raw materials are designed to be taken care of at most plants by storage bins of varying forms and sizes.

Usually the shale or clay supplied the mill, whether obtained by means of shovels or hand labor, is of regular composition. Sometimes with clay the moisture content needs careful supervision. A few mills use a calcareous shale in which the lime content varies over quite a range. The use of such shale always greatly complicates the problem of controlling the chemical composition of the mix by introducing two variables instead of one.

Storage of Stone and Prevention of Segregation

The employment of a large stone storage divided into two or more bins seems to be the most feasible method of securing a uniform raw material. In many instances, however, such stone-houses are poorly designed. If we place rock continuously on the middle of a pile and draw at the same time below from the center of this, we will obtain pretty much the same stone that is being delivered to the pile and very little if any mixing will occur. Even where the discharge is not directly under the point of filling this flow of material between the two points occurs. In designing a stone-house, therefore, this should be divided into at least two bins, although it is doubtful if anything is gained by numerous small tanks or bins.

Another action which should be kept in mind is the so-called segregation of materials in the bins. If a mixture of coarsely crushed limestone is fed from an overhead source into the center of a pile it will be found that the coarse material will roll to the outside of the pile while the fine material will lie where it falls. If the pile is tapped from the center, the first material drawn is almost entirely the fines while the coarse material is the last to be obtained. As the fine material usually contains the stripping and is always lower in lime than the coarse material, it will be seen that the composition of the material obtained when the pile is first tapped

will be much lower in lime than that of the last portion obtained.

Many plants employ what are termed blending bins, consisting of large tanks in which the coarsely crushed material is stored. My observation has been that these bins instead of blending, actually segregate, for the reason given above.

It has always seemed to me that the traveling crane and grab bucket afford excellent methods of storing limestone. With this outfit the material as crushed can be uniformly distributed over a large pile. There is no segregation of fines and coarse and the reclaiming can also be distributed over a large area. It is a simple matter for the chemist to work out for the crane operator a cycle of filling and emptying such a storage which will give uniform material and leave nothing to the judgment of the operator.

Another excellent storage is one consisting of several long rectangular and fairly deep bins filled by means of an overhead belt conveyor. This latter is in turn equipped with a traveling tripper. This tripper is so designed as to move at a regular rate slowly back and forth over the entire length of the bin and spread the material in uniform layers over this. If the bin is relatively narrow and the openings below are alternately to each side of the center line, the segregation between coarse and fine material is negligible where the stone is drawn from several openings.

For those who prefer a pan conveyor or bucket carrier to the belt conveyor, the buckets can be arranged to deposit the material at a number of points in the bin. No doubt, other methods of securing the same result are available. Where a silo storage is employed, if the number of bins is sufficient to permit it, better results will be obtained by filling or emptying a number of these at the same time by some such method as I have suggested, rather than to fill and empty in rotation.

So much for the form of storage. Another fact which should be borne in mind is that the finer the rock is crushed the better mixture will be obtained and the less segregation will occur in the bins. For this reason, I would suggest crushing the materials as far as practicable before storage.

Proportioning the Mix—Sampling and Measuring

For determining the proportions of the two materials where the mixing is done directly after the large stone-house, two methods are generally employed. One is to obtain a sample of the contents of the bins of clay and limestone and mix the two as indicated by the analysis of this sample. The other is what is generally designated as the "reading" method and consists in mixing the two materials according to the results obtained from a determination of the carbonate of lime in the mix after this has been ground in the mill. In spite of the fact that it is apparently much the less scientific of the two methods, the second one will usually give better results. This is because of the difficulty of properly sampling material in large pieces mixed with fines and intermediates.

The only method of sampling such material which will give accurate results will be some system of crushing and quartering in several steps such as is used for ore sampling and this would involve an expensive sampling plant. As an illustration of such a plant, let us suppose that the material came from the crusher in a pan conveyor. Arrangement could be made to trip every tenth bucket into a small crusher which would crush to, say, 1 in. and under. The discharge from this crushe would then be sampled and the sample crushed to, say ½ in. This ¼-in. material in turn would be sampled an the sample crushed to 10 mesh. The fine material coul then be sampled and this final sample ground to th necessary fineness for analysis. It will be seen tha such an arrangement would involve handling quite a lo of material.

In a cement plant using 1,000 tons of stone per da the first sample would amount to 100 tons to be crushe to 1 in., the second to 10 tons to be crushed to ¼ in., th third to 1 ton to be ground to 10 mesh and the fourt to 200 lb. to be ground to laboratory fineness. It i doubtful if accurate results can be obtained with muc greater fractions. It will readily be seen that th equipment necessary for such quantities is beyond tha now available in cement mill laboratories.

The methods necessary for securing uniform rock a the mill are the same whether the wet or dry proces is employed and the desirability of such a supply o rock of uniform composition is as great in the on process as the other. In the older wet process plant provision was made for adding clay or marl as desire to the ground slurry before this was pumped to th kiln supply basins. Today, however, when necessary t correct the composition of the slurry, the general prac tice is to mix two or more tanks to give the desire results, so that as far as the mix goes, the two processe approach each other much more nearly than they di when the raw materials of the wet process were ma and clay. In the matter of chemical control, there ar unquestionably much better facilities provided at mos wet-process plants than there are in the general run o dry-process mills. When difficulties of controlling th mix to occur in wet-process plants, this is usually du to too few or too small slurry basins and kiln fee tanks or to improper or insufficient agitation.

Dry-Process Plants Need More Complete Contro

The writer has always felt that the methods employe to control the mix at most dry-process plants are in sufficient and that a system of correcting tanks planne after those of wet-process plants could be employed t advantage. If the grinding is done in two stages, suc as with ball and tube mills, the use of two sets of tank or bins is suggested; one set of at least four, and bette six or eight tanks to be placed after the preliminar mills (ball mills) and one set of four or more after th secondary mills (tube mills). The tanks in the firs set should be sufficiently large to take care of at leas four hours' run of the mill. The system should be pro vided with an automatic sampler so that the content of each tank can be sampled as ground. Where ampl rock storage had been provided to give fairly uniform rock, the four tanks could then be used in this manne One tank would be filling, the second tank would b under test and the third and fourth tanks would b used straight, or mixed if necessary to give the prope composition. When analysis proved a tank to be o incorrect composition it would be necessary to so pro portion the next tank that the two could be mixed s as to give a mixture of correct composition. Th second set of tanks would receive the fully groun material and these should also be provided with auto matic samplers. They serve as a further means o correcting the mix when necessary by blending th contents of two or more tanks as the pulverized materia is sent to the kiln. The mixing here is not as thoroug

s would occur when the two materials were ground ut still fairly good mixing would occur when the screw nveyors were used to carry the mix from the tanks nd considerable mixing would also be effected in the pper part of the kiln before the material began to rm into balls.

Suggested Method

At some plants, it would no doubt be found most nvenient to use such a series of tanks for mixing. hat is, to grind the materials separately to 10 to 20 esh before the mixing is done. In this case certain nks would be set aside for limestone and certain nks for clay and both materials would be sampled utomatically and mixed according to the analysis of ese samples. It is comparatively easy to secure an ccurate sample of 10- or 20-mesh material, while it is xtremely difficult to obtain anything which will prop-rly represent material crushed only to 1 in. So that is system of sampling, analyzing and mixing will do ith 10-mesh material but will not give satisfaction ith 1-in. material. The statement that the finer the aterial the easier it is to sample accurately will hold ood for all materials.

No doubt various modifications of this system would e devised to suit local conditions. For instance, at rtain plants it might be found best to mix partly by nalysis and then to do the correcting by adding to ie contents of the tanks as drawn a small amount f clay or limestone ground to 10 mesh. I am not ying to outline a plan to be followed by all plants, ut merely to indicate lines along which such a sys-m may be worked out. The cost of operating such system would be low and the initial investment small. believe the saving in other lines aside from quality ould pay for the installation and upkeep of the sys-m. Such saving would include fuel required to burn ver-limed mix, power to grind under-limed clinker, bor due to greater kiln outputs, greater life of kiln nings, etc.

Interdependence of Steps in Portland Cement Manufacture

In the earlier paragraphs of this paper, it has been own how the various steps in the process of cement anufacture bear one on the other. From this it ill be evident that if there are shortcomings in one ep these must be made up for in the next. If the mposition is irregular, the grinding of the raw ma-rials must be carried to the degree of fineness neces-ary to give sound cement from the high-lime mixture s well as from the low-lime. Every chemist knows at where the lime is high, much finer raw grinding s required than where it is low or even normal. In rder to make sure of sound cement, the chemist must herefore grind finer where occasional runs of high-me material are encountered than where the mixture s constant. The proper fineness of the raw materials s therefore influenced to some extent by their com-osition.

The proper burning of cement is largely one of feeding ie material and fuel to the kiln at a regular rate. If he composition of the mixture is constant, it is evident hat if the material is fed to the kiln at a regular rate nd the kiln is kept at a definite temperature and evolved at a constant speed, the resulting clinker will e uniformly burned. The trouble with the burning s, first, that the composition changes, requiring a higher temperature or a longer time in the kiln and, second, that the rate at which both raw material and coal are fed to the kiln is subject to violent and sudden fluctuations, or in other words, both coal and raw material "flood." Where trouble with the burning results, much of this can be eliminated by designing proper feeding arrangements for both raw material and fuel. The irregularities due to change of composition come gradually and can be kept up with, while the feeding of the raw material is usually sudden and the extra load of material occasioned thereby is hard to catch and properly burn. The arrangements for feeding slurry to the kiln, where this is done by positive means such as buckets and scoops, are excellent and something of the same sort of arrangement is desirable in the dry process.

Summary

The qualities most desirable in cement are soundness, strength and uniformity in the rate of setting and hardening. All are dependent to a marked degree on chemical composition, the fineness of the raw materials and the burning. These three steps are therefore the ones which must be under perfect control if quality cement is to be produced. The chemical composition should be regarded as the keystone of the arch. Unfortunately, it is the step least under control. While there are many plants where unsound or quick setting cement is a rarity, even here there might be an appreciable improvement in quality by a closer regulation of chemical composition. Most cement chemists are playing safe, as it were, rather than attempting to attain any ideals. Perfect control of the composition would enable them to make cements much higher in lime than they do at present, with the result that their clinker would be more easily ground and the resulting cement stronger and more uniform in setting and hardening qualities.

Iron and Steel Situation in Japan

Latest advices from Department of Commerce representatives in Japan indicate that the iron and steel industry has been adversely affected by the financial stringency and general depression which set in during April of this year. Prices have been unstable and weak, but as yet have shown only fractional declines. Stocks are increasing, while the volume of sales is narrowing. Despite the depression, however, Japan continues its purchases of iron and steel in considerable volume.

Imports of iron ore, pig iron, and iron and steel products into Japan during April amounted to 175,813 long tons, bringing the total of foreign iron and steel purchased by that country during the first 4 months of 1922 up to 686,047 tons.

In May of this year its purchases from the United States were 88,400 gross tons, or 5,000 tons more than in April.

Japan has always been a large buyer of United States finished steel products, and since November of last year has been our leading customer. In the year 1921 the Japanese market received 614,281 tons of rolled iron and steel, 566,722 tons or iron ore, 222,639 tons of pig iron, and 9,239 tons of scrap iron and steel. Of the rolled iron and steel tonnage, the United States supplied 59 per cent, and of the pig iron and scrap, 1,409 and 2,247 tons, respectively. In that year the United States furnished over 70 per cent of the 59,000 tons of rails imported by Japan.

The Native Paper Industry of Western China

By H. K. Richardson

PAPER has been manufactured in China since the beginning of the Christian era. Paper money is mentioned in the history of Szechuen as early as 960 A.D. Today this industry is carried on in much the same way as it has been for the past ten centuries.

Many different kinds of paper are made in the western provinces of Szechuen and Kweichow, of which four are of particular interest. These are:

1—Kou Pi Chih or bark paper, which is made from the paper mulberry, probably the original paper made in China.

2—Rice paper, so called, which is sliced from a pith.

3—Ts'ao Chih, or coarse paper, made from rice straw or reeds.

4—Chu Chih, or bamboo paper, made from young bamboo trees.

Each of these papers is made by a method more or less distinctive, so the manufacture of each will be given in detail.

Kou Pi Chih

The bark paper is made from the bark of the paper mulberry, *Broussonetia papyrifera,* a much-branched tree about 45 ft. tall with a smooth gray bark. Marco Polo in his "Book" states regarding the manufacture of this paper: "What they take is a certain white bast or skin which lies between the wood of the tree and the thick outer bark and they make something resembling sheets of paper, but black." Most of this paper is made today in Kweichow province, a region but little visited by white men, so there is little to add to the above description of the manufacture of this article. The process must have undergone some change, for this paper is rather gray, not black. It is the toughest paper obtainable in China. It is extensively used to wrap up rolls of silver dollars and to serve as the interlining between the fur and silk of the Chinese winter garments. In this latter case its tough texture prevents the sewed seams of the fur from wearing through the silk. This paper is considered by many to be the original "india paper," which actually was a Cantonese, not an Indian, product. The steamed bark of this tree finds use as string.

Rice Paper

This variety of paper, known as rice paper to foreigners, is made from the pith of *Tung Ts'ao* or *Tetrapanex papyrifera,* a shrub similar to our common ivy. The beautiful and strong white pith of this plant is rolled against a sharp knife in a manner similar to the way a veneer knife is applied to a log of wood. The result is a large piece of very white absorbent paper, much in demand for artificial flowers and artists' painting paper. One whole street in Chengtu is given over to the making of artificial flowers and butterflies, for which a large supply of this paper is needed. Many are the colors shown, for the paper takes dyes wonderfully well. The slicing of the paper is a trade in itself and is handed down from father to son. Much skill is required for this operation. It is usually carried on in the quiet of the night hours when no noise distracts, for the concentrated attention of the operator is needed to preclude serious accidents.

FIG. 1—PITS LINED WITH CONCRETE FOR DIGESTING THE BAMBOO CULMS

Ts'ao Chih

This variety of coarse paper is made more according to modern ideas from (*a*) rice straw, *Oryza sativa l.* or (*b*) *Mao Ts'ao,* a reed of the species *Imperata arundinacea koengii* or (*c*) a mixture of the above.

The apparatus used to make this paper is similar to that used for bamboo paper and will be described under that heading. The reduction process, although similar to that used for bamboo paper, is simpler and takes less time.

The straw is bundled and soaked in a pit of water for a month. It is then removed, washed thoroughly and stacked in layers in a dry pit, each layer being sprinkled with slaked lime containing 1 per cent soda. After removing the excess water and lime, the fiber is steamed and made up into a thin pulp with mucilage. The paper is made on a hand frame, after which it is pressed and dried, generally on the kiln drier described later.

This coarse, dark brown paper is familiar to the American boy as the inner tube of the Chinese firecracker. It is the wrapping paper for all foodstuffs, doing the work of our old butcher paper. Large quantities are punched full of holes to represent the Chinese cash—brass money with square holes—and burned at funeral ceremonies to provide the spirit with money to pay the ferryman across the River Styx. This paper is produced in large quantities, especially on the northern border of the Chengtu plain, where plenty of rice straw and water from the irrigation system are available.

Chu Chih or Bamboo Paper

This is the most interesting paper to the chemical engineer. The best paper produced in Szechuen is

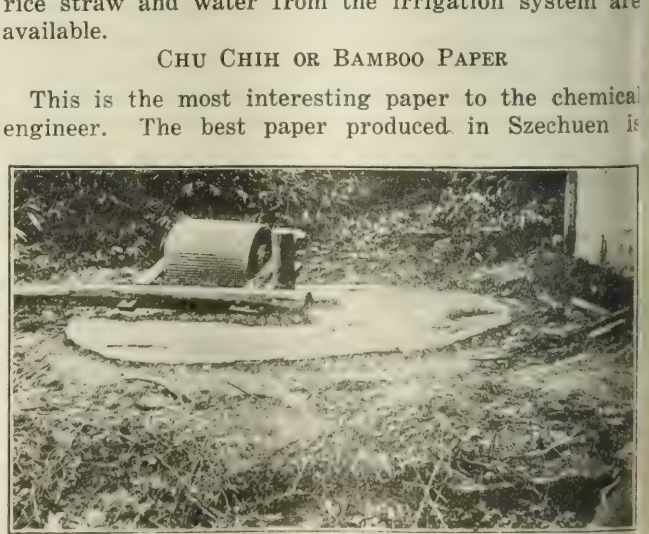


FIG. 2—STONE GRINDING FLOOR

de from bamboos. Since the process is said to be r ten centuries old, it will be described in detail.

More than thirty varieties of bamboo grow in west- China, of which only two are commonly used for per making. These are *Tzu Chu* or Spiny Bamboo, *mbusa arundinacea* and *Ch'ung Chu* or Grove Bam- , *Phyllostaclys heteroclada*. The second is used by st paper makers. This variety grows to a height of to 18 ft. and is 1½ to 2 in. in diameter. It grows its full height in about 2 months, naked of leaves. hen the full height is attained leaves spring out at h joint, which roughly represent each day's growth. st Chinese paper makers prefer to use the young lms before this leafing-out occurs, for they say the fing-out process hardens the nodes and makes them ficult to reduce by the usual retting process.

Manufacture of Paper From Young Bamboo

The process used to turn this bamboo into paper ries a little in the different parts of the province. ie process as it was observed in the district along the engtu-Wanhsien post road will be outlined first; and e differences as given[1a] by other observers for other portant centers will then be mentioned.

The bamboo is first cut into 8-ft. lengths and then lit lengthwise into eight parts. The split cane is d in pits with alternate layers of lime, about 10,000 tties of bamboo with 1,000 catties of lime making a charge. The matted bamboo is weighted down th stones and covered with water, in which condition is permitted to stand for 2 months. The bamboo then removed, washed and soaked for 2 months in an water to leach out the lime. The water is drawn and the mass permitted to ret in this moist condi- n for 2 months, after which it is hammered to a lp in a mortar or stone mill and finally is rubbed a fine pulp in a stone trough by stamping under ot. This pulp is mixed with cold water and mucilage stone vats, after which it is dipped out on hand ames which are stacked in a press and pressed semi- y. The sheets are dipped singly into rice water and e then dried on the side of a hot kiln.

Hosie and Wilson describing the same process state at the first reduction of the fiber is done in the vats th wooden rakes. They also state that 1 to 3 per nt of soda is added to the slaked lime in the retting ocess. It is known that caustic soda is sent to the ung Chow and Mien Chu districts for paper making importing firms. This use may account for the ct that the paper from these districts is whiter and tter than that from the other districts. Probably a uch larger amount of caustic would be used if the 00 a ton freight charge and the extra importing mmissions did not make the price almost prohibitive.

Apparatus Used

Concrete Vats.—A deep hole 12x6x5 ft. deep is g in the ground and lined with Chinese cement— ne, mud and crushed brick. In these pits, one of hich is shown in Fig. 1, all the treatment with lime release the fiber is carried out.

Pulp Reducers.—The well-retted bamboo is first re- ced in either a giant mortar and pestle by man- wer or more usually by cow-power on a stone grinding or. Such a floor is seen in Fig. 2. A grooved lime- one roller is hauled around the post counter-clockwise, eaking up the bamboo on the floor. To clear the floor, ie direction of rotation is reversed. The pulp is moist in this operation. The pulp thus prepared is broken up finer by being trodden under the feet of men in an inclined ribbed stone trough, such as is shown in sketch of Fig. 3.

Mixing Vats.—The well-trodden pulp is mixed up with mucilage from the Hibiscus plant in stone tanks 80x30x30 in. deep. These are made from red sandstone slabs 2 in. thick, made watertight by use of china-wood oil putty—i.e., whiting plus the oil.

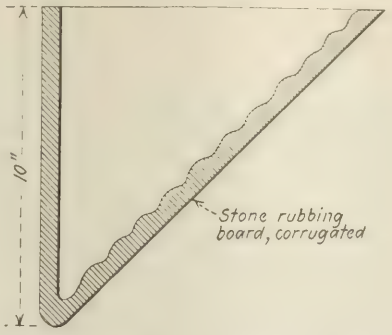


FIG. 3—CROSS-SECTION OF STONE RUBBING TROUGH

Paper-Making Frames.—The paper-making frames are a stout framework of bamboo slats with end handles. A split bamboo netting woven in a fine mesh lays over the slats. The longest papers are about 60 in. long and 23 in. wide, so these nettings are a clever piece of bamboo workmanship. An edge clamp extending the length of the frame keeps the netting from floating. In use the frame with the netting is dipped down endwise and sidewise into the well-stirred pulp and gently lifted in a line parallel to the surface, so that a uniform layer is produced. The clamp is lifted, the sheet permitted to drain and the netting turned upside down on the pile of sheets already made, thus causing the new sheet to stick to the pile so that the netting comes loose. The sheets are piled in the bed of the press.

Presses.—When a pile of paper sheets about a foot high is collected in the press bed a board is placed on top, blocks are inserted and the power applied. This is done by means of a capstan and bars. Fig. 4 shows a complete outfit of tank, frame and press. The press is to be seen through the slats of the frame from which the netting is removed. A spring came out of the hill in the rear of the tank so that water was available. Practically all the paper work observed was done in open sheds like the one shown, a thatched roof being the only protection from sun and rain. The mild climate permits this economy.

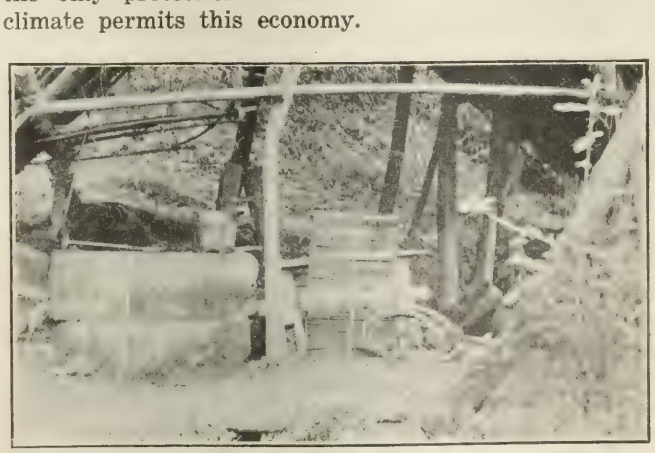


FIG. 4—STONE TROUGH, WOODEN FRAME AND CAPSTAN OF PRESS (SEEN THROUGH SLATS OF FRAME)

Name of Paper		Size Sheet Inches		Cost Per Sheet		
Chinese	English Translation	Length	Width	Chinese Cash	U. S. Cents	Uses
Hsu Peh Chien	White	60.5	12	25	1.0	Writing and printing books.
Go Hsae Chan	Various color	23	14.5	2.5	0.1	Models of houses and servants to use at funerals.
Hwang To Lian	Coarse yellow	16	12.2	1	0.04	Burned sacrifices to gods.
Peh Tu Lian	Pale white	17	12.2	1	0.04	Cleaning surface of tea.
Gong Chuan	Best kind white	24.1	10.1	2.5	0.1	Writing letters.
Gin Chuan	Second best white	20	8.5	1	0.04	Writing letters.
Chin Chang-Chia Chiang	Chia Chiang made white	33	19	4	0.16	Beginning students' writing.
Er Lian	Double	23	15	2.5	0.10	Good printing.
Lao Lian	Old	23.4	17	2	0.08	Account books, printing.
Chang Lian	Long	24.5	16	2.5	0.10	Wrappings.
Dreh Fang	Square	37	19	5	0.20	Window panes.
Hug Lian	Changed white	39	19.5	4	0.16	Wrappings.
Hwang Gin Chi	Golden yellow	38	20	8	0.32	Writing characters to gods to stave off calamity.
Hwang Gin Chi	Golden yellow	45	21.5	12	0.48	
Fang Chi	Square	25	20.5	6	0.24	Window panes.
Chan Lian	Packing	48	23	8	0.32	Writing large characters for invitations to birth and wedding fêtes.
Yang Hong	Foreign red dye	43	20	8	0.32	
Ya Tiao	Good red	45	22.5	16	0.64	Window panes.
Wu Sai Gong Chuan	Five colors good	34	10	4	0.16	Wrappings for presents.

Drying Kilns.—Fig. 5 is a cross-section of the kilns, which are nothing more than plastered flues. Some are 24 ft. long. The pressed, moist paper is spread out on the plastered sides of the kiln and permitted to dry. When a workman has plastered up the whole side with sheets, the first sheet is about dry and peels off, so he can start right over the side again, removing dry paper and putting on wet sheets. These simple kilns are wonderfully efficient and cheap. Straw is the usual fuel.

Sizes of Paper Made.—In an investigation made to see if a modern paper mill was an economic proposition in Szechuen, samples of the most used papers were collected. Since these give a good idea of the skill reached by the native paper maker, the data are reproduced in the accompanying table. The original sheets were sent to a well-known industrial laboratory which was co-operating in the survey. It is interesting to note some of the unusual uses to which the paper is put, such as window panes—a very large use, as there is little glass is used in Szechuen—and funeral ceremonies.

Economics of the Industry

The centers of production of paper in the province are Mien Chu, Chung Chow, Chia Chiang, Lu Chow and the Ta Chu districts. Each is famous for a particular kind of paper. Mien Chu makes the best fine-texture bamboo paper, while most of the straw paper comes from Lu Chow. All the industry is in the hands of small proprietors. It is somewhat seasonal, as the old pulp is just about used up when the new bamboo is ready for cutting.

Four men were required to make a stack of bamboo paper 48x13x30 in. in the Ta Chu district in order to earn 640 cash or 21 cents for the four per day. One man prepared the pulp, one man handled the frame and two operated the drying kiln. All the work was piece work so any extra inches of paper made was paid for at proportional rates. All material and apparatus were furnished by the owners of the plant.

Some of the paper is dyed through, some only on one side, both native and aniline dyes being used. Glossy paper for visiting cards and note paper is glazed by rubbing white insect wax on to the surface with a smooth hard stone.

Modernization of the Industry

We know of only one attempt to erect a modern type of paper mill in Szechuen. This mill was to supply drawing paper for the modern education movement that started about 15 years ago. When the writer first saw

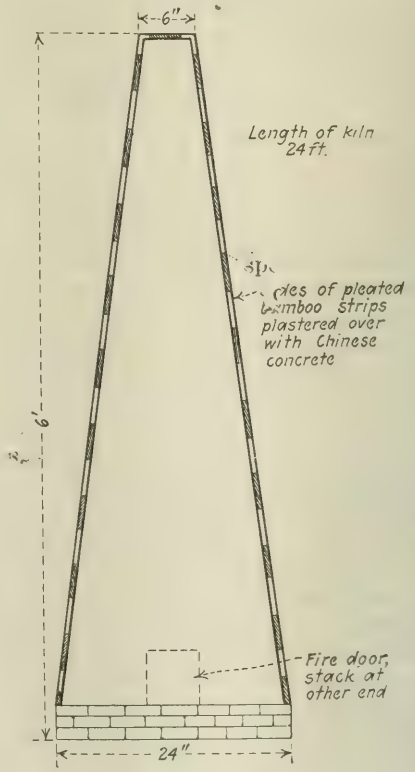

6"
Length of kiln 24 ft.
Sides of pleated bamboo strips plastered over with Chinese concrete
6'
Fire door, stack at other end
24"

FIG. 5—CROSS-SECTION OF PAPER DRYING KILN

the mill it had been closed down for over 2 years. An investigation was made to see if a real plant could be grafted upon the ruins. The reasons for the failure of the mill are such as frequently beset Oriental enterprises and are as follows:

1. Plant was wrongly located, since the raw material for the kind of paper wanted had to be imported from Japan. This meant that for every pound of paper produced 2 to 3 lb. of raw material had to pay a freight rate of $200 per ton. Thus Japanese paper, in spite of cheaper Szechuenese labor, could sell for less than the local product.

2. The local market for the paper produced was not of sufficient size to run the plant at a reasonable percentage of capacity, so the paper produced had a very high overhead charge. There was no export market, as will be seen from reason No. 1.

3. Officials who had supplied part of the funds to finance the undertaking demanded dividends from the day of investment. It takes 18 to 24 months to get machinery from abroad to the interior of China and have it set up and in working order, so this requirement was a severe drain on the liquid funds of the enterprise.

The estimate of the value of the existing plant as the basis of a new enterprise was not sufficiently attractive

o interest the new investors, so the plant was permitted o settle back into the discard.

Since the native plants have seen the advantage of austic soda a good demand has sprung up for this naterial. British merchants supply most of the de- nand. There is a good chance for an electrolytic austic-bleach plant in the paper regions if the central overnment could be influenced to forego the present rohibitory tax on the necessary salt. Hydro-electric ower could be developed in most of the paper sections ery cheaply.

The present craze for newspaper publishing in China as given rise to a demand for paper of better quality han the best bamboo paper. At present all this paper omes from abroad, making a 10,000-mile trip to the nterior and paying the large freight rate spoken of efore. The risk of spoilage that accompanies so many ehandlings and water transport in the rapids of the angstze River adds considerable to the expense. Con- iderable research will be needed to get a paper of ufficient strength for printing presses of modern type, ut experience in India has demonstrated that bamboo aper of high quality can be made with a competent echnical organization. Bamboo grows so quickly that n abundant supply of raw material is always at hand, o that a fairly large modern paper mill could be run n this part of the world and be assured an abundant upply of raw material and a ready market for its roduct.

Legal Notes

By Wellington Gustin

Refining Company Responsible for Escaping Oil Causing Damage to Overflowed Lands

In an action brought against the Midwest Refining o. the Sussex Land & Live Stock Co. charged that it as committing a nuisance in permitting oil from wells n the Salt Creek oil field operated by it to find its way nto Salt Creek, and upon occasion of floods in that reek to overflow with the water upon plaintiff's pasture nds, damaging the pastures. Plaintiff sought to en- in the refining company from permitting the escape f the oil in the manner indicated and asked damages of pproximately $222,140.

The Refining company denied the escape of any sub- antial quantity of oil upon plaintiff's land, and denied here was any damage in consequence of the escape of ny such oil; that the damage, if any, was caused by he natural escape of oil not within its control. It rther contended that the damage, if any, was largely ntributed to by other practices, and that the oil field, far as the defendant was concerned, was operated rough modern, scientific and best-known methods hich would in law relieve the defendant of any damage n account of the escape of oil. And further it argued at if damage were caused through the operation of e oil field by itself in the manner indicated, in any ent an injunction should not issue, on account of the blic welfare, including the vast amount of money volved, the great number of employees engaged in the terprise and the life and prosperity of entire com- unities being largely dependent upon the continued eration of the field.

The District Court for Wyoming, after hearing testimony covering 3 weeks, entered a decree providing that if within 60 days the Refining company pay plaintiff damages assessed in the sum of $2,880 with costs of the suit, and further pay the sum of $720, the annual rental of the lands, yearly the injunction would not issue, but otherwise the injunction to issue restrain- ing the Refining company from the commission of the trespass upon the lands.

Rental Value of the Land Is Measure of Damages

Further the court says that in such cases where damages result from oil escaping into a stream and carried over lands upon the overflow of the stream, the measure of damages may be based upon the usable value of the lands as measured by loss of profits, or upon the rental value of the land. Here the proper measure of damages was the rental value of the land.

The court further says that the damage to a going business by another either on account of negligence or the commission of a continuing trespass may be the loss of prospective profits, providing they are proved with reasonable certainty so as to take them out of the realm of speculation, uncertainty and remoteness. In this case there was insufficient evidence to show plain- tiff's profits before the damage as compared with his profits after the damage, and therefore the court held this would not justify an award for loss of prospective profits. Accordingly the rental value of the land was all plaintiff was able to recover from the Refining company.

Damages for Refusal to Accept Goods

The damages for refusal to accept goods are the difference between the market price and the contract price at the time and place of delivery, says the Ap- pellate Term of the New York Supreme Court in an action brought by Robert W. Bonynge against the Carex Company, Incorporated, 188 N. Y. S. 750.

It appears that the Carex Company bought of plain- tiff 50 barrels of acid in March, which product was duly tendered in June to the company, which refused to accept delivery, but requested the sellers to hold said goods for its account, agreeing to pay the storage and insurance charged. But between July 29 and Nov. 1 of the same year, the sellers sold the acid at the best prices obtainable, the result being a difference of some $1,093, for which they brought this suit, together with certain storage charges.

Price Difference on Delivery Date Basis for Fixing Damage

It was not denied that the seller was entitled to a judgment for failure of buyer to receive and pay for the acid, but the buyer contended the measure of damages should be the difference in the contract price and the market price on June 1, when the acid was tendered for delivery. The seller contended that the buyer's request that the goods be held by the seller for its account amounted to a "waiver" of its right to object to complainant's failure to resell on that day. However, it was not shown that the seller agreed to such extension of time, nor was there set out any definite time for the extension to agree to. Having not shown any agree- ment for an extension of time to the buyer to receive and accept the acid, the court held that there could be no recovery for the difference betwen the contract price and proceeds of resale at a later date because of the buyer's request for extension of time.

The Technology of the Carbon-Electrode Industry—IV Grinding, Mixing, Molding and Extrusion

These Important Steps in Production as Carried Out in Modern Electrode Plants Receive Critical Attention, With Special Reference to Effects Produced by Various Types of Equipment — Other Factors Affecting the Quality of the Finished Carbons—Inspection and Grading*

BY CHARLES L. MANTELL
Division of Industrial Chemical Engineering, Pratt Institute, Brooklyn

IN PRIOR articles of this series the discussion has been carried through the selection and calcination of the carbonaceous materials used in the manufacture of carbon electrodes. The next step in the production process is that of grinding. The calcined materials (coal, coke and petroleum coke) are delivered from the calciners in sizes varying from fines to the largest pieces that will pass through a 3-in. screen.

To obtain the greatest density and highest tensile strength in the finished electrode, it is necessary for the pulverized material to be graded properly—that is, to be composed of a mixture of large and smaller particles in a definite proportion rather than entirely of uniformly sized particles. The theory is that the smaller particles fill in the interstices between the larger ones and thus reduce the porosity of the mass and also increase its density. It can easily be shown that the porosity is the same in a mass of round particles of the same size, regardless of their dimensions.

Reasons for Pulverizing

Pulverizing is done with either of two ends in view: (1) To obtain the desired or as near as possible the desired grading by grinding all of the material in a mill which has been arranged to give the specific grading, or (2) To obtain the desired grading by screening the differently sized components of the pulverized material into various divisions and later building up a second mixture of the proportions desired.

Both of these methods are used, the latter principally in Europe and not at all in the United States. The second method tends to become complicated, as there is likely to be, at some time or other, an excess of some division of the pulverized material after screening. The second method involves a number of tanks for the screened material, a number of weighings and proportionings of the separate divisions of the screened material and a remixing to cause the large and small particles to be uniformly distributed throughout the mass.

Inasmuch as most electrodes are made of at least two carbonaceous materials, it is not necessary to go to the trouble of separating the various sizes of pulverized materials. Grading of the particles may be accomplished by pulverizing one material finer than the other, and mixing them in the proportions desired.

The unit most largely used in American practice for pulverizing the calcined material is the roller pulverizer with air separation. This machine requires a feed of material of approximately 1-in. size for efficiency operation at maximum capacity. It is usual therefore, to pass the calcined material through a roll crusher in order to break it down from 3- to 1-in pieces, preparatory to sending it through the pulverizing mill. These crushers are corrugated rolls, equipped with reciprocating plate feeders.

Butts, the unconsumed portions of used electrodes constitute a large portion of the raw material of electrode plants supplying certain industries, such for instance as the reduction of aluminum. Butts are generally hard, tough and somewhat brittle. Their pulverization for re-use presents a more difficult problem than grinding petroleum coke. Former practice was to crush them first in a rotary crusher and then feed them to a ring pulverizer or a roller mill. Under present practice greater capacity per machine is obtained by first cracking and crushing the butts in a jaw crusher, then after picking out metals and other contamination they are run into a rotary crusher and finally are fed to a roller mill.

Pitch Grinding and Storing

Practice as to grinding pitch differs in the various plants according to the mixing requirements. Some plants obtain satisfactory results by merely coarse grinding the pitch in a rotary or a gyratory mill after the material (as it comes from the still) has been broken up in a corrugated roll crusher. This method gives a ground product varying in size from fines to pieces passing through a 2-in. ring.

The second method is to fine-grind the crushed pitch in a mill of the swing hammer type. This yields a product all of which is smaller than $\frac{1}{8}$ in.

The storage of great quantities of finely ground pitch is a difficult problem. If large masses are left undisturbed for several weeks, it will be found that the lower portions of the pile have regilated, or run together much like ice when it freezes. The pile can be broken up only by pickaxes, air drills or blasting. For this reason it is common practice in electrode plants using finely ground pitch to grind only a single day's supply in advance.

Pitch dust, according to tests in the explosion gallery of the Bureau of Mines, is very explosive. This is due to its high percentage of volatile matter. The grinding of calcined petroleum coke and calcined coal on the other hand, is attended with very little hazard since these materials have had practically all of the volatile matter driven off.

Pulverized materials are usually stored in large closed steel tanks, elevated from the floor and having outlets at the bottom. Material of this fineness flows

*Part I of this series of articles reviewed the history of the electrode industry and appeared in *Chem. & Met. Eng.*, vol. 27, No. 3, p. 109; Part II, discussing the raw materials, was published in vol. 27, No. 4, p. 161; Part III was concerned with the calcination process and is to be found in vol. 27, No. 5, p. 205.

very readily and accordingly leaks out through every small opening much as if it were a liquid. Two devices which are successfully used to control the flow of pulverized material of this sort are the "blast gates" or "coal cocks" made by the manufacturers of pulverized fuel equipment.

Soft pitch is melted prior to use or else a supply is kept in a melted condition. When tar is employed as a binder, it is usually thinned by heating so that it will flow more easily and can be more readily measured. Summer oil, another constituent of the mix, is usually stored in large tanks, from which it is piped to the mixer room.

Mixing Practice

Proportioning of materials is usually done by weight in the case of solid substances, and by volume in the case of liquids. The solid materials are drawn from their various tanks and weighed into the mix box in the proportions desired. Experience with table proportioning machines has been generally unsuccessful because the dust is so lively that it would flow over the tables of the machine and would not assume a position of rest which is necessary for the operation of the machine. The dial type scale has been successfully used for weighing dusts. In operating this, a workman permits dust from one tank to run into the mix box until the required weight is obtained, and then closes the valve on one pipe and opens it for the supply of the next constituent, thus making the operation continuous until the mix is obtained. No matter how clever the workman was, some poorly proportioned mixes would slip through.

An improvement in proportioning mixes has come with the installation of automatic weighing machines. Separate scales are used for each material, each scale dropping its charge into a common hopper which empties into a mix box. They operate on the balanced beam principle, discharge through toggle mechanisms when they have weighed their charge, and after discharging, return to position for another weighing. They can be set for any number of successive weighings without interruption.

The weighed dust, along with the binder if it be hard pitch, is dumped from the mix box into the mixing machine. If the binder has not yet been added, it is poured or run in some time during the mixing. Mixes with pitch as a binder are not stored for any great length of time after being proportioned, as segregation may take place and make it difficult to produce an even and uniform mix.

The mixing machines are heated by steam jackets and have some sort of provision for loading and dumping of the charge. One type, which is perhaps the most used, consists essentially of a steam-heated drum mounted on its side. Mixing is accomplished by rotating a central shaft with arms attached to it. The forward tilt of the arms, which during rotation carry the mix forward, finally discharges it through the door at the end of the drum.

The object desired in mixing carbon is to use as little binder as possible and still have the material extrude from the die and not crush or fall to pieces. The condition which is desired in making a carbon mix is to cover each particle of dust with as thin a film of binder as possible, so that when the various particles come in contact they will be well bonded together. Theoretically it is possible to calculate the minimum amount of pitch necessary to accomplish this purpose and several attempts in this direction have been made by the National Carbon Co. The practical difficulties met with in carrying out experiments of this type are practically insurmountable, due to the inability to obtain the size of all the particles. Fortunately, however, an experienced mixing and pressroom foreman who has had the proper training, can gage the amount of binder in the mix he is using so closely that if ½ lb. of binder per 100 lb. of mix is removed from the mix, it will cause the product to come from the extrusion press badly cracked.

Pan rolls are used both in this country and abroad for the purpose of obtaining a more uniform and denser mix than that given by the mixer alone. As far as the writer has been able to ascertain, they are not used for rolling a mix with a hard pitch binder.

Comparison of Molding and Extruding

But to return to the flow of material itself, it is delivered from the mixers to the presses for the shaping of the electrodes. This can be done in two different ways. One is by placing the mixed material in a mold and subjecting it to great pressure. The other is to place the carbon mixture in a cylinder, and by means of hydraulic pressure force the mixture through a die or mouthpiece of the requisite shape. Electrodes made by the first method are termed "molded," and those by the second extruded or "forced." Both the methods produce products that are homogeneous and of low porosity. The molding process usually results in a higher density electrode.

Extruded electrodes are usually used for electrolytic work. The reason for this is that it is easier to make the sizes of electrolytic carbons by extrusion, as only one or a few dies are needed, while many molds would be required to produce the same result by the molding process.

Due to the rapidity of the process, small electrodes are usually made by extrusion. Large electrodes can be made by both methods, those made by molding being preferred because of their higher density. Extrusion presses are now made so that electrodes as large as 36 in. in diameter can be produced by this process.

In the case of large electrothermic electrodes, the high density and low resistivity of the electrode are not as important as when smaller currents are used.

The equipment usually used for molding consists of the dies of the shape of the finished molded article and upright hydraulic presses to compress the materials in the mold. The molds are made of steel, or in some cases of heavy cast-iron construction, for they must stand great pressure.

The mixed material is placed in the mold as compactly as possible with enough extra material as has been determined by practice to compensate for the compression and still have the finished article fill the mold. The mass is pressed to shape between the top and the plunger of the hydraulic press. It is stated that pressures as high as 25,000 lb. to the square inch are sometimes used. Mixes for molding are generally made with pitch binders. The articles are removed from the mold as soon as they are cold enough to hold their shape, excess material is removed and the mold cleaned and lubricated for the next pressing.

Extrusion is a much more rapid process than molding, requires less labor per ton of material produced when the same size is produced in quantity. Since

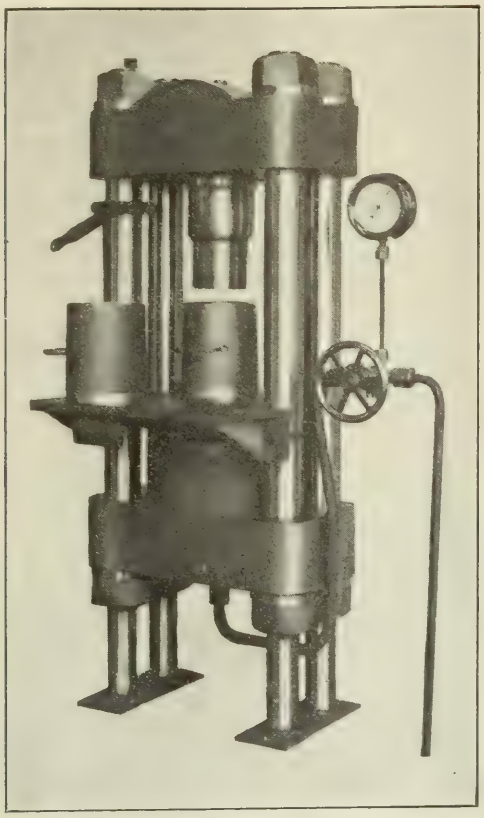


FIG. 12—A 250-TON VERTICAL SLUG PRESS FOR SLUGS 7-IN. IN DIAMETER

most electrodes are made by that process, extrusion will therefore be considered in somewhat greater detail in the paragraphs which follow.

In making electrodes by the extrusion method the hot mix is first "slugged" in the slug presses. These are vertical hydraulic presses, examples of which are shown in Figs. 12 and 13. The hot mix is placed in the mold or "pot," as shown in the illustration, and the material is compressed between the head and plunger of the press. This operation serves only to shape the mix and give it a form in which it can be readily handled. The slug is removed from the pot and is sent forward to be fed to the extrusion press.

Slug presses are normally operated at low pressures —that is, between 800 and 2,000 lb. per sq. in. Often it is necessary to employ some sort of lever arrangement, as is shown in the second illustration, to knock the slug out of the mold. As shown in Fig. 13, this is directly over a hole in working table of the press, through which the slug drops out to the floor or platform beneath. Automatic slug presses, capable of much greater capacity and entailing a much less physical effort on the part of the workmen in slugging the material, are replacing the type of press here illustrated. These are built with revolving tables, the pots being locked in place on the table. Three pots are used, one being filled with the material, another being compressed and a third discharged.

Slugs are made cylindrical in shape, the height being as great as permissible and still allow the slug to be easily handled. Slugging serves to remove occluded air and gas from the carbonaceous mass. The slugs are kept hot and are fed into the "mud" chamber of the extrusion press. This is the steam-jacketed cylindrical section of the extrusion press that serves as a loading chamber. Illustrations of extrusion presses are shown in Fig. 14. This type of press is used for electrodes from 2 to approximately 8 in. in diameter.

Extrusion Pressing

Extrusion or "plug" presses, as they are often called, are operated at hydraulic pressures as low as 1,200 lb. per sq.in., to as high as 7,000 lb., the variation being caused by different plasticities of the carbon mix. Operation is arranged to obtain mixes which extrude at approximately the same pressure. Opinions as to extrusion pressures favoring best results differ somewhat in different plants, but the usual range is between 2,000 and 4,000 lb.

In operation the extruding ram of the press chamber

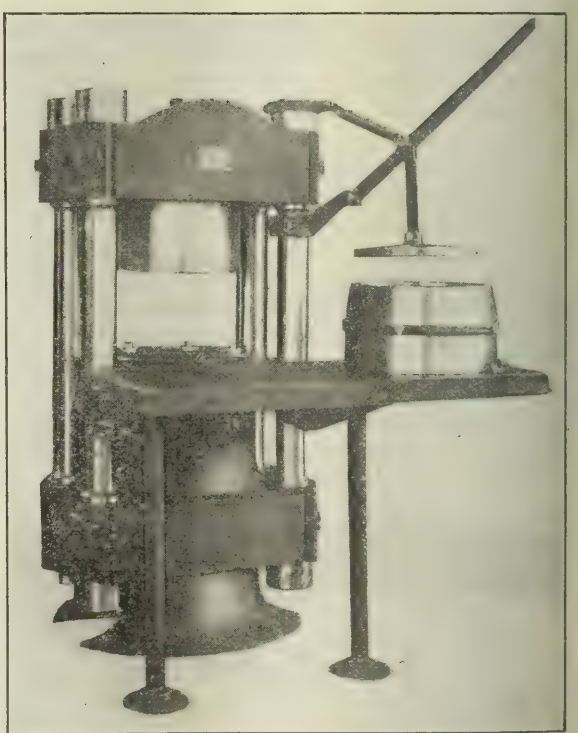


FIG. 13—A 350-TON VERTICAL SLUG PRESS

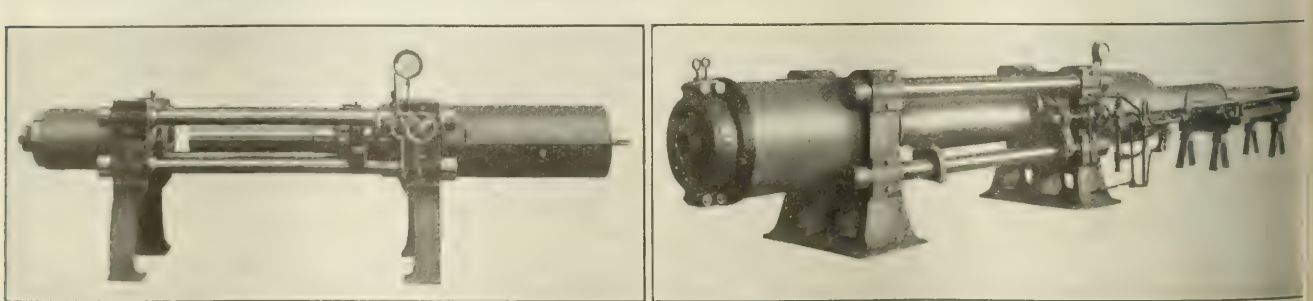


FIG. 14—A 300-TON (AT LEFT) AND A 350-TON (AT RIGHT) HORIZONTAL EXTRUSION PRESS

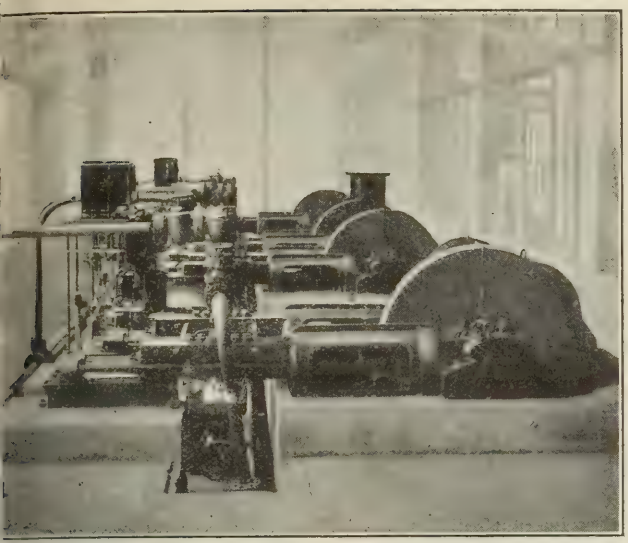


FIG. 15—INSTALLATION OF FOUR 6,000-LB. PRESSURE HYDRAULIC PUMPS FOR ELECTRODE EXTRUSION

s filled with low-pressure water and the ram moves up) and against the carbon slugs in the mud chamber. (igh-pressure water is then turned into the chamber being bypassed when not used) and the ram pushes ne carbon mass out through the mouthpiece, at the ame time pulling the backing ram forward and thus mptying its chamber. When the stroke is finished,)w-pressure water is run into the backing chamber, ushing the backing ram out of the chamber. The acking ram pulls the extruding ram back to position, mptying the extruding ram chamber. When the ex-uding ram is back in position, another load of slugs usually six), are fed in and the cycle repeated.

The size and shape of the extruded electrode will aturally depend upon the shape of the die or mouth-iece. Tubes can be extruded by the use of a spider etting, placed in the throat of the mouthpiece. The ngth of the electrode is limited only by the capacity the loading chamber of the press in terms of the olume of the electrode shape.

The carbons, after being pressed and shaped, are rmed "green" to distinguish them from the finished id baked electrode.

Fig. 15 shows an electrode plant installation of four orizontal 60-gal. 6,000-lb. pressure hydraulic pumps ipplying power for extrusion.

A Typical Installation

Fig. 16 shows a typical installation for extrusion. n overhead monorail crane carries mixes in a mix ox (*B*) to hoppers (*H*) on the third floor, located, one a machine, directly over the mixing machines (*M*) the second floor. The dust and binder have pre-ously been proportioned in an adjoining dust storage ilding. The materials are mixed, and discharged om the machines into a dump car (*C*) traveling on acks in front of the mixers. The dump car discharges to a hopper (*S*) feeding the pot (*P*) of the slug press *P*). The slug press discharges onto a platform (*L*), om which the slugs are conveyed on a roller carrier the extrusion press loading table (*LL*). The slugs e loaded into the extrusion press (*E*), extruded rough the mouthpiece of the press hot, cut to length a cutting knife mounted on a table next to the die, d dropped into the cooling tank (*C*), which consists of a wood slat conveyor running under water. The green electrodes are discharged from the cooling tank onto an inspection table, inspected, loaded onto weighed truck, and transported to the baking furnaces.

Conditions Affecting Mixing

The mixer and press rooms are the heart of the electrode plant. The quality of the finished carbon is largely dependent upon the quality of the green carbon extruded. A good green carbon will usually produce a good baked one if baking conditions are right. A poor green carbon will never produce a good product no matter how well the baking operations are conducted.

Mixing practice differs even in plants making the same kind of electrodes for the same purpose. Practically all mixing is accomplished by cut-and-try methods and the test as to whether a mix is finished or not is to take up a handful of material and "feel" it. If it "feels" as past experience has shown the mixer man a good mix should, it is finished. It is practically impossible to proportion a mix on paper and have it actually work out in that desired manner.

Most of the difficulties of mixing are due to lack of uniformity of the binder. There is as yet no satisfactory method of determining the binding power of a binding material except actually trying it out. The binding power of pitches varies more or less with their melting points, but differences in the method of manufacture make it possible to have two pitches of nearly the same melting point with widely different binding properties. The thing of greatest importance about pitch and mixing methods is that the pitch be uniform at all times. A good carbon can be made of high-melting pitch; likewise a good carbon can be made of low-melting pitch, but if there occurs, in the course of the day's work, several batches of high- and several batches of low-melting pitch, naturally the carbons themselves will not be uniform in their characteristics unless the mixing and forcing conditions are changed accordingly.

While the melting point has the predominating influence on a mix, the fact that the insoluble residue, which is carbon also, has its effect should not be overlooked. Its effect is not as pronounced as the melting point, for it does not vary so greatly. Obviously a pitch with a

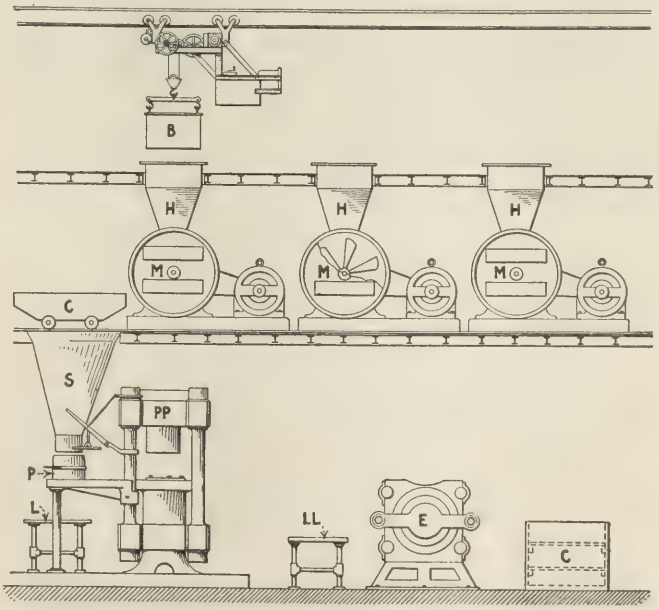


FIG. 16—A TYPICAL INSTALLATION FOR EXTRUSION

high residue will have to be used in greater quantities with a given amount of dust than would be the case with a pitch of low residue, for this residue is finely divided carbon.

Good carbons can be made whether the pitch is finely ground, crushed or melted, but the actual mixing and forcing conditions will vary with each process. Naturally if the pitch is already melted it need not stay in the mixer so long to give a good mix, but there will be some difficulty in adding the pitch so as to keep it from coagulating or agglomerating when it touches the dust. To prevent this it would be necessary to have the dust at the same or nearly the same temperature as the added pitch. Melted pitch can be added to a cold flour and a good mix obtained, although the chances are it would take a higher mixer temperature and a longer mixing time.

A good mix can be obtained by finely grinding the pitch and adding it to the mixer either with the flour or after the flour has been put into the mixer and become heated. A good mix can be obtained by using a pitch crushed in a gyratory crusher, as is the practice at some of the Niagara Falls plants, but here again the same mixing conditions must not be used as with pitch which is melted or more finely ground.

Factors in Green Electrode Production

Table IV shows the most important factors in green carbon production by the extrusion method. Volatile matter (1) has been discussed under calcination, moisture (2) just previously, fineness (3) and grading (4) under grinding, and chemical analysis (5) under raw materials. The effect of uniformity of melting point (6) has just been explained. The term long range of viscosity (7) refers to the amount of change per temperature deg. C. of the viscosity of a pitch. Viscosity is more or less a measure of binding power; for a pitch to have a small change of viscosity per degree means that its binding powers are practically the same over a wide temperature range. Such a pitch would be more desirable than a narrow range viscosity—one whose binding powers change rapidly with temperature. A pitch with a high coking value (8) is preferred, as less of it would distill off in baking and be lost. The grinding (9) of pitch, minimum amount of binder (10) and the grading of dusts (11) have already been touched on. Since pitch has a much lower density than carbonaceous materials, any excess over that needed in the mix tends to lower the density of the green carbon. A green carbon of lower density has its effect in lowering the density of the finished electrodes. The factors (12-14) affecting mixing have already been discussed.

It is necessary to carry out the slug pressing (15) more rapidly with a mix containing a high-melting pitch than with a low one, since the higher melting mix does not remain soft and workable as long as the low. The apparent density (i.e., weight divided by apparent volume) of the green electrode will be largely affected by the pressure (16) employed in slugging. Naturally, within limits, the higher the pressure the greater will be the density. The apparent density of the extruded carbon is usually only two or three points above that of the slug. Uniformity of temperatures (17) is important, as slugs made at different temperatures will have different plasticities and different extrusion pressure. In the plug press one slug is likely to push through another. Lack of unformity of slug temperatures is held to be the cause of "core carbons," a defective product which must be scrapped.

TABLE IV—FACTORS AFFECTING PRODUCTION OF GREEN ELECTRODES IN EXTRUSION PROCESS

DUSTS	BINDER (pitch)
1. Volatile matter	6. Uniform melting point.
2. Moisture	7. Long range of viscosity
3. Fineness	8. High coking value
4. Grading	9. Grinding
5. Chemical composition	

PROPORTIONING

10. Minimum amount of binder
11. Grading of dusts

MIXING

12. Temperature of mixer
13. Time of mixing
14. Additional constituents (summer oil, tar, etc.)

SLUGGING

15. Speed of operation
16. Pressure
17. Uniformity of temperatures

EXTRUSION

18. Pressure
19. Temperature of mudchamber
20. Temperature of die
21. Temperature of extruded carbon

CUTTING

22. Ease of cutting

COOLING

23. Temperature of cooling water in tank

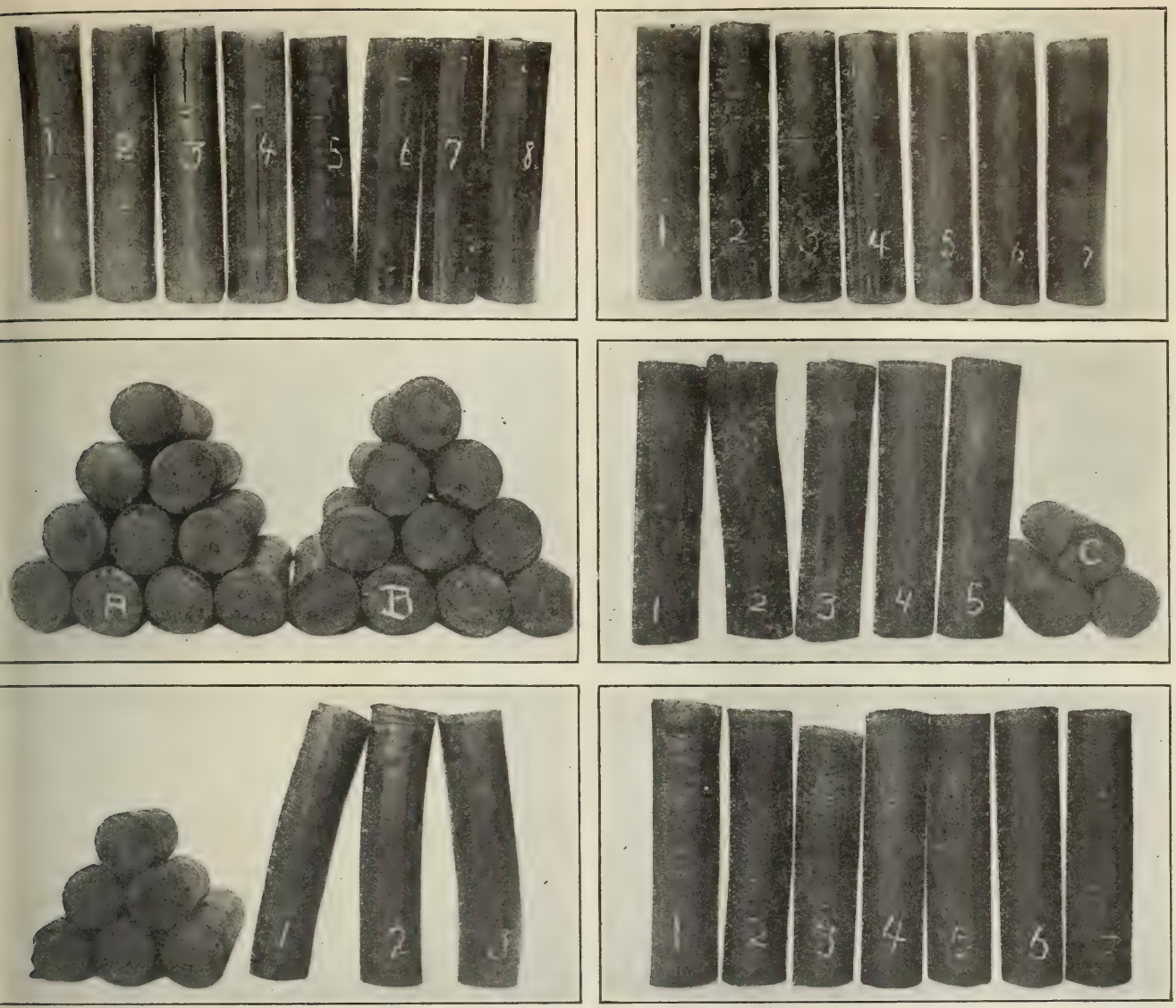
INSPECTION

24. Scrap

The pressure of extrusion (18) depends upon the plasticity of the material. The addition of summer oil to the mix reduces the extrusion pressure. Excess pitch results in more plastic mixes and lower extrusion pressures. Cold mixes require higher pressures, as their plasticity is less because of the freezing of the pitch. The temperatures of the mud chamber (19) and dies affect both the extrusion pressure and the surface appearance of the extruded carbon. With a colder mud chamber and die the friction between the mix and the walls of the chamber and die becomes greater and additional pressure must be used to overcome this. Summer oil is usually used as a lubricant for the inside of the mud chamber and for the head of the extruding ram. With too hot a mud chamber and die, the carbonaceous mass will be heated, locally probably, and may rise to a high enough temperature to cause some of the binder to distill, evolving gases which break through the outside surface of the green electrode. The temperature of the extruded carbon (21) is affected by the temperature of the original mix, the rate of its cooling and the temperature of the mud chamber and die. It is not desired to have an extruded carbon so hot and plastic that handling destroys its shape. It must be cold enough to retain its form and still hot enough to be extruded.

Summer oil in the mix, lessening the binding power of the binder, permits greater ease in cutting (22) than the same mix without summer oil. The closer the mass comes to falling apart at the die the easier it is to cut up the extruded stream into lengths. Excess pitch makes the mass tougher and more difficult to cut.

The temperature of the cooling water in the tank (23) should not be too low, otherwise there is the danger of having the electrodes split. This may be due



FIGS. 17 TO 22—SAMPLES OF DEFECTIVE CARBONS SHOWING CAUSES FOR REJECTION

Fig. 17—Split carbons showing longitudinal cracks.
Fig. 18—End splits (A pile) and core carbons (B pile).
Fig. 19—Pitch carbons (at left) and distorted shapes (1, 2 nd 3).
Fig. 20—Die ring carbons.
Fig. 21—Carbons with enlarged (1-5) and oval (C) ends.
Fig. 22—Blistered carbons.

o the contraction of the outside shell (from the sudden reezing of the pitch caused by the abrupt change of emperature) around an internal mass still quite hot. The outside shell may not be strong enough to stand he resistance to compression from the inside and the uter shell splits at the weakest point.

Inspection and Grading

Inspection at the tables at the end of the cooling tanks eparates the passable electrodes from those which go o the scrap pile. Good electrodes must be of proper lensity, have smooth outside surfaces, be free from ross checks or splits, contain no cores, unmelted pitch r foreign material, be cut to proper lengths, be cut quare and be well shaped.

The following is a classification of reasons for rejection due to physical defects: (1) Splits. (2) Core carons. (3) End splits. (4) Distorted in shape. (5) Pitch (in excess). (6) Die rings. (7) Enlarged ends. (8) Oval ends. (9) Blistered skins. (10) Cross checks.

Representative samples of these defects in small ound electrodes may be observed from the photographs reproduced in Figs. 17 to 23. The nature of these defects and their causes are discussed in the following paragraphs:

Splits. Splitting of electrodes occurs at the die, at the cutting table and in the cooling tanks. The size of the fissures may vary from a length just perceptible to the eye to the full length of the carbon. The width of the fissure may vary from a very slight crack (as shown in carbons 2 and 6 of Fig. 17 between the chalk marks on the carbon) to easily noticeable defects (as carbons 3 and 8). All, however, are equally undesirable.

Cores. In extreme cases of "coring," the inner cylinder may be separated from the outer shell. If core carbons such as are shown in the "B" pile in Fig. 18 are baked, the inner cylinder may be easily pulled out of the outer shell. The lines of division between the shell and cylinder may be arcs or complete circles. Sometimes an indication of coring may be found at only one end of a carbon.

End Splits. Fig. 18 "A" needs little description. The defect varies in size from a hair line to a quarter of an inch in extreme cases.

Pitch Carbons. The six carbons on the left-hand side of Fig. 19, if examined closely, can be seen to contain pieces of unmelted pitch.

Distorted Shapes. The three carbons at the right of Fig. 19 were rejected because of their distorted shapes. Even if satisfactory for some use, it would be difficult to load such distorted carbons into the baking furnaces.

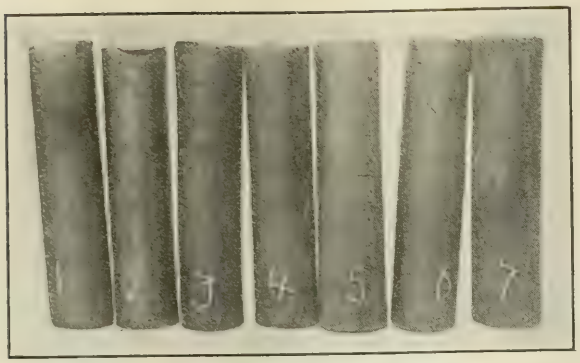


FIG. 23—CROSS CHECKS IN CARBONS

Die Rings. Die ring carbons usually occur at the first carbon of a push. The carbons are scrapped because of possible weakness at the rings and because of difficulties in loading and unloading in the baking furnaces.

Die ring carbons may be roughly divided into two classes. (1) Those produced during a push when for some reason the press was stopped and started. It will be noticed in Fig. 20 that carbons 3, 4 and 5 show a slightly smaller diameter of carbon above the ring than below it. These carbons were produced during a push. The lower portion was the part of the carbon protruding from the press. The protruding portion had expanded slightly. (2) Those produced by an operation analogous to a weld—this is to say, a union made between material left in the press from a previous push and the slugs loaded into the mud chamber for the succeeding push. Examples of these are shown by carbons 1, 2 and 6.

Enlarged Ends. As arranged in Fig. 21 the enlarged ends of the carbons are at the top. It is probable that the enlarged end is of low density and that the ends of the carbon are of unequal density and porosity. These carbons would give difficulty in loading and unloading in the baking furnaces.

Oval Ends. The ends of the carbons shown in Fig. 21 "C" have been mashed by the knife in cutting. Because of their badly shaped ends they would give difficulties in baking as far as loading and unloading in the furnaces is concerned and would give poorer results in use.

Blisters. Blistering may be due to excessive friction between the carbon stream and the die, or else the building up of too high a local temperature under the die when the stream is stopped. The volatile portions of the binder begin to distill and form gas bubbles under the skin of the carbons. As the gases expand, they cause the bubbles to grow larger and finally break. Blistering occurs as the carbons are extruded and released from the pressure of the die. Another theory is that blisters are caused by imprisoned air in the slugs, due to slugs being too tight a fit to press chamber and not permitting air to escape when loading. Blistered carbons are shown in Fig. 22.

Cross Checks. It is not easy to see the defects in carbons 1, 2, 3 and 4 of Fig. 23. The cross check in 1 is near the top of the carbon; in 2, 3 and 4, it is nearer the middle. Cross checks are weak sections. They might be termed lines or planes of breakage. In baking, cleaning or handling these carbons will invariably break at the cross check.

After the electrodes have been inspected and those of the defective types just described have been eliminated, the sound, well-shaped electrodes are piled on trucks, weighed and sent to the baking furnaces. Samples of each lot are taken for density determination and chemical analysis.

Editor's Note. The next article of this series, which will be the baking process and the equipment used therein, will appear in a subsequent issue.

Verifying the Elastic Limit

The French Committee on Standardization authorizes the following method for verifying a supposed elastic limit: "The gaged test-piece is subjected to a quiescent load specified as the elastic limit, and on releasing the load no permanent set must have taken place."

Equipment Used in Petroleum Refining

Chemical equipment manufacturers will be interested in the results of the detailed study of statistical returns made by the petroleum industry in connection with the fourteenth census of manufactures. In the report just issued by the Bureau of the Census a tabular comparison is made of equipment, such as stills, agitators, storage tanks, etc., used in petroleum refining. These statistics are compared with those of the preceding census (1914) in the table which follows:

Kind	1919	1914
Stills, number	6,935	3,639
Capacity (gal.)	174,295,000	(1)
Steam—		
Number	1,061	612
Capacity (gal.)	27,550,000	17,892,000
Fire—		
Number	4,394	3,027
Capacity (gal.)	130,115,000	88,882,000
Pressure—		
Number	1,480	(1)
Capacity (gal.)	16,630,000	(1)
Agitators:		
Number	1,083	770
Capacity (gal.)	52,427,181	(1)
Chilling houses for paraffine:		
Number	105	70
Capacity (gal.)	4,712,000	(1)
Filter houses:		
Number	357	(1)
Capacity (gal.)	11,381,452	(1)
Hydraulic or other presses:		
Number	645	450
Capacity (gal.)	6,258,924	(1)
Storage tanks for:		
Crude petroleum—		
Number	2,183	1,014
Capacity (gal.)	1,511,889,000	580,202,000
Refined products—		
Number	11,380	6,967
Capacity (gal.)	2,152,820,000	1,042,836,000
Fuel oil—		
Number	1,822	807
Capacity (gal.)	1,069,813,000	343,132,000
Other—		
Number	5,546	4,111
Capacity (gal.)	655,346,000	646,608,000

[1] Figures not available.

Z-Transformations in Iron

If a rod of uniform wrought iron be cut into small pieces, each one quenched from a series of successively higher temperatures from 100 to 1,000 deg. C., and its thermal e.m.f. compared against an untreated piece, a curve may be drawn which will not only show the well-known A_1, A_2 and A_3 transformations, but twelve others. The unknown points are called Z-transformations by Prof. G. Borelius of the University of Lund, Sweden (*Annalen der Physik,* vol. 67, p. 227). These irregularities do not occur in pure electrolytic iron fused in vacuo, but reappear and grow in intensity with extended annealings in hydrogen. They may be related to the discontinuous liberation of hydrogen below the critical ranges which are held responsible for the small liberations of heat first observed in thermal analysis of iron by Roberts Austin. Quenching seems to be essential to the Z-effect, and Dr. Borelius concludes they are due to carbon or hydrogen, or other impurities (but not silicon).

Etching of Aluminum Bronze

It is particularly difficult to develop the structure of aluminum bronze (92:8 Cu:Al), especially in the form of rolled and annealed sheet. Rawdon and Lorentz, in Scientific Paper 435 of the Bureau of Standards, note that in a score of comparative etchings the best results by far are had by bubbling oxygen through concentrated ammonia. By this means the boundaries of the crystals are clearly outlined, with a considerable contrast between the different crystals. Cast aluminum bronze will show excellent contrast after 20 seconds in a 10 to 1 mixture of concentrated NH_4OH and 3 per cent H_2O_2 or 5 seconds in concentrated HNO_3.

Black Fractures in Carbon Tool Steels

Occasionally All Bars From a Certain Crucible Steel Ingot Will Show Black Centers When Fractured on Final Inspection — Black Masses Machine Like Cast Iron but Become File Hard on Normal Quenching, Yet Return After Reannealing

By Arthur W. F. Green
The John Illingworth Steel Co., Frankford, Philadelphia, Pa.

IT IS not an uncommon thing to go into metallurgical laboratories and hear the various "ites" which are found in steel and iron referred to as "animals." Occasionally one hears that a new "animal" has come into being, and then everyone is set to work trying to find whether or not it had been seen before, and if so, what the technical name of it may be, or else they give it a suitable name and otherwise designate it so that it will be immediately recognized when seen again. It is the purpose of this note to show an "animal" which has been seen on a few occasions in this laboratory, but to the best of my knowledge has not been named or otherwise definitely identified.

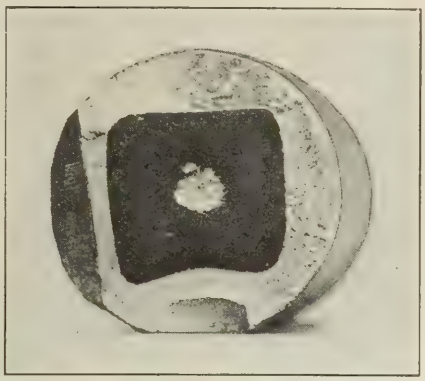


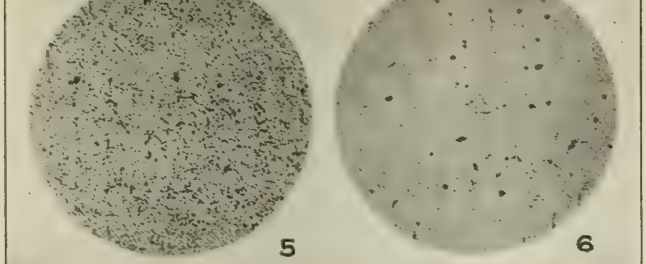
FIG. 1—FRACTURE OF TOOL STEEL WITH BLACK CENTER

The particular "animal" in question has been noted only in hyper-eutectoid steel made by the crucible process and only in straight carbon tool steel. It is seen by the unaided eye as a mossy, solid black constituent. A definite idea of the material and the well-defined area which it may occupy is seen in Fig. 1. This represents a section taken from a bar of 1⅛ in. diameter. The same condition existed in the several bars coming from one 100-lb. ingot. None other appeared in several weeks' or months' production. The chemical analysis was in no way unusual or deviated from that aimed at, which was: C 1.16, Mn 0.30, P 0.024, S 0.02 and Si 0.25 per cent. Samples have later been found in which the entire section of the bar has been black in fracture, with the exception of a small area about ¼ in. in diameter in the center, and a ring about 1/16 in. around the outside. Other samples have been found in which only small black areas have been noted, as for instance, in a 2-in. round, in which several well-defined squares were distinguished, one inside of the other, the largest about ¾ in. square and the smallest about ¼ in. In all cases the blackened areas are symmetrical about the axis of the bar, and conform in shape to the outline of the ingot, billet or bar at same stage in its manufacture.

These black areas have never been noted except in steel after it had been annealed and in which complete spheroidization of the cementite in the unaffected areas had taken place (a structure, it may be remarked in passing, which we consider most desirable for carbon tool steels). On one or two occasions it has been found that the steel was permitted to remain in the reheating furnace at rolling temperatures for a longer time than necessary, so that the square-shaped areas usually noted may be the result of conditions caused by that circumstance. However, it is not until the bars have been annealed, as before stated, that the black areas become noticeable. The temperatures employed for annealing were always about 1,300 to 1,350 deg. F. or just under the $Ac_{1,2,3}$ range, as evidenced by the complete spheroidization of the cementite in the unaffected areas. Annealing is done with careful pyrometric control in large modern furnaces, holding about 7 or 8 tons per charge. Only occasionally will two or three bars from a certain ingot emerge with this defect. It is discovered in the inspection, since each bar is nicked, broken, and the fracture examined before it is sent out on order.

Chemical analyses have been made of both the black portions and the light ones in the same bar, but no differences have been noted in carbon content or otherwise. The sample depicted in Fig. 1 showed 1.16 per cent carbon throughout. When the dark portions are

FIGS. 2 TO 4—MICROSTRUCTURE, ETCHED WITH PICRIC ACID. × 100
FIG. 2—Transverse section at junction. FIG. 3—Longitudinal section at junction. Fig. 4—Longitudinal section in black mass.



FIGS. 5 AND 6—MICROSTRUCTURE ETCHED WITH SODIUM PICRATE. × 100

Fig. 5—Normal structure of steel.
Fig. 6—Longitudinal section in black mass.

machined they give off identically the same kind and color chips as does high-grade gray cast iron. The black areas are also much softer in the annealed steel than are the good ones (Brinell 95 against 170). When the material is ground on an emery wheel, no difference is noted in the sparking between the good areas and the black ones, both giving off the characteristic sparks of a hyper-eutectoid steel of the same analysis.

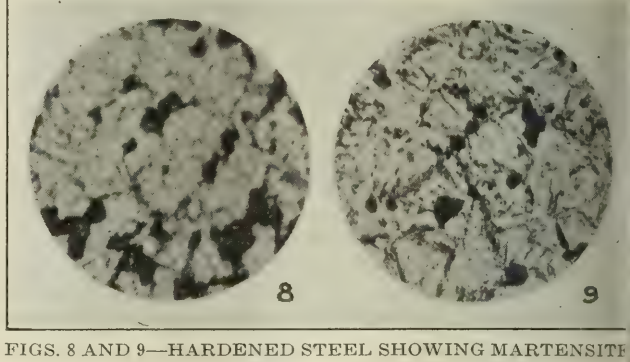
Microscopic study of the material shows some interesting conditions as seen by referring to the accompanying photomicrographs. Fig. 2 represents a section of the material at the sharp junction between the good and the blackened areas. The cementite is spheroidized in those areas which do not appear black to the unaided eye. You will also note that the other portion which appears black to the unaided eye shows microscopically somewhat as a low-carbon steel. This photomicrograph was made from a transverse section. In Fig. 3 is shown

FIG. 7—HEATING AND COOLING CURVE OF SAMPLE CUT FROM BLACK MASS

a portion of the same sample in a position approximate to that shown in Fig. 2, but here the material was cut longitudinally, and the etching is slightly deeper. Fig. 4 shows a lightly etched section of the black area in longitudinal section, and attention is especially called to the free iron areas and the dark network in the etched portions.

Some of the material was etched in boiling sodium picrate solution to ascertain whether any free cementite occurred in the blackened areas. The results of this treatment on the good portions are shown in Fig. 5, conclusively proving the existence of spheroidized cementite. Fig. 6 shows the effects of the same etching on the blackened parts. Here will be noted the large black dots which appear in the free iron and in the slightly darkened areas. The latter may be made up of finely spheroidized cementite.

It was at first believed that the black material would not harden, especially because the manner in which it machined suggested that it was full of graphite. In



FIGS. 8 AND 9—HARDENED STEEL SHOWING MARTENSITE AND TROOSTITE, ETCHED WITH PICRIC ACID. × 500

Fig. 8—Spheroidized cementite after hardening.
Fig. 9—Black mass after hardening.

order to get as much information about the hardening as possible, a sample was carefully machined from the blackened portion of a sample and critical points obtained therefrom. The curves are shown in Fig. 7 and are no different than those of a usual hypereutectoid steel of 1.10 to 1.20 per cent carbon. Several pieces were then taken from bars containing some of the blackened material and heated to an indicated furnace temperature of 1,420 deg. F. One was quenched in water, and two were quenched in brine from the indicated temperature. All of the samples were file hard throughout. The microstructure of one of the brine-quenched pieces is shown in the photomicrographs, Figs. 8 and 9. The piece shown in Fig. 8 was taken from a section of the good portion, while that shown in Fig. 9 was taken from the blackened area.

After the pieces had been hardened, two were taken and annealed. The first was heated to 1,400 deg. and held for 3 hours, then slow-cooled in the furnace. The second was heated to 1,320 deg. F. for 2 hours and slow-cooled in the furnace. In the first piece the original black areas returned and the good portion showed no difference from the original, but in the second piece it was noted that parts of the original good areas had started to become black. This would seem to show that the low-temperature annealing further the promotion of this blackened material.

The present writer has speculated upon the origin of this structure, but has not been able to formulate a hypothesis which explains all the facts. Therefore

e effort has been made to give the facts about the nimal" exactly as they have been found, hoping that may excite some criticism and possibly argument. thers may be able to identify and name the black nimal" from these notes, or present a plausible theory the cause or causes for its existence. We also have few bar-fragments on hand which are available to etallurgists who wish to study the phenomenon at st hand.

The Utilization of Waste Heat*

GREAT progress has been made in recent years in the development of methods of utilizing heat, especially in the steel and cement industries, and serving region in which these products are extensively manufactured, the Lehigh Valley section of the A.S.M.E. appropriately devoted a recent meeting held at Bethlehem, Pa., to a consideration of this subject. Three papers were presented: "Waste-Heat Boilers," by B. Smith, of the Babcock & Wilcox Co., New York, Y.; "Utilization of Waste Heat in the Steel Industry," by A. T. Lewis, of the Bethlehem Steel Co., Bethlehem, Pa.; and "The Utilization of Waste Heat From otary Cement Kilns," by Joseph Brobston, vice-president, Dexter Portland Cement Co., Nazareth, Pa.

The Application and Performance of Waste-Heat Boilers

The Babcock and Wilcox Co. has at the present time stalled and in operation, in connection with the various types of industrial furnaces, waste-heat boilers of total capacity of 153,499 rated boiler horsepower, stributed as follows:

pen-hearth furnaces..	102,211	Glass tanks.....	1,716
ment kilns.....	15,834	Copper-refining furnaces..	1,347
ehive coke ovens....	11,730	Nickel furnaces.....	922
nc furnaces.....	8,740	Lime and dolomite furnaces	848
eating furnaces (various types).....	4,243	Malleable-iron furnaces..	373
l stills.....	3,975	Silicate furnaces.....	232
as benches.....	1,328		

The flues and valves connecting the furnace and the aste-heat boiler must be of such construction that the r infiltration and radiation may be kept at a minium. Very little difficulty is found with radiation sses, but the air infiltration in every plant is, without xception, a difficult problem. Of course, it is possible install a fan and fan turbine of sufficient size and pacity to overcome all of the air infiltration, but if is is done the net steam output of the installation ay be reduced to such a point that the return will not arrant the investment.

Draft and the resistance of the gases passing through boiler are two of the important factors in waste-heat stallation design. The draft loss is a function of two ctors—the loss due to frictional resistance and the ss due to the passage of gases over and under the affles. In order to obtain the greatest net amount of eam from the boiler, the draft required at the entance to the boiler and the draft loss through the boiler hould be so proportioned that when a steam turbine of inimum water rate for this class of machine is used drive the fan, the exhaust steam from this turbine ill not be greater than can be absorbed by the water heating all the water consumed by the boiler to 10 deg. F. With such an arrangement there is a ermal loss which, when expressed in boiler horsepower, will be approximately 2 per cent of that generated by the boiler.

Failures Due to Lack of Attention

"Because of the war" is an expression much used when citing causes for trouble and sometimes failure, and to this same cause can be attributed in a large measure the failure of some of the users of waste-heat boilers to give proper attention to the upkeep of their installations. This failure has come through the abnormal drive for output which has affected not only the waste-heat-boiler installations but the apparatus of the entire industrial plant as well. Another thing which has contributed to the inadequate attention has been unreliability of the labor obtainable.

Upkeep Costs Low

There is every reason to believe that the upkeep costs of waste-heat installations are very low, for, taking them as a whole, it will be agreed that because of the low-temperature gases which are encountered the tube losses from blisters will be rendered practically negligible, if not impossible. These low-temperature gases also result in a minimum brick deterioration, and in practically all cases the brick replacement cost should also be negligible. The only class of waste-heat work where brickwork upkeep cost need be considered is in the open-hearth field. While there are systems of reversing valves which entirely eliminate the possibility of explosions in open-hearth waste-heat work, the use of such systems is not general, and with the valve reversing systems in common use it is practically impossible to prevent an occasional explosion. These explosions vary in intensity and have under certain conditions been sufficiently severe to blow out the side boiler wall, and in one instance to break off the header doors from the hinges.

Types of Boilers Used in Steel Works

The simplest form of Babcock & Wilcox waste-heat boiler offered is of the single-pass short-tube type, usually 9 to 11 ft. in length and 27 tubes high with a stack located on top of the boiler setting. This type of boiler is particularly applicable to furnaces requiring a low draft for operation and high gas temperatures as the gases leave the furnace. By high gas temperature is meant a temperature considerably in excess of that encountered in open-hearth and cement work, yet below that encountered in coal- and oil-fired furnaces. It does not follow, however, that such a boiler could not be used with temperatures from 2,500 to 3,000 deg. F., for with these temperatures and the very low draft required the boiler would show a high efficiency.

The typical Babcock & Wilcox waste-heat boiler for open-hearth furnace work is an 18-high cross-drum, usually with 16-ft. tubes, the gases being delivered to the fan through the horizontal circulating tubes. The fan, gears and turbine are supported on a platform above the boiler carried on the boiler columns.

The majority of installations with open-hearth furnaces have been in mills already in operation, and oftentimes it has been no little problem to find a space large enough to install a boiler of the proper heating surface. The sectional design of the B. & W. boiler, however, has been of advantage in such cases, for with this it is possible to modify the width, length and sometimes the height to accommodate the local space conditions and thereby provide a sufficient and efficient heating surface.

*Abstracted from *Mechanical Engineering* for August, 1922.

The returns from such installations have been most gratifying. Not only has there been a return in steam sufficient to pay a handsome return on the investment, but in many of the plants there has been an increase of two heats a week from the open-hearth furnaces accompanied by an appreciable reduction in the coal per ton of steel. This reduction follows from a positive draft control.

Figures given during the war indicated a saving due to the installation of waste-heat boilers on open-hearth furnaces of from 25 to 30 cents per ton of steel produced. On the basis of 25 cents a ton, 50-ton heats and fourteen heats a week for 45 weeks, the annual saving would amount to $8,400, while for a 100-ton furnace it would be $16,800. With a 100-ton furnace there would be offered a boiler of 550 hp., which at the period mentioned could be installed complete for approximately $50 per horsepower, or $27,500. On such a basis the installation would pay for itself well within 2 years.

In a representative arrangement such as would be made with a malleable-iron furnace the boiler employed is 24-high, three-pass, with longitudinal drums, the draft apparatus being located on a platform carried on the boiler columns. The unit is equipped with an auxiliary hand-fired furnace, which makes possible steam generation during such times as the malleable-iron furnace may be shut down. It is possible, however, to operate the boiler on both waste gases and gases from the hand-fired furnace, due to the fact that the draft required to operate the malleable furnace is about the same as that which would be required for hand firing.

Installations in Cement Mills

In 1915 a 1,530-hp. Babcock & Wilcox boiler was installed for the Louisville Cement Co., this company being really the pioneer in the use of the modern design of waste-heat boiler in connection with cement kilns. Regarding the operation of this boiler, H. D. Baylor, superintendent of the company, in a paper presented before the American Institute of Chemical Engineers in June, 1917, said:

> Our coal consumption in the boiler room for 1914 averaged 91.7 lb. per barrel of cement. The waste-heat boiler was put into service during May, 1915, with the result that our average coal consumption for 1915 was 57.6 lb. per barrel of cement. During 1916 the boiler was operated practically full time and our average fuel in the boiler room for the year was 40.2 lb. per barrel.
>
> By using the hot clinker to heat the air for combustion and the waste kiln gases to generate steam, our percentage of heat utilized has almost doubled, showing 67.2 per cent fuel efficiency in the combined system of kilns and waste-heat boiler, and this we hope to increase to 70 per cent by reclaiming a part of the heat now lost by radiation from the kiln shell; and it is but another step to reclaim a part of the heat now escaping from the stack of the waste-heat boiler; or in other words, our combustion efficiency will eventually compare very favorably with general boiler-room efficiency.

In one standard arrangement of waste-heat boilers, economizers, fans, collecting and connecting flues for cement-kiln work there is a common flue located transversely to the kilns into which they deliver the gases. On the opposite side of this flue the boilers are located, the gases passing through the short connecting flues. Between the kilns and the collecting flues, as well as between the collecting flue and the boilers, water-cooled dampers are provided. The bottom of the flue is a series of hoppers for depositing and handling the dust precipitated from the gases. These hoppers are provided with a slide valve and chute for discharging the dust to screw conveyors located beneath the main flue. The boilers, economizers and all short connecting flues are also provided with hoppers similarly equipped with slide valves and chutes. The main flue and all connecting flues are made of steel plate lined with insulating material and firebrick.

An arrangement of this kind lends itself to flexibility in that any boiler or kilns may be taken off without interruption of the plant output, since the boilers are so designed, when there are three or more, that one boiler may be taken out of service and the remaining boilers handle all of the gases. When an installation of only two boilers is made it is not practicable, from the standpoint of cost, to have each unit of sufficient size to handle the total weight of gas, should it be necessary to take one unit off the line. A two-unit installation is therefore not as flexible as one with a greater number of boilers, and with one unit down, the remaining unit, while capable of handling more than half the total gas, would probably not handle more than 75 per cent of the total, necessitating the bypassing of the remaining gas to the atmosphere.

The economizer employed is of the counterflow type. The tubes are inclined horizontally, extending transversely to the boiler tubes. The gases pass downward over the heating surface, thereby reducing the tendency of dust to settle and lodge on top of the tubes. The water flows upward, thereby avoiding pockets should any steam be formed in the economizer.

These boilers and economizers are provided with a type of soot blower which, if properly operated and properly cared for, will keep the gas passages entirely free from dust lodging, so that it hardly becomes necessary to shut down a boiler for external cleaning.

The fan location is at the floor line and a steel stack is carried on the fan housing. The stack should be of sufficient height to relieve the fan of labor in discharging the gases. It should also be of sufficient height to guard against the gases entering adjoining buildings as they leave the stack.

Utilization of Waste Heat in the Steel Industry

The operations of the steel industry are such that very large quantities of heat are necessary to perform the desired work. Only a small part is being converted into useful work, which leaves a large per cent of energy in the form of waste heat.

Blast Furnaces

Most steel plants are equipped with blast furnaces, open-hearth furnaces, mills, forge and machine shops, power plants and buildings, and they are usually so grouped that the utilization of heat in any branch can be converted into work of benefit to the other departments.

In blast-furnace work the gas was considered a waste product a short time back, and still in many furnaces this valuable fuel is bled to the atmosphere. Even in many modern blast-furnace plants a great improvement can be accomplished in its better utilization. This gas is primarily used for stoves, blowing and power engines, boilers and miscellaneous heating. With properly designed equipment and proper control the maximum economy should be obtained, and the quantities are so large that such economy would spell great savings.

A blast-furnace heat balance shows that approximately 40 per cent of the heat available in the furnace

ABLE I—APPROXIMATE HEAT BALANCE OF A 500-TON BLAST FURNACE

otal available gas leaving the furnace, cu.ft. per ton iron	128,000
et heat value of cold gas, B.t.u.	95
oke rate, lb. per ton	1,917
r displacement per ton at blowing engines, cu.ft.	116,000
r heated at stoves per ton (from 160 deg. F. to 1115 deg. F.) cu.ft.	110,000
ove efficiency, per cent	60.0
equired by stoves, per cent	32.4
equired by blowing engines, per cent (26 per cent thermal efficiency per air hp.)	8.4
equired by power engines, per cent (23 per cent thermal efficiency per kw.)	21.6
vailable for boilers, per cent	37.6
	100.0
u.ft. gas per lb. net coke	70
u.ft. air to stove per lb. coke	66

used in its own operation. This includes preheating f the air and the losses carried away from the furnace nd leaves 60 per cent available for other useful work, uch as power units, boilers and miscellaneous heating. o realize the importance of the proper utilization of his waste gas an approximate heat balance of a 500- on blast furnace is given in Table I.

Open-Hearth Furnaces

The highest temperature that can be obtained from uel is desired in the refining of steel. For this rocess a relatively small percentage of the available eat of the fuel is abstracted, which leaves a very igh percentage to pass out from the furnace. A small art of this heat leaving the furnace is recovered in he preheating of the incoming air and gas. In a 70-ton pen-hearth furnace from 70,000 to 100,000 lb. of gas ormally enters the stack per hour at a temperature f from 1,000 to 1,200 deg. F., and this heat should e utilized. The steel mill usually requires a large eneration of steam. The utilization of this heat by eans of waste-heat boilers is a means of reducing con- iderably the total steam-generating costs.

The fuel usually employed is producer gas, unless oke-oven or natural gases—of higher calorific value— re available. In order to develop the necessary tem- erature and also to effect economy of fuel the air for ombustion is preheated before entering the furnace. Where the more sluggish producer gas is used, it is lso preheated, which enables it to ignite more readily han when cold. When coke-oven or natural gas is sed it is introduced into the furnace without pre- eating because both are high in hydrocarbons which isintegrate at temperatures above 1,000 deg. F. hereby causing great fuel loss. In the average open- earth furnace it will be well to note that of the heat bsorbed and the heat that is available for waste heat evelopment—

18 per cent is abstracted for useful work
3 per cent is lost in the sensible heat of the slag
40 per cent is lost in the sensible heat of the stack gases, and
39 per cent represents other losses such as radiation, etc.

The largest item is the heat lost to the stack, and n many furnaces this amounts to more than 50 per ent. To reduce it the steel plants have resorted to vaste-heat boilers by means of which about 50 per cent f the loss can be converted into steam. Furnace gases normally enter the boiler at from 1,000 to 1,200 deg. F. nd are reduced to a temperature of from 450 to 550 eg. F. before leaving. A well-designed boiler equip- ment with necessary flues is an asset in the operation of a furnace, since the draft may be regulated by the fan speed at the will of the furnace operator. Furthermore, the value of this abstracted heat is equivalent to 60 boiler horsepower per ton of steel. This is equivalent to at least 350 boiler horsepower per furnace of about 70 tons capacity and is valued at $3.50 per hour, using anthracite steam coal at $3 per ton as a basis for calculation. It amounts to $2,500 a year per furnace and is the best way of recovering heat energy that would otherwise be lost at certain times in metallurgical processes.

Mill heating furnaces have a lower exit temperature than open-hearth furnaces, and if the proper state of combustion is maintained and the furnace is designed correctly a higher thermal efficiency should result. The exit temperatures of mill furnaces vary from 850 to 2,000 deg. F., and the quantity of heat generated is dependent upon the capacity of the furnace. A waste-heat boiler installation on such furnaces makes an ideal layout and fits in nicely with the steel-mill boiler plant. Table II shows a typical heat balance of an open-hearth furnace including waste-heat boiler.

TABLE II—TYPICAL HEAT BALANCE OF AN OPEN-HEARTH FURNACE INCLUDING WASTE-HEAT BOILER*

	B.t.u. Per Hour	B.t.u. Per Ton Ingots	Per Cent of Heat in Coal	Per Cent of Heat in Fuel Gas	Per Cent of Heat to Furnace
Coal to gas producers	52,500,000	7,000,000	100.0	.....	.....
Producer loss	8,610,000	1,150,000	16.4	.....	.....
Heat delivered to furnace:					
Gas from producers	43,890,000	5,850,000	83.6	100.0	.....
Combustion of C, Si, and Mn in charge	9,370,000	1,250,000	17.8	21.4	.....
Sensible heat of hot metal	3,450,000	460,000	6.6	7.9	.....
Total heat to furnace except regenerated gas and air	56,710,000	7,560,000	108.0	129.3	100.0
Distribution of heat:					
Consumed in furnace and losses	31,450,000	4,192,000	59.9	71.8	55.5
Utilized in boiler	15,510,000	2,068,000	29.5	35.3	27.3
Wasted to stack at 500 deg. F.	9,750,000	1,300,000	18.6	22.2	17.2
Total	56,710,000	7,560,000	108.0	129.3	100.0

*Results based on the following empirical data:

Size of heats, tons	75
Time per heat, hours	10
Hot metal in charge, per cent	64
Ratio of product to charge, per cent	88
Fuel consumption (4,875 lb. per hr. or) lb. per ton	650
Heat value of coal, B.t.u. per lb.	10,700
Weight waste gases at boiler, lb. per hour	81,400
CO_2 in waste gases at boiler, per cent	12
Temperature of waste gases at boiler inlet, deg. F.	1,200
Temperature of waste gases to stack deg. F.	500
Performance of boiler under above conditions, boiler hp	460

Gas Versus Steam Power

Modern steel plants that have blast furnaces are usually equipped with gas-engine installations. Gas engines have shown marked improvement in recent years and are employed on account of the low total cost of operation, which is particularly true in the blowing units. This is caused by their relatively high efficiency when compared to steam units.

It will be well to consider the percentage heat balance of a gas engine and compare it to that of a steam engine as follows:

	Gas Engine	Steam Engine
Effective work	28	11
Friction in engine	5	2
Exhaust gases	36	..
Exhaust steam	..	57
Cooling water and radiation	31	..
Boiler loss	..	30
	100	100

The total gas-engine efficiency can be raised to above 60 per cent, which establishes it as a most economical

thermal unit. The development of waste-heat utilization in gas-engine installations should create a greater demand for this type of prime mover in the future, and it will show up to better advantage as the price of fuels increases. A very high efficiency is readily obtained by installing waste-heat boilers or economizers in the gas-engine exhaust and utilizing the jacket water either for feedwater, heating buildings, or any other scheme that will fit into plant conditions.

Utilization of Waste Heat From Rotary Cement Kilns

In America, portland cement is burned exclusively in what is known as a rotary kiln. This is strictly an American development. It has always been known that it was not an economical method of burning, but as coal was cheap and labor high in America, it was universally adopted immediately after its introduction, whereas in Europe, where coal was dear and labor cheap, the old style upright kiln similar to a limekiln held its own up to within a few years.

While the largest loss of heat in the rotary kiln was in the excessive temperatures of the flue gases, there were two other important heat losses which were at that time attracting attention, one being the heat carried off by the material or resulting clinker, when it was discharged from the kiln; the other being the loss by radiation through the kiln shell.

There was one notably successful attempt made to utilize a part of the heat of the flue gases. In the dry process of cement manufacture it is necessary to dry the raw material before it can be pulverized. Charles Matcham put his stone driers immediately back of his kilns, and passed a portion of his kiln gases through them. This did not affect the operation of his kilns, dried the stone more effectively, saved about 3 to 4 lb. of coal per barrel of cement made and materially reduced the labor charge in connection with the drying. Only a small percentage of the total stack gases were required for this, however, and there were not many of the installations made.

Money Saved From Waste-Heat Utilization

The sporadic efforts made to use the waste heat of rotary kilns prior to the sudden and material increase in the price of coal caused by the war did not amount to more because of the very low price that the industry as a whole paid for its kiln coal. The coal generally used is the slack or screenings from three-quarter gas coal. This was formerly considered a waste product by the coal mines and had to be moved when the three-quarter coal was shipped, which resulted in a price to the cement industry ranging from 20 to 75 cents a ton at the mines. The cost per barrel for burning cement was therefore comparatively low and the efforts of the manufacturers were mainly directed to installing labor-saving machinery and reducing the cost of pulverizing the raw material and clinker.

When the price of coal jumped to $5 per ton at the mines, however, conditions were entirely different, and in 1915 the first modern waste-heat boiler plant in the cement industry was installed at the Catskill plant of the Alpha Portland Cement Co. This installation was a success from the start. The plant operates five kilns, three being 9 ft. in diameter by 120 ft. long and the other two 7 ft. 6 in. in diameter and 120 ft. in length, resulting in an output of about 3,000 bbl. of cement per day. The gases from these kilns are drawn into a main or equalizing flue directly in the rear of the kiln housing or dust chamber, dampers being installed to bypass gases into the kiln stacks, if necessary. Connections leading from the back of this flue conduct the gases to two 750-hp. Edge Moor boilers, of the four-pass type. Two Green fuel economizers, horizontal type, are installed after the boilers.

The forced draft is provided by a fan located directly back of the economizers, driven by a Terry turbine. A steam pressure of 175 to 180 lb. is maintained, and sufficient power is generated to operate the entire plant. The finely pulverized stone carried over from the kiln by the hot gases is blown from the boiler tubes three to four times in each 24 hours, a hand lance using 140 lb. of air being employed for this purpose. The economizer tubes are blown off through plugged openings in the top of the casing several times each week. The clean-out doors at the bottom of each pass are opened once a week and the dust removed. Clean-out doors are also provided in the flues. In this way, if the draft at the stack chamber is not allowed to drop below 0.25 in. (water pressure), no real difficulty is experienced in keeping the installation free from dust. The temperature of the gases is reduced from approximately 1,400 deg. F. at the mouth of the kiln to about 450 deg. when they leave the economizer. The Cochran feedwater heater is heated by the exhaust steam from the pumps and fan turbine.

Coal Savings From Waste-Heat Utilization

The operation of the boilers has not increased the amount of coal used per barrel in the kilns. It is about 95 lb. per barrel. It requires not less than 40 lb. of coal per barrel to generate the power required to operate a cement mill. Deducting this from the 95 lb. being used in the kiln we find that today this company is burning its cement with 55 lb. of coal, which is much closer to the theoretical amount required—that is, 30 lb.—than the cement manufacturers had ever hoped to come, and means that a rotary kiln with a waste-heat boiler attached is as economical in its coal consumption as the old-style upright kiln. Plants almost exactly duplicating the one described were promptly installed at another plant of the Alpha Portland Cement Co. and at the Dexter Portland Cement Co., and plants using B. & W. boilers were installed by the Universal and Louisville cement plants.

By this time all the manufacturers of portland cement were aware of the importance of this development, and the conservation committee of the Portland Cement Association started an extensive investigation of the entire question. The first report, presented in December, 1918, showed eight plants in operation. Today there are twenty-four plants in operation generating with their flue gases from 51 to 140 per cent of the power they require. There are about 120 operating portland cement plants in the United States, so that 20 per cent of the plants are now making use of their stack gases, saving on the average 40 lb. of coal for every barrel made. This means that these companies are actually using about 400,000 tons of coal less per year than they did formerly.

It may be noted that in some cases more steam than is required to operate the entire cement plant is gen-

rated by the waste-heat installation. In other cases nly a little over one-half of the amount required is ecured.

While this is to a certain extent a question of the fficiency of the boiler installation, it may be due to ther causes. The plant that is burning cement with 0 lb. of coal to the barrel will not have the volume of tack gases or temperature that will be found at the lant using over 100 lb. to the barrel, so that naturally ot as much steam can be generated. The total amount f coal used per barrel, however, may be lower at the lant using the 80 lb., as it may be possible to gen- rate the additional power required in auxiliary boilers ith less than the extra 25 or 30 lb. of coal consumed n the kiln.

But even when two waste-heat plants generate the ame amount of steam, there may be a great difference n the percentage of the machinery that can be run with . Where the amount of steam secured is just sufficient o operate a mill in which the prime movers are well- esigned modern turbines, it would probably be only 5 per cent of the steam required to operate another lant which is still being run with old-style inefficient eciprocating engines.

Power Required to Grind a Barrel of Cement

Where the prime movers are identical, there might ill be a wide difference in the percentage shown. ecent investigations show that the power required to roduce a barrel of cement at plants using different ypes of grinding machinery varies from about 13 w.-hr. per barrel to about 19 kw.-hr.

Some progress has also been made in the last three r four years in solving two other problems. The loss through radiation is being materially reduced by put- ting between the shell and the firebrick lining in the upper part of the kiln, a brick cut from diatomaceous earth. While it has not been possible to determine the exact amount saved in this way, it has been shown conclusively that where waste-heat boilers are being used this installation raises the temperature of the flue gases 150 deg., and where boilers are not installed the insulated kilns require from 5 to 10 lb. per barrel less coal to burn clinker than those not insulated.

This problem is not as yet fully solved, however, as it has been found impossible to use the insulating brick in the hottest section of the kiln, known as the burning zone. Here the fluxing action of the clinker at the high temperature necessarily maintained was such that the firebrick were practically destroyed in from 16 hours to four days. The hot zone can un- doubtedly be insulated by using carborundum, but at the present time the cost of doing this would be prohibitive.

Possibility of Reclaiming Heat Carried Off by Clinker

As to the possibility of reclaiming the heat carried off by the clinker, the development of the rotary pres- sure cooler in the last few years has demonstrated that where the cooler is of sufficient size and proper design to handle the kiln output it is possible to heat the air entering the kiln to a temperature of 800 to 900 deg. F. and to have enough heat left over to dry the coal used for kiln operation. How much this saves is problematical. So far the power required to operate the system has been found to be so great that there appears to be very little actual saving.

Synopsis of Recent Chemical & Metallurgical Literature

Prism Hardness

A prize was awarded in the fall of 920 to Dr. Bernard P. Haigh of the oyal Naval College, Greenwich, Eng- nd, by the Institution of Mechanical ngineers for a method of determining ne hardness of excessively hard steels. also appears to be capable of con- stent results on metals as soft as an- ealed copper.

Briefly, the method consists in cross- ng two finished bars of the material to e tested and pressing them together ith a known force, P. The width of ne resulting notch or indentation, w, then measured with a microvernier, hereupon the "Prism Hardness" quals $P \div w^2$. In practice it is handy o use the fragments of an impact test, olding them in place in a jig and ressing them slowly together in a rinell machine or small testing ma- nine.

Sharp edges are necessary only on ne hardest metals. Tooled or rough round surfaces are sufficiently smooth, xcept for glass hard specimens. Pro- ided the faces are reasonably plane nd the width rather than the depth f indentation is measured, it is not es- ential that the angle should be exactly 0 deg.

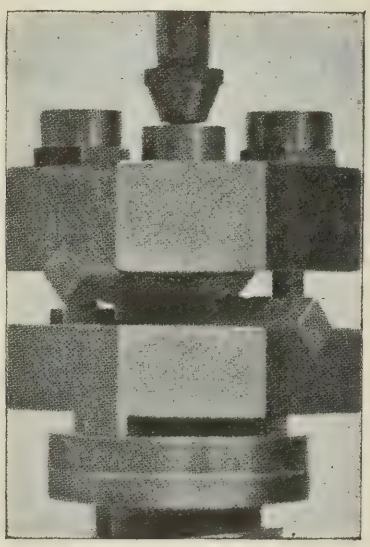


FIG. 1—JIG WITH CROSSED PRISMS IN PLACE

Prism hardness. $P \div w^2$, is remark- ably constant with varying loads, as long as the width of indentation is less than half the side of the prism (in soft metals), or no splintering occurs (in hard metals). The tests in the foregoing table on a good 60: 39: 1 naval brass are illustrative.

Prism Hardness — Load (Long Tons)	Hardness	Brinell Hardness — Load Pounds	Hardness (10 mm. Ball)
1	36.5	200	63
2	35.8	600	78
3	35.3	1,000	79
4	34.8	2,000	89
5	33.5	3,000	87
..	..	4,000	90.5
..	..	5,000	92
..	..	6,000	93

Results derived from a series of tests on 4 hardened carbon steel knife edges are as follows:

Load in Long Tons	Prism Hardness — A	B	C	D
¼	...	...	359	388
½	282	403	357	358
¾	288	..	354	...
1	298	392	359	376
1¼	293	..	345	..
1½	289	382	S	393
1¾	...	..	...	387
2	294	380	..	S
3	287	373	...	...
4	283	378	...	...
5	287	387	...	...

Sample A appears to be incompletely hardened. B is harder than the ball steel usually used in the Brinell test. (Prism hardness 318 tons per sq.in.). Sample C was rejected at the works for brittleness and splintering occurred under loads of 1½ tons or greater. Sample D was rejected for water cracks and splintered at a 2-ton load. "The hardness values do not vary with load more widely than may be attrib- uted to experimental variance or slight changes in structure, and may be regarded as independent of the load applied in making the test."

"The test has proved sensitive to slight differences of hardness, even in the hardest metals."

Loam Molding as an Art

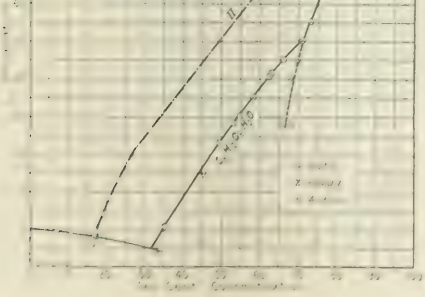
A "History of Loam Molding in the Province of Liége" was presented to the Institution of British Foundrymen at their Birmingham meeting, 1922, by J. Varlet. In a few pages, the author traces the development of the process from the first attempts of a patternmaker named Pirson in 1846, its general adoption by Belgian foundries in 1870, through the period of its greatest perfection (1890-95) to the present practice. Modern methods of molding large cylindrical or conical castings like slag pots or sugar cane colanders and more complex things like flywheels and marine engine cylinders are given in detail.

About 30 years ago a man could not claim to be a loam molder unless he had served his apprenticeship as a core maker, had then studied mechanical drawing and machine design so as to be able to read blue-prints with great facility and understand the function of all common machine units, and finally had served a long second apprenticeship to a leading molder. "He worked with his hands in the foundry and his head at home. Every night he organized his work for the next day. He was animated by a sincere love for his profession; he had the respect of his chiefs; he respected himself, and, above all, he conducted himself as an artisan of an intellectual profession, who had the right to everyone's consideration."

Nothwithstanding the fact that the general appearance and skin of loam castings are much superior to sand castings, the method is not used as much now as formerly, according to the author, because of the disappearance of the long-stroke, low-pressure or slow-speed steam engine.

The Solubility of Dextrose in Water

A recent publication from the Bureau of Standards, No. 437, dated February, 1922, deals with the determination of the solubility of dextrose in water, and of the various solid phases which can exist, including the range during which those phases are stable. The authors, Richard F. Jackson and Clara Gillis Silsbee, have made a really valuable contribution to industrial work with this substance, because the solubilities are of fundamental importance in controlling the processes of manufacture. They found, among other things, that the temperature coefficience of solubility was much higher with the dextrose hydrate, which has a transition point at 50 deg., than it is with the anhydrous dextrose which exists above 50 deg. The existence of the anhydrous form persists in unstable equilibrium even as low as 28 deg. C. The accompanying cut represents the solubility curves as determined at the bureau and as calculated from other literature.



American Fertilizer Production

A paper read by J. B. Lipman, before the Chemical Industry Club, London, on May 24, 1922, and printed in the *Journal of the Society of Chemical Industry*, June 15, vol. 41, p. 233, is entitled, "The Fertilizer Industry in the United States." Dr. Lipman makes a very interesting analysis of the consumption of fertilizer in the United States which, in 1919, was nearly 7,000,000 tons of material. It rose to 7,500,000 tons in 1920, but fell to 5,000,000 tons in 1921, owing to the economic depression. Expectation is that it will increase again at the rate of 5 to 10 per cent a year. It is interesting to note that South Carolina, North Carolina and Georgia use more than 3,000,000 tons and with Virginia, Alabama, Mississippi and Tennessee, these states consume more than two-thirds of the entire fertilizer output. It is used largely for the cotton crop. Naturally, the fertilizer industry depends for its health on the success of the cotton grower. One million tons of fertilizer are consumed in New York, New Jersey and Pennsylvania, and about 800,000 tons in Ohio, Indiana, Illinois, Michigan and Wisconsin. It is to be expected that a marked increase in fertilizer demand will come from the Western states, notably those mentioned last, together with Iowa, Missouri and Kansas, due to the effort to produce more yield per acre.

Raw Materials and Their Distribution

Dr. Lipman then takes up the distribution of raw material and points out that practically all of the phosphate rock now used in the preparation of fertilizer comes from Florida. A half million tons or so come from Tennessee and South Carolina. These supplies may be exhausted within a reasonable time, but there are tremendous deposits of high-grade phosphate rock in Idaho, Utah, Wyoming, and Montana.

Other ingredients, such as dried blood, ground bone, tankage, horns, sulphuric acid, potash, etc., are discussed. In 1918 the large packing houses in Chicago produced about 200,000 tons of high-grade tankage, which is prepared from the refuse from the slaughter house put in specially designed vessels freed from fat and filter-pressed. About 35,000 tons of dried blood and 55,000 tons of bone also originated in packing houses. The production of sulphate of ammonia and sodium nitrate is also discussed extensively and estimates are given of the production and consumption of sulphuric acid and potash.

Dr. Lipman describes two steps in the manufacture of artificial fertilizer. The first has to do with the production of superphosphate, which can be either plain superphosphate or ammoniated superphosphate. This latter is secured by mixing low-grade nitrogenous material, such as leather wastes, hair etc., with ground phosphate rock and treating the mixture with sulphuric acid. The second step consists of mixing the "base material" with potash and nitrogen in proper proportions.

Many brands on the market are a very low-grade fertilizer—the so-called 1:8:1, or an equivalent of 1 per cent ammonia, 8 per cent phosphoric acid and 1 per cent potash. In the Middle West the proportion is more often 2:8:2, or twelve units of total plant food. Any fertilizer above 14 units in total plant food is called high analysis fertilizer. Some of them go as high as 6 per cent ammonia, 10 per cent phosphoric acid and 7 per cent potash. Due very largely to the tremendous meat-packing establishments in America, nitrogen from animal and vegetable sources has been widely used in fertilizing, although this nitrogen is not nearly as efficient as the nitrogen in nitrate or ammonium salt and in addition, it costs more.

Effect of High Transportation Cost

The problem of transportation of low grade fertilizers has turned the attention of the fertilizer association to the use of high-grade fertilizers. This tendency will become stronger as the education of the consuming public progresses. A double superphosphate has been turned out by one company containing 45 per cent available phosphoric acid and 11 per cent nitrogen. The future of this industry is somewhat problematical. Undoubtedly the phosphates will always be American in origin and there probably will be a strong tendency on the part of the large meat-packing establishments to dispose of their tankage at any price rather than have the problem of disposal in other ways on their hands; so that animal nitrogen will always be a constitutent of American fertilizer. Where the rest of the nitrogen will come from depends on the success of the synthetic nitrate and ammonia industry in America. The third ingredient, potash, will have the hardest fight of the trio, but American producers of potash hope to be able to hold their own against the German and French.

Under former conditions, the American farmer averaged about 30 bushels of wheat on 2 acres, whereas the English farmer would raise 30 bushels of wheat on 1 acre. But this procedure has been profitable to the American wheat grower, due to his economic status.

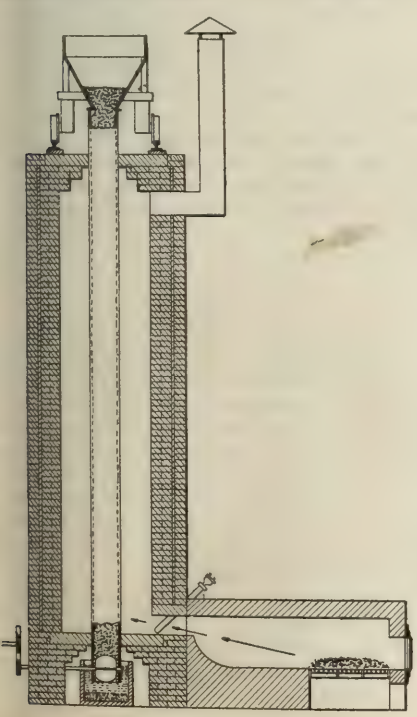
Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Tungsten Trioxide.—S. J. Lubowsky of Jersey City has assigned to the Metal & Thermit Corporation a process for preparing pure tungsten trioxide from tungsten ore. The process is quite simple, as it consists only in roasting the ore with chloride or chlorate of an alkali metal at a bright red heat. The broken up roast is then treated with concentrated mineral acids, which turn into solution many of the original impurities. The solid residue is washed with ammonia liquor and the resulting solution evaporated and calcined to get rid of the last traces of ammonia. It looks fairly simple after you get by the first roast, but the author talks about temperatures at 1,700 deg. F. and that confines you pretty well to the less volatile alkali. Even at 1,200 to 1,400 a lot of alkali would be lost. (1,410,584; March 28, 1922).

Manufacture of Lithopone.—James A. Singmaster and Frank G. Bryer, of Palmerton, Pa., have assigned to the New Jersey Zinc Co. the following patent on the manufacture of lithopone. In principle, it reminds one very much of the ethylene furnaces used in the Chemical Warfare Service, this indirect fired muffle for the continuous production of lithopone. A reproduction of the apparatus is given herewith and is practically self-explanatory. The dry cake of zinc sulphate and barium sulphide is fed in to the hopper at the top of the stand pipe, which is 25 ft. long and 10 in. in diameter. The discharge at the bottom is carried out by means of a star wheel and empties directly into a tank of water. The dimensions of the muffle are extremely important, inasmuch as the experimenters have found that a 12-in. pipe of the same length produces a very irregular product, while a 10-in. pipe produces unusually good material. The temperature is accurately controlled by means of the thermocouple shown in the diagram at the base of the vertical shaft, and this precaution follows the experimental work carried out at the New Jersey Zinc Co., which has shown the existence of critical temperatures for lithopone. The apparatus looks like a distinct advance over the old rotary muffle, which was horizontal and which had large volumes of gas above it. This last was a source of continual trouble, as the lithopone is very sensitive to the composition of the atmosphere in which it is muffled. The invention further has the distinct advantage of continuous operation, and on the face of it, looks like a big advance in manufacturing process. (1,411,646; April 4, 1922.)



Heat- and Moisture-Resistant Leather—For certain purposes it is desirable to have leather which is extremely resistant to heat and moisture. Such leather can be economically manufactured by a combination of pyrophosphate and chrome tanning methods. The process may be carried out by first treating the prepared hides with a solution containing sodium pyrophosphate, ammonia alum and salt, adding single bath chrome liquor to the spent solution, or the chrome liquor may be added gradually during the pyrophosphate tanning. For general purposes the range of relative proportions of alum to pyrophosphate may be from 5 : 1 to 7 : 1, while the amount of standard chrome liquor will vary from a fraction of 1 per cent up to 8 per cent. (1,415,671; Ernest W. Merry, of Sheffield, England, assignor to Pyrotan Leather Corporation, Wilmington, Del. May 9, 1922.)

Rotating Leer for Lamp Bulbs—In a rotating cylindrical chamber, articles of a conoidal shape will gradually progress through the cylinder in the direction of the apex of the conoid. A cylindrical object in a rotating conoidal chamber will move toward the base of the conoid. These observations were utilized by James Bailey, of Corning, N. Y., in designing a rotating leer for annealing glass articles of suitable shape, such as lamp bulbs. It was also found that if the bottom of the chamber were inclined to the horizontal, while the driving effect of the rotation of the chamber on articles capable of being set in rotation, there was sufficient to cause such articles fed to the lower end to move upwardly through the chamber, broken particles and fragments not of proper cross-section to be set in rotation will slide down and fall from the charging end, thus causing the device to act as a separator. Accordingly, the leer is formed of inclined cylindrical pipe arranged so that it can be rotated and heated externally. The bulbs are fed in at the lower end and the fact that they are rotating constantly while passing through the leer assures uniform annealing. Broken bulbs which cannot be set in rotation will not feed through but will drop out at the charging end. (1,416,595; assigned to Corning Glass Works. May 16, 1922.)

Refractory From Chromite Tailings—Tailings from the concentration of disseminated chromium ore are pulverized, mixed with tar or pitch as binder, and pressed into bricks which when burned are found to possess satisfactory refractory qualities. The tailings contain only about 5 per cent chromite, the remainder being silica, alumina, serpentine, olivin and magnesite. (1,418,648; Robert W. Hull, of Hingham, Mass. June 6, 1922.)

Artificial Corundum — Harold A. Richmond and Robert MacDonald, Jr., of Niagara Falls, have taken out a patent for the manufacture of artificial corundum. In some experimental work they discovered that corundum for fine grinding such as surface grinding, cutting and knife grinding and automatic cylindrical grinding could not be made from bauxite or emery as a raw material. This was due to the presence of titanium in the raw material. By selecting a natural corundum ore substantially free from titantium they have eliminated this objection. The product will also be free of aluminum carbide if the process is properly controlled. The crystals are said to be stronger and denser than those made from anhydrous alumina, which is also more expensive. The process is not in itself very different from the present process, except that a natural corundum free from titanium is used. Steel chips are added in quantities sufficient to make the total iron in the charge more than three times the amount of silicon present, so that the resulting ferrosilicon will be magnetic. Pulverized coke is also added so that reduction of the silica and iron oxide will take place. To get the best results titanium should not exceed 1 per cent and iron and silica should not exceed 2 per cent each. (1,413,785; April 25, 1922.)

Vulcanizing Rubber—Rowell C. Naylor, of Springfield, has invented a new accelerator, which he claims is very satisfactory. It consists in incorporating phenylhydrazine in the rubber mix. This gives a very even spongy rubber, so that vulcanization in a mold can take place very readily. The formula he suggests is 89 parts by weight of rubber, 5 parts by weight of sulphur, 5 parts by weight of black substitute and 2 parts by weight of phenylhydrazine. For the information of those unfamiliar with rubber, it might be added that black substitute is the trade name given to a compound formed by boiling a raw or oxidized oil, such as corn oil with sulphur. Vulcanization takes place in 45 minutes, with 50 lb. of steam pressure, which would be a very satisfactory vulcanization period. (1,418,215; June 6, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Muscle Shoals Minority Favors Ford

Senator Ladd Submits Report Strongly Recommending Acceptance of Manufacturer's Offer—Opposition Also Presents Arguments

INTEREST in Washington has again focused on the Muscle Shoals situation. Friends of the Ford offer are apparently determined to die hard. Now that the real estate promotions and chimeras of newly created industrial giants in the South have received an awakening jolt by the majority report of the Senate Committee on Agriculture, the general tendency is to omit fireworks and subject the main possibilities to a logical survey. Senator Ladd has presented the views of the minority of the Agriculture Committee —an earnest attempt to argue the acceptance of the Ford offer. It is refreshing to note that flag-waving does not predominate in the report and that the "benefits that would accrue to the people" are left to the judgment of the legislators. It is emphasized that the minority does not claim that the Ford proposal is without objection. They do not forecast nor prophesy that its acceptance will bring the millennium. But it is feared that if the offer is rejected, the waste and the losses at Muscle Shoals since the armistice will continue increasingly.

The present fuel and transportation emergencies are pointed to in the report to emphasize the fact that the development of such great hydro-electric power as is found at Muscle Shoals seems to be the only certain and permanent relief in the future from the present paralysis of American industry.

It is admitted in Mr. Ladd's report that certain objections to the Ford offer seem apparent, but it is felt that none of the objections to the Ford offer can be remedied or solved by government ownership and operation at Muscle Shoals—by the government going into the power business or entering the hazardous field of operating nitrate plants at Muscle Shoals in the production of nitrogenous and other commercial fertilizers using electrochemical processes the commercial success of which is yet controversial. "For Congress to adopt such a policy, when Henry Ford's offer makes it unnecessary for the government to do so, would subject Congress to the just condemnation and reproach of all sober-minded people," says the report.

Senator Ladd's report then gives parallel quotations from the bill providing for lease and sale to Henry Ford and from the bill providing for government ownership and operation, and summarizes the Ford offer under twelve headings. The report then states what are considered as the four main advantages which will follow the acceptance of this offer:

Contribution to Defense

First, it will contribute to our national defense by providing a supply of the indispensable nitrates that must be had for the manufacture of explosives in time of war. The primary object in undertaking the Muscle Shoals project was to provide a supply of fixed nitrogen for explosives. Mr. Ford's offer agrees to maintain Nitrate Plant No. 2 for 100 years ready for immediate use, to carry on a program of research to determine the most improved methods of operation of such a plant, and to operate this plant continuously for the period of the lease.

Reduction in Fertilizer Price

Second, the Muscle Shoals project, under the Ford offer, provides a large-scale production of fertilizer under the most favorable conditions, which cannot fail to reduce the cost of fertilizer to the farmer. Confidence in this reduction of cost is held because of the statements of F. S. Washburn, who introduced the cyanamide process in this country, and because of the statements of the byproduct coke-oven interests in requesting protection for their ammonium-sulphate product, when they stated that fertilizer produced by the cyanamide process in Germany could be sold in this country at one-half the price of their product.

In any case the evidence is convincing to the minority of the Committee on Agriculture and Forestry that modern processes can be applied at Muscle Shoals in such a way as to reduce this cost and they feel that Mr. Ford has the cash to develop and adopt these processes. It is felt that the farmer can look for but little reduction of prices from the present fertilizer interests, who, protected by the Chilean export duty, are now asking for an import duty of $12 per ton in addition.

Development of Water Power

Third, the project developed under the Ford offer will contribute to the advancement of industry by introducing a plan of water-power development which provides the means whereby hydro-electric power ultimately may be had in the United States as cheaply as in the more naturally favored countries such as Canada and Norway.

Since a hydro-electric plant costs a great deal to construct and but little to operate, there is a feature of hydro-electric power economics well known to those in the business, that the general public probably does not appreciate. When the items which go to make up the cost of hydro-electric power at the switchboard of the generating station are examined, it is found that under the conditions of construction and financing existing in the United States, the single item of interest on the investment constitutes 80 per cent or more of the cost of the power.

Mr. Ford proposes to eliminate the interest by amortizing and returning the investment, through the operation of a long-time sinking fund. He therefore provides a series of payments which, when invested in a sinking fund at as low a rate of interest as 4½ per cent, will return the entire cost of both dams, including the $17,000,000 already expended by the government. This eliminates the capital charges and interest and ultimately reduces the cost of power to the mere cost of operation and maintenance, which in a large plant is from $1 to $3 per horsepower per year, or less than one-half of 1 mill per kilowatt-hour. Under this plan the bonded indebtedness on a water-power development is reduced instead of being increased as is the customary procedure in refinancing operations.

Navigation

Fourth, the project developed under the Ford offer will contribute to the early completion of permanent navigation improvement on one of the most important of our inland streams. It will provide an outlet by water for a section of the country having a great variety of useful raw materials and will do so under a plan which may be applied on other American power streams whereby the water power furnishes the government with its navigation facilities without cost.

This contribution to navigation is

(*Continued on page* 278)

Wood Pulp Goes on Free List

By a vote of 22 to 30 the Senate rejected the Finance Committee recommendation for a duty of 5 per cent ad valorem on chemical wood pulp. The tariff was urged by Chairman McCumber of the Senate Finance Committee, who said the industry is important and can produce for an indefinite period if given a protective tariff.

hemical Manufacturers Demand Reinstatement of Dye Embargo

A. O'Reilly Tells Synthetic Organic Chemical Manufacturers That Facts Must Be Presented to Legislators if Industry Is to Receive Consideration

ECLARING that the American chemical industry will be unable urvive the ruthless competition of great German cartel unless the em-go on foreign dyes is continued, fifty nbers of the Synthetic Organic mical Manufacturers Association of United States unanimously peti-ed the Senate Finance Committee reinstate the protective provisions ch had been eliminated after the e fight in the Senate on July 15.

his action followed an all-day ses- at the Hotel Pennsylvania, New k City, where Dr. Charles H. Herty, sident of the association, and rge A. O'Reilly, vice-president of Irving National Bank, led in the ussion of this serious problem of domestic organic chemical industry. unfavorable action of the Senate attributed by Dr. Herty to the con-on resulting from the controversy veen the government and the Chem- Foundation. In the course of his ussion he declared:

It is my belief that the recent vote he Senate, sitting as a committee of whole, was due to a confusion of ught in the minds of several Sena- between two issues—patents and tection for this industry. This con-on arises, I believe, from the recent on of the government in connection n the Chemical Foundation. Logi-y this has no connection with the sideration of the question of ade-te protection for this vitally im-tant American industry.

I sincerely hope that the confusion thought which existed at the time vote was taken in the Senate strik-out the provisions placed in the bill the Senate Finance Committee will cleared away and that these para-phs will be reinserted in the meas- before it is passed.

Unless this is done, I foresee the n of the American industry by the at German chemical cartel, with its years of experience and its vast re-rces, which has been so strenuously ting us through its agents in this ntry."

Banker Presents Views

The trouble with your industry is damental, not incidental," said A. O'Reilly, addressing the associa- at the luncheon which was held veen the morning and afternoon ions.

n a spirited address Mr. O'Reilly ared that the chemical industry will er receive the consideration it de-es, either by the public or by Con-s, until the futility of telegrams to ators, delegations to officials and lutions by societies is realized and industries send to Washington the men they have to "put over" their story. And these men must not be the theorists, or the talkers, or the wind merchants, but they must be the pick of the industry, the men who know more about their business than anyone else in the country—its history, its theory, its problems and its business phases. When the chemical industry adopts such a policy there will be less talk of the "blockheads in Washington" and less need for resolutions of protest.

Mr. O'Reilly is probably as familiar with the present-day problems of the chemical industry as anyone in the country not directly connected with it, and at the same time his viewpoint is impartial and unprejudiced.

Bankers are conservative by nature and by necessity. When approached with a new venture, their attitude is inevitably skeptical and before they will agree to back the new undertaking they must be convinced that it is sound, and convinced by irrefutable facts. In the absence of such conviction American bankers are still skeptical of the American chemical industry. Chemistry is out of their line. They know nothing about it. Consequently, the chemical venture can scarce hope to enlist their support.

"We bankers are coming out of our shells. We have begun to learn that we have to put our business forward as everyone else does who has anything to sell. You should break into the banking situation. Break into the banking consciousness. They would be glad to get into this with you. But we do not know. We are uninformed and misinformed."

Advertising Needed

The same situation exists with regard to the legislators. With one or two possible exceptions, our Congressmen are not "sold" on the American chemical industry any more than are the bankers or the public as a whole. In the face of adverse legislation the chemical industry has reached the point where it throws up its hands in disgust and exclaims, "What's the use, with such blockheads in Washington?"

Such an attitude is not only unjust but it betrays ignorance, said Mr. O'Reilly. The fact of the matter is that the great majority of our lawmakers are doing the best they can with something they don't know anything about. And the blame for this ignorance can fairly be laid at the door of the industry. The most earnest plea and the most patient explanation of one or two legislators who know enough about the chemical industry to lend it full support will be regarded merely as the propoganda of "special interests" until their colleagues—and, more important still, their constituents—are brought to realize the fundamental place that the chemical industry holds in their everyday lives.

Efforts Are Misdirected

The solution demands the adoption of a new policy by the industry, said the speaker. It demands a revised opinion of the mental capacity of our Congressmen. It demands the education of the individual and of the public to the true importance of the chemical industry and an education based not on resolutions, or petitions, or protests, but on facts. The representatives in Washington of the industry must be men with a broad knowledge and thorough understanding of the details and figures of the business they represent. Our Congressmen are swamped with telegrams and with the resolutions of a thousand and one organizations. They are forced into a skeptical attitude by a multitude of demands that are entirely one-sided and selfish. The one solution for the chemical industry is a concerted effort to advertise itself—to "sell" the idea of chemistry to the people of America.

The failure of the dye embargo, the antagonism to the C.W.S. and the Chemical Foundation situation are due to the same reticence.

(*Continued on page* 277)

Oil Discoveries Reported in Northern Alberta, Canada

Reports from the neighborhood of Fabyan, near Wainwright, where the Imperial Oil Co. is boring for oil, assert that the company has struck a heavy flow of oil, which flowed outside the precincts of the company's barbed-wire entanglement and converted the dust of the district into an oily mud. The company, however, refuses to confirm the report. The result of the rumor has been another run on the Dominion land office at Edmonton and filing of a large area of ground in the vicinity of the reported strike.

A number of companies are boring for oil at and near Pouce Coupe, which is situated close to the interprovincial boundary between Alberta and British Columbia. It will be remembered that the Imperial Oil Co. struck a heavy flow of gas in a well at Pouce Coupe last year. The gas has been shut out, and the well is now down 2,160 ft. The drill has passed through several strata of oily sand, and, it is said, will be continued to 4,200 ft., unless a commercial flow of oil is struck sooner.

The Pouce Coupe Oil Co. has a diamond drill in operation 10 miles to the south of the Imperial company's well, and is down 500 ft. and sinking at the rate of 60 ft. daily. The drill has a capacity of 3,000 ft.

The Great Slave Oil Co. is operating a similar outfit near Rolla, and is down 400 ft.

Northern Alberta Oil Fields, Ltd., has freighted in a large Californian drilling outfit, and is waiting instructions as to the particular point at which it is to be erected. The Mackenzie River Oil Co. has a similar drill in transit to Rolla.

National Safety Council Announces Its Annual Meeting

Detroit Scene of Elaborate Sessions, Including Many Discussions of Interest to Chemical Industries

THE eleventh annual meeting of members of the National Safety Council is announced for the week of Aug. 28 in Detroit, Mich. Sessions will be held in the Cass Technical High School and judging by the program as it stands to date, the proceedings will be of very lively interest, not only to safety workers but to many of the chemical industries. Among the speakers at the four days of meetings appear the names of many well-known engineers and executives of the chemical and allied fields.

The business of the Council will be disposed of at the opening session on Monday morning, Aug. 28. The general session the same afternoon will be under the chairmanship of George A. Walters, Deputy Commissioner of Police in Detroit, and a number of papers on the general status of safety work will be presented, among which is one by A. H. Lichty, vice-president of the Colorado Fuel & Iron Co. of Denver.

The general subject of plant publications and their function in spreading the safety habit will be discussed on Tuesday, under the chairmanship of A. Ellis Frampton, of the Hammermill Paper Co. of Erie, Pa.

General Session

The general session on Tuesday, Aug. 29, under the direction of H. W. Forster, vice-president of the Independence Bureau, Philadelphia, Pa., will include several papers of more than passing interest to chemical engineers. M. F. Crass, of the Grasselli Chemical Co., will read a paper on "Safety in the Handling and Use of Acids." F. A. Rogers, of Lewis Institute, Chicago, Ill., and H. H. Brown, of Norwood, Mass., will discuss static electricity, its occurrence and its hazards in industry, with special reference to safety devices for preventing or overcoming the danger. The discussion will be led by L. A. De Blois, of E. I. du Pont de Nemours & Co.

A general round table will be conducted by C. W. Price, of the Price-Rasmussen Corporation of Chicago, Wednesday afternoon. The program includes papers on several phases of accident prevention. J. M. Woltz, of the Youngstown Sheet & Tube Co., is chairman of the "ABC" session on Thursday morning and R. S. Quinby, of the Hood Rubber Co., will direct the discussion that afternoon on "Sanitation and Factory Housekeeping."

Section Meetings

Of special interest to the chemical industries will be the meetings of the chemical, cement, packers' and tanners', paper and pulp, petroleum and rubber sections. The chemical section is headed by S. H. Kershaw, of the Hercules Powder Co. Included in the program are papers by the following:

Walter G. Whitman, assistant professor of chemical engineering, Massachusetts Institute of Technology: "Safe Handling in Chemical Plants."

F. J. Hoxie, Associated Factory Mutual Fire Insurance Companies: "Preventing Vapor and Gas Explosions."

A. L. Watson, Hooker Electrochemical Co.: "Report by Industrial Poisons Committee."

Charles F. Horan, Hood Rubber Co.: "Benzol Poisoning, Its Occurrence and Prevention."

The cement section will discuss accident problems of the industry. The packers' and tanners' section has scheduled several papers relating to the welfare of workers in the packing and leather industries and to the efficient conduct of safety departments in those industries. The paper and pulp section is under the chairmanship of W. A. Gleason, of the Hammermill Paper Co., and the program includes papers on the special problems that confront the safety workers in the pulp and paper mill, particularly the hazards of unguarded machinery. In the petroleum industry, dangers are more likely to exist in the combustion of fuel oil or petroleum distillates, and several of the papers will touch on these hazards and their prevention. The rubber section will arouse considerable interest, as several papers are to be presented by delegates from the large rubber companies and a wide variety of subjects will be discussed. This section is under the chairmanship of H. T. Martin, of the Fisk Rubber Co. Besides the reports of several committees their sessions will include a talk entitled "Vulcanizers," by C. W. Cook.

Motion pictures, as usual, will contribute to the breadth of the sessions. A number of new films have been obtained and will be shown to demonstrate both new ideas in safety measures and the means that are being adopted to spread the council's propaganda.

An informal banquet will be held Thursday evening, for which several interesting features have been arranged.

American Institute of Chemical Engineers Plans Meeting

The American Institute of Chemical Engineers will hold a dinner in New York during the week of the Chemical Exposition, Sept. 11 to 16. Preliminary plans announce that the dinner will be held on Thursday. It will be preceded by a Council meeting. Ladies are to be invited to attend the dinner. Further announcement will be made when plans are completed. The arrangements are in charge of a committee of which David Wesson, of the Southern Cotton Oil Co., is chairman.

Federated Engineering Societi to Meet in Boston

Findings in a nationwide survey the three-shift day in American indu try will be placed before the executi board of the American Engineeri Council of the Federated American E gineering Societies, at a meeting of t board to be held in Boston on Sept. and 9.

Two reports, dealing with exhausti investigations of the two-shift and t three-shift day problems in numero industries will be presented. One, p pared by Horace B. Drury, formerly the faculty of Ohio State Universi will describe the extent of 2-shift ope tions in the continuous industries well as the procedure followed and t results noted by those companies whi have changed from the 2-shift day 12 hours each to the 3-shift day of hours each. Mr. Drury's report w discuss the general practicability abolishing 12-hour turns.

Among the industries investigat are the metals, glass, cement, li brick, pottery, chemicals, sugar, s petroleum, cottonseed and other ve table oils, paper, flour, rubber, g water and ice.

A second report on an investigat of the *modus operandi* involved changing the operations of a steel pl from 2-shift to 3-shift methods will made by Bradley Stoughton, forn secretary of the American Institute Mining and Metallurgical Enginee Both investigations are being direct by the American Engineering Counc committee on work periods in c tinuous operation industries.

Many national economic, political a social problems bound up with en neering will probably also be consider at the Boston meeting. The question government reorganization, involvi a proposal to establish a national d partment of public works, reforest tion problems, international affiliati with engineering societies, flood c trol and water supply, and plans the country-wide expansion of the F erated American Engineering Societ will be discussed, in addition to repo of numerous committees which are c sidering questions of national inter

Mortimer E. Cooley, dean of the E gineering Schools of the University Michigan, will preside.

Acts on Foundation Patents

The committee on procedure adopt and sent to President Harding a re lution expressing the hope that no tion will be taken by the federal g ernment regarding the recovery of tents from the Chemical Foundati until representatives of chemis chemical engineers, chemical manuf turers, the medical profession a others most directly concerned heard.

The resolution "implores t nothing be done which can, in any w or to the slightest extent, tend tow the ultimate return to former owne of patents or other property, lawfu sequestered and sold to Americans.

Japan Rejects Proposal for Dye Embargo

l Tariff of 35 Per Cent ad Valorem Must Meet Condition Analogous to That in U. S.

Japan has declined to grant either lye embargo or higher rates to pro- t it from foreign imports, according a cablegram from Commercial At- hé Abbott, at Tokyo, received at the partment of Commerce. The dye uation in Japan is analogous to that America, the industry having been eloped since the war and just becom- established. Recent cablegrams had licated that the licensing system uld be adopted, hence the final report me as a surprise. The domestic nufacturers were asking an increase duties of from 35 per cent ad valorem 70 per cent and a licensing system cover eighteen colors satisfactorily oduced in Japan.

The market for Japanese dyestuffs is w limited to buyers in nearby Orien- markets, and even then quotations l sales must be made at an extremely price. The local Japanese market quite overstocked with German goods, ainst which American, French and lian dyes are competing. On the er hand the depressed conditions of textile trade furnishes little relief the excessive stock of dyes.

t is indicated that the present rate 35 per cent ad valorem will stand hout any increase, and that no spe- l provisions will be adopted.

The total requirements of Japan ount to approximately $15,000,000 nually. Of this amount imports are out 50 per cent. Recent importations m Germany and Italy have amounted about $7,000,000 annually, with 0,000 from the United States.

The colors of Japanese manufacture ich are generally giving a degree of isfaction in the home market and which protection against imported ds is desired are: Rhodamine B, line methyl violet, bismarck brown, t red A, malachite green, direct ck, naphthol brown, cotton violet, phur black, sulphur brown, magenta, nge A, and Congo red.

Grasselli Gets Freight Refund on Iron Pyrites Shipments

The Grasselli Chemical Co. is to re- ve a refund of about $2,000 from the lroads which levied unreasonable ight rates on shipments of iron rites between DeKalb and Newcastle, The Interstate Commerce Commis- n, in an opinion just handed down, s ruled that the freight charges were reasonable to the extent that they ceeded $3.90 per long ton. The ship- nts were made when labor troubles vented the obtaining of supplies of c ore at the company's sulphuric d plant. Iron pyrites were substi- ed and 43 carloads were moved. A e of 5.30 was assessed on the ground t it was a sporadic movement. The mmission decided that in view of the fact that 3,163,660 lb. had moved the chemical company was entitled to a rate which would accord with the general ton-mile earnings within the territory concerned.

In the complaint of the Arlington Silver Mining Co. an examiner of the Interstate Commerce Commission has recommended that rates on ore from Okanogan to Tacoma, Wash., be held unreasonable.

Unreasonable rates on bauxite ore from various points to Omaha are alleged in a complaint to the Interstate Commerce Commission by the Metropolitan Utilities District of that city.

Experimental Therapy Institute Planned for Philadelphia

The creation of a national institute of experimental therapy, to have relatively the same scope as the Rockefeller Institute in pathology or the Mayo clinics in surgery, is the plan of Rear Admiral William C. Braisted, retired, for the expansion of the Philadelphia College of Pharmacy and Science, of which he is president.

The college soon is to leave its present site for newer and more commodious quarters in West Philadelphia. A plot has been acquired in this section of the city and work on the new college edifice will begin within the year.

Demand Dye Embargo

(*Continued from page* 275)

The speaker cited as an example of what could be done by the intelligent presentation of the facts the case of the manganese producers in the recent tariff wrangle. The position of the manganese producers threatened to be even less enviable than that of the dye manufacturers, but the businesslike efforts of capable representatives succeeded in convincing the legislators that the industry needed and deserved protection.

Manufacturers' Petition

The petition sent to members of the Senate Finance Committee read as follows:

> At a meeting of the Synthetic Organic Chemical Manufacturers Association of the United States, held at New York, Aug. 4, 1922, the undersigned manufacturers of dyes, drugs and other organic chemicals gave consideration to the serious danger that threatens their industry by reason of the defeat of the dye and chemical control act in the Senate, July 15. They now respectfully petition the Finance Committee to take such action as may be appropriate to reinstate the clauses in the tariff act stricken out by the Senate's action. They repeat what they have heretofore testified to before your committee, that nothing less than the provisions of the dye and chemical control act will adequately protect their industry; that no specific or ad valorem rates will prevent the German cartel from regaining absolute control of the American organic chemical market; and that the manufacture of dyes, medicinals and other organic chemicals can no longer be maintained in this country without the legislative protection heretofore advocated by your committee after thorough investigation of all the facts.

The business meetings were, as usual, conducted behind closed doors.

A.C.S. Secretary Reports on Conditions in Europe

After a visit to several European countries, during which he attended meetings of the International Union of Pure and Applied Chemistry and of the Société Chimie Industrielle, C. L. Parsons, secretary of the American Chemical Society, returns to this country with the report that the chemical industry in Germany is booming, but in the other European countries it is having great difficulty in emerging from the depression.

Germany is employing in the European countries the same questionable methods it is using in this country to regain its chemical supremacy, says Dr. Parsons, the only difference being that the German efforts are less effective abroad because the Europeans know them better. The consumers of dyes in European countries, Dr. Parsons asserts, seem to have more vision than those in this country and do not permit themselves to be made the agency through which Germany is trying to attain her ambitions. Then, too, officials in high places in England are not permitting themselves to be used to the permanent injury of their country's chemical industry, he says. There is no counterpart of Senator Moses in the English Parliament.

Nevertheless, Dr. Parsons reports, such headway as the Germans have made in the European countries has been by employing the same methods they have used here by obtaining a certain amount of co-operation with short-sighted consumers of their products and by having the whole-hearted support of importers.

Dr. Parsons was particularly impressed during his trip by the distinct advances which the English have made in the oxidation of ammonia; by the success and great possibilities of the new process for vulcanizing rubber by the action of sulphur dioxide and hydrogen sulphide; by the remarkable results made in the enameling of iron, and by the efficiency which the French have achieved in applying two colors in the same dyeing vat.

During the meetings which Dr. Parsons attended, several references were made to the advantages which American chemists possess by having only one national organization. The influence of chemists in several countries in Europe is impaired materially, it was stated, by multiplicity of organizations.

National Lead Charged With Price Fixing

A complaint of unfair competition has been made by the Federal Trade Commission against the National Lead Co. It charges the company with enforcing a system of fixing and maintaining specified standard prices at which its white lead, litharge and paint products are sold, through a system of support and co-operation of wholesale and retail dealers.

Minority Favors Ford

(Continued from page 274)

regarded as an important part of the Ford offer and an added reason for its acceptance.

Objection to Ford Offer

One of the principal objections to this offer lies in the 100-year lease. The Ladd report, in view of the fact that the rights of those with whom Mr. Ford would compete are either perpetual or not less than 99 years, feels that this time of lease is only fair.

It is also claimed that acceptance of the offer would give Mr. Ford a government subsidy in the development of power and the manufacture of fertilizer.

In rebuttal, the report cites a comparison between the Ladd bill and that proposing federal relief for the merchant marine, showing that the former called for an expenditure of $42,000,000, while the latter required an expenditure of $125,000,000, and asks how the subsidy to ship operators can be supported, while the Ford offer is condemned on the same grounds.

The Matter of Repairs

It has been maintained that the $55,000 payable by Mr. Ford annually for the maintenance and operation of the locks and dams, outside of the power houses, is insufficient but the Chief of Engineers has testified that this is a sufficient sum (House hearings, p. 19), and his testimony is confirmed by the experience of the Reclamation Service, for it is shown in the record that such large dams as the Arrow Rock (about half the size of Dam No. 2, 349 ft. high), built in 1915, has required an average for the maintenance expense of $950 since it was completed, the amount for the calendar year 1920 being only $567. This is not an isolated exception, as is evident from the record of seven large dams, the most expensive of which in 1920 was the Pathfinder Dam, 218 ft. high, built in 1909, which required $1,304 for its maintenance.

As in the case of the nitrate plants, the dam was started during a war-time period of maximum prices and minimum efficiency of labor, and since the total cost of the dam, equipped with 125,000 hp., was estimated in normal times to be $14,500,000, it is reasonable to say that the actual normal value of the work done is probably not over 50 per cent of the $17,000,000, or about $8,500,000. The United States engineers, after careful studies extending over several years, reported that the amount chargeable to navigation on a pre-war basis of cost was $8,575,000. The record therefore indicates that the value of the work done to date is an approximate measure of the amount which should be charged to navigation. Through the operation of the Ford amortization fund, however, if the money is placed at only 4½ per cent, the table given by the Secretary of War shows that the resulting fund would repay to the government not only the entire cost of completing the project but the full amount of the present $17,000,000 investment as well, the total amount returned being $70,100,000.

The Question of an Amortization Fund

It has also been contended that the government could not administer an amortization fund and that it does not do so. The administration of a sinking fund is nothing new to the federal government. The act of Feb. 25, 1862, provided that all duties on imported goods shall be paid in coin, and that the coin so paid should be set apart as a special fund known as a sinking fund which, together with the interest on the same, should be applied to the purchase or payment of the public debt as the Secretary of the Treasury should from time to time direct. The operation of a sinking fund in a long-time contract such as the Ford offer proposes can secure the most valuable results, and should be adopted. This fund, through the Federal Reserve Board and the Farm Loan Bank systems, should be placed at not less than 4½ per cent. If the fund was to be placed today, it could be placed in farm loan bonds at 5 per cent.

Senator McKinley Argues the Other Side of the Case

Complying with a request from Gray Silver, the Washington representative of the Farm Bureau Federation, Senator McKinley of Illinois has reduced to writing his arguments against the acceptance of the Ford offer. Senator McKinley's letteer was inserted in the *Congressional Record* of July 31. The opinion was expressed on Capitol Hill that the McKinley argument is much more likely to be effective than some of those which are less dispassionate. The text of the McKinley letter is in part as follows:

Government Deprived of Revenue

> The testimony of the United States engineers who are in charge at Muscle Shoals shows that with the auxiliary steam power which the government has bought and paid for and which it is proposed to give Mr. Ford 200,000 hp. can be depended upon for practically every day in the year and an additional 150,000 to 200,000 hp. for 10 months in the year. Under the present standard of electrical art this power can be distributed to towns and cities, mines, and manufacturing plants covering a circle of 600 miles in diameter, thus providing untold advantages for a very large section of the United States. Power of this kind delivered from Keokuk over parts of the western and southern Illinois sells at the dam for about $40 per horsepower per year which would mean a revenue to the government for the Muscle Shoals power of not less than eight or ten million dollars per year if the government should sell same to a distributing company at same price. This is figured on a basis of about one-half of 1 cent per kilowatt-hour.
>
> One objection I have to Mr. Ford taking over this power under his present plan is because he proposes to deprive thousands and thousands of people over an area of 600 miles in diameter of power and its use in order that he may build up at Muscle Shoals a new Detroit. That is a fine thing for the inhabitants of Muscle Shoals, and naturally they are extremely desirous of seeing their real estate advance in value from $50 per acre to $10,000 an acre, but it is a bad thing for the thousands and thousands of people within this 600-mile area. This power which will wholesale at $10,000,000 per year will retail for over $50,000,000 per year. Mr. Ford proposes to buy from the government for $5,000,000 what has cost the government $150,000,000 and pay 4 per cent interest on the additional forty or fifty million dollars which the government must invest to complete the dams, and in addition to that he proposes to pay the government $46,000 a year, which he calls amortizement, and $55,000 a year which he calls repairs.

Repairs to Cost More Than Ford Allows

> The testimony of the army engineers is that the repairs at the dams will be about $227,000 a year, and not $55,000 a year. As Mr. Ford is to have the benefits if he gets this property on his terms and is to have these benefits for 100 years, he certainly, instead of offering to pay $55,000 a year, ought to agree to keep the dam in repair, which the army engineers say will cost $227,000 a year.
>
> Mr. Ford does not propose to take the property, but to have a $10,000,000 corporation take title to it, and this title stands for 100 years. The experience with all large capital investments as corporations is that sooner or later within 10 or 20 years, they pass into control of large money holders commonly known as "Wall Street." Mr. Ford, if he secures this property, gets the property tax free for 100 years with no control of any kind as to what price he should charge for power. He requires the government to install, at government cost, machinery for 850,000 hp. and agrees to use 100,000 of this power to make 40,000 tons of ammonia, which would make an amount of fertilizer which would not be sufficient to fertilize one-third of the acreage of Illinois alone, not including any other state, and he only agrees to furnish this provided he can sell at a profit of 8 per cent on the per cent interest money he has secured from the government. The testimony of the army engineers who have had this property in charge since its inception is that with Chilean nitrate or ammonia made from the byproducts of coke ovens, power must be secured at three-quarters of a mill per kilowatt. They further testify that, not getting any interest on the money the government has already invested, and 4 per cent on the additional money which the government must invest under Mr. Ford's offer, it would cost 2½ mills per kilowatt to generate the power, or three times, as much as they testify that power must necessarily be provided in order to compete with present fertilizer.

Alpha Chi Sigma to Banquet During Exposition Week

Members of the chemical fraternity Alpha Chi Sigma have arranged to get together during the week of the Eighth National Exposition of Chemical Industries in New York City. Dinner will be held at 6:30 p.m., Thursday, Sept. 14, at Keen's Chop House, 107 West 44th St., New York City. In view of the fact that many members of the fraternity will be in New York attending the exposition, a large dinner gathering is expected.

Canadian Paper Co. Ordered S

Justice Morrison has ordered the s on Oct. 13 of the Prince Rupert P & Paper Co., and has appointed S. Hyatt receiver for the bondholders creditors. Mr. Hyatt has been thorized to borrow $10,000 to license fees and taxes. The comp passed the payment of interest on first mortgage debentures on Jan. 1 on July 1.

Personal

Prof. CHARLES S. BISSON has left the South Dakota School of Mines to take charge of the department of chemistry at the Northern Branch of the University of California, Davis, Calif.

G. G. CREWSON has resigned the plant managership of the Refractory Products Corporation's plant at Index, Va., to become associated with the engineering staff of the National Aniline & Chemical Co., Buffalo, N. Y.

EDWARD J. P. FISHER, metallurgical engineer, formerly with the Atlas Die-Casting Co., Worcester, Mass., is now with the Edison Lamp Works of the General Electric Co., at Harrison, N. J.

F. B. FOLEY has been transferred by the Bureau of Mines from its Minneapolis station to the station at Rolla, Mo. At his new location Mr. Foley will continue active experimental work on the production and heat-treatment of drill steels.

CARL E. JULIHN, who has been superintendent of the Bureau of Mines station at Minneapolis, has been transferred to Washington, where he will serve on the technical staff of the War Minerals Relief Commission for the coming fiscal year. In the absence of Mr. Julihn, T. L. JOSEPH is acting as superintendent of the Minneapolis station.

D. H. KILLEFFER, on the editorial staff of *Drug and Chemical Markets*, will, on Sept. 1, be the New York editor of the *Journal of Industrial and Engineering Chemistry*, succeeding R. T. Stokes.

MENGO L. MORGENTHAU of 431 Hudson St., New York, has presented to Prof. W. L. Estabrooke for use at the College of the City of New York, especially in connection with Dr. Estabrooke's courses in inorganic chemistry, a collection of over fifteen hundred minerals, valued at $25,000. The collection is beautifully incased and electrically lighted. It has been placed in the entrance hall of the chemistry building, now called Baskerville Hall in honor of the late Charles Baskerville, director of the department of chemistry 1904-1922. Mr. Morgenthau is a member of the class of 1874.

A. A. MURPHY has been appointed resident sales manager of the industrial and railway paint and varnish division of E. I. du Pont de Nemours & Co., with headquarters at New York.

C. J. MURPHY, vice-president of the Phoenix Leather Co., Pittsburgh, Pa., has resigned, effective Aug. 1, to become connected with the Deford Co., Baltimore, Md.

Dr. ROLAND P. SOULE, a graduate of the department of chemical engineering, Columbia University, has accepted a position with the Combustion Utilities Corporation, 24 State St., New York.

Among the notable additions to the Federated American Engineering Societies is the Engineers Club of Columbus, Ohio, which has appointed Prof. James R. Withrow of Ohio State University as its representative on the American Engineering Council, the executive organ of the federation. Professor Withrow will serve until Jan. 1, 1924.

Obituary

JOSIAH MONROE, for many years secretary and treasurer of the Juragua Iron Co., with plant in Cuba, died at his residence, Philadelphia, Pa., on July 26, following an illness of several weeks, at the age of 70 years. He is survived by his wife and a daughter.

CHARLES ADAMS PATTERSON, vice-president of E. I. du Pont de Nemours & Co., died on July 26 at the Presbyterian Hospital, Philadelphia. Mr. Patterson was taken to the hospital on July 10 suffering with a carbuncle. An operation was performed and was apparently successful until a few days before his death, when complications set in and septic pneumonia developed.

Mr. Patterson's death came as a shock to a multitude of friends, for he was in the prime of life and of a sturdy constitution. His unfailing good humor, keen aggressiveness and wholesome conviviality made him a true friend to literally hundreds of persons with whom he dealt. Charles L. Reese, chemical director of the du Pont company, says of Mr. Patterson: "He was a lovable character and a staunch friend—probably the most popular man in the company."

Mr. Patterson had spent his entire business life in the explosives industry, which he entered as an office boy with the Repauno Chemical Co. in 1894. From that position he advanced rapidly until he had become one of the best known and most important men in the world of explosives manufacture.

He was born at Minersville, Pa., April 9, 1876, the son of the late George Patterson, onetime manager of the black powder operating department of the du Pont company.

Mr. Patterson was graduated from the Wilmington High School in 1894, and he immediately took his first office boy position with the Repauno company. His desire for advancement led him to study shorthand at night and he was soon made stenographer and clerk to the late H. M. Barksdale, at that time managing head of the Repauno company. In September, 1896, he was granted leave of absence to enter college and he became a student at the University of Pennsylvania, taking the chemical course, in which he was graduated in 1900. During his college years he spent the summer vacations working in various plants of the du Pont company, so that on his graduation he was remarkably well equipped for his lifelong work in the explosives industry.

Immediately after his graduation he was employed as a chemist at the Repauno works and 3 years later was made assistant superintendent. During the succeeding 6 years he was successively superintendent at the Forcite works, the Barksdale works and the Hercules works, returning in May, 1912, to the Repauno plant as its superintendent.

Mr. Patterson's experience and managerial ability played an important part in the rapid expansion of the du Pont company's activities during the war. In May, 1916, he was made general superintendent of the du Pont company's high explosives operating department and a year later became assistant director of the explosives manufacturing department. It soon became necessary for him to take on more responsibilities and he was made director of the explosives manufacturing department and a short time later was elected a member of the board of directors of the du Pont company.

After the armistice Mr. Patterson was chosen as a member of the executive committee, charged with the duty of readjusting the company's affairs to a peace-time basis. He was elected a vice-president and was given general supervision of the explosives manufacturing department, in which position he continued until September of last year, when he was elected as general manager of the explosives department, which had been enlarged to include not only manufacture but also sales and all other activities connected with this branch of the company's business. This new position threw upon him a greater burden of responsibility, as it gave him the entire management of a branch of the business almost as large as the company's whole organization in the years before the war.

Mr. Patterson was always interested in educational matters and was particularly devoted to the interests of the University of Pennsylvania. He was closely identified with civic movements and was deeply interested in political matters. He had been chairman of the Republican County Committee for 2 years and had taken an active interest in several national and state campaigns.

Irenée du Pont, president of the du Pont company, paid tribute to Mr. Patterson in the following words: "The company has lost a vice-president whose knowledge and judgment were extraordinary and whose energy and loyalty were an example to all of us. Even more than that, his lovable character made him the friend of substantially every employee and thereby contributed in no small degree to the esprit de corps which has meant so much to the success of the du Pont company."

WILLIAM ANDREW THOMPSON, JR., vice-president of the Texas Co., New York, died suddenly on July 24, at his residence, 282 East Seventeenth St., Brooklyn, N. Y., aged 50 years. He was in charge of the export, marine and northern sales departments of the company.

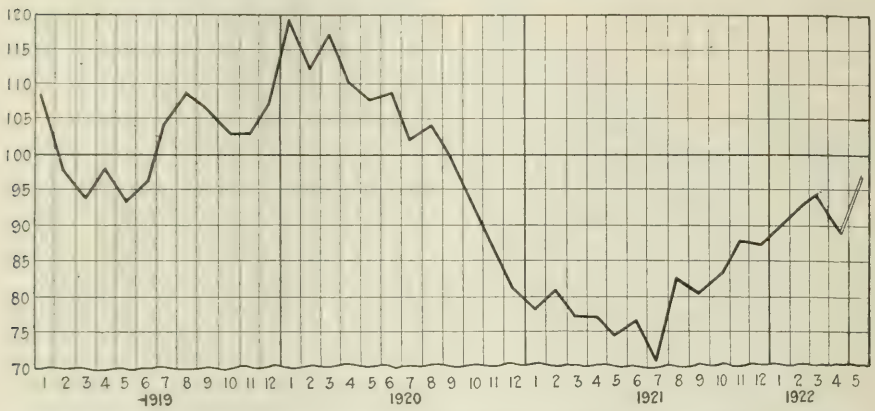
Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

The Trend of Production in the Chemical and Allied Industries

A Few Statistical High-Spots Along the Business Horizon—Manufacture in Some Lines Increasing in Spite of Strikes—Record Set by Paper and Rubber Industries



THE HARVARD ADJUSTED INDEX OF THE VOLUME OF MANUFACTURE. (*NORMAL = 100*)

AS LATER STATISTICS of production are becoming available for the chemically controlled industries it is increasingly evident that the improvement noted during earlier months has been of a very general nature. Few if any of these basic industries have failed to respond to the stimulus of better times. Even at present in the face of strikes which threaten serious fuel and transportation shortages it is encouraging to know that the progress of production in certain lines continues practically without interruption. This demonstrates clearly the inherent strength of the present position of industry. The Harvard Service's adjusted volume index is gradually approaching the normal of 100, which is an average value determined on the basis of production in good and bad years and in which both seasonal influences and long-time tendencies have been considered. This index, which had risen to 93.7 in March, fell to 90.1 in April, but in May arose to 96.0—the highest point to be reached in the present movement.

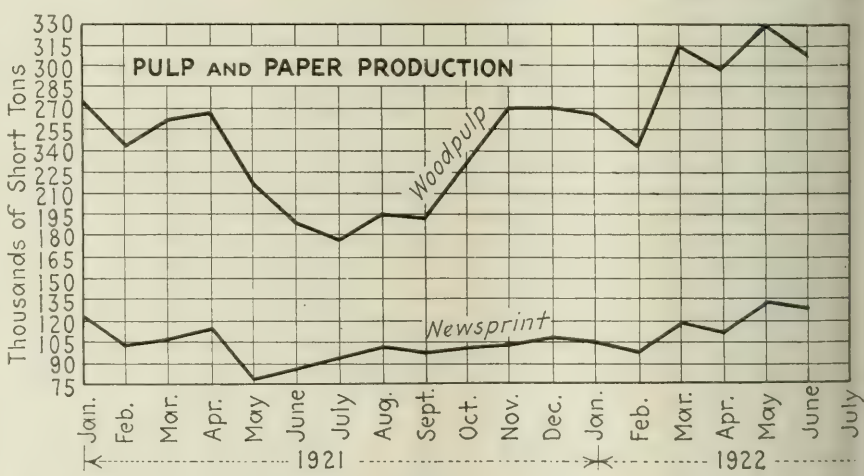
PAPER AND RUBBER INDUSTRIES SET RECORDS

Among the high-spots in production which have not already received comment on these pages is the paper situation. The output in May was the highest point which has been reached since 1920. As measured by the Harvard index, production had attained a value of 99.2 per cent of normal. In June there was a slight recession. Newsprint produced in that month was 127,230 net tons, as compared with 87,724 tons in June, 1921, and 114,440 tons as the 5-year average for that month. The total for all grades of wood pulp for June was 313,259 net tons, while the corresponding figure for last year was but 189,389 tons.

According to recent news from Akron, July will stand out as the month of greatest tire production for that district. Over two and a half million tires were produced in Akron tire plants during the month, as compared with a total in May for the entire country of 2,722,000. In the preceding month the total output had been 2,421,000 tires. The imports of crude rubber during the first 5 months of the current year show an increase of 112.4 per cent over the receipts of the corresponding period in 1921.

Notwithstanding the several recent cuts in the price of crude oil as well as the accumulation of vast stocks of oil and of various petroleum products, production during June continued at an even greater rate than in the record month of March, 1922. The daily average reported by the Geological Survey was 1,508,233 bbl. for June and 1,504,323 bbl. for March. The total output in June, however, was about a million barrels less than in either March or May.

Other production and consumption statistics for the chemical and allied industries may be found in Table I. These are taken from the "Trend of Business Movements" section of the *Survey of Current Business* which is being compiled through the co-operative work of the Bureaus of Standards,



PULP AND PAPER PRODUCTION, BY MONTHS, JANUARY, 1921, TO JUNE, 1922

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	152.08
Last week	153.56
August, 1921	158
August, 1920	264
April, 1918 (high)	286
April, 1921 (low)	140

For over a month this index number has shown a consistent decline, having now fallen more than 8 points below the maximum of 160.49 reached during the week of May 24. This week's recession is traceable principally to the much lower prices for cottonseed and linseed oils.

ABLE I—THE TREND OF PRODUCTION IN CERTAIN OF THE CHEMICAL AND RELATED INDUSTRIES

Production of—	Feb., 1922	Mar., 1922	April, 1922	May, 1922	First 5 Months of 1921	First 5 Months of 1922	Percentage Increase or Decrease in 1922
cetate of lime, thous. of lb....	7,942	11,134	7,836	7,107	25,088	42,513	+ 69.5
cohol (wood), gal.....	433,024	587,928	418,271	380,237	1,692,593	2,272,160	+ 34.2
ment, thous. of bbl.....	4,278	6,685	9,243	11,176	33,172	35,673	+ 7.5
oke, byproduct, thous. of short tons.....	1,795	2,137	2,227	2,537	9,047	10,599	+ 17.2
oke, beehive, thous. of short tons.....	549	732	528	432	3,296	2,737	— 17.0
ottonseed oil, thous. of lb....	91,321	72,237	27,610	12,389	607,092	304,263	— 49.9
eather, sole, thous. of sides...	1,466	1,473	1,327	1,321	6,704	7,241	+ 8.0
eather, finished upper, thous. of sq.ft.....	70,296	77,510	66,700	67,275	222,779	356,344	+ 60.0
nseed oil*, thous. of lb.....	6,647	7,232	6,069	7,952	38,294	34,357	— 10.3
Metals:							
g iron, thous. of long tons...	1,630	2,035	2,072	2,307	8,363	9,682	+ 15.8
eel ingots, thous. of long tons.....	2,072	2,816	2,794	3,099	9,149	12,420	+ 35.8
pper, thous. of lb.....	37,416	61,867	76,601	88,714	326,906	290,434	— 11.2
nc, thous. of lb.....	45,026	53,064	51,012	54,838	188,004	251,352	+ 33.7
Paper and pulp:							
ood pulp, chemical, sh. tons.....	144,568	170,995	147,608	167,197	659,138	666,318	+ 1.1
ewsprint, sh. tons.....	97,786	117,507	111,861	129,950	528,678	562,812	+ 6.5
l other paper, short tons....	404,031	475,353	528,461	589,971	2,075,218	2,720,304	+ 31.1
Petroleum:							
ude oil, thous. of bbl.....	40,814	46,916	44,635	46,473	196,255	221,697	+ 13.0
soline, thous. of gal.....	398,223	472,228	472,920	513,659	2,032,050	2,291,703	+ 11.3
rosene, thous. of gal.....	167,220	178,785	188,809	173,824	835,493	881,555	+ 5.3
Rubber:							
ude†, thous. of lb.....	18,467	26,771	43,407	35,727	124,332	264,105	+112.4
eumatic tires, thous.....	2,084	2,646	2,401	2,722	6,439	11,908	+ 84.9
Sugar:							
ports, raw, long tons.....	448,321	571,836	473,137	446,678	1,520,336	2,254,911	+ 48.3
eltings, raw, long tons.....	415,723	535,357	531,962	577,330	1,512,831	2,351,973	+ 55.5

* Shipments from Minneapolis. † Includes January and February only. ‡ Consumption by tire manufacturers.

ensus and Foreign and Domestic ommerce. It is to be regretted that few of the strictly chemical industies are represented in this worthhile compilation. At present the ood chemical manufacturers are practally the only branch of the chemical dustry whose production is reported the Commerce Department.

As an important index of industrial ogress it is of interest to note that the twenty-three commodities inuded in Table I, nineteen showed ineases over 1921. The only decreases re in the case of bee-hive coke, cotnseed and linseed oils and copper etal.

The New York Market

NEW YORK, Aug. 7, 1922.

The possibilities of an acute fuel ortage has doubtless been responsie for the much livelier interest which e chemical market has shown in ny of the more basic commodities. a few instances producers have alady advanced their quotations, prenably in anticipation of fuel and nsportation difficulties. An addinal factor which has stimulated pment business, especially among porters, has been the news from ashington that an agreement was ely to be reached on the tariff. In ll-informed circles, however, it is nerally believed that the tariff bill l not become a law much before t. 1.

Bichromates of potash and soda have own appreciable increases during the erval and a much better inquiry was orted by several producers. Imcters of powdered white arsenic have own considerable firmness in their otations, although domestic factors ve not altered former prices. Cop- sulphate continues along the same n lines recently reported. Oxalic acid was in light supply on spot and several producers named higher prices for shipment. Caustic soda for export showed very little change, but domestic material was in steady demand for fair-sized quantities. Yellow prussiate of potash showed effects of renewed activity at slightly higher levels. Sulphate of ammonia remained in very light supply, with the export demand rather brisk. Zinc chloride prices were recorded at slightly lower levels and imported white granular sal ammoniac was considerably lower on spot, due to the recent importations.

General and Special Chemicals

Arsenic—A good inquiry was reported among resale merchants, with several fair-sized orders transacted at 8c. per lb. Domestic factors have not altered former prices of 7½c. The insecticide industry continues to show considerable activity.

Barium Chloride—Material was offered at $85@$90 per ton on spot, with shipments from abroad held around $82 per ton. The demand has slackened noticeably.

Bichromate of Soda—Spot goods among resellers were higher at 7½@8c. per lb. Large producers have also advanced quotations and name 7½c. as a low figure. The fuel shortage and export demand are responsible for the advance.

Bichromate of Potash — Producers were quoting 10½c. per lb., showing an advance of 1c. per lb. Smaller lots are bringing as high as 11c. per lb. Fuel conditions are also the cause of the increase in this commodity.

Caustic Potash—Prices have shown very little change during the past few weeks. General conditions are rather quiet, with prices ranging around $5.60 @$6 per 100 lb.

Caustic Soda—There has been no unusual feature reported in the export market during the week. A few odd lots were sold around $3.50 per 100 lb. f.a.s. Domestic goods were in moderate demand at $3.75 per 100 lb., exstore. Contracts remain quotably unchanged.

Fluoride of Soda—There has been keen competition among resellers, with sales recorded as low as 9c. per lb. Domestic factors quote the market at 9½c. per lb. The demand has been fairly active for small lots.

Formaldehyde—Small-quantity purchases featured the market during the past week, with sales heard around 8@8½c. per lb. Goods were not as freely offered as reported a few weeks ago and competition was less keen.

Glaubers Salt—Domestic producers continue to quote $1.25 per 100 lb. in bags and $1.40 in barrels. Imported goods in barrels brought as low as 95c. per 100 lb. The demand is rather dull at present.

Nickel Salts—Manufacturers have announced an advance of ½c. per lb. on the single variety, the present market for which is quoted around 12c. per lb. The double salt is held at around 11½c.

Oxalic Acid—A very firm tendency has been shown by this product during the interval, with prices ranging around 15c. per lb. f.o.b. works. Spot prices are quoted at 15½@16c. per lb.

Coal-Tar Products

The spot market for benzene was materially higher, although no change in former prices was reported. Water white solvent naphtha was reported higher among second hands and toluene, 90 per cent, was also much stronger on spot. Phenol is exceedingly scarce and dealers reported a very firm market. Technical beta naphthol has been offered rather freely of late, with prices fractionally lower, however.

Aniline Oil—Consumers have shown a better interest during the week and prices have been well maintained at 14@15c. per lb. Spot stocks are not as plentiful as recently reported.

Benzene—Spot supplies are very scarce and producers are finding difficulty to make regular contract deliveries. Contracts of the pure material were quoted at 30@35c. per gal. and 90 per cent at 27@32c. per gal. Dealers quote the resale market at 40@45c. per gal. for the 90 per cent.

Cresylic Acid—Consumers continue to send in a steady call for quantity shipments and the general market situation remains very firm. Sales of the 97-99 per cent for shipment were reported at 56@58c. per gal., with the 95-97 per cent at 51@53c. per gal. The spot resale market for 97-99 per cent held around 65c. per gal. and 62c. per gal. for the 95-97 per cent.

Phenol—There has been a very strong demand during the past few weeks, with the prime U.S.P. material in very scanty supply. A few odd lots were reported sold up to 17c. per lb. The general range is around 15@16c. per lb.

Hercules Earnings Four Times Those of 1921

For the 6 months ended June 30 the Hercules Powder Co. shows net earnings of $717,326. After subtracting charges, taxes and preferred dividends this is equivalent to $5.50 a share on the $7,150,000 common stock. This compares with earnings of $103,009, or $1.37 a share, for the corresponding period of 1921. This is shown in the following statement of income during the first half of each of the last 4 years:

	1922	1921	1920	1919
Gross receipts	$7,978,201	$6,537,615	$9,683,942	$12,173,831
Net earnings	717,326	103,009	1,265,285	488,420
Pref. dividends	324,051	253,154	190,582	187,250
Surplus	$393,275	$150,145 (a)	$1,074,703	$301,170

(a) Deficit.

The consolidated balance sheet on June 30, 1922, follows:

Assets	
Property and plants	$22,635,431
Cash	1,606,860
Accounts receivable	3,039,519
Collateral loans	2,028,019
Investment securities	1,874,676
Liberty bonds	1,172,239
Supplies	2,877,315
Finished products	1,950,105
Deferred charges	82,704
Contingent assets	146,268
Total	$37,413,136
Liabilities	
Common stock	$7,150,000
Preferred stock	8,112,900
Preferred stock in escrow	1,350,000
Aetna bonds	3,891,475
Bills payable	42,960
Accounts payable	293,266
Preferred dividends	82,800
Deferred credits	34,911
Federal taxes	88,898
Reserves	1,893,287
Contingent liabilities	146,268
Profit and loss surplus	14,326,371
Total	$37,413,136

Allied Chemical & Dye Active on Stock Market

Rumors that the dividend rate on the common stock of the Allied Chemical & Dye Corporation was shortly to be increased from $4 to $6 per year were largely responsible for sending this stock up to 74½ on Aug. 1. This was a new high for the year and is particularly significant, since it came in the face of the Senate's recent unfavorable action on the dye embargo.

No statement has been made by officials of the company regarding either dividends or earnings, but it is generally believed that current earnings after preferred dividends and taxes are at the rate of over $8 a share on outstanding common stock.

Air Reduction Co.'s Profits in Second Quarter, 1922

The operations of the Air Reduction Co., Inc., for the second quarter of 1922 show net profits of $231,351.25 before deduction is made for federal taxes. The gross income for the period was $1,773,882.89 and the operating expenses amounted to $1,235,004.67.

The operating income of $538,878.22 was divided between $270,585.72 of additions to reserves, $36,941.25 for paid and accrued bond and mortgage interest and the net profits referred to above. On the outstanding stock of 153,114 shares of no par value, the earnings are equivalent to $1.50 per share.

Exports of Chemicals

A special compilation of exports of domestic merchandise has been prepared by the Bureau of Foreign and Domestic Commerce for the Finance Committee of the Senate to use in connection with its study of the tariff. The report shows the value of all exports of chemicals to have been as follows:

1918	$165,239,860
1919	133,739,066
1920	168,999,706
1921	61,111,410

Exports to certain countries were as follows:

	1918	1920	1921
France	$35,624,663	$7,952,707	$2,740,229
Italy	13,687,087	5,336,540	603,273
England	24,819,739	19,759,556	8,888,363
Canada	26,682,349	20,790,637	11,989,648
Japan	16,643,052	21,943,000	5,238,540

Some of the totals for chemicals exported during 1920 and 1921 are as follows:

Article and	Unit	1920	1921
Carbolic acid,	lb.	2,151,475	249,658
Nitric acid,	lb.	716,914	177,580
Sulphuric acid,	lb.	28,987,342	12,814,344
Wood alcohol,	gal.	703,064	412,110
Calcium carbide,	lb.	23,369,534	11,808,252
Benzene,	lb.	13,174,268	72,030,400
Copper sulphate,	lb.	3,783,409	3,582,933
Aniline dyes,	dollars	22,450,480	5,067,000
Formaldehyde,	dollars	2,640,225	349,089
Glycerine,	lb.	1,742,708	2,394,714
Acetate of lime,	lb.	23,309,469	18,239,740
Chloride of lime,	lb.	48,826,348	18,447,579
Bicarb'nate of soda	lb.	20,642,201	11,703,183
Caustic soda,	lb.	224,137,406	49,865,219
Sal soda,	lb.	12,030,193	10,354,513
Silicate of soda,	lb.	34,095,542	20,789,095
Soda ash,	lb.	166,761,603	35,042,791
Borax,	lb.	14,325,037	4,061,633

Cottonseed Products During 1921 and 1922

Production, stocks and shipments of various cottonseed products for the 11 months' period ended June 30, 1921 and 1922, are compared in the following tabulation of the Census Bureau:

Export and Import Figures Show Trend of Chemical Business

Exports of chemicals and allied products declined from $10,424,794 in May to $8,662,326 in June. There was an increase as compared with exports in June of 1921, when the total value was $7,106,802. Exports of fertilizers in June were less than one-half those in May. Exports of explosives were only slightly more than one-third of those of May. Paints, pigments and varnishes almost held their own. Some comparisons between exports in June 1922, with those of June, 1921, are as follows:

	1921	1922
Benzene, lb.	5,839,131	6,713,57
Carbolic acid, lb.	116,846	4,61
Acetic acid, lb.	817,159	2,481,29
Wood alcohol, gal.	24,036	63,93
Ammonium sulphate, lb.	261,725	217,28
Copper sulphate, lb.	55,020	291,27
Cyanide of soda, lb.	165,563	1,633,60
Soda ash, lb.	4,259,695	1,898,90
Caustic soda, lb.	3,239,833	11,355,90

Imports of chemicals on the free lis during June were valued at $6,815,381 Imports of dutiable chemicals in Jun were valued at $4,429,532. While th imports of free-list chemicals show a increase of about $400,000 over those o June, 1921, there was a falling off o nearly $600,000 as compared with im ports in May.

There was a decided upturn in th imports of dutiable chemicals, doubt less in anticipation of tariff legislation The June imports of dutiable chemical were nearly one million and a hal dollars greater than those in May an exceeded those of June, 1921, by nearl $2,000,000.

The value of coal-tar products im ported during June was $1,455,345, a compared with $817,364 in June o 1921. A comparison of other import is given in the following table:

	1921	1922
Calcium acetate, etc., lb.	3,728,670	6,546,8
Quinine, oz.	70,700	132,3
Carbonate of potash, lb.	359,232	673,4
Cyanide of soda, lb.	3,295,887	519,9
Nitrate of soda, tons	37,847	49,4

As compared with last year, th greatest increases came in the gu group. More than $1,000,000 wort of gums was imported during Jun than in June of 1921. The imports o copal in June amounted to 3,597,596 l Receipts of gum arabic amounted t 1,338,286 lb. Actual camphor import totaled 208,675 lb.

COTTONSEED PRODUCTS MANUFACTURED, SHIPPED OUT AND ON HAND

Item	Year	On Hand Aug. 1	Produced Aug. 1 to June 30	Shipped out Aug. 1 to June 30	On Hand June 30
Crude oil, lb.	1922	18,762,794*	922,790,186	922,739,461	12,193,69
	1921	22,620,357	1,285,626,797	1,278,151,580	37,299,21
Refined oil, lb.	1922	228,263,633†	831,952,028‡	.....	211,070,22
	1921	297,741,580	1,129,147,699	.....	299,617,78
Cake and meal, tons	1922	36,303	1,343,470	1,295,022	87,35
	1921	133,475	1,757,543	1,822,815	68,20
Hulls, tons	1922	73,280	927,832	958,323	42,78
	1921	18,304	1,234,573	1,164,021	88,85
Linters, 500-lb. bales	1922	124,377	394,004	449,760	68,62
	1921	176,316	434,239	456,333	154,22
Hull fiber, 500-lb. bales	1922	30,676	42,123	33,132	39,66
	1921	150,659	87,223	117,624	120,25

* Includes 4,346,848 and 1,272,420 lb. held by refining and manufacturing establishments and 5,507,8 and 1,962,480 lb. in transit to refiners and consumers Aug. 1 and June 30, respectively.

† Includes 5,884,495 and 4,229,584 lb. held by refiners, brokers, agents and warehousemen at places oth than refineries and manufacturing establishments and 7,969,713 and 5,377,083 lb. in transit to manufactur of lard substitute, oleomargarine, soap, etc., Aug. 1 and June 30, respectively.

‡ Produced from 903,708,168 lb. crude oil.

The St. Louis Market

ST. LOUIS, MO., Aug. 3, 1922.

Trading conditions in this market for chemicals have undergone no change since our last report. The market has felt very little effect of the coal shortage or transportation difficulties, but there is a tendency to rush shipments of some commodities in the hope of avoiding a tie-up should the situation become more serious. One of the outstanding features for the past 2 weeks has been the steadiness of prices in spite of the present unsettled situation. Business for the month of July has been much better than for the corresponding month of last year, and has by far exceeded the preceding month of June, with a continued broadening of inquiries indicating that confidence is again being restored.

ALKALIS

The market on alkalis has been very steady. No price changes have been reported and practically nothing except routine business is being done. *Soda ash* can be placed in the same classification with *caustic* in regard to price and volume of business. *Bicarbonate of soda* is moving fairly well and prices remain firm, with all dealers bringing their prices in line with the top market. *Sal soda* is moving rather slowly and jobbers are carrying very small stocks during the hot weather.

GENERAL AND SPECIAL CHEMICALS

Heavy mineral acids continue to move at the same rate. *Acetone* has again been advanced on account of the increase in *acetate of lime*, and is now being quoted at 13c. in carlots and 14½c. in less than carlots in drums, f.o.b. producers' works. Some of the leading producers of *acetic acid* have announced their new prices based on acetate of lime at $2.35 per 100 lb. This is the second advance in acetic acid as well as acetate of lime since the first of July. The demand for *citric acid* has been along quiet lines and the spot market is liberally supplied. Makers of *oxalic acid* are now quoting 16¾@17c. with a curtailment of supplies, and buyers are finding it difficult to locate spot goods. Supplies of *ammonia water*, 26 deg., are very large with an erratic demand. The market for *white arsenic, powdered*, is much stronger today than it was in our last report, prices now being quoted at 7½@7¾c. f.o.b. New York. The demand for *carbon bisulphide technical* has not eased since our last report and prices remain very firm. *Carbon tetrachloride* is moving in a routine way and is now being quoted at 9c. f.o.b. New York in large drums. *Glycerine* is steadily advancing and spot goods are now being held at 16c. per lb. There are no surplus stocks, the market being completely in the hands of producers. *Sulphur* has moved rather briskly due to consumers trying to anticipate the railroad strike. Prices did not change and business is again of normal volume. *Zinc sulphate* is still very strong at $2.85 per 100 lb. carlots f.o.b. St. Louis, and is keeping in line with the spelter market, which is now around $5.80 per 100 lb. with a further advance expected at any time.

VEGETABLE OILS AND NAVAL STORES

Turpentine is still the wild Indian of the naval stores. It has run prices up and down and is today anchored at $1.27 in single barrels, 6c. higher than when last reported. *Linseed oil* is running the usual course for this season. No contract business is being done, and only the necessary daily requirements are in demand. *Castor oil* remains firm and in good demand. Price is 13¼c. in drums for quantities of 200 gal., ½c. advance for less quantities. Further advances in castor would not come as a surprise.

PAINT MATERIAL

The month of August is a continuation of the dull period in the paint trade. Only routine buying is being done at present. Railroads are not buying and this curtails almost the entire business of several grinders in this district. Shipments of supplies are not coming through as they should and this too holds up operations.

The Iron and Steel Market

PITTSBURGH, Aug. 4, 1922.

Production of pig iron and steel has not decreased as much as was feared when railroad congestion due to the shopmen's strike increased the scarcity of coal. Production in July was approximately equal to production in May and June and thus was greater than in any earlier month of the year. As matters now stand, it is practically certain that production in August will show a great decline, but it does not follow that this will cause steel to become scarce. During the 4 months since the coal strike started there has been heavy production of steel, at a rate 20 per cent above the rate in the two biggest tonnage years before the war. In February, March and April it was commonly believed that part of the buying of steel was by way of insurance against a possible curtailment of production by the coal strike. If there was anything in that theory, steel consumers are more or less fortified. It is no small thing for the steel industry to run for 4 months at the rate of producing 36,000,000 tons of ingots a year. The two war years, 1917 and 1918, showed production between 43,000,000 and 44,000,000 tons, and the first 9 months of 1920, when consumption appeared to be very heavy, showed a rate of 42,000,000 tons.

STEEL INDUSTRY KEEPING AHEAD OF THE STRIKES

The fact that most buyers are pressing mills for better deliveries and the further fact that there is some inquiry for finished steel products for early delivery at premium prices are not conclusive that steel is going to become genuinely scarce. Consumers know that mills are well sold up ahead, and the individual consumer may be exerting pressure in fear that otherwise he may not receive his quota. The payment of delivery premiums involves only a relatively small tonnage. Finally, it is inconceivable that when the steel mills have been able to run so well during 4 months of the coal strike a fuel or transportation condition could arise that would greatly restrict the production of steel without also interfering very decidedly with the consumption of steel. The steel trade, taking it as a whole, possibly stands in less danger of steel becoming inconveniently scarce than it does of jobbers and manufacturing consumers being seized with a liquidating fever when coal and transportation conditions eventually begin to approach normal.

The turnover in steel products in the open market has become lighter still. The fact in itself is not significant, for the market is now in the middle of the midsummer period, always a dull one in steel. As to forward deliveries, the mills are not in position to sell, as they are already well sold up and farther ahead than they thought since production promises to be lighter than expected. While the mills would be unwilling to sell, buyers are unwilling to buy, and the habits of the market are too well known for anyone to expect buyers to become more willing to buy merely from seeing, later, that steel is more readily obtainable.

STEEL, IRON AND COKE PRICES

Basis prices, for deferred delivery, are substantially unchanged, at 1.70c. for bars, shapes, plates, 3.15c. for sheets, and so on, but the prices are in some cases more or less nominal, there being little trading.

For early deliveries limited tonnages are available at premiums ranging roughly speaking from $2 to $5 a ton. The demand is rather limited in point of tonnage, but the balance is somewhat in favor of sellers, so that delivery premiums show a slight tendency to increase.

The coal market means little to the iron and steel industry, prices being high while tonnages available are limited. Connellsville steam coal reached a new high point of $8.50 on Wednesday, July 26, and then reacted sharply to $6 Tuesday morning, Aug. 1, by reason of withdrawal of buyers. On the reappearance of buyers the market has since advanced to $7. Connellsville coke, which is so scarce and at such high prices as to interest practically no consumers but foundries, advanced to $15.50 for foundry grade at the beginning of this week, having since softened a trifle.

Merchant production of pig iron has decreased greatly and is now quite light. There are some stocks at furnaces and some consumers have very fair stocks, while it appears that consumption has been decreasing. Offerings are very limited, as is also demand, but the latter preponderates and prices have been rising.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... -	$0.38 - $0.40
Acetone	lb.	$0.13½ - $0.13¾	14 - .14¼
Acid, acetic, 28 per cent	100 lbs.	2.60 - 2.65	2.70 - 3.25
Acetic, 56 per cent	100 lbs.	5.25 - 5.35	5.40 - 5.75
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	11.50 - 12.00	12.25 - 12.50
Boric, crystals	lb.	11 - 11½	11¾ - .12
Boric, powder	lb.	11 - 11½	11¾ - .12½
Citric	lb.	..... -	.45 - .45½
Hydrochloric	100 lb.	1.10 - 1.20	1.25 - 1.70
Hydrofluoric, 52 per cent	lb.	.11 - .11½	.11¾ - .12
Lactic, 44 per cent tech	lb.	.09½ - .10	.10½ - .12
Lactic, 22 per cent tech	lb.	.04 - .04½	.04½ - .05
Molybdic, c.p.	lb.	3.00 - 3.25	3.30 - 3.75
Muriatic, 20 deg. (see hydrochloric)	....	..... -	..... - .....
Nitric, 40 deg.	lb.	.06 - .06¼	.06½ - .07
Nitric, 42 deg.	lb.	.06½ - .06¾	.07 - .07¼
Oxalic, crystals	lb.	.15½ - .16	.16½ - .16¾
Phosphoric, 50 per cent solution	lb.	.08 - .08½	.08¾ - .09¾
Picric	lb.	.20 - .22	.23 - .27
Pyrogallic, resublimed	lb.	..... -	1.65 - 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 - 10.00	..... - .....
Sulphuric, 60 deg., drums	ton	12.00 - 14.00	..... - .....
Sulphuric, 66 deg., tank cars	ton	14.50 - 15.00	..... - .....
Sulphuric, 66 deg., drums	ton	19.00 - 20.00	20.50 - 21.00
Sulphuric, 66 deg., carboys	ton	..... -	..... - .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 - 20.00	..... - .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 - 22.50	23.00 - 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.	lb.	..... -	.60 - .75
Tannic (tech.)	lb.	.40 - .45	.46 - .50
Tartaric, imported crystals	lb.	..... -	.28½ - .29
Tartaric acid, imported, powdered	lb.	..... -	.29 - .30
Tartaric acid, domestic	lb.	..... -	..... - .30
Tungstic, per lb. of WO	lb.	..... -	1.00 - 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... -	4.75 - 4.95
Alcohol, methyl (see methanol)	....	..... -	..... - .....
Alcohol, denatured, 188 proof No. 1	gal.	..... -	.31 - .33
Alcohol, denatured, 188 proof No. 5	gal.	..... -	.31 - .33
Alum, ammonia, lump	lb.	.03½ - .03½	.03½ - .04
Alum, potash, lump	lb.	.03 - .03¼	.03¼ - .04
Alum, chrome lump	lb.	.05 - .05¼	.05½ - .06
Aluminum sulphate, commercial	100 lb.	1.50 - 1.65	1.70 - 2.25
Aluminum sulphate, iron free	lb.	.02½ - .02¾	.03 - .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½ - .07¼	.07¾ - .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 - .30½	.30½ - .31
Ammonium carbonate, powder	lb.	.08¼ - .08½	.08¾ - .09
Ammonium nitrate	lb.	.06 - .06½	.06¾ - .07½
Amylacetate tech	gal.	..... -	2.00 - 2.25
Arsenic, white, powdered	lb.	.07½ - .08	.08¼ - .08½
Arsenic, red, powdered	lb.	.12 - .12½	.12½ - .13
Barium carbonate	ton	60.00 - 62.00	63.00 - 66.00
Barium chloride	ton	85.00 - 90.00	91.00 - 100.00
Barium dioxide (peroxide)	lb.	.20 - .21	.21½ - .22
Barium nitrate	lb.	.07½ - .07¾	.08 - .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 - .04¼	.04½ - .04¾
Blanc fixe, dry	lb.	.04 - .04½	..... - .....
Blanc fixe, pulp	ton	45.00 - 55.00	..... - .....
Bleaching powder	100 lb.	1.60 - 1.75	1.85 - 2.50
Blue vitriol (see copper sulphate)	....	..... -	..... - .....
Borax	lb.	.05¼ - .05¾	.06 - .06¾
Brimstone (see sulphur, roll)	....	..... -	..... - .....
Bromine	lb.	.27 - .28	.28½ - .35
Calcium acetate	100 lbs.	2.35 - 2.40	2.45 - 2.50
Calcium carbide	lb.	.04½ - .04¾	.05 - .05½
Calcium chloride, fused, lump	ton	22.00 - 23.00	23.50 - 27.00
Calcium chloride, granulated	lb.	.01½ - .01¾	.02 - .02¼
Calcium peroxide	lb.	..... -	1.40 - 1.50
Calcium phosphate, tribasic	lb.	..... -	.15 - .16
Camphor	lb.	..... -	.81 - .83
Carbon bisulphide	lb.	.06½ - .06¾	.07 - .07½
Carbon tetrachloride, drums	lb.	.09½ - .10	.10½ - .12
Carbonyl chloride, (phosgene)	lb.	..... -	.60 - .75
Caustic potash (see potassium hydroxide)	....	..... -	..... - ....
Caustic soda (see sodium hydroxide)	...	..... -	..... - .....
Chalk, precip.—domestic, light	lb.	.04½ - .04½	..... - .....
Chalk, precip.—domestic, heavy	lb.	.03½ - .03½	..... - .....
Chalk, precip.—imported, light	lb.	.04½ - .05	..... - .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 - .05½	.05¾ - .06
Chloroform	lb.	..... -	.25 - .32
Cobalt oxide	lb.	..... -	2.00 - 2.10
Copperas	ton	20.00 - 22.00	23.00 - 30.00
Copper carbonate, green precipitate	lb.	.19 - .20	.20¾ - .21
Copper cyanide	lb.	..... -	.58 - .60
Copper sulphate, crystals	100 lb.	6.50 - 6.60	6.65 - 7.00
Cream of tartar	lb.	..... -	.23 - .25
Epsom salt (see magnesium sulphate)	....	..... -	..... - .....
Ethyl acetate com. 85%	gal.	..... -	.65 - .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... -	.90 - .95
Formaldehyde, 40 per cent	lb.	.08 - .08¼	.08½ - .09
Fullers earth, f.o.b. mines	net ton	16.00 - 17.00	..... - .....
Fullers earth—imported powdered—net	ton	30.00 - 32.00	..... - .....
Fusel oil, ref.	gal.	..... -	2.25 - 2.65
Fusel oil, crude	gal.	..... -	1.45 - 1.50
Glauber's salt (see sodium sulphate)	...	..... -	.16½ - .17
Glycerine, c. p. drums extra	lb.	..... -	.15½ - .15¾
Iodine, resublimed	lb.	..... -	4.20 - 4.25
Iron oxide, red	lb.	..... -	.12 - .18
Lead acetate, white crystals	lb.	..... -	.10½ - .11½
Lead arsenate, powd	lb.	.13 - .13½	.13¾ - .14½
Lead nitrate	lb.	..... -	.15 - .20
Litharge	lb.	.07½ - .08	.08½ - .09
Magnesium carbonate, technical	lb.	.06 - .06½	.06¾ - .07¾
Magnesium sulphate, U. S. P.	100 lb.	2.00 - 2.25	2.30 - 2.50
Magnesium sulphate, technical	100 lb.	..... -	1.60 - 1.80
Methanol, 95%	gal.	..... -	.57 - .58
Methanol, 97%	gal.	..... -	.59 - .60
Nickel salt, double	lb.	..... -	.11 - .11½
Nickel salt, single	lb.	..... -	.12 - .12½
Phogene (see carbonyl chloride)	....	..... -	..... - .....
Phosphorus, red	lb.	..... -	.40 - .45
Phosphorus, yellow	lb.	..... -	.30 - .35
Potassium bichromate	lb.	.10½ - .10¾	.11 - .11¼
Potassium bromide, granular	lb.	..... -	.17 - .23
Potassium carbonate, U. S. P.	lb.	.12 - .12½	.13 - .16
Potassium carbonate, 80-85%	lb.	.05 - .05¼	.05½ - .06
Potassium chlorate, powdered and crystals	lb.	.06½ - .07	.07¼ - .08
Potassium cyanide	lb.	..... -	.55 - .57
Potassium hydroxide (caustic potash)	100 lb.	5.60 - 6.00	6.10 - 6.25
Potassium iodide	lb.	..... -	3.20 - 3.35
Potassium nitrate	lb.	.06½ - .06¾	.07 - .08
Potassium permanganate	lb.	.13 - .13½	.14 - .15
Potassium prussiate, red	lb.	..... -	.90 - .95
Potassium prussiate, yellow	lb.	.32 - .32½	.32¾ - .33
Rochelle salts (see sodium potas. tartrate)	....	..... -	..... - .....
Salammoniac, white, granular	lb.	.06½ - .06½	.06¾ - .07¼
Salammoniac, gray, granular	lb.	.07¾ - .08	.08¼ - .08½
Salsoda	100 lb.	1.20 - 1.40	1.45 - 1.60
Salt cake (bulk)	ton	19.00 -22.00	..... - .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 - 1.67	2.00 - 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 - 1.80	1.85 - 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 - 1.90	1.95 - 2.40
Sodium acetate	lb.	.06½ - .06¾	.07 - .07¼
Sodium bicarbonate	100 lb.	1.75 - 1.85	1.90 - 2.30
Sodium bichromate	lb.	.07½ - .07¾	.08 - .08¼
Sodium bisulphate (nitre cake)	ton	4.50 - 4.60	4.65 - 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ - .04½	.04¾ - .05¼
Sodium chlorate	lb.	.06¼ - .06¾	.07 - .07½
Sodium chloride	long ton	12.00 -13.00	..... - .....
Sodium cyanide	lb.	.20 - .21	.22 - .25
Sodium fluoride	lb.	.09½ - .10	.10¼ - .10¾
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 - 3.40	3.75 - 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 - 3.55	3.60 - 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 - 3.90	4.25 - 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 - 4.15	4.40 - 4.60
Sodium hyposulphite	lb.	.02½ - .03	.03¼ - .03¾
Sodium nitrite	lb.	.07¾ - .08	.08¼ - .08¾
Sodium peroxide, powdered	lb.	.28 - .30	.31 - .35
Sodium phosphate, dibasic	lb.	.03½ - .04	.04¼ - .04¾
Sodium potassium tartrate (Rochelle salts)	lb.	..... -	.18 - .21
Sodium prussiate, yellow	lb.	.20½ - .21	.21¼ - .21¾
Sodium silicate, (40 deg. in drums)	100 lb.	.80 - 1.00	1.05 - 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 - 2.40	2.45 - 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 - 1.00	1.05 - 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 - .04¼	.04½ - .05
Sodium sulphite, crystals	lb.	.03¼ - .03⅝	.03¾ - .04¼
Strontium nitrate, powdered	lb.	.09½ - .10	.10¼ - .12
Sulphur chloride, yellow	lb.	.04½ - .05	.05¼ - .06
Sulphur, crude	ton	18.00 -20.00	..... - .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 - .08½	.09 - .10
Sulphur (sublimed), flour	100 lb.	..... -	2.25 - 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 - 2.15	2.20 - 2.70
Talc—imported	ton	30.00 -40.00	..... - .....
Talc—domestic powdered	ton	18.00 -25.00	..... - .....
Tin bichloride	lb.	.09 - .09½	.09½ - .10
Tin oxide	lb.	..... -	.35 - .37
Zinc carbonate	lb.	.14 - .14½	.14¾ - .15¼
Zinc chloride, gran.	lb.	.5¾ - .06	.06¼ - .06½
Zinc cyanide	lb.	.42 - .44	.45 - .47
Zinc oxide, XX	lb.	.07¾ - .08	.08¼ - .08½
Zinc sulphate	100 lb.	2.75 - 3.00	3.05 - 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.65 — .67
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.22 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.55 — .58
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.85 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06¼ — .07
Naphthalene, balls	lb.	.07¼ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15 —	$0.17
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.10 —	2.15
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.75 —	.77
Ortho-nitro-toluene	lb.	.10 —	.13
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.30 —	1.35
Para-amidophenol, HCl	lb.	1.35 —	1.40
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.15 —	.15½
Pyridine	gal.	1.75 —	2.75
Resorcinol, technical	lb.	1.30 —	1.35
Resorcinol, pure	lb.	1.75 —	1.80
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.23 —	.24
Salicylic acid, U. S. P	lb.	.25 —	.26
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.14 —	.18
Sulphanilic acid, crude	lb.	24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.20 —	$0.21
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.38 —	.42
Candellila, wax	lb.	.38 —	.40
Carnauba, No. 1	lb.	.40 —	.42
Carnauba No. 2, North Country	lb.	.24 —	.25
Carnauba, No. 3, North Country	lb.	.17 —	.17¼
Japan	lb.	.16½ —	.17
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04¼ —	....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02¾ —	....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03⅜ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½ —	.03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09¼
Stearic acid, double pressed	lb.	.09½ —	.09¼
Stearic acid, triple pressed	lb.	.10½ —	.10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$5.75 —	$6.20
Rosin E-I	280 lb.	6.25 —	6.65
Rosin K-N	280 lb.	6.70 —	7.80
Rosin W. G.-W. W	280 lb.	7.85 —	8.40
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.16 —	1.17
Wood turpentine, steam dist	gal.	.85 —	....
Wood turpentine, dest. dist	gal.	.70 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb	—	9.00
Rosin oil, first run	gal.	.36 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.46 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Cardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Prices Remain Quotably Unchanged

Crude Rubber

Quotations Remain Same as Previous Report

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12¼
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12½ —	12½
Coconut oil, Ceylon grade, in bbls	lb.	.08½ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
Corn oil, crude, in bbls	lb.	.10½ —	.10¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.08¾ —	.09
Cottonseed oil, summer yellow	lb.	.10¾ —	.11
Cottonseed oil, winter yellow	lb.	.11¼ —	.12
Linseed oil, raw, car lots (domestic)	gal.	.85 —	.86
Linseed oil, raw, tank cars (domestic)	gal.	.80 —	.81
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.87 —	.88
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07⅛
Palm, Niger	lb.	.06⅛ —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09 —	.09½
Peanut oil, refined, in bbls	lb.	.12 —	.12½
Rapeseed oil, refined in bbls	gal.	.82 —	.83
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11¼ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¾ —	....

FISH

Light pressed menhaden	gal.	$0.51 —	....
Yellow bleached menhaden	gal.	.53 —	.54
White bleached menhaden	gal.	.55 —	.56
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Shellac, orange fine	lb.	.75 —	.76
Shellac, orange superfine	lb.	.77 —	.78
Shellac, A. C. garnet	lb.	.68 —	.69
Shellac, T. N.	lb.	.72 —	.73

Other Prices Same as Previous Report

Refractories

All Quotations Remain Unchanged

Ferro-Alloys

All Prices Same as Report of July 31

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	19.00 —	21.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	18.00 —	21.00
Coke, foundry, f.o.b. ovens	net ton	14.50 —	....
Coke, furnace, f.o.b. ovens	net ton	14.00 —	....
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01¼ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.28½ —	.29
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.45 —	.50
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.25 —	3.50
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.975–14.00
Aluminum, 98 to 99 per cent	18.00–19.00
Antimony, wholesale lots, Chinese and Japanese	5.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.25
Lead, New York, spot	5.75–5.80
Lead, E. St. Louis, spot	5.45–5.475
Zinc, spot, New York	6.60–6.65
Zinc, spot, E. St. Louis	6.20–6.25

OTHER METALS

Silver (commercial)	oz.	$0.69⅞
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.15@1.25
Platinum	oz.	90.00
Iridium	oz.	180.00@185.90
Palladium	oz.	55.00
Mercury	75 lb.	55.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

PAPER—The Chesapeake Paper Board Co., Baltimore, Md., has placed its plant on the Key Highway on a maximum production basis, under 24-hour operation, giving employment to a full working force. The output is averaging about 60,000 lb. of material per day.

The Clarion Paper Co., Johnsonburg, Pa., is operating its local mill on a full production basis, giving employment to a regular working force.

The International Paper Co., New York, N. Y., is increasing production at its newsprint plants, and is now averaging in excess of its normal rated capacity of 1,300 tons per day. It is expected to maintain operations at close to this basis.

OIL—The Midcontinent Producing & Refining Corp. is perfecting plans for the resumption of operations at its oil refinery at Greenville, Tex., comprising the former plant of the North Texas Oil & Refining Co., recently acquired. Improvements will be made in the refinery, and regular working force employed.

The oil refinery of the Beaver Elcctra Refining Co., Electra, near Wichita Falls, Tex., will be placed in operation by the new owners, D. E. DeCourse and associates, who recently purchased the plant. It is expected to develop normal capacity at an early date. Improvements are being made.

The Pure Oil Co. and the Humphreys Oil Co., Mexia, Tex., affiliated, are increasing production at their local properties.

IRON AND STEEL—The Iron Products Corp., Birmingham, Ala., is operating full at all its plants with the exception of the blast furnace at Holt, Ala.; it is expected to blow in this unit during the present month.

The Crucible Steel Co. is increasing production at its plant at Syracuse, N. Y. The works have been on a curtailed operating basis for about 18 months past. Other plants of the company are also advancing their outputs, including the works at Pittsburgh, Pa., and Harrison, N. J., and it is expected to operate at normal at an early date.

Coal shortage and the railroad strike have been responsible for the partial shutdown of a number of steel mills during the past week, as well as the banking of certain blast furnaces, as follows: The A. M. Byers Co., Pittsburgh, Pa., has curtailed operations at 21 puddling furnaces at Girard, O.; the Briar Hill Steel Co., Youngstown, O., has banked a second furnace, leaving but one active unit at the works; the Fort Wayne Rolling Mills, Fort Wayne, Ind., has closed its plant for an indefinite period; the American Sheet & Tin Plate Co., Youngstown, O., has shut down temporarily 26 tin mills, with expectation of resuming at an early date; the Buffalo-Union Furnace Co., Buffalo, N. Y., has banked one of its furnaces, and the Doner Steel Co., in the same district, has also closed down a blast furnace at its works; the Follansbee Brothers Co., Pittsburgh, Pa., has closed down its sheet and tinplate mills temporarily at Steubenville, O., and Follansbee, W. Va., affecting about 2,000 men; the American Sheet & Tinplate Co., a subsidiary of the United States Steel Corp., has curtailed operations at a number of hot mills at its Farrell, Pa., works, with plans for resumption in the immediate future; the Shenango Furnace Co. has banked its furnace at Sharpsville, Pa.

In order to insure continuous operations at its steel mills the Central Iron & Steel Co., Harrisburg, Pa., has discontinued the use of coal as fuel at two of its open-hearth furnaces, and is now running on oil.

The Gulf States Steel Co., Birmingham, Ala., has all departments of its works in full operation, and is planning to increase production immediately at its finishing mills.

MISCELLANEOUS—The Stonecreek Brick Co., Stonecreek, O., has commenced operations at its local plant with all 8 kilns ready for service, on a working basis of 50,000 bricks per day.

The American Window Glass Co. has commenced preliminary operations at the No. 1 tank at its Kane, Pa., works; the No. 2 tank is in full operation and it is proposed to have the entire plant running at capacity before the close of the month. About 200 men will be added to the working force. The Interstate Window Glass Co., at this same place, is making ready to resume operations at its plant after a shutdown for about 90 days, and will give employment to about 250 operatives.

Owing to fuel shortage the Giant Portland Cement Co. has closed down temporarily its Central mill at Copley, Pa. Unless there is a change in the situation the company will soon curtail production at its Reliance mill in this same district.

The Summit Solvay Co., Birmingham, Ala., has placed its final battery of coke ovens in operation, making 240 ovens now in service, or full plant capacity. It is expected to operate on this basis for an indefinite period.

The American Brass Co., Waterbury, Conn., is increasing operations at its local mills, and is now consuming at the rate of more than 800,000 lb. of copper per day. The company is a subsidiary of the Anaconda Copper Mining Co.

The National Sulphur Co., Akron, O., is arranging for the immediate operation of its local plant and will recruit a working force of about 250 men.

The W. D. Byron & Sons Leather Co., Williamsport, Md., is running its local tannery at full capacity in all departments. A number of extensions will be made in the plant at an early date.

The Continental Leather Co., Wissimoming, Philadelphia, Pa., is maintaining active operations at good capacity at its local tannery.

Construction and Operation

California

OAKDALE—The Pacific Asbestos Corp., operating mining properties in this section, has preliminary plans under way for the construction of a new plant. Plans will be prepared at an early date. The company has recently been acquired by new interests headed by W. A. Sutherland, president of the Fidelity Trust & Savings Bank, Fresno.

LINDSAY—The Big Fertilizer Co. is negotiating with the local Chamber of Commerce relative to a site for the construction of a new plant for the manufacture of commercial fertilizer products. The initial works will cost about $25,000. George W. Abel is president of the company; A. M. Robertson, secretary of the Chamber of Commerce, is in charge of local details of the project.

MARYSVILLE—Local interests have organized a new company to construct and operate a plant for the manufacture of brick and other burned clay products. The initial works will have a capacity of about 10,000 bricks per day. Machinery will be purchased and operations placed under way at an early date. The company is headed by officials of the Shasta Lumber Co. and the Union Lumber Co.; L. E. Hite, L. A. Williams and Calvin Smith, all of Marysville.

SAN FRANCISCO—The Stauffer Chemical Co., 624 California St., manufacturer of sulphur products, etc., has tentative plans under consideration for the reconstruction of its building on Kearny St., recently destroyed by fire, with loss reported in excess of $75,000. The power house at the works was destroyed.

Florida

JACKSONVILLE—The Garage Equipment Co., 732 West Adams St., recently organized, is planning for the installation of machinery in a local building for the manufacture of chemical polishes, cements, and kindred specialties. L. P. Weathers is president; and O. T. Edwards, vice-president.

Georgia

ATLANTA—The Atlanta Glass Mfg. Co., recently organized with a capital of $500,000, has plans under way for the construction of a local plant for the manufacture of glass bottles, containers, etc. F. J. Cooledge, Jr., is president.

Idaho

SANDPOINT—The Lakeview Silver Mines Co., operating at the Conjecture mine, has tentative plans under consideration for the construction of a new concentrating mill, estimated to cost approximately $80,000.

Illinois

CHICAGO—Pratt & Lambert, Inc., 10 South LaSalle St., manufacturer of paints, varnishes, etc., has awarded a contract to P. J. & J. W. O'Connor, 189 West Madison St., for the construction of a 2-story addition to its plant, on North 26th St. near Princeton Ave., 50x150 ft., estimated to cost about $60,000.

ROCK ISLAND—The Service Rubber Co., 401 Central Trust Bldg., has commenced excavations for its proposed new 3-story plant on 2nd St., near 11th St., 60x300 ft., estimated to cost about $100,000, including equipment. Vervin & Horn, 311 Safety Bldg., are architects.

CHICAGO—The Swigart Paper Co., 653 South Wells St., has construction under way on a new 10-story and basement building at 715 South Wells St., 92x100 ft., to be used in connection with local operations, estimated to cost close to $500,000.

GRANITE CITY—The proposed new addition to be constructed at the local plant of the National Enameling & Stamping Co., estimated to cost about $1,500,000, will be used for increased production of coke and pig iron, and for the utilization of a greater number of byproducts from the coke ovens. The structures will include a coke-oven building, enlargement in blast furnaces, and extensions in the main steel plant, with new 3-story plate mill, 54x150 ft. Contract for the latter has been awarded to the St. Louis Structural Steel Co., National Bank of Commerce Bldg., St. Louis, Mo.

Indiana

GARY—The National Tube Co., Frick Bldg., Pittsburgh, Pa., has awarded a general contract to the Mellon-Stuart Co., Oliver Bldg., Pittsburgh, for the construction of its proposed new tube mill on the lake front at Gary. The works will consist of a number of furnaces with lap mills, butt mills and skelp mills, and are estimated to cost approximately $10,000,000, with machinery. The company is also perfecting plans for the early construction of a new battery of 140 coke ovens at this same location.

Kansas

LYONS—The Bevis Salt Co., Lyons, has plans under way for the construction of a new evaporating plant on local site, estimated to cost about $175,000, including equipment. A power house will be built and two electric turbines and auxiliary operating machinery installed.

Louisiana

SHREVEPORT—The Shreveport Brick & Tile Co. has acquired a tract of land on Douglass Island, comprising about 100 acres, as a site for the construction of a new plant for the manufacture of pressed brick and other burned clay products. The equipment installation will provide for an initial output of about 750,000 bricks per day. J. W. Peyton is president.

Maryland

BALTIMORE—The James Robertson Lead Works, Inc., 827 South Howard St., a subsidiary of the United Lead Co., 111 Broadway, New York, N. Y., has awarded a general contract to the Consolidated Engineering Co., 243 Calvert Bldg., Baltimore, for the construction of an addition to its plant on South Howard St. Charles E. McPhail is manager.

BALTIMORE—The White Co., 206 Water St., manufacturer of paints, varnishes, etc., has plans nearing completion for the construction of a 3-story addition to its plant to be equipped for general production.

BALTIMORE—The Maurice Chemical Co., 1427 Washington Blvd., D. E. Collins, president, recently organized, has plans under way for the establishment of a local plant to manufacture refractory and high-temperature furnace cements, and other products. A list of equipment to be installed is being prepared.

Michigan

PORT HURON—The Egyptian Portland Cement Co., Fenton, has leased the former

nops of the Grand Trunk Railway Co. ort Huron. Possession will be taken ce and the existing buildings remodeled mproved, and new machinery installed. planned to have the mill ready for ce early in the coming year.

AT ROCK—The Ford Motor Co., High-Park, will call for bids before the close e present month for the construction s proposed 1- and 2-story plant at Rock, for the manufacture of plate It is estimated to cost close to 0,000, with machinery. Albert Kahn, Marquette Bldg., Detroit, is architect.

Minnesota

PAUL — The Minnesota Wax Paper 1832 St. Anthony Ave., will commence mmediate construction of a new 1-story on Fairview Ave. near Roblyn St., ated to cost about $15,000.

Nevada

Y—The Nevada Consolidated Copper as plans in preparation for the rebuild-of its concentrating plant, known as fcGill concentrator, recently destroyed re with loss in excess of $1,000,000. new mill is estimated to cost approx-ely a like amount.

New Jersey

SEY CITY—The Robert Griffin Co., 151 field Ave., manufacturer of paper ucts, has filed plans for the erection of tory addition to its plant to cost about 00, exclusive of equipment.

ENTON — The Trent Tile Co., Klagg has awarded a contract to the N. A. K. ee Co., 206 East Hanover St., for the ion of a 1-story building at its plant, 56 ft.

ENTON—The Healey Bedson Pottery recently organized with a capital of 000, to manufacture sanitary ware, has ired property in Ewing Township, front-n the line of the Philadelphia & Read-Ry., and has plans under way for the ruction of a new plant. Work will be nenced at an early date. The company aded by Stephen J. Healey, Sr. and Jr., J. Harry Bedson, all of Trenton. Andrew ealey, 303 Washington Ave., Elizabeth, ., also an incorporator, represents the any.

WARK—The Essex Foundry, Murray anufacturer of iron castings, has com-ed the construction of a 1-story addi-84x110 ft.

New York

AMAPPAQUA—The F. W. Kraft & Sons Co., t Ave., Bronxville, N. Y., manufacturer ather products, has awarded a contract he Blaw-Knox Co., 30 East 42nd St., York, for the construction of a new ry tannery, 50x400 ft., at Chappaqua, nated to cost approximately $55,000. V. Kraft is president.

OCKPORT—The Lockport Foundries Corp. preliminary plans under way for the truction of a number of new buildings s plant. The capacity will be increased. ert E. Bryant is treasurer and general ager.

North Carolina

LTMORE—The Felstone Co., 326 Hay-l Bldg., Asheville, N. C., has completed s and will soon commence the construc-of a new plant at Biltmore, for the ufacture of ornamental concrete prod-The equipment installation will com-grinding and mixing machinery, ens. polishing apparatus, etc. The ini-structure will be 56x112 ft. C. Marshall Vatt is president.

SHEVILLE—The Southern Spar & Mica Haywood Bldg., has plans in progress the construction of an addition to its plant, for the manufacture of artificial ble products.

ILMINGTON—The City Council will soon nence the construction of a new filtra-plant at the municipal water works.

Ohio

KRON — The Falor Mfg. Co., recently nized, is arranging for the immediate ation of a new local plant for the ufacture of automobile tires and tubes, has leased the plant of the B. & W. ber Co. for its initial works. Machinery be installed at once to provide for an ut of about 2,000 tubes per day. Aaron r, formerly connected with the Good-Tire & Rubber Co., heads the organi-n.

EVELAND—The Otis Steel Co., Leader ., has arranged for the sale of bonds to mount of $5,000,000, a large portion he proceeds to be used for the construction of new plant additions. The extensions will include four open-hearth furnaces, sheet bar mill, blooming mill and strip mill, providing for an annual output of about 84,000 tons. It is planned to commence work at an early date, and have the structures ready for service late in 1923. G. Bartol is president.

Pennsylvania

PITTSBURGH—The Air Reduction Sales Co., 1100 Ridge St., manufacturer of commercial oxygen, acetylene, etc., has plans under way for the construction of an addition to its local plant. The company will also erect a new works on property acquired at Birmingham, Ala., to cost in excess of $200,000, with equipment, as well as an addition to its plant at Milwaukee, Wis. Headquarters are at 342 Madison Ave., New York, N. Y.

READING—The Consumers' Gas Co., Reading, has acquired property on Willow Grove Island, in the Schuylkill River, near the city, completing the acquisition of the entire island, and will use the tract for the construction of a new artificial gas manufacturing plant, utilizing bituminous coal as fuel, estimated to cost close to $1,000,000, with equipment. The company is a subsidiary of the United Gas Improvement Co., Broad and Arch Sts., Philadelphia.

ARNOLD—The American Window Glass Co. has preliminary plans under consideration for the rebuilding of the portion of its local glass manufacturing plant, including mechanical and other buildings, destroyed by fire, July 20, with loss in excess of $150,000, with equipment.

CLAIRTON—The Carnegie Steel Co. is said to be planning for the installation of a number of new batteries of byproduct coke ovens, totaling about 800 ovens in all, at its local plant. The project is estimated to cost in excess of $10,000,000.

LOCK HAVEN—The Borough Council has commenced the construction of a new chlorinating plant at the municipal water works. William T. M. Crowley, Pursley Bldg., Lock Haven, is engineer.

Texas

SISCO—The Sweetwater Cotton Oil Co., Sweetwater, Tex., has acquired the local plant of the Sisco Cotton Oil Co., and will take immediate possession of the property. The plant will be improved and operations commenced at an early date.

DALLAS—The Planters' Cotton Seed Products Co. has been organized with a capital of $100,000 to take over and operate the local plant of the Planters' Cotton Oil Co., recently acquired under bankruptcy proceedings. Extensions and improvements will be made and the mill placed in operation for the manufacture of cotton oil products, at an early date. E. L. Flippen, formerly vice-president of the last noted company, heads the new organization. Other officials are W. H. Jasson and Hugh E. Prather.

LAREDO—The Humble Oil Co. and the Pierce Oil Co., operating neighboring distributing plants, are planning for the rebuilding of the portions of their works destroyed by fire July 19, with loss estimated at close to $100,000, including equipment.

Virginia

WEBSTER — The Roanoke Brick Co., Roanoke, Va., has acquired the plant of the Roanoke Brick & Tile Corp. at Webster, and will take immediate possession. A number of improvements will be made to increase the present capacity of about 20,000 bricks per day. The purchasing company was organized recently with a capital of $100,000. W. W. Hobbie is general manager.

COVINGTON—The City Council will commence the immediate installation of a mechanical filtration plant at the municipal waterworks.

Wisconsin

PARK FALLS—The Flambeau Paper Co. has work under way on the rebuilding of its 2-story pulp and paper mill, recently destroyed by fire. The new structure will cost about $100,000, including equipment. Guy Waldo is general manager.

Washington

PRESCOTT—The Portland Flour Co. is reported to be planning for the rebuilding of its local mill, including power house and other mechanical departments, destroyed by fire July 22, with loss estimated at close to $1,000,000, with equipment.

Canada

FORT WILLIAM, ONT.—The Fort William Paper Co. is completing plans and will soon break ground for the construction of a new paper mill, adjoining its local wood pulp plant, estimated to cost about $1,500,000, including machinery. The local council has given the company authority to proceed with the work.

RICE LAKE, MAN.—The Gold Pan Mining Co. has preliminary plans under consideration for the rebuilding of the portion of its mill destroyed by fire July 19.

Mexico

TAMPICO — The Mexican Petroleum Co., Ltd., 120 Broadway, New York, N. Y., has commenced preliminary work for the construction of a new local oil-refining plant, estimated to cost about $2,000,000. A portion of the works will be given over to the production of gasoline, with equipment installation to provide for an output of about 800,000 gal. per day.

Industrial Notes

The Bethlehem Foundry & Machine Co., Bethlehem, Pa., announces that it has acquired all the capital stock, assets and equipment of the Wedge Mechanical Furnace Co. of Philadelphia. Henceforth the design, manufacture and sale of Wedge roasting furnaces will be conducted as a department of the Bethlehem Foundry & Machine Co., Bethlehem, Pa. All correspondence pertaining to roasting furnaces should be addressed to the Wedge Furnace Department of the company. Members of the operating staff of the Wedge Mechanical Furnace Co. have been retained, including Leslie H. Webb, whose services are available in a consulting capacity. The special facilities for laboratory, research and experimental roasting will also be continued. Inasmuch as the Bethlehem Foundry & Machine Co. has built these furnaces under contract for the Wedge Mechanical Furnace Co., it has all the necessary shop facilities to continue production on the same high plane that has characterized past performance. In brief, this change in ownership of the Wedge Mechanical Furnace Co. is no departure from past policies, service or product.

The American Gas Association has announced that its headquarters are located on the 18th floor of the Canadian Pacific Building, 342 Madison Ave., New York City. The telephone number at the new location is Murray Hill 4209.

The Conveyors' Corporation of America, Chicago, Ill. Announces that the Younglove Construction Co., United Bank Bldg., Sioux City, Iowa, has been appointed its representatives for the sale of American trolley carriers in northwestern Iowa, and in South Dakota. The American trolley carrier is equipment for handling coal from cars to storage pile or overhead silos by means of monorail and self dumping buckets.

The Electric Furnace Construction Co., 908 Chestnut Street, Philadelphia, manufacturers of electric furnaces, "Electro" steam boilers, etc., report an increase in capital and the appointment of the following new officers: P. H. Falter, vice-president and treasurer; Arthur G. Dickson, of Dickson, Beitler & McCouch, Philadelphia, vice-president and counsel and of the following new directors: John Gilbert, of Maderia, Hill & Co. William A. Webb, President Empire Coal Mining Co. T. H. Weisenburg. Frank Hodson retains the Presidency of the Company. P. H. Falter, the new vice-president and treasurer, is a graduate of the Engineering Department of the University of Michigan, and until recently has been vice-president and general manager of the Canadian Electro Products Co., at Shawinigan Falls, Quebec, a subsidiary of the Shawinigan Water & Power Co. Prior to his connection with the Canadian Electro Products Co., he had been general manager of the Baltimore Electric Alloys Co., in the manufacture of ferro-silicon and other electric furnace alloys, and for 13 years with the Aluminum Co. of America in various capacities, including design, construction and operation of a number of its plants. Mr. Falter was also general manager of the Shawinigan Electro Metals Co., Montreal, manufacturers of metallic magnesium, and he has also had considerable experience on hydro electric power plant work at Sault Ste. Marie and Shawinigan Falls, Canada.

The W. A. Jones Foundry and Machine Co., Chicago, Ill., announce that C. F. Ford, who for the past several years has been with the Chicago Pulley and Shafting Co. has joined its engineering sales forces. In the near future Mr. Ford will be located in Minneapolis as manager of the Jones branch there. Several years ago when the Jones Co. were in their old plant at North Avenue and Noble Street, Mr. Ford was their transmission engineer and acted in that capacity over an extended period.

New Companies

THE TITAN CEMENT CO., Ackerman, W. Va., has been incorporated with a capital of $500,000, to construct and operate a cement mill in this secteion. The incorporators are W. L. Sperry, J. W. Cook and D. R. Bartz, all of Ackerman.

THE MANUFACTURERS' KID CORP., New York, N. Y., care of the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa., representative, has been incorporated under Delaware laws with capital of $400,000, to manufacture leather. The incorporators are Harold J. Baldwin, New York; J. Albert Barton, Allentown, Pa.; and Franklin Haddock, Lynn, Mass.

THE RAYOLA CHEMICAL CO., Newark, N. J., has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are James Hughes, Thomas A. Webb and John H. Valentine, 126 Commerce St., Newark.

GREEN BROTHERS, INC., East Providence, R. I., has been incorporated with a capital of $50,000, to manufacture paper products. The incorporators are Frederick M., George F. and Harry E. Green, all of Providence, R. I.

THE SHINGLE-GIBB LEATHER CO., Philadelphia, Pa., has been incorporated with a capital of $180,000, to manufacture leather products. Walton Gibb, 4650 Locust St., Philadelphia, is treasurer.

THE NOVELOID WORKS, INC., New York, N. Y., care of C. S. Lubin, 55 Liberty St., representative, has been incorporated with a capital of $10,000, to manufacture celluloid products. The incorporators are A. Storch, F. Klein and L. K. Wasser.

THE SUMMERS FERTILIZER CO., INC., 210 East Redwood St., Baltimore, Md., has been incorporated with a capital of $150,000, to manufacture fertilizer products. The incorporators are Willis R. Dresser, Walter P. Summers and James E. Totman.

THE TUSCUMBIA COTTON OIL CO., Tuscumbia, Ala., has been incorporated with a capital of $50,000, to manufacture cotton oil products. The incorporators are Leon Reed and N. A. Graham, Jr., Birmingham, Ala.; and W. H. Jasspon, Houston, Tex.

THE EBECO CHEMICAL CO., Newark, N. J., has been incorporated with a capital of $125,000, to manufacture chemicals and chemical byproducts. The incorporators are Charles Yorhum and Joseph Ebert, 13 Margaretta St., Newark.

THE BERTDICK OIL & REFINING CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $1,350,000, to manufacture refined petroleum products.

THE FREEMAN-HAMPTON OIL CORP., Wichita Falls, Tex., has been incorporated with a capital of $112,000, to manufacture refined petroleum products. The incorporators are J. H. Freeman, J. W. Hampton and Nathaniel Henderson, all of Wichita Falls.

THE SUPERIOR STEEL PRODUCTS, INC., Detroit, Mich., has been incorporated with a capital of $30,000, to manufacture steel products. The incorporators are Harry D. McCullough, Frederick J. B. Sevald and James A. Dompier, 9367 Navarre Ave., Detroit.

THE HENRY A. DEWEY CO., New York, N. Y., care of Moffatt & Devlin, 342 Madison Ave., representative, has been incorporated with a capital of $20,000, to manufacture chemicals, paints, etc. The incorporators are H. L. Dewey, S. M. Moffatt and E. I. Devlin, Jr.

THE BURKHART-SCHIER CHEMICAL CO., Chattanooga, Tenn., has been incorporated with a capital of $60,000, to manufacture chemicals and chemical byproducts. The incorporators are A. C. Burkhart, M. E. Lane and John H. Cantrell, all of Chattanooga.

THE WEBBER-WOOD SPAR MINING CO., 911 Third St., Eldorado, Ill., has been incorporated with a capital of $50,000, to operate feldspar properties and mills. The incorporators are C. E. Webber, D. L. Wood and A. H. Kinsall.

H. C. ZEAMER, INC., Pleasantville, Pa., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws with capital of $500,000, to manufacture chemicals and affiliated products. The incorporators are H. C. and M. M. Zeamer, Pleasantville; and John E. Engle, Harrisburg, Pa.

THE FLINT STEEL CO., Davison Rd., Flint, Mich., has been incorporated with a capital of $75,000, to manufacture steel products. The incorporators are Edward H. Richmond S. and William L. Perkins, 1632 Garland St., Flint.

THE GRAY BROTHERS OIL CORP., Oklahoma City, Okla., has been incorporated with a capital of $50,000, to manufacture petroleum products. The incorporators are R. R. and C. C. Gray, both of Oklahoma City.

THE MELVILLE FERTILIZER CO., Tampa, Fla., has been incorporated with a capital of $100,000, to manufacture commercial fertilizers. Herbert M. Benker is president; Clarence W. Nelson, vice-president; and Fremont C. Stevens, secretary, all of Tampa.

THE T. H. E. HANOVER CHEMICAL CO., Hanover, Ind., has been incorporated with a capital of $6,000, to manufacture chemicals and chemical byproducts. The incorporators are James O. Taff, Charles A. Hunt and Earl Eldridge, all of Hanover.

THE LITTLE WONDER PRODUCTS CO., Burgettstown, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa., has been incorporated under Delaware laws, with a capital of $500,000, to manufacture washing compounds and kindred products. The incorporators are K. D. and John J. Downey and H. A. McLain, all of Burgettstown.

THE STATES OIL CO., Room 815, 118 North LaSalle St., Chicago, Ill., has been incorporated with a capital of 50 shares of stock, no par value, to manufacture refined oil products. The incorporators are G. A. Buresh and Louis I. Gottlieb.

THE MELCHERS FULLERS EARTH CORP., San Antonio, Tex., has been incorporated with a capital of $100,000, to operate mining and refining plants for the production of fullers earth and affiliated products. The incorporators are L. L. Shropshire, F. J. Dykstra and E. G. Potter, all of San Antonio.

THE CAPE FEAR FERTILIZER CO., Fayetteville, N. C., has been incorporated with a capital of $150,000, to manufacture fertilizer products. The incorporators are R. E. Nimocks, A. L. McCaskill and A. H. Slocumb, all of Fayetteville.

THE WILSON OIL CORP., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., representative, has been incorporated with a capital of $250,000, under Delaware laws, to manufacture petroleum products.

THE BRUMUND BROTHERS-HUFKER FOUNDRY, INC., 4406 West Carroll Ave., Chicago, Ill., has been incorporated with a capital of $5,000, to manufacture steel, iron and other metal castings. The incorporators are Henry O. and Elmer G. Brumund and John Hufker.

THE SUNSHINE SOAP CO., Shreveport, La., has been incorporated with a capital of $100,000, to manufacture soap products. W. A. Vickers is president; R. L. Mayfield, vice-president; and J. M. Crimmett, secretary, all of Shreveport.

THE BRIGHTON ELECTRIC STEEL CASTING CO., Beaver Falls, Pa., has been incorporated with a capital of $25,000, to manufacture steel and other metal castings. Earl D. Townsend, Beaver Falls, is treasurer.

THE DUNDEE FERTILIZER CO., Winter Haven, Fla., has been incorporated with a capital of $25,000, to manufacture fertilizer products. W. T. Overstreet is president; and Bradford D. Williams, secretary, both of Winter Haven.

THE GULF SUPERIOR PETROLEUM CORP., Chicago, Ill., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $3,000,000, to manufacture refined petroleum products. The incorporators are George J. Woods, M. S. Gregory and H. Wunderlin, Chicago.

THE NIAGARA FALLS SMELTING & REFINING CO., Niagara Falls, N. Y., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, to manufacture refined metals. The incorporators are Thomas J. Beardmore and Arthur Murphy, Paterson, N. J.

THE ROTHERT PROCESS STEEL CO., 622 Othello St., Seattle, Wash., has been incorporated with a capital of $1,000,000, to manufacture steel products.

THE WELLINGTON PETROLEUM CORP., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture petroleum products.

THE ALLIED CHEMICAL CO., Dallas, Tex., has been incorporated with a capital of $60,000, to manufacture chemicals and chemical byproducts. The incorporators are K. C. Scott, W. B. Sparkman and A. B. Farrington, all of Dallas.

THE GRAHAM CLAY PRODUCTS CO., Conneaut, O., has been chartered under state laws to manufacture brick and other burned clay specialties. The incorporators are Charles Follett and John W. Eckelberry, both of Conneaut.

Manufacturers' Catalogs

THE MCALEAR MFG. CO., 1901-7 S. Weste Ave., Chicago, Ill., has ready for distrib tion a new 128-page catalog, known as N 27, which illustrates many new devices, i cluding an individual temperature cont valve, specialties for all power plan vacuum and vapor heating system, oil fining and waterworks plants, plumbi systems and marine service, together wi illustrations showing their application a use. The individual temperature cont valve is self-contained and can be appli to any radiator, old or new, without ad tional piping other than the supply and turn. When the thermostatic member is for the desired room temperature, it au matically controls the opening and closi of the valve. The catalog contains a ve comprehensive detailed description of specialties.

THE UEHLING INSTRUMENT CO., Paters N. J., has issued Bulletin 113, on "Prep ing Flue Gas for Analysis."

THE YALE & TOWNE MFG. CO., Stamfo Conn., has issued a revised price list trolleys, cranes, switches, etc., which illustrated and described in Yale Cata 20D.

COOPER-HEWITT ELECTRIC CO., Hobok N. J., is distributing Bulletin 104, by L. Buttolph, on "Lab-Arc," a monochroma light.

E. J. CODD CO., Baltimore, Md., in a n bulletin describes chain screen doors furnaces and ovens, which have found plication in metallurgical, glass, chemi and boiler furnaces. The screen consists a multitude of individual strands of st chain, forming a penetrable transpar sheet of chain, which does not interf with the view of the interior of the f nace, the passage of the charge, or the to necessary for manipulation of the same.

THE NORTHERN ENGINEERING WOR Detroit, Mich., announces the publication a condensed catalog showing a few sta ardized designs of electric hoists.

THE TRUSCON LABORATORIES, Detr Mich., calls attention to a very attract "Architects Specification Handbook" wh has just come off the press. This book 108 pages, approximately 8½x11 in. binding is loose leaf, making the set specifications adaptable for use either a reference book for the A.I.A. filing syst or for any other classification adopted the architect's or engineer's office. It c tains complete specifications on waterpr ings, damp-proofings and technical coati

Coming Meetings and Events

ALPHA CHI SIGMA dinner, during Chemical Exposition, will be held Thurs Sept. 14, at 6:30 p.m. at Keen's Chop Ho 107 West 44th St., New York City.

AMERICAN CERAMIC SOCIETY will hol summer excursion meeting to Roches Montreal, Ottawa, Kingston, Toronto, H ilton, Niagara Falls and Buffalo, Aug. 13

AMERICAN CHEMICAL SOCIETY will h its fall meeting in Pittsburgh, Pa., Sep to 9.

AMERICAN ELECTROCHEMICAL SOCIETY hold its fall meeting in Montreal, Sept. 22 and 23. Headquarters will be at Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold annual convention and exhibition at At tic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING METALLURGICAL ENGINEERS will hold 126th meeting at San Francisco, Calif., 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREA will hold its International Steel Exposi and Convention in the General Mot Bldg., Detroit, Mich., Oct. 2 to 7.

NATIONAL EXPOSITION OF CHEMICAL DUSTRIES (EIGHTH) will be held in York Sept. 11-16.

NATIONAL EXPOSITION OF POWER MECHANICAL ENGINEERING will be hel the Grand Central Palace Dec. 7-13, the exception of the intervening Sunda

NATIONAL SAFETY COUNCIL will hol Eleventh Annual Safety Congress in troit, Aug. 28 to Sept. 1.

NEW JERSEY CHEMICAL SOCIETY has continued meetings for the summer, will resume them in October.

THE SOCIETY OF INDUSTRIAL ENGI will hold its next national convention exhibitions of labor-saving equipme the Hotel McAlpin, New York, Oct. 1 and 20.

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nsulting Editor
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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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R. S. McBRIDE
SIDNEY D. KIRKPATRICK
A. E. BUCHANAN, JR.
GRAHAM L. MONTGOMERY
CHARLES WADSWORTH, 3D
CHARLES N. HULBURT
Assistant Editors

olume 27 | New York, August 16, 1922 | Number 7

he Tariff on Its Last Lap in the Senate

USPENSE regarding the Senate's action on the) tariff will be ended on August 19, when, according an agreement reached last week, the final vote will taken. There will be a certain sense of relief on e part of the interested public when the vote is finally nounced, even though the provisions of the bill cannot ssibly satisfy everyone concerned. As the Senate s proceeded with the consideration of the bill and s successively taken its action on dye embargo, tash, wool and sugar, apparently without rhyme, rean or any attempt at consistency, the average citizen s grown dizzy in an effort to follow all the gyrations d forecast the final outcome.

As far as the chemical industries are concerned, the cture is not entirely devoid of relief from the deep ue in which some have painted it. It is true that e dye embargo has now been eliminated by both the ouse and Senate and that the only hope for its furer consideration is to have the Senate replace it in e bill on final vote next Saturday. If this is not complished, the feature is lost, because the conferees ll have no power to consider it again.

On the other hand, little fault can be found with e ad valorem and specific rates to be levied on coal-tar emicals. This is particularly true when we consider at the Senate has applied the principle of American luation to dyes and chemicals covered in sections 25 d 26 of the chemical schedule, with a further reinrcement in the form of the flexible tariff provision of e bill which gives the President the power to alter tes as much as 50 per cent in order to rectify inequales in cost of production abroad and at home. Of urse we would rather have the embargo, and we still pe that it will prevail; but if it does not, the dye dustry will have obtained a large measure of otection.

The outlook for potash is not so favorable. The nate fairly ran amuck in considering this item, not ly eliminating from the bill the proposed sliding scale duties, but also declining to consider a bounty on oduction. In other words, potash was thrown out of e Senate, bag and baggage. And unless it receives me consideration on final vote the matter will have to fought out in conference committee, for the House l contains provision for a sliding tariff.

As intimated above, the Senate has just taken action two important matters, both of which will favor the emical industry. These are the application of Amerin valuation to imports of coal-tar dyes and chemicals d the so-called flexible tariff provision that gives the esident the power to raise or lower the rates as much 50 per cent. In adopting both of these provisions e Senate made radical changes in the original proposals. American valuation was first applied to all commodities, but under an attack led by Senator LENROOT, the proposal was amended so as to apply only to coal-tar dyes and chemicals. The provision for flexibility in the rates was strongly opposed by those who object to vesting in the Executive the tax-levying power of the Congress. Nevertheless the President's own preference for flexibility in the tariff undoubtedly had some influence in the Senate's adoption of the measure. According to its provisions the Tariff Commission will aid the President in determining the difference in cost of production of commodities abroad and at home. The President cannot change a specific duty to an ad valorem duty, or vice versa, nor can he transfer articles from the dutiable and free lists. An important amendment to the original measure was one providing for public hearings by the Tariff Commission. In ascertaining the difference in the cost of production the President is directed to take into consideration the advantages granted to foreign nationals by their governments.

Considering the belligerent attitude of some of the Senators and the fact that the Senate has already greatly modified the House bill, it is practically impossible to forecast the final action on any of these provisions. These will be determined only by agreement among the conferees of the House and Senate.

The Bedrock of Facts and Figures

IN PLEDGING their whole-hearted support to the work of the new Chemical Division seventy-seven of our organic chemical manufacturers have added their approval to the constructive service which the Department of Commerce is rendering to industry. As more funds become available Secretary HOOVER'S plans are gradually taking effect and it is increasingly evident that the department under his direction will reach and serve practically every branch of business.

It is peculiarly significant that the chemical manufacturers' first demand on the division is for statistics. Apparently even the monthly figures for the imports and exports of dyes have already proved their value to these practical business men. It is well known that a part of the dye industry must look to the world markets for the disposition of surplus production that is inevitable with efficient operation. Likewise other factors in the industry must keep closest tab on incoming goods, for their market may be swept away by a tide of imports. These industries want the actual facts and figures on which to base the control of their individual businesses.

But accurate information on production, consumption and stocks is even more vital—both to industry and to the country at large. The primary cause of runaway markets during a period of inflation is usually the lack

of just such data. Distribution is carried on unintelligently. Stocks pile up in one place and shortage exists in another. With the latter comes a false demand which in turn results in overproduction, market demoralization and loss.

The new Chemical Division, if given support, can become a valuable distributor of the essential business statistics of the industry. Furthermore, our trade associations—those representing the manufacturing chemists, the synthetic organic chemical manufacturers and the chemical equipment producers—are ideal agencies for carrying on this work, and they will be ably assisted by the government and by such national organizations as the Chamber of Commerce of the United States. What is most needed is the support of the individual business man, who must be made to realize the necessity for furnishing his quota of the needed data. Industry will not be guided intelligently until he is willing to take the guess out of his own business and get down to the bedrock of facts and figures.

Armchair Chemistry And Its Value

RECENTLY there was abstracted in *Chemical Abstracts* a paper entitled "Odor Value Analysis." In it a theory was advanced that odor is the response of the olfactory nerves to intermolecular vibration. It was further advanced that each pure substance has its own rate of vibration, which may, however, be too high or too low to be detected, just as there is in vision an ultra-violet and an infra-red region. It was further pointed out that most substances having any perceptible odor are unsaturated in the chemical sense. In addition, the authors have stated that odor undoubtedly could be modified by the addition of substances which do not of themselves have a very characteristic odor. Many substances become almost odorless as they approach purity, and yet when the impurity is isolated, it itself has almost no odor. The final suggestion is that since this theory would indicate that perfumers are wasting large quantities of material simply by nullification, constructive research would consist of the design of the most delicate kind of instrument and the most careful scientific work.

This paper interested us a great deal. The suggestion is interesting in itself and the theory might prove to be workable and the result far reaching. It is the kind of paper that often makes technicians and research men scornful, saying that it is an armchair paper representing no laboratory work of any kind and proving nothing. We can sympathize with that attitude, for we always seem to sense a trace of superiority in such articles, an attitude which might be translated to mean, "Let other people do the manual labor, we have done the thinking." Yet with all the objections, such papers have a vital place in research. Too often the research man is wrapped up in the details of manipulation. With his nose too close to the grindstone, he fails to get his problems in proper perspective. He often misses some valuable leads.

This same criticism can be applied with tremendous force to industrial research. The "vital" problems of industrial research are too often problems involving merely technique. How valuable it would be for industry if there were some men who could sit back and suggest things which "can't be done."

For Him Who Runs

SOMETIMES we wonder whether readers of th magazine know of and appreciate the excellent wo that is being done on behalf of business by the Fabr cated Production Department of the Chamber of Cor merce of the United States. An able series of bulleti and pamphlets has been prepared, the last of whi came to our notice some months ago. It is entitl "Perpetual Inventory or Stores Control." In our opini there is not a manufacturing executive today who c afford to neglect the subject matter of this pamphl Doubtless the same information can be obtained fr other sources, for there are books and articles on t subject and experts ready to give advice. But t service which the Chamber of Commerce is performi in this connection, making available expert knowled on many phases of business, deserves the approbation those in whose interest the work is done.

Another report recently received from this organiz tion announces that uniform cost accounting has be adopted in approximately 120 lines of commodities. mentions the benefits which accrue from a unifo system. First of all it inspires confidence that selli prices are determined on a fair basis and thus mak possible more intelligent competition. Obviously if co are figured in a haphazard manner one man may be serious detriment to an industry by selling at a pr which he thinks would return a fair profit but whi actually entails loss. Finally uniform cost-accounti systems reveal at once the unprofitable commodities any manufacturing enterprise.

We have mentioned but two of the topics on whi the Chamber of Commerce has rendered signal serv to business. Executives who will take the trouble keep in close touch with this organization will find th time and effort amply rewarded.

Sawing Off the Branch On Which They Sit

QUITE recently the fact that engineers and techni men are intermediaries between labor and capi has been given much greater recognition. Upon th capital must depend for the efficient carrying out processes. It must count on their loyalty and enthusia to make possible that extra percentage of yield u which the success of the whole enterprise may depe This enthusiasm is no abstract thing; it is transla into everyday work. For example: A somewhat dish eled foreigner sticks his head inside the little of of the plant foreman or the chemist in charge. "A pomp he leak," he grunts. "All right, JOHN," repl the chemist. If the technical man is loyal, eager, enth siastic, he will go at once and repair the pump or that it is repaired. If for any reason enthusiasm s lacking, he will sit around a while before he mo Those minutes spell money!

Hence the enthusiasm of the technical man is most valuable asset of chemical corporations. To o anything to diminish this enthusiasm would seem, the face of it, blind and absurd. And yet in the p few years how many companies are there who have cut the salaries of technical men, often out of proport to the reductions made in other salaries and wages? T twenty or thirty per cent cut from the payroll of company seems like money well saved to the board

irectors or the executive who is pinched in his yearly udget. But is it? If these executives and boards of irectors had only had close contact with plants, they ould realize that the money saved on the books shows p as money lost through little items none of which is vident in the cost accounts. How enthusiastically will technical man throw himself into his work if his ervices have just been re-estimated at 80 per cent of heir former value? It is a problem in elementary uman nature, and one that can be solved if the execuives will only put on a pair of overalls and stay around ny chemical plant for a few days.

At the same time that the salary cuts were being nade, it is likely that the company was calling upon the oyalty of its employees. How little such companies nderstand elementary psychology! Loyalty can never e given when the aim of the corporation and the aspiraions of the individual do not coincide. Upon that rinciple hangs all the law and the "profit."

A "Bucket Shop" In Chemical Industry

IT LOOKS as though we have been unwittingly guilty of aiding and abetting the operations of a company hat has the earmarks of a wildcat in the chemical inlustry. Last winter we printed in our Searchlight Section an advertisement announcing positions in the ngineering, chemical, traffic and sales departments of company purporting to manufacture metallic aluminum and aluminum compounds. A 3-year minimum conract at a good salary with annual increases was offered o successful applicants. It was stipulated, however, hat they must take a financial interest in the company, which would be "solidly protected." "These are not jobs,' but positions with real future ahead." With housands of chemists unemployed, it is small wonder hat there was generous response to the advertisement.

It appears now, however, that the glitter was not gold ut basest dross. A correspondent recently told us that e left a good position to become factory superintendent or this outfit and that while he was there he produced tons of alum, which was "the only salable material which the company ever made." He found a rather esperate situation, with workmen unpaid and dissatisied, and he dug into his own pocket to assist their amilies. He personally received only part of his salary nd when he left the company it owed him several undred dollars on personal account and for money adanced to the workmen. Subsequently he saw the glitterng advertisement which was published in *Chem. & Met.* nd other technical journals and straightway protested t the main office of the company, accusing the officials of ad faith. He was urged not to "spill the beans." The fficials took him into their confidence and showed the ctual situation. Among other things there was a stack f replies to the advertisement from men offering to invest" anywhere from $500 to $30,000 for a good job. Our correspondent's protest against this method of oing business having failed, he promptly resigned.

Since then several men are reported to have "invested" n the company after leaving good jobs, and the comany has meanwhile been ousted from its manufacturing lant. Other correspondents tell of having applied for ositions and of growing wary when they learned that hey might be tied to a lot of incompetent men who had invested" in the company and could not be discharged.

Whenever an incident of this kind occurs we feel that an apology is due to our readers, because they are entitled to protection against the operations of wildcat and fake concerns. Needless to say, this advertisement slipped into our columns despite a standing regulation that should have prevented it. The lines have been tightened still further, however, and we believe that our readers will be safe from future exploitation by irresponsible advertisers. The reader is entitled to feel that he can place the same confidence in an advertisement that he does in the text of a technical magazine, and it is the publisher's duty to throw every possible safeguard around him and merit his confidence. In return the reader should give prompt notification of cases such as the one here cited so that immediate exposure can be made and further dupes prevented from investing in a chemical bucket shop.

New Ideas For Old Industries

SEVERAL weeks ago we published an article describing a revolution in the production methods of porcelain manufacture—a revolution that was wrought by men having no prior acquaintance with the industry. Long trained and thoroughly skilled in the production methods of other industries, they brought to the porcelain field a new viewpoint. They studied this field in the light of their previous experience, and by judiciously combining what they had learned elsewhere with the fundamental necessities in porcelain manufacture they accomplished truly remarkable results in increased production and lowered costs.

This also brings to mind an experience some years ago of a brewer acquaintance of ours. In the course of his business dealings he acquired the burden of ownership of a bankrupt motorcar plant. As this property stood when our friend acquired it, it was much more of a liability than an asset. Our friend made beer, and at that time hoped to continue to do so; and so he viewed his new property as something to get rid of as soon as he advantageously could. After some study, he determined that the fault was with the motorcar plant management and not with the product. So he carefully reorganized this management, using what he knew of brewing business methods as a basis and disregarding the mushroom-grown methods then prevalent in the automotive industry.

The results obtained were highly satisfactory, to say the least. In 3 years time he had established a steady market for his car, the plant was running profitably, and he was able to sell the property for a splendid sum. The impetus of his reforms holds to this day and the present owners have cut many coupons as a result of business ideas brought into their plant from a totally foreign industry.

It is with a knowledge of the possibilities of the outside viewpoint in mind, a knowledge based on many examples other than those cited above, that we are often filled with wonder at the attitude of so many plant owners and executives. They are so often hesitant to employ an engineer unless he has had years of experience in their own industry. And they angrily tell the consultant that he cannot hope to show them anything of value about a game of which he knows nothing and they know almost everything. Surely, if we will but delve a bit into our memories, we can all find examples at least as pointed as those given here of the surprising growth of the seed of a new idea when planted in the fertile soil of an old industry.

Readers' Views and Comments

Castings of Electric Iron

To the Editor of Chemical & Metallurgical Engineering

SIR:—Mr. Elliott, in his excellent paper read before the last meeting of the Electrochemical Society on "Cast Iron as Produced in the Electric Furnace, and Some of Its Problems" and republished in your magazine of July 19, thoroughly covers the subject from the standpoint of practice and utility. While the conditions as enumerated are those of Cincinnati or such other center near by blast furnaces, they do not hold on the Pacific Coast. To operate a cupola our problem is the obtaining of pig iron of quality and sufficient cheapness together with cheap cast-iron scrap. Freight on Eastern iron amounts to $14 to $19 per ton, depending on whether shipped by rail or water. Foreign irons can be laid down on the dock at about $30, but of questionable quality in the majority of cases. Cast scrap is now selling at about $23 per ton, and steel scrap for general melting at $14. As against these you have steel borings selling at $6 and cast iron borings selling at $7. With a conversion cost of $12 to $15 per ton in the electric furnace working on cheap scrap, you can readily see where cold melting is more economical than the refining of hot metal from a cupola.

When the Los Angeles Foundry Co. first started manufacturing electric furnace cast iron an acid bottom furnace was used, but this was quickly changed to basic, when it was found that we could not make a quality casting in the acid furnace. We have tried both duplexing and cold melting and prefer cold melt iron to duplex iron for several reasons:

1. It can be made from steel scrap with a low phosphorus content, giving a much stronger iron.

2. It can be melted down under strong reducing atmosphere with a carbide slag. This means that the period of refining is lengthened from ½ hour to about 3 hours. What is more important, the slag protects the metal during the period of fusing and melting, and before there has been any chance for the metal to dissolve oxides or gases which later cannot be removed.

3. Metal is never exposed to chance oxidation, as happens in the cupola when not properly running. It is a well-known fact that very often iron can be oxidized in the cupola, and even the most rigorous basic electric furnace refining will never bring that iron back into the quality class.

Electric iron is always more difficult to machine than cupola iron, and I thoroughly agree with Mr. Elliott that this is caused primarily by the elimination of microscopic gas pockets giving a much denser and sounder iron. Electric iron, however, can be so manufactured that it will have all of the excellent qualities of basic iron, and yet can be machined at high rates of speed. At the present time we are making gray iron castings of the analysis: carbon 3.25 to 3.75 per cent, silicon 2.00 to 2.50 per cent, manganese 0.30 to 0.50 per cent, sulphur less than 0.04 per cent, phosphorus less than 0.05 per cent which fills the conditions perfectly.

The above is a general statement of the conditions in the southern Pacific Coast region and especially under our conditions of operation, and while they are indicative of our experience, they may vary greatly in other sections of the country. The freight problem is a serious one out here, and from the general trend can see a great expansion in the manufacture of electric furnace iron in the future. With the wonderful development of the power companies there is the assurance of abundant electric energy to serve our future needs.

LARRY J. BARTON.

Los Angeles Foundry Co.,
Los Angeles, Calif.

Chemists in Public Life

To the Editor of Chemical & Metallurgical Engineering

SIR:—I wish to thank you for sending me the July 5 issue of *Chemical & Metallurgical Engineering*, as was very much interested in your editorial review of the question of the public and semi-public activities of chemists. Personally I think you have put your finger upon the weakness of the chemical profession, if it may be so called. In my very humble opinion, the reason the public has failed to appreciate chemistry and chemists has been due to the fact that chemists, as a class, have failed to distinguish themselves in the communities in which they live from the large group of manual workers. The reason for their tendency to become recluses and for their lack of interest in public affairs has always been a source of wonderment to me. University professors, as a rule, are not so subject to this criticism since they are, by the very nature of their work forced into a larger participation in community affairs unless they are research men.

As to the reasons for this condition, it has seemed to me that our university and college courses in chemistry lack what may be called directional emphasis. As a result a chemistry student who has seen the emphasis placed on laboratory work associates this in his mind as the goal of chemical training. If our colleges and universities had a short course in what may be called "vocational guidance for chemistry students," in which could be pointed out the opportunities for executive, administrative or consulting work and in which the obligation or opportunity of the chemist to his community could also be indicated, I believe the situation would improve within a generation.

As you know, I am connected with a company which receives a great many applications for positions each year from graduates of our universities. In practically every case the applicant asks for laboratory work and ceases to be interested when informed that the only openings available are in the operating, sales or administrative departments. In other words, the opportunity to use his training for what may be called mental task does not seem to appeal as does the opportunity to use his hands in mere mechanical laboratory work. I always wonder if laboratory work as such does not have a certain "play" appeal and possibly gratifies the instinct possessed by us all to manipulate apparatus in order to enjoy the glow of satisfaction derived from the successful outcome of the experiment.

Chicago, Ill. S. L. REDMAN.

The Business Side of Chemical Manufacture

This Article, the Sixth of the Series, Presents the Purposes, the Limitations and the Great Advantages of Cost Accounting—The Methods Are Briefly Discussed and a Few of the Practical Difficulties Enumerated

By Charles Wadsworth, 3d

F A young doctor has as much money at the end of a year as he had at the beginning and has paid his expenses, he calls it a good year. That may sound ther rudimentary as accounting. It is. But it is not whit more rudimentary than most commercial cost ding until quite recent years.

Of course it must be remembered that there was not arly so imperative a need for accurate costs until thin the last 30 years. Previous to that time the world as a manufacturers' market. Demand was always in cess of production, or nearly always. Manufacturing iciency was not so perfect and it was nearly impossie to flood the market in a short time. Therefore the lling price of a commodity was a comfortable fraction ove manufacturing costs. Since the margin was not close, the less complex problems of markets and disibution permitted the manufacturer to read the pulse his business from a number of indicators which perience has taught him to respect, such as sales, sh balance, bills receivable, bills due and the general eling of health or the reverse.

Modern cost accounting is a much more reliable and much more flexible method of observing and controlg any business. It is becoming a prerequisite to inlligent executive action. The modern executive can-t possibly keep in touch with his business as the l-time business head could. Therefore accurate cost alysis is coming to be his business eye.

One Danger of Cost Accounting

There is one very great danger in this and it is the nger into which many large corporations have fallen. st analyses look much the same in one business as in other. So, frequently, a successful executive in one e of business sees a set of cost figures from another e of business and as they look perfectly intelligible, is confident that he understands them. He sees at the trouble is. He says so. Boards of directors lieve him. He is invited to take charge of such and ch a company. If this new company is a chemical nufacturing company and he has had no experience that industry, heaven help the company. Even execues who have grown up in chemical plants, but whose in contact is now through costs, often do absurd ings. In our last article on plant yield we mentioned almost universal example of lack of executive con-t with manufacturing conditions. The query as to y such and such a yield is low or such and such a t is high when the variation observed is within the ssible limits of accuracy illustrates the lack of execue contact and the danger of depending too much on sts.

The Aims of Cost Accounting

Cost accounting must be developed as a theoretical stem first and then some practical considerations cussed. Naturally, in an article such as this, telegraphic brevity and glaring omissions must be the rule, but we can perhaps give some conception of the advantages, the difficulties and the methods of cost accounting in chemical plants. Many manufacturers have objected, and many still do, that their business is unique and ordinary cost accounting could not be applied. They further object to the cost of installation and operation. Finally, when it's all in, what have you got? Can you tell him anything that he doesn't know? He's getting as much as the market will stand for all his products and he's making money!

The answer should be cautious and not sweeping. Cost accounting, Mr. Manufacturer, will tell you many things that you don't know. It will show you what factors go into the manufacturing cost and it will enable you to put your finger on the items that are costing too much. It will segregate the selling cost and indicate whether that is too high. It will enable you to determine which of your products is the best money maker. Perhaps some are actually losing money. It will show you the definite price limits of raw materials and labor. It is true that the system will cost something to install and something to operate. The forms cost money to print and take time to fill them out. The accounting department will have to be increased. But the expense will be small compared with the gain. We urge you to try it, but not until you and your whole organization understand and believe in cost accounting. Your men must realize that it is not a spy system and that it is to their interest to make the system accurate and dependable. Unless they are behind it the system will have relatively small value. (Many fail to appreciate the necessity of the co-operation of the men in this work.)

How Accurate Are Costs?

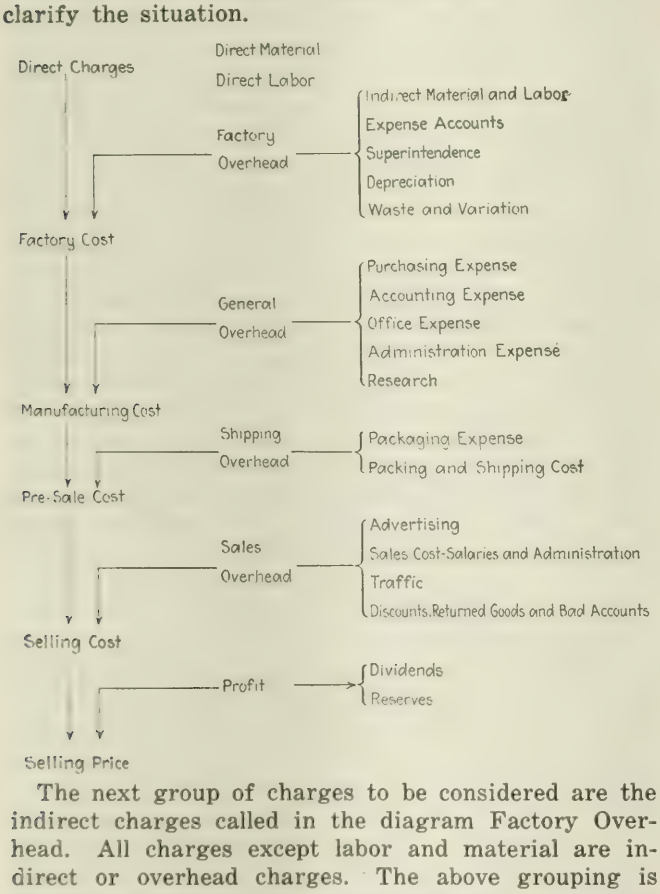
As we discuss the details of cost accounting it will be readily seen that the accuracy of the system will be directly proportional to its cost. The point of marginal utility must be determined. For example, it might be possible to estimate costs with an accuracy of 10 per cent under a given system. With a few more forms and an extra clerk or so the accuracy might well be increased plus or minus 2 per cent. Still further refinement would be possible at increased cost, but might be considered unnecessary. For example, assume that handling and trucking of material amounted to a considerable item. The total cost might be split equally among the products. However, an accurate distribution could be obtained only through a voucher and order system. This might make a difference in cost of some of the products amounting to several per cent, due to greater accuracy of distributing the charges. Is that greater accuracy worth while? It is a question which must be specific, but which should always be asked. Relatively few do ask the question, for the tendency is, if you have a cost system, to go the whole hog and install many wholly unnecessary forms.

All cost accounts are based on systematic arrangements of expenditures. Payments by the company are recorded in books of original entry, usually called journals to distinguish them from ledgers, which are the books of final entry. A typical journal account would be "payrolls," to which all money paid to employees would be debited each week. The account is then credited as the various amounts are charged out to the plants in which the employees worked. When the credits equal the debits the account is said to be balanced or "wiped out." Journal accounts are wiped out as frequently as possible.

Those items of cost which can be charged directly from the journal accounts to the departments as above are called Direct Charges. These are of two kinds—Direct Material and Direct Labor. The terms signify that the material and labor so itemized were definitely used in that process. That much of cost finding is simple, accurate, unquestionable—BUT

Indirect Charges—The Real Problem of Cost Accounting

Before we go further a simple diagram will help to clarify the situation.



The next group of charges to be considered are the indirect charges called in the diagram Factory Overhead. All charges except labor and material are indirect or overhead charges. The above grouping is somewhat arbitrary, but is a very frequent practice and can be commended because it is comprehensible. Indirect charges cannot be made directly from the books of original entry to the proper ledger account. The charges are first grouped under intermediate accounts with proper headings. For example, the journal payroll account is debited to process ledger accounts and, as far as repair and shop men go, to a shop account which is an intermediate account. From this account time is charged out on a basis of orders by different plants. Another type of indirect charge is an account such as superintendence which is split up not by an order system but on an arbitrary percentage basis. One general principle which should be followed in making indirect charges is that under no circumstances should an extraordinarily large charge be made in a given period to boost the cost of production unduly. If a large amount of repair work is undertaken in a given month or fortnight it would be decidedly unfair to charge all of that repair work to the cost of making the material produced in that short time. To avoid this a special account is opened called deferred charges to expense and this account is gradually wiped out by crediting monthly (or fortnightly) charges made to various ledger accounts. This is also the method for handling such charges as taxes and insurance where payments are made once or twice a year and the amount distributed to the various producers periodically.

If we now return to the diagram the various items deserve some more detailed consideration.

Indirect Labor and Material—For example, repairs are made on a piece of equipment. The wages of the shop men, machinists, carpenters, etc., are charged out of the Payroll Account into a shop account and the time consumed on that particular repair job is charged against the department in question. Similarly the material used on the repair has been debited to Stores and is now charged out to the department. Again, oilers and motor repair men who work in a number of departments are charged to a general account and the account divided appropriately. Material handling and trucking in the factory are also included in indirect labor.

Expense Accounts are more difficult still. Such items as steam, electric power, compressed air, rent, taxes, insurance can not be easily evaluated for a given product. The total cost of such items for the whole plant must be obtained by accumulating all the charges in accounts with proper headings. Then these charges must be distributed according to the amount of steam or air or power consumed or, in case of rent or insurance, according to the value of that part of the property used by each department. Obviously this involves either measurement or estimation of the quantities distributed in the first instance. This can be accomplished with more or less inaccuracy.

Superintendence is again an item the total cost of which must be divided. Shall the division be based upon the capital value of the individual plant, upon the total value of the product made, or upon an estimated proportion of time spent on each plant? In instances where the superintendence charges are high, the policy of distribution would make an appreciable difference. This brings us to a generalization which is extremely important. *Costs can be made to vary to an amazing extent depending on the policy of distributing overhead charges.*

This will become more and more apparent, and right there is the meat of the whole problem of cost accounting. It is the reason why standardization of costs is difficult. One manufacturer distributes his overhead charges according to the capital value of his respective units, another according to the value of the product made. One may include research as a capital charge to be written off. Another prefers to write it off as current expenses. All these variations make for variations in cost. In other words, it amounts to this: The distribution of indirect charges is a matter of business policy and this fact makes it impossible to say *this* is the right way to distribute your overhead charges

There can therefore be no absolute method or figure for osts no matter how accurately the system is devised. t is well to bear these facts in mind when you are dealng with costs. They are not heaven-sent mathematical ertainties, but they represent an intelligent approxiation and the most valuable instruments yet devised or determining business health.

Depreciation—the Greased Pig of Cost Accounting

A prime example of the effect of business policy upon osts is evident from the treatment of *Depreciation.* A good friend of mine remarked that a discussion of lepreciation resembled a debate on free will or deerminism. It reached no definite conclusion as to what vas ultimately correct. Depreciation represents the liminution in value which equipment or buildings ndergo with use and time. Some accountants believe hat depreciation should be figured at a definite per ent of the original value. A machine costing $5,000 f depreciated at 10 per cent per year would have values f $4,500, $4,000, $3,500, etc., at each succeeding year. nother theory would depreciate at a fixed per cent of hat year's value. ($5,000 at 10 per cent equals $4,500 t the end of 1 year; $4,500 at 10 per cent equals 4,050 at the end of 2 years, etc.) Others believe that epreciation should be modified to correspond with the eplacement value of the equipment. For example, at he end of 3 years the cost of the $5,000 machine is ctually $6,000. Ought not the amount written off e a definite percentage of $6,000 instead of $5,000?

Remember the theory behind depreciation is to set side out of profits a reserve for replacement of equipent. It has always seemed to me that the simplest ethod of figuring depreciation should be followed and ne percentage set high enough so that there is a defiite factor of safety in it. The same policy should be dopted in determining depreciation that is used in eciding about the installation of new types of equipent. In some industries—for example, cement—new quipment is installed if it can show a 20 per cent eturn on the investment. Therefore a conservative epreciation rate in that industry would be between 0 to 15 and a normal depreciation about 10 per cent.

Many industries and firms are foolishly demanding nd frequently miss extremely good investments on nat account. They will not invest in changes of equipent unless the return amounts to 100 per cent in a ear. Heavy chemical firms are notably conservative nvestors and their depreciation rates are usually high.

Another refinement in estimating depreciation consts of estimating the rate on each piece of equipment eparately or each major piece costing over a definite mount. Except as a method of arriving at the average epreciation in a given unit, this does not seem necesary or wise. What you are after really is an adequate eserve for replacement and an estimate of the capital alue of the plant on which interest must be earned. can be rather easily understood if a small company e considered, with investment of $50,000 in equipent. The value of that equipment will depreciate , say, 10 per cent a year. Then in 2 years it will be orth $40,000. Out of the profits a reserve for dereciation should have been set aside in that time of 10,000. Thus the total capital will be the same.

As a matter of fact this is not universally done. irms will spend a tremendous amount of time estiating depreciation rates with great care so that costs will be accurate and income taxes as low as possible, but no cash reserve is set aside for depreciation in any way. It is just a book figure and has only theoretical significance.

Still another factor of depreciation is commonly called *Obsolescence.* It refers to the decrease in value of a machine due to the development of better manufacturing processes. In some industries obsolescence is a much larger factor than depreciation, and in all businesses it must be considered.

There is yet another difficulty introduced into cost accounting by the necessity of meeting definite specifications. Some of the material may not come up to standard, in which case it may either have to be marketed at a loss, discarded completely or worked off in batches of standard material. The cost treatment obviously will vary with the method of disposing of the material. The treatment of waste, or spoilage as it is called, is most difficult when the material must be discarded. How shall the loss involved be treated? Shall it be accumulated in a special account and written off in small monthly increments, or charged off once a year in the profit and loss account? The former way is preferable.

General Overhead

Following the desirable doctrine of simplicity, a large majority of firms add all the charges for purchasing and stores, such as salaries, wages, etc., to one general account. This account is fairly regular and is wiped out each month (or period) by debiting it proportionally to the ledger accounts. There is a more complicated method which consists of wiping out the purchasing and stores accounts by adding a small fixed charge to everything that is purchased to cover the cost of purchasing. This requires more bookkeeping and is scarcely worth the effort.

An exactly similar procedure to that given in the first part of the last paragraph can be followed with the distribution of Accounting Department Expense, Office Expense and Administration Expense. Each of these items is fairly steady and thus the general overhead does not offer as much complication as the factory overhead. The amount varies very slightly from month to month and it is entirely safe to wipe out the account from month to month. No deferred charges need arise. The differentiation of the General Overhead from Factory Overhead is entirely logical. Even in firms which operate only one factory and therefore do not compare one factory cost with another, the practice is desirable. The types of accounts are quite different.

Cost of Packaging and Shipping

Just a word is needed on this point. The charges embraced in this heading are not strictly manufacturing charges and should therefore be segregated under a separate heading. This is exceedingly convenient, as the cost of this item is frequently higher than necessary. Much attention is devoted to production efficiency in the plant and often many hundreds of dollars are wasted by letting this item slide by.

In many industries there are very big problems involved in this work. Carboys, barrels, drums, etc., are returnable and represent a very large capital investment in themselves. Definite regulations in the crediting of these items must be followed and enough margin allowed to take care of repairs. Replacements should

take care of themselves. The whole container system should as nearly as possible be on a self-supporting basis. This is usually taken care of by a service charge included in the price of the commodity and credited to a special fund for taking care of these items.

Selling Overhead

Finally, after production expense is all accumulated, the cost of selling the product must be added. This means that the cost of advertising, the sales department expenses, including many items not usually thought about, such as warehousing expenses, freight to distributing points, trucking, etc., must be collected in appropriate accounts. There is opportunity for many complications in this work. Take this little problem. Sulphuric acid and alum are sold by one firm. Assume that sulphuric acid is placed largely on contract during October, whereas alum is sold largely on spot sales throughout the year. The volume of sales is the same as to cash value, but the alum is literally ten times as difficult and expensive to market. Is it fair to split the selling expense equally? In such a clear-cut case as the above it might be possible to make a fair distribution, but in practice such clear differentiation does not exist. Therefore distribution is usually carried out on the simpler basis of cash value of product.

Computing Selling Prices

With the addition of the selling overhead we have completed the compilation of the total cost of the product. To this must now be added whatever profit is to be made in order to determine the selling price. That sounds like putting the cart before the horse. Many executives and most salesmen would be inclined to laugh at "adding whatever profit is to be made." The idea is that the most you can get is the correct profit. However, the mechanism of calculating minimum prices and the extensive use of these in the chemical industry make the above statement pertinent. One of the main advantages of cost accounting is that it will tell you when a product is losing money and it is losing money when the total cost plus a fair return on the capital invested is greater than the selling price.

Interest on Borrowed Money

Up to the present time no mention has been made of interest on borrowed capital. Many cost accountants believe that it should be considered an expense and treated exactly as an expense account is treated. It is more logical, however, not to include it in the manufacturing cost. If the capital was not borrowed, but subscribed by the owner, there would be no such item in the cost. Therefore it should be taken out of profits and not added as an expense. This is a rather moot question and the confusion arises from the fact that interest on bonded debt or stock dividends must be paid and are therefore regarded as fixed expenses. Actually, however, they do not belong in manufacturing cost. The disposal of profits to proper reserves, etc., is not a problem of cost accounting but of business policy, and does not belong here.

Some Plant Problems in Cost Accounting

Cost of Raw Materials. It is easy enough to write down the cost of material when it is purchased from an outside source at a definite cost. But suppose you made a product in one department, consumed part of it in another department and sold the rest, how muc should department 2 pay for product made in depar ment 1? Shall it pay market price or manufacturi cost? There is no correct way of handling this pro lem. It is a matter of business policy solely. It wi make a decided difference in the profit made on eith product and executive decisions must in either ca take into consideration these variations.

Joint Products and Byproducts are also difficult handle, since any distribution of cost is arbitrary. T only fair way is to consider the profit on the group a whole. Take the example of muriatic (hydrochlori acid and saltcake (sodium sulphate). Both of the products are made in the same reaction. If an ar trary distribution of overhead is made, it is concei able that a greater profit might be found in muriat whereas on another basis a greater profit would accr from salt cake. It would be folly therefore to specia ize in the sale of one under the mistaken idea that mo money could thus be made. The above is precise what happened in another process in my own exper ence. Beware of squirrels!

Research is a difficult thing to handle from the a countant's standpoint. First, what is it? In additi to laboratory research, this item includes developme work, drafting work, design and engineering wor In other words, all things tending toward production material which do not represent real value. It is t "overhead" of plant construction cost. The distinct is not clean cut and is ultimately a matter of degr rather than kind.

For accounting purposes it can be divided into r search on products already manufactured and resear on new products. This division is somewhat depende also on the kind of industry. Dyestuffs and fine chem cals have the largest ratio of research per unit capit and it is usual for them to write off the research charg into current expenses by adding an amount equal to average of the past 3 months. This procedure is d sirable, as dye processes may have very irregular u and may not be able to bear their share of any amo ization of capital charges annually.

Postlude

Do you now resemble the sweet young lady who t the clergyman that he had made the subject of fr will prefectly intelligible? Do you understand c accounting perfectly? Well, neither does anyone el but as it is the greatest single aid to intelligent prod tion, it would not be a bad idea to study it.

This series of articles on the Business Side of Che cal Manufacturing ends with this article. This mea simply that the six articles originally planned ha been published. Other articles will appear from ti to time, and we have the promise of special articles these non-technical phases of chemical manufact from eminent specialists. The subject is too vital leave and it shall be one of the purposes of *Chemical Metallurgical Engineering* to awaken the technical m to the vital nature of non-technical work and the necessity of his mastering the technique of th departments if he is to attain to effective execut positions. At present he is too much dominated the business man whose mastery of business techni has made him more valuable to industry than the te nical man without it. This has been bad for indus as well as for the technical man.

A Visit to the Plant of the Nobel Industries, Ltd., at Ardeer, Scotland

By Ellwood Hendrick

AN INTERESTING feature of the Glasgow meeting of the Society of Chemical Industry was the visit to the Ardeer works of the Nobel Industries, Ltd. The party was restricted to 100 persons, who left Glasgow on a special train and arrived at the factory about 10 a.m. Here, after giving up all smoking materials, cigar lighters and matches, the visiting company was divided into several groups of about twenty, each group being placed in charge of one of the chemists of the establishment for an inspection of their various departments. The passage through the sulphuric acid and nitric acid plants was just rapid enough to be a bit tantalizing, but the whole tour gave a clear idea of the general arrangement of the works. At noon the company met in the great hall of the club building for lunch. Sir Hugh Anstruther, vice-chairman of the board, presided and Lord Cochrane of Caith, together with one or two other directors of the corporation, was present as well as many of the staff. A quality of measured and proper conviviality reigned which was unusual to those of us who are accustomed to lead from dryness rather than the bottle on festal occasions.

The chairman made a short address in which he declared that their research staff had been their key to progress. Business, he said, was dull; they were working only 5 days in the week; but they continued to promote research at all times with energy and fervor, as their best means of making advancement. Without it they could not have done their work during the war successfully, nor could they have continued to produce needed things up to the armistice. Dr. Armstrong, the new president of the Society, made a happy response, and then the company was off again to witness a series of demonstrations of the testing of blasting explosives and demonstrations of some of the properties and of several applications of explosives.

It was noted in a descriptive pamphlet given to each visitor that in some explosives, such as black powder, the burning of successive layers of the substance takes place at a velocity of only a few meters per second, whereas in the more modern blasting explosives the combustion travels through the mass at from 1,000 to over 8,000 meters per second. This rapid type of explosion is called detonation, and the impulse passing through the mass is called the detonating wave. A few

FIG. 1—VIEW OF ARDEER FACTORY OF NOBEL'S EXPLOSIVES, LTD., SHOWING ACID PLANTS

detonating explosives, such as mercury fulminate, flash almost immediately when ignited, whereas others explode only after burning for some time; or they may burn up entirely without detonating. The former more sensitive detonators are used to initiate the wave in the latter. Thus a metal tube containing the initiating explosive is imbedded in the mass of the other and then ignited by safety fuse or an electrically ignited composition, which detonates the main explosive.

Experimental Demonstrations

Three experiments showed the difference between an explosion caused by rapid burning and one due to rapid detonation. The demonstrations included an explosion of gunpowder by safety fuse alone; an explosion of dynamite by a detonator fired by a safety fuse; the explosion of dynamite by a detonator fired electrically. A second series showed 8 oz. of Cambrite No. 2 ignited by a flame and 8 oz. of Cambrite No. 2 detonated by a No. 6 detonator. The differences were very marked and the experiments most instructive. Demonstrations were also made of the testing of blasting explosives. The "power" of an explosive is a function of the actual pressure developed by the products of decomposition, which are chiefly gaseous at the time, and of the velocity at which the pressure is developed. To determine the former, the lead block test is made.

The apparatus for this test is a lead cylinder containing a cylindrical cavity into which a given weight of the explosive to be tested is placed, tamped with dry sand, and fired. The cavity so produced is measured by pouring water into it from a measuring cylinder and comparing it with the amount needed to fill the bore before the explosion. This determines the shattering effect.

The ballistic mortar test determines the gas pressure developed or the heaving effect. In this test, the explosive is contained in a horizontal cavity in a steel block or mortar which forms the bob of a huge pendulum. The shot is tamped by means of another steel block which forms a sliding fit into the first. When the shot is fired the tamping block is propelled into a sand bed beyond it and the pendulum is swung back in the opposite direction. A marker shows how far, on a circular scale, the pendulum has swung.

Velocity of Detonation

The velocity detonation test is an important factor in testing the quality of an explosive and the method is very ingenious. A quick explosion is suitable where the size of the fragments is of no importance, but if too great pulverizing action is to be avoided, as in quarrying or getting out coal, then an explosive of comparatively slow detonation is desired.

The apparatus consists of a thin lead tube containing a core of TNT. This is called "TNT fuse," because the detonation wave travels through TNT at a very uniform rate. If a length of this tube is detonated simultaneously at each end, the detonation wave will meet at exactly the middle point of the fuse, and this point may be readily found by laying the fuse on a lead bar; then the point at which the detonation waves meet is clearly shown by the presence of a fine line across the lead bar, perpendicular to the fuse. But if the ends of the fuse are detonated successively by a detonation wave which travels along a cartridge of known length of an explosive to be tested, then a certain time will elapse between the detonations at the respective ends of the TNT

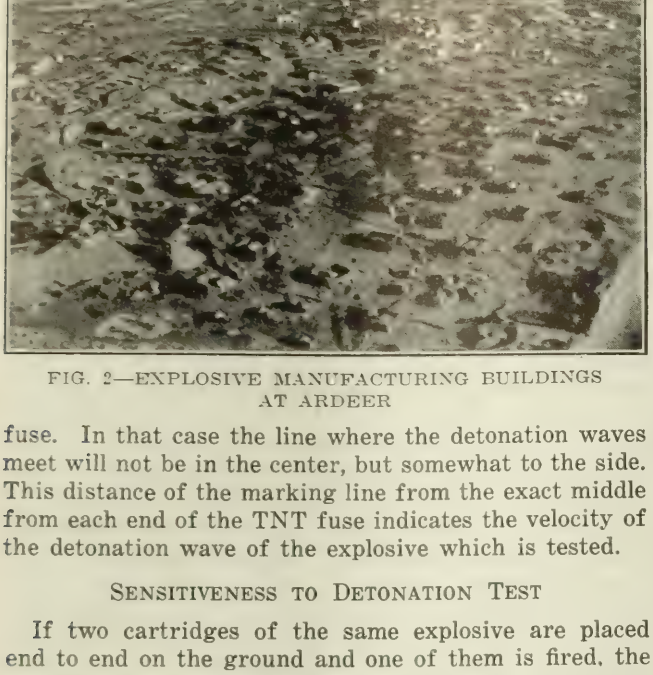


FIG. 2—EXPLOSIVE MANUFACTURING BUILDINGS AT ARDEER

fuse. In that case the line where the detonation waves meet will not be in the center, but somewhat to the side. This distance of the marking line from the exact middle from each end of the TNT fuse indicates the velocity of the detonation wave of the explosive which is tested.

Sensitiveness to Detonation Test

If two cartridges of the same explosive are placed end to end on the ground and one of them is fired, the detonation of the first is transmitted to the other. If the experiment is repeated, gradually increasing the distance between the cartridges, it will be found that the range of transmission is not the same for all explosives. The maximum distance at which one cartridge can propagate explosion in another is known as the Ardeer double cartridge test or the "A.D.C." Cartridges were shown which failed to "catch" an explosion this way at 4 in. distance from the same kind of cartridges which were detonated, whereas another flared up when placed as far as 24 in. distant from a similar cartridge that was shot.

Safety Explosives Gallery Test

This determines how far it is possible to go, or rather how much of a "safety" explosive may be fired in a mine in the presence of fire damp or coal dust. The company's "gallery" is a long steel chamber like a long boiler, into which a mixture of coal gas is introduced and openings in the gallery are sealed with paper. Coal gas is introduced so as to produce an explosive mixture with air. Then varying amounts of the explosives to be tested are shot into the container. When an explosion ensues, it is known that the limits of safety for that powder have been reached. Similar tests are made with coal dust and air mixtures.

The final series consisted of demonstrations of some properties and practical applications of explosives. Three dynamite cartridges were fired successively, the first in the open air, the second partly confined, and the third tamped on an iron plate. The third experiment showed a method in use for cutting steel plates in the destruction of old ships. To show the use of explosives in the removal of obstacles, a wooden palisade was set up and a row of cartridges laid close to the foot and confined by banks of the earth. To dig a trench for drainage purposes a row of holes was bored in the ground along the line of the proposed trench and a cartridge placed in each hole and exploded. A large cast-iron cylinder, which was the top section of a nitric acid pot condemned to the scrap heap, was broken into two pieces by the application of a plaster charge to the inner face of that portion of the ring which was next the ground.

A large cast-iron pot was also consigned to the scrap heap, but owing to its size and shape, a plaster shot would have been dangerous on account of the flying pieces of metal. In this demonstration the pot was filled with water and the explosive suspended in the center and fired. The water acted as a transmission medium, causing a heaving pressure against the sides of the pot, breaking it up into small pieces very effectively and within a comparatively small area. Then followed demonstrations of distress and sound signals designed for ships at sea, and finally a chimney stack was demolished and caused to fall in a definite direction by removing bricks from the base of the stack, leaving only supporting pillars on the side on which it was required to fall. The pillars were then bored and charged with the required weight of explosive.

An extensive exhibition was provided in the club building of materials made by the corporation at its various plants which, besides explosives and the heavy chemicals to make them, included gas mantles, celluloid materials, nitrocellulose cements and varnishes, plastic wood, metal goods, bicycles, soaps and other materials.

Heat-Treating Steel Castings to Spheroidize Cementite

By using proper magnification, it is usually possible to resolve the eutectoid areas of well-annealed carbon steels into lamellar pearlite. It has ordinarily been supposed that an extremely long anneal just below Ac is necessary to spheroidize the structure—i.e., cause the cementite plates in the pearlite to break and ball up into small spheres, through the influence of surface tension.

H. C. Ilsen points out, in July *Forging and Heat Treating*, that a steel having spheroidized cementite is analogous to a good bearing metal, in that it contains small hard particles which resist wear imbedded in a relatively soft, tough matrix. He tested some open-hearth cast steel (C 1.0 per cent, Mn 0.71, P 0.045 S 0.042 and Si 0.37) which after annealing 2 hours at 1,400 deg. F. showed a pearlite structure, coarse fracture and the following physical properties: tensile strength 103,100 lb. per sq.in., yield point 56,640 lb per sq.in., elongation 6 per cent in 2 in., reduction in area 6.3 per cent, and Brinell hardness 233. $Ac_{1,2,3}$ for this steel was at 1,325 deg. F., and Ac_{cm} 1,485.

Results of several heat-treatments are given, from which it appears that after correct preliminary heat treatment, this steel can be spheroidized by a 1-hour draw at 1,300 deg. F. Best results were had by a rather complex heat-treatment: Anneal 2 hours at 1,400 deg F., to equalize the phosphorus and other solid solutions Quench in oil after 30 minutes at 1,600 deg. C. to effect fine dispersion of the carbide. A similar quench from just above the lower critical (1,370 deg. F.) is then necessary to prepare for the spheroidizing, which is effected by 1-hour stay just below the transformation range (furnace cooled from 1,300 deg. F.). This treatment gives a test-bar having ultimate 98,550 lb. per sq in., yield point 65,990, elongation 19.5 per cent, contraction 26.2 per cent and Brinell hardness of 196 Practically the same result, except that the contraction is about 20 per cent, may be had if the hardening treatment be omitted.

Commercial Furfural— Its Properties and Uses—I

Part I of a Paper Describing This Laboratory Curiosity Which Has Lately Become an Important Industrial Aldehyde — Its Occurrence, Manufacture and Properties

By Carl S. Miner, John P. Trickey and Harold J. Brownlee
The Miner Laboratories, Chicago, Ill.

FURFURAL occupies an anomalous position in the realm of chemistry. It was first prepared nearly a hundred years ago and for forty years it has been utilized in a standard and widely used analytical procedure. Yet furfural itself has remained until very recently a chemical curiosity, its chemical properties and even its very appearance practically unknown even to many who have frequently utilized its services in the determination of pentoses and pentosans. A considerable number of years ago, the senior author of this paper had occasion to make several hundred pentose determinations within a few months. Yet despite the fact that in each of these determinations he made furfural by boiling the carbohydrates with acid, distilled that furfural and precipitated it with phenylhydrazin, not once did he see any furfural, since, because of the solubility of furfural in water, no separation of it occurs during the distillation process. The general lack of knowledge of or interest in furfural on the part of the chemical profession becomes the more comprehensible when we realize that it has never been quoted at less than $6.50 per lb. until very recently. Such a price has not encouraged laboratory experimentation nor any important commercial utilization.

Very recently the processes for manufacturing it have been developed to a point where it now sells for substantially less than benzaldehyde and current developments are such that one may confidently predict an ultimate price materially below that at which formaldehyde is now sold. Since it bids fair eventually to become the cheapest aldehydic body commercially available, it has seemed expedient at this time to present a summary of the present state of knowledge of furfural together with the bibliography of the subject which we have thus far compiled. Our own difficulty in finding information to aid us in our investigation of possible uses for the compound leads us to hope that the publication of this information may be helpful to the workers in this field during the formative period of what seems likely to become an important branch of American chemical industry.

Occurrence and Preparation

Furfural was first obtained by Dobereiner (1)* in 1830 while preparing formic acid by the action of sulphuric acid and manganese dioxide on sugar. During the distillation he noticed that the distillate came over milky and on standing, a yellow "oil" separated out. He succeeded in obtaining only a small amount, not enough to make any extensive investigation of its nature. The "oil" was described as having an odor similar to a mixture of oil of bitter almonds and oil of cinnamon and was given the name "artificial oil of ants." A short time later Emmet noticed that an oil" was obtained when formic acid was prepared from rye or corn by treating with sulphuric acid.

Stenhouse (2, 6) in 1840 was the first to prepare any quantity of this "oil." He used Emmet's process for preparation of formic acid, using oatmeal and sawdust as the material from which to make the "oil." He succeeded in obtaining a yield of an ounce from twelve pounds of meal. The composition of the "oil" was determined and formula of $C_5H_4O_2$ given to the compound. This formula has been shown by subsequent investigation to be correct. The effect of treating it with acids and alkalis was studied, and its boiling point, specific gravity and solubilities in water and alcohol determined. Comparison of these constants with those determined more recently indicate that Stenhouse was working with a very impure product.

Fownes (3) in 1845 was the next to work on an "oil" obtained by distillation of bran with sulphuric acid. He found this to be identical with the "oil" studied by Stenhouse and suggested the name furfurol (furfur-bran, oleum-oil). Ultimately, when the aldehyde nature of the compound was established, it became known as furfuraldehyde, which is now ordinarily abbreviated to furfural. He also prepared the ammonia compound to which he gave the name furfurol amide (now furfuramide). The formulas for the two compounds were determined as $C_{15}H_6O_6$ for furfurol and $C_{15}H_6NO_3$ for furfurol amide. He also prepared a compound from the amide which he named furfurin and having the formula $C_{30}H_{12}N_2O_6$. Cahours (7) also obtained furfural from wheat by sulphuric acid distillation and prepared the amide and furfurin. Stenhouse in 1850 (6) prepared "oils" from various vegetable sources and found that these "oils" were similar, but from some classes of vegetable growth, especially seaweeds, there was an "oil" obtained which he claimed was an isomer of furfural and to which he gave the name fucusol. This compound gave an ammonia compound, fucuscamide, and from this by action of dilute potassium hydroxide fucusin could be prepared. In later papers further study is made of fucusol and an acid is prepared analogous to the acid obtained by oxidation of furfural, pyromucic acid, to which he gave the name β-pyromucic acid.

Maquenne (15) and Tollens proved the fucusol of Stenhouse to be a mixture of furfural and methyl furfural. This is the first record of differentiation between furfural and methyl furfural, the product formed by hydrolysis of methyl pentosans.

Many others worked on furfural preparing it from a wide variety of materials such as cane sugar (4), wood (10), glucose (22), and albumen (21), and eventually it was found that pentoses and pentosans were the substances ordinarily yielding furfural, although in a few cases such as glucose, cane sugar, etc., furfural is produced in very small quantities from carbohydrates other than pentoses.

Neff, in his investigations of the actions of various oxidizing agents on glucose, has isolated a series of acids containing 1, 2, 3, 4, 5 and 6 carbon atoms. This reaction is not progressive, the acids being formed

*Numbers in parentheses refer to the bibliography which will be found at end of the second installment, to be published in *Chem. Met. Eng.*, Aug. 23, 1922.

simultaneously. This phenomenon explains satisfactorily the fact that small amounts of furfural are produced by action of sulphuric acid on the hexoses. Sulphuric acid, being an oxidizing agent, first oxidizes the sugar to a five-carbon compound and from this the furfural is probably derived.

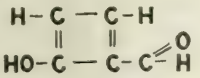
It has been shown that some proteins, especially the nucleo proteins, contain pentose groups, a fact which offers an explanation of the reported production of furfural from "albumen."

It was also found that furfural may be prepared by distillation of pentosans with concentrated solutions of zinc chloride, calcium chloride (5) and other acid salts, as well as by dry distillation. Furfural has been found in commercial fusel oil (109), glacial acetic acid (9), and sulphite-waste-liquors (19). In the case of fusel oil, the furfural was not the product of normal fermentation, but was found to be due to the action of certain acids on solids of the mash during distillation (17).

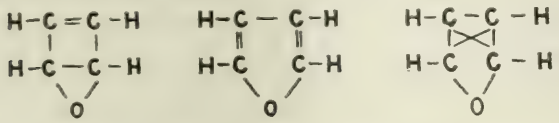
It may be noted that all the products in question where furfural occurs as an impurity have been subjected during the process of manufacture to conditions where a mixture of carbohydrates and acid may have been acted upon by heat.

Structure of Furfural

Limpricht (29) in 1869, by studying the actions of the furfural group with bromine, chlorine, etc., proposes the formula



Baeyer (30) proposes the formulas

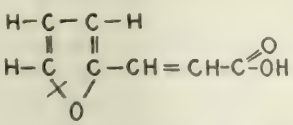


and from the results of his work considers formula 1 as representing the formula of the furfurane group.

Pawlinoff (31) by means of the zinc ethyl reactions established the non-presence of any hydroxide group and favors formula 2 of Baeyer. Markwald prepared a keto acid from furfuracrylic acid having the formula

$$HOOC - CH_2 - CH_2 - CO - CH_2 - CH_2 - COOH$$

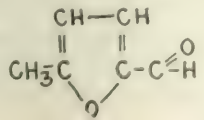
proving the position of the ketone group and concluded that the structure of the furfuracrylic acid is



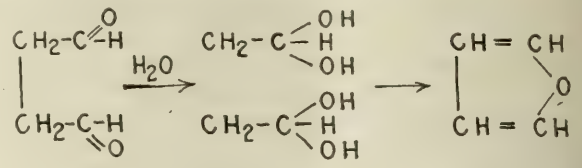
The break in the ring comes at the place indicated, in the forming of the keto acid. Tollens (35) and Maquenne (15) determined the structure of methyl furfural by its derivation for isodulcite

$$\underset{4}{CH_2} - \underset{3}{CHOH} - \underset{2}{CHOH} - \underset{1}{CHOH} - CHOH - CHO$$

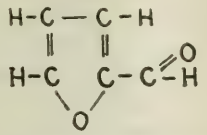
an anhydride being formed by the dehydration of the two alcoholic groups 1 and 4 to give the formula



Harris synthesizes furfurane by heating succinic-dialdehyde with water as follows:



From this evidence the formula for furfural has been accepted as



Manufacture

Until very recently furfural has not been manufactured in commercial quantities and although a number of methods of producing it have been proposed at various times, so far as we are able to learn very few of these have ever been practiced. In the case of those who have actually produced furfural on a commercial scale, very little publicity has been given to the methods used. We can only judge from such uncertain data as the patents issued to them or their published work. On this basis there is some reason to believe that much of the furfural which has been imported has been made from kapok waste by a method which, in a general way, approximates the laboratory procedure for the determination of pentosans, which consists in boiling the pentose-bearing material with 12 per cent hydrochloric acid and distilling. In this country, the excellent research conducted by the Bureau of Chemistry has developed a method not yet utilized commercially so far as we are aware, in which corn cobs or similar materials are treated in a stationary digester at comparatively high pressure without the introduction of acid. We understand that this process has been operated successfully on a semi-commercial scale in connection with the bureau's experimental work.

Our own investigations in this field have led us to select oat hulls as the most readily available raw material for the process, since they are produced continuously throughout the year in large quantities (as much as 200 tons a day at a single plant) by factories centrally located and in a form convenient for treatment. We have developed a simple and effective procedure in which the hulls are subjected to the action of steam and acid in large rotary digesters. By this method very satisfactory yields are obtained and the furfural is produced admixed with relatively small quantities of water. This process is now being operated successfully in a commercial production of furfural amounting to several tons per month, which production will be very greatly increased in the near future.

Since the theoretical yield of furfural from oat hulls is in the vicinity of 20 per cent and the annual production of oat hulls in the United States 220,000 tons, the possibilities of production of furfural from this source alone are enormous.

Chemistry of Furfural

In the following, a rather brief survey of the work done on the compounds of furfural has been made. Our endeavor has been to present a few of the typical examples showing in a general way the types of reac-

ions into which furfural enters and the chemical nature of the compound itself. In the bibliography appended, a much larger number of references will be found than are cited in the body of the paper.

But very little work has been done on the physical properties of furfural. Its boiling point has been determined by a number of workers with varying degrees of accuracy. Probably the most exact results are those of Mains, of the Bureau of Chemistry, recently published in *Chemical and Metallurgical Engineering* (260). Working on a highly purified product, he found the boiling point as 161.7 deg. C. at 760 mm. Its specific gravity was also determined by Mains as $1.1598^{\frac{20}{4,\ Vac.}}$ and $1.1545^{\frac{25}{4,\ Vac.}}$. Its solubility in water and the composition density tables at 20 and 25 deg. C. he determined up to the saturation concentration. The solubility data are reproduced in Table I.

TABLE I—OBSERVED DATA ON MUTUAL SOLUBILITY OF FURFURAL AND WATER

Water Layer		Furfural Layer	
Temperature, Deg. C.	Per Cent Furfural by Weight	Per Cent, Deg. C.	Per Cent Furfural by Weight
16	8.12	8	96.5
17.0	8.18	26.6	94.6
27	8.72	37	93.3
27.2	8.72	44	92.8
27.5	8.68	65	90.9
44	9.80	70	90.3
61	11.9	84	88.0
66	12.5	96	84.5
92	17.0	....	....

Bruhl (80) determined its refractive index with the following results:

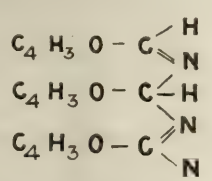
$$\mu_\alpha = 1.51862$$
$$\mu_D = 1.52608$$
$$\mu_\beta = 1.54566$$
$$\mu_\gamma = 1.56484$$

Sir W. Ramsay determined its heat of formation as ,985 cal. The flash point of furfural is 55 to 57 deg. C. Other physical constants of furfural are now the subject f investigation by several workers whose results will e published shortly.

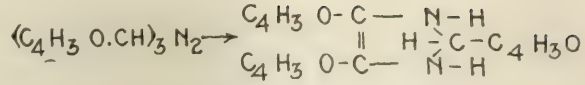
In general it resembles in its reactions benzaldehyde n one hand and formaldehyde on the other. It differs rom both of them in being a liquid of very high boilng point and wide range of solvent power.

It was early discovered that furfural had many chemcal characteristics in common with benzaldehyde, which ed to a rather extensive study of its reactions with arious aliphatic and aromatic compounds as well as he study of the reactions of furfural with ammonia, ydroxylamine, etc.

Among the earliest compounds prepared was fururamide. Stenhouse, Maquenne, Fownes and others repared the compound, but its structure was first deternined by R. Schiff to be



As the corresponding benzaldehyde ammonia compound is converted by treatment with dilute alkali solution into benzin, Bahrmann, Schiff and Cahours prepared furfurin by similar treatment. Bertaginini (129) repared furfurin by simply heating furfuramide at 110 to 120 deg. C. for about an hour.



This compound is much more basic than furfuramide, forming well-defined salts with acids and being alkaline to indicators. Ramsay (89) established that furfurin was a secondary base with two replaceable hydrogens.

By the same method that benzaldehyde, by treatment with alcoholic KOH, is converted into benzylalcohol and benzoic acid, Schiff (97) and Limpricht (99) prepared pyromucic acid and furfuralcohol.

$$2C_5H_4O_2 + KOH \rightarrow C_5H_6O_2 + C_4H_3O.COOK$$

Pyromucic acid was also prepared by oxidation of furfural with silver oxide (96). Furfuralcohol prepared by reduction of furfural with sodium amalgam (95)

$$C_4H_3O.CHO \rightarrow C_4H_3O.CH_2OH$$

Furfurnitrile is prepared by action of PCl_5 on pyromucicamide (94)

$$C_4H_3O.CONH_2 + PCl_5 \rightarrow C_4H_3O.CN + POCl_3 + 2HCl$$

The nitrile by reduction with zinc and H_2SO_4 to furfurylamine (94)

$$C_4H_3O.CN + 2H_2 \rightarrow C_4H_3O.CH_2.NH_2$$

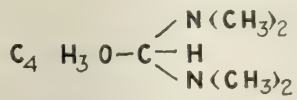
E. Fischer (88) prepared furoin by action of KCN in alcoholic solution on furfural.

$$2C_4H_3O.CHO \rightarrow C_4H_3O.CO.CH(OH).C_4H_3O$$

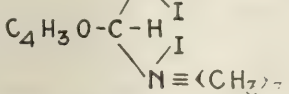
This compound oxidized gives furil, $C_4H_3O.CO.CO.C_4H_3O$. Fischer also prepared mixed compounds such as benzfuroin, $C_4H_3O.CO.CH(OH).C_6H_5$, etc. Furfural forms condensation products with urea and related compounds.

The reactions of furfural with aliphatic compounds have been rather extensively studied. Priebs (237) studied the condensation of nitromethane in alkaline solutions preparing furfurnitroethylene, $C_4H_3O.CH:CHNO_2$ and from this compound by ordinary nitrating methods prepared nitrofurfurnitroethylene, $C_4H_2O(NO_2)(CH:CHNO_2)$, which on oxidation gave nitromucic acid, $C_4H_2O(NO_2)(COOH)$.

Litterscheid (236) prepared furfuryliden-methylamine, $C_4H_3O.CH:NCH_3$, by the action of furfural on methylamine, also the compound furfurylidentetramethyldiamine



Both of these compounds form salts with acids and addition products with alkylhalides such as



Claisen (233), Mehne (232) and Schmidt (231), prepared condensation products of furfural with acetone and acetaldehyde such as: Furfuracrolein, $C_4H_3O.CH:CH.CHO$; furfuralacetone, $C_4H_3O.CH:CH.CO.CH_3$; difurfuralacetone, $C_4H_3O.CH:CH.CO.CH:CH.C_4H_3O$; as well as mixed compounds such as benzal-furfural-acetone, $C_4H_3O.CH:CH.CO.CH:CH.C_6H_5$

Claisen (226), Hill (228), and Markwald (227) condensed furfural with acetic acid forming furfuracrylic acid, $C_4H_3O.CH:CH.COOH$, and studied the halogen compounds of the acid.

Claisen (211), Knoevenagel (224) and Sandelin (207) condensed furfural with acetaceticester forming

$$C_4H_3O.CH:C(CO.CH_3)(CO.OC_2H_5)$$

Furfuralacetaceticester

$$C_4H_3O.CO.CH(CO.CH_3)(C_4H_3O.CH)$$

$$C_4H_3O.CO.CH(CO.CH_3)(C_2H_5O.CO.CH.CO.CH_3)$$

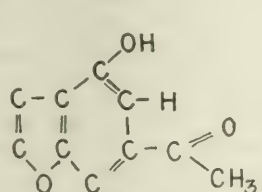
Furfurylidenbiacetaceticester

By condensation of furfural with levulic acid, Ludwig (206), Kehrer (205) and Erdman (86) prepared

$$C_4H_3O.CH:C(CO.CH_3)(CH_2.COOH)$$

β-furfuryl-levulic acid

which on distillation in a current of H_2 or CO_2 condenses forming



Acetooxycumaron.

Succinic and malonic (154) acids condense with furfural forming compounds of the type

$$C_4H_3O.CH:C(COOH)(COOH)$$

Similar reactions were studied by Rohmer (214), Volander (215), Tonnies (213) and others.

The action of phenylhydrazine, hydroxylamine, barbituric acid and phloroglucinol was studied in relation to the quantitative determinations of furfural, pentoses and pentosans. Tollens, Cross and Bevan, and Unger and Jaeger did by far the most work on this subject.

Furfural condenses with acetophenone (165) to form furfural-acetophenone, $C_4H_3O.CH:CH.CO.C_6H_5$, and furfuryl-di-acetophenone

$$C_4H_3O.CH(CH_2.CO.C_6H_5)(CH_2.CO.C_6H_5)$$

Benzylcyanide (167) condenses with furfural to form α-phenylfurfuracrylicnitrile, $C_4H_3O.CH:C(C_6H_5)(CN)$, which is easily reduced forming

$$C_4H_3O.CH_2.CH(C_6H_5).CH_2.NH_2$$

α - furfur - β - phenyl-propyl-amine

By far the greatest amount of work has been done on the reaction of furfural with the amines and related compounds because of the possibility of developing dyes. As early as 1870, Stenhouse (203) prepared the compound of furfural with aniline and various acids, finding that additional products were formed,

$$C_5H_4O_2.2C_6H_5NH_2.HCl.$$

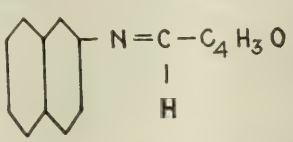
Toluidine behaved in similar manner. H. Schiff (175) supports Stenhouse's reaction and further shows that diphenylamine and *m*-nitraniline react in similar way, forming addition products. However, monomethyl-diamino-benzene follows the regular aldehyde reaction.

$$C_6H_3(CH_3)(NH_2)(NH_2) + 2\,C_4H_3O.CHO \rightarrow C_6H_3(CH_3)(N{=}CH.C_4H_3O)(N{=}CH.C_4H_3O)$$

Benzidene reacts in similar manner, condensation taking place with both amino groups forming

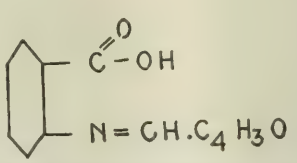
$$C_6H_4.N:CH.C_4H_3O$$
$$C_6H_4.N:CH.C_4H_3O$$

G. de Chalmot (168), however, claims that the reaction of furfural with aniline is a true condensation, the reaction taking place according to the aldehyde-amine condensation reaction. Schiff (170) also studied the action of furfural on various other amines, diamines, tri-amines, as well as acid amines, forming compounds such as



β-furfuronaphtylamine

and

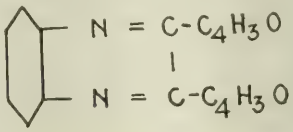


o-furfuramidobenzoic acid

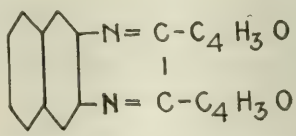
O. Fischer (180) and Schiff (177) studied the analogous reaction to the preparation of malachite green from benzaldehyde and dimethyl aniline forming tetramethyl-diamino-diphenyl-furyl-methane

$$C_4H_3O.CH(C_6H_4N(CH_3)_2)(C_6H_4N(CH_3)_2)$$

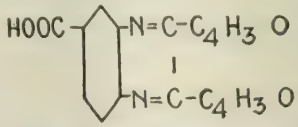
This compound on oxidation forms a dye analogous to malachite green. This reaction has recently been more thoroughly investigated by Renshaw and Naylor and a very satisfactory dyestuff obtained. Fischer (181) also studied the reaction of furoin on *o*-phenyldiamine and α-β-naphthylendiamine forming



and



Zehra (182) prepared a similar compound from 1:2 diamino 4 benzoic acid



Many others have investigated reactions of this type forming many color bases.

It is interesting to note that in spite of the large amount of work done on the chemistry of furfural the

o study has been made of the nature of the chemical action taking place in the formation of resinous condensation products.

Physiological Action of Furfural

But little work has been done on the toxicity or the general physiological action of furfural. Jaff and Cohn (118) studied the metabolism of furfural in dogs, rabbits and hens, and isolated from the excreta considerable amounts of pyromucic acid, a compound of pyromucic acid with glycocoll which they called pyromykuric acid, and a substance difficultly soluble in water which proved to be a glyococoll compound with furfuracrylic acid. Mention is made of the toxic effect, but no specific data are given.

Hugh McGuigan, of the University of Illinois, College of Medicine, has recently finished an investigation on the action of furfural on bacteria, yeast, gold fish, frogs, white mice, rabbits, cats and dogs. The results of this investigation will be published shortly in the *Journal of Pharmacology & Experimental Therapeutics.* Dr. McGuigan has kindly communicated to us the results obtained, which briefly are as follows:

1. The phenol coefficient of furfural, measured from its bactericidal action, is 0.26.

2. A 2 per cent solution of furfural entirely inhibits the action of yeast on dextrose. A 1 per cent solution only delays this fermentation. Weaker solutions have no effect.

3. Furfural is about one-half as toxic for gold fish as phenol and about one-third as toxic as formaldehyde for the same animal.

4. Furfural in large doses has a paralytic effect on frogs similar to chloral. There are evidences of stimulation of the central nervous system when smaller doses are used, but this is more marked in cats. Locally it is corrosive and anesthetic.

5. The fatal dose by stomach for rabbits is about 0.8 c.c. per kg. of body weight. The action on white mice is similar to that on rabbits.

6. In the case of cats, 0.12 c.c. is the fatal dose and with dogs the action is similar.

Part II of this paper, describing the varied uses of furfural and including a complete bibliography on the subject, will appear in Chemical & Metallurgical Engineering for Aug. 23, 1922.

Legal Notes

By Wellington Gustin

Buyer of Patented Welder Recovers Expense of Infringement Suit

In an action at law brought by the Lalance & Grosjean Manufacturing Co. against Neil Macneale and others, directors of the Toledo Electric Welder Co., judgment of the District Court in favor of plaintiff has been affirmed by the United States Circuit Court of Appeals. (276 Federal, 491.)

The action arose from the following transaction. In 1915 the Toledo Electric Welder Co. sold the Lalance & Grosjean Manufacturing Co. three spot welding machines of different sizes and specifications under the following terms and conditions:

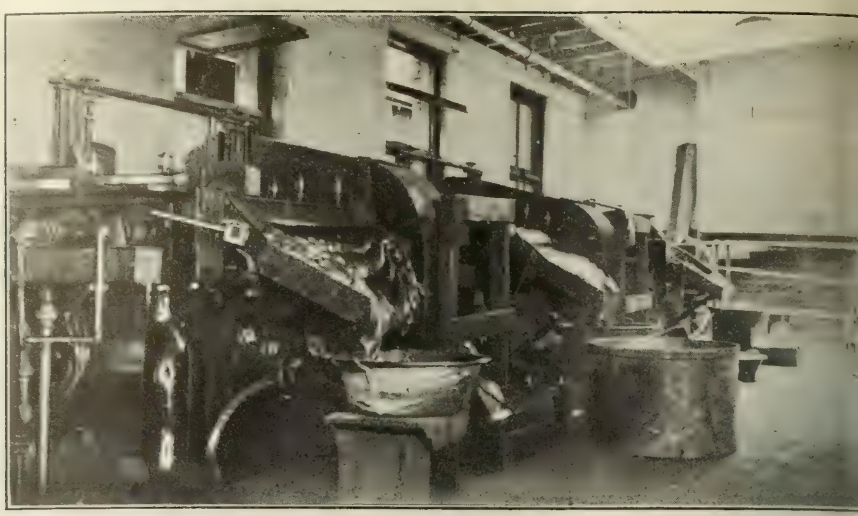
The company agrees that it shall, at its own expense, defend any suits that may be instituted by any party against the purchaser for alleged infringement of any electrical or mechanical patents relating to the machinery furnished under this proposal, providing the purchaser shall have made all payments then due therein and gives to the company immediate notice in writing of the institution of such suits, and permits the company, through its counsel, to defend the same, and give all needed information, assistance and authority to enable the company to so do, and thereupon in case of final award of damages in such suit the company will pay such award." Afterward, in 1917, the American Electric Welding Co. and the Thompson Electric Welding Co. filed a bill of complaint in the U. S. District Court against the Lalance & Grosjean Manufacturing Co. for the infringement of the Harmatta patent, No. 1,046,066, and the latter company was forced to pay $6,572 in defending this suit. The present action was brought to recover of defendants this amount, and also sought to recover in this same action money expended by it in defense of an action brought by the American Welding Co. against the Jordan Marsh Co. of Boston, Mass., one of its customers, for a like infringement; but the District Court held it not entitled, under the terms and conditions of its written contract, to recover the expense of that suit, and it made no appeal from this minor decision.

Although defendants were given notice of the infringement suit over the Harmatta patent, they neglected and failed to defend as per the agreement, and plaintiff was forced to defend. In this action to recover their costs and expenses of defending the suit, the defendants contended as a defense that the machines sold were adapted to other uses which did not infringe the patent sued on; and further that the suit was based on the product of the machines and not on the machines themselves; and still further that the suit was dismissed on objections to jurisdiction and not on the merits.

But the Court of Appeals has held that none of these propositions is a good defense under the provision of the contract as above set out. The contract does not call for defending suits for actual infringement only, but for "alleged infringement."

Another feature in this action was the fact that the Toledo company had been dissolved and its assets had been distributed to the stockholders. The defendant directors contended that they had no money of the company at their disposal to pay the expense of such defense in the infringement suit. Nevertheless, the court said that as directors of the Toledo company at the time that corporation was dissolved the said directors became and were trustees, not only for its stockholders but for creditors, of the assets coming into their hands as such directors. If they distributed these assets to its stockholders before the payment of its creditors or the performance of the obligations of its contracts, they did so at their own risk, and accordingly were held personally liable in this action. They knew or ought to have known that it was the duty of the company under its contracts to defend and pay damages awarded and, being in control of the corporate assets, they should have applied same to this purpose.

Manufacture of Printing-Inks



By Taylor W. Anstead
Dry Color Department, Ault & Wiborg Co.

PRINTING-INK may be said to consist primarily of varnish and pigment, together with a considerable measure of applied research and technical experience. These factors are intimately related, since the quality and properties of the finished ink are largely determined by the fineness, shade, strength and body of the raw materials. Although actual manufacturing experience has shown that for efficient production the varnish, pigment and ink-making should be conducted in separate departments, it is nevertheless essential that the efforts of these departments be closely co-ordinated and frequent consultation should be held, in order that the varnish and pigment makers thoroughly understand and properly interpret the requirements of the ink manufacturer.

It will not be possible within the limits of the present article to present an exhaustive treatment of all of the manufacturing requirements of the printing-ink industry. An effort will be made, however, to refer briefly to those phases of its technology of most interest to the chemist and chemical engineer and to indicate the line along which the industry is developing. This treatment naturally falls under three heads, namely, varnish, pigment and finished printing-ink.

Printing-Ink Varnishes

The manufacture of varnishes for ink-making involves but few features that are not common to the varnish industry. From the chemical viewpoint, a deal of interest attaches to the various varnish oils, principal among which are linseed, chinawood oil or tung oil, soya bean oil, rosin oil, perilla oil and various mineral oils. Linseed oil is by far the most important for varnish making, because of its superior drying qualities, the ease with which it can be "bodied" or "heavied," the better working qualities it gives to the ink, and its good color and pleasant odor.

Many procedures have been outlined by various authorities for determining the quality of linseed oil by means of its specific gravity, iodine number, acid number, etc. But it has been found through practice that these figures are not worth much to the ink maker, and their determination is scarcely worth his while. The writer has found it most satisfactory to make varnish in the laboratory by a standard method and then to test the finished varnish for the properties required of it. Exposure in a drying oven for 2 hours gives its drying value. The varnish should have "flow" and not be "livery"; that is, it should follow the finge after it is dipped into the varnish and not be jelly like. The oil should give a varnish of clear colo with a pleasant odor, and free from sediment.

Chinawood oil has but a very limited application i the printing-ink industry. Its use is confined to appli cations in which unusually rapid drying is essential.

Soya bean oil has come to be regarded as an im portant substitute for linseed oil in certain of the in dustry's requirements. It is used either alone or i mixtures with linseed oil, especially at times when th price of linseed oil is exceedingly high. Although i is the best of the semi-drying oils, it cannot be sai to be as satisfactory as linseed as a varnish oil.

Only recently has perilla oil become a factor in th ink industry. It is imported from China, is practi cally odorless and has a good color. It has most of th good qualities of linseed oil, as far as drying an thickening are concerned. The great disadvantage t its use has been the fact that shipments are not uni form in character and therefore the quality of the oi is not absolutely dependable.

Rosin oil is obtained by the destructive distillatio of ordinary rosin and is marketed as first, second, thir and fourth run rosin oil. The oil ordinarily used fo varnish-making is the first run. Varnishes made fro it cannot, of course, be used on bright pigments, bu rosin oil makes excellent varnishes for black ink especially when treated to obtain drying qualities.

Mineral oils of various kinds are used as varnishe in very cheap inks where a porous paper stock is use They also find application as thinners in higher-grad inks in connection with rosin and linseed oils.

Treating the Oils

Linseed oil, as such, when ground with a pigmen would give a sloppy ink; it must therefore be thick ened or bodied to give an ink of satisfactory workin qualities. The raw linseed oil, which has about th fluidity of water, can be bodied through various inte mediate stages to the consistency of molasses taff The various bodies are numbered as a rule from a 000 for the lightest to No. 7 for the heaviest of the boile or blown oils. In the boiling process the linseed o is heated in a copper kettle over a gas, coal or oil fir the temperature and time varying with the grade t be produced.

In blowing linseed oil, air is bubbled through the o

ntil the desired body is obtained. The advantage laimed for blown oils is a lower acid value and there- ore better drying qualities. However, this better dry- ng is offset by the fact that blown oils do not mix s easily with other oils and varnishes, the color is ot so good, and they will not lithograph as well as he varnishes made by external heating.

In making rosin-oil varnishes, the first run oil is sed because it is of a heavier body at the start and he varnishes made from it have greater drying quali- ies. Rosin oil is heated and then about 1 per cent f its free rosin acids are neutralized with lime. If nore is neutralized the varnish dries too rapidly and s likely to form an oxidized film or skin. A more uni- orm drying can be obtained by adding a small quan- ity of some drier such for example as about 2 per ent of lead and manganese resinates.

Driers and Retarders

A drier, it will be recalled, is a substance which when dded to a varnish acts as an oxygen carrier and thus ccelerates the oxidation of the varnish and causes t to dry. The action of these driers is purely atalytic.

In contrast to the driers there are substances which ct as negative catalysts and actually prevent drying. Among these the most notable is selenium, the presence f a small amount of which retards drying to an extent ut of all proportion to the quantity present. Recent xperiments would seem to indicate that to a lesser xtent the presence of sulphur in carbon blacks will etard their drying. Blacks which are free from sul- hur dry much more readily than blacks which contain hat element. It is a well-known fact that pigments ade from basic dyes are notoriously poor driers and xcess drier has to be added to the inks.

The driers in most common use are the linoleate, esinate and tungate of lead, the borate and resinate f manganese, and the acetate and resinate of cobalt. he drying effects of vanadium compounds, especially mmonium vanadate, have been referred to in a recent rticle by Rhodes and Chen[1], but their activity has een placed below that of cobalt. Furthermore their ost at present is prohibitive.

Each metallic drier may be said to have a different se depending upon its drying qualities. Cobalt is the est drier. Its action is to dry quickly on the surface, iving a hard film. It is surprising how small a quan- ity of cobalt, calculated as the metal, is necessary.)ne hundredth of one per cent will often dry an ink atisfactorily. Manganese dries peculiarly in that the nk remains raw for some time and then suddenly ardens. Lead dries gradually and ink in which it is sed is inclined to be rather sticky. Manganese and ead together, however, will give a well-balanced drying ffect.

Few people realize that the drying of an ink is not ndependent of the paper stock on which the ink is to e used. The oxidation which occurs is not only af- ected by the metallic driers but also, either positively r negatively, by the fillers and pigments used in mak- ng the paper. Too often the ink-maker is kept in gnorance of the kind of paper on which his ink is to e used. He tries to meet an average condition and requently has his ink returned because it has not ried properly, when the fault lies in the paper.

[1] F. H. Rhodes and K. I. Chen, *J. Ind. Eng. Chem.*, vol. 14, pp. 22-4 (1922).

Ink Pigments

In the manufacture of printing-inks two general classes of pigments are used (exclusive of carbon blacks)—namely, the natural or earth colors and the artificial colors. To the former class belong the ochres, umbers and siennas; to the latter class, the organic lakes, the chrome yellows and the iron blues.

The natural colors are noted for their fastness to light and for their resistance to alkalis, acids and bleaches. However, they are not easily worked, do not cover well, have a tendency to fill up the plates, and have little tinctorial value. On the other hand, the manufactured colors yield an infinite variety of shades, have great color strength and work well in varnish. Many of them, too, are comparatively fast to light and to the action of acids and alkalis.

Organic Color Lakes

In making an organic lake the manufacturer attempts to render the dye as insoluble as possible. This is done by treating the soluble dye with barium or calcium chloride, thereby forming the barium or calcium lakes of the dye, which in nearly all cases are insoluble. Or in place of the soluble dye an insoluble product may be formed by the combination of intermediates such as the formation of the para reds by the coupling of diazotized paranitraniline with beta-naphthol.

Most organic lakes have too high a tinctorial value to be used as such. Besides, they do not give as good working qualities as when diluted with an inert base. The 100 per cent color lakes are known as toners and the diluted colors are referred to in terms of the percentage of pure color present.

Bases for Color Lakes

The usual bases for printing-ink colors are blanc-fixe, aluminum hydrate or a mixture of the two. Blanc-fixe is used as the base for the cheaper colors designed for poster or bag inks. The artificial barium is preferred to the naturally occurring barytes, which is very rarely used in printing-inks because it is gritty. Blanc-fixe is of two kinds, the precipitated and the byproduct material. Experience has shown that the byproduct blanc-fixe is usually unsuited for lithographic inks because of its action with water. The ink from such a lake becomes pasty because of its water absorption or, in exaggerated cases, it may literally "go to pieces" and break down entirely. Precipitated blanc-fixe should be white, neutral and free from sulphides. Sulphides very often give trouble in connection with copper plates or when the blanc-fixe is mixed with a lead chromate yellow.

Aluminum hydrate is very transparent and is therefore suitable for process inks where one color must be seen through the color above it. Great care must be exercised in the manufacture of aluminum hydrate for color lakes. It is ordinarily prepared from aluminum sulphate and soda ash. The former should be free from iron, since ferric hydroxide gives the aluminum hydrate a dirty, brownish color. Precipitation is best effected in dilute solutions, 10 per cent or less, because too great a concentration is likely to give a product which dries out too much. The base should be carefully washed to free it from soluble sulphates, as these are likely to give trouble in lakes precipitated with barium chloride where the presence of barium sulphate would throw the color toward the semi-transparent

side. The writer has observed batches of color made from the barium lake of lithol red where the addition of poorly washed aluminum hydrate has caused the lake to lose its bluish shade and take on a yellower shade due to the barium leaving the dye and combining with the free sulphate in the hydrate.

A base which is quite popular is a mixture of blanc-fixe and aluminum hydrate. In this base, the advantage of the comparatively low cost of the blanc-fixe is combined with the high finish and luster given by the aluminum hydrate.

Para and Toluidine Reds

The red organic lakes present the greatest variation in color from the yellow-red, almost orange shade, of a light para red to the deep blue shade of the eosines. The good old standby of the ink-maker, as of the paint-maker, is paranitraniline red. The light shade is produced by combining diazotized paranitraniline with beta-naphthol. The deep shade is produced—and here is one of Nature's mysteries—by the addition of about 5 per cent of beta-naphthol monosulphonic acid F to the beta. Paranitraniline gives nothing like the same shade with F acid alone; the shade results only when the color is heated and furthermore, the addition of too much F acid is likely to throw the color over to the brown side and cause it to lose its blue tone entirely.

The para reds are popular because of their good working qualities, the comparatively low cost of the intermediates entering into their production, their relative fastness to light and to the action of acids and alkalis.

A color of even greater permanency is toluidine red from diazotized meta-nitro-paratoluidine and beta-naphthol. The cost of the former intermediate makes its use not quite so common. An interesting incident grew out of the attempts of the writer to improve upon the quality of the post-war toluidine reds. The laboratory results were fine and bright and so too were the results on the semi-plant scale tests, but the first four or five large plant batches were miserable failures. Temperatures were checked, dilutions were checked, materials were checked, but to no avail. Finally the only difference that could be seen was that lead brine coils were being used to cool the diazo solution, whereas ice had been used in the laboratory and the semi-plant operation. In the next run ice was therefore used and the diazotization was carried on in a vat free from lead. The results were all that could be desired.

Lithol Reds and Eosine Lakes

Next color in importance to the toluidine reds are the lakes made from lithol red, which is a combination of Tobias acid (2-napththylamine——1—sulphonic acid) with betanaphthol. The sodium salt is used alone or diluted with white to give a yellowish red; when the sodium salt is boiled with barium chloride a bluer shade results. Treatment with calcium chloride produces a very deep, bluish red. An interesting fact to be noted in connection with the lithol colors is that the calcium lake will stand baking, whereas the sodium and barium lakes will not. In purchasing the dye, care must be taken to see that it does not give lakes which "bleed" in oil. This bleeding is due to the presence of beta-naphthylamine arising from the use of impure Tobias acid. Lithol reds now appearing on the market as a rule are free from this objectionable feature. This oil-bleeding is a serious defect in fine printing because the color will strike through with the oil and can be seen to stain the reverse side of the paper.

Eosine lakes are used to a considerable extent in process work where a very pure red of bluish hue is desired. The lakes can be prepared from eosine by precipitation with lead nitrate or lead acetate, but it is more economical to prepare them from the bromo acids. Eosine is the sodium salt of tetrabromo-fluorescein, whereas the bromo acid is the acid of the same compound. If the acid is used it is first dissolved in alkali and then re-precipitated as the lead salt. Experience has shown that greater strength is to be had from the bromo acid than from the corresponding eosine. Bromo acids are to be had in two classes, the boiling bromos which are precipitated and boiled and the non-boiling bromos which are struck at lower temperatures. The first class gives a bronze red while the second class gives a red of dark overtone and more transparency.

These are the main divisions of the reds, though many others might be named. In fact, a well-equipped printing-ink concern uses 20 to 25 different red pigments. Unfortunately it seems to be a rule with red pigments that the stronger and brighter the color the less permanent it is to light. For instance, the bright clean eosine and rhodamine lakes are very fugitive with light, whereas the duller para reds and madder lake are comparatively permanent.

Blue Pigments

The blue pigments used in the greatest quantity are the so-called iron blues. They vary in shade from a greenish blue to the blue of a reddish, almost purplish cast. Before 1914 nearly all the blues were made from potassium ferrocyanide, either alone or in combination with sodium ferrocyanide. The impression existed in pre-war days that good blues could not be made from prussiate of soda. However, that impression was speedily removed from necessity when the supply of potash was cut off and it was not long before the American dry-color maker learned that very good blues could be made from prussiate of soda. Even now when prussiate of potash is available, the soda blues have not lost their popularity.

Ultramarine blue, another pigment of great utility because of its cheapness and resistance to alkali, has reached a perfection in this country never known before, even among the products of the best of the European makers.

The only blue lake used to any great extent is peacock blue, the barium lake of patent blue. This is used largely in process inks on account of its pure blue tone. The peacock blues of war times and post-war times were not very satisfactory.

The product was helped some by imported dyes, but now the American manufacturers are making very good patent blue.

Other Ink Pigments

The yellow pigments in greatest demand are the chrome yellows made from sodium bichromate and lead acetate. To a basic lead acetate solution is added a bichromate solution containing sulphuric acid. The lead chromate formed varies all the way from a light lemon yellow to an orange depending on their reaction

The light yellows show an acid reaction, the medium yellows are practically neutral lead chromate, while the orange yellows are made by boiling the precipitated lead chromate with caustic soda or soda ash, thereby forming the basic lead chromate.

Yellow lakes from the barium precipitation of acid yellow dyes are used where a transparent yellow is desired in contrast to the opaque chrome yellows.

Most of the purples and violets are made from methyl violet which can be had in a great variety of shades from the very red (R) to the very blue (6 B). Where brilliancy of color and no great amount of permanency are required, the usual method is to precipitate the methyl violet with tannic acid and tartar emetic. However, under patents now licensed by the Chemical Foundation, violet lakes may be produced from methyl violet by precipitation with sodium tungstate or with phosphotungstic acid. This increases the permanency of the violet lakes to a remarkable degree and raises them from the "fugitive" to the "semi-permanent" class. The peculiar thing about the lakes so produced is that when acted upon by light they turn darker. This increased permanency may be extended to some of the other basic dyes like fuchsine, malachite green, and Victoria blue, but the lakes of these dyes have not the variety of application that the purple lakes have.

Manufacturing Kinks

In the manufacture of pigments a good washing is necessary because the salts formed on drying down with the pigment not only reduce the strength but are likely to affect the ink, especially when intended for lithographic purposes where the action of the salts with the water may destroy the working qualities of the ink. Drying must be watched closely in pigment making.

Some colors are very readily affected by heat and it is better in most cases to dry for a longer time at a low temperature than to heat too high in order to speed up drying. About 160 deg. F. is a very good temperature for the drying ovens. The general scheme is to draw air through coils heated by steam. This heated air then passes over the color, which is in thin cakes on drying racks. Exhaust steam from the boilers can be used to good advantage here.

When dried, the color is ground. The finer the color, up to certain limits, the better it can be ground on the ink mill with varnish. About 60 to 80 mesh is the proper fineness. Finer than 80 mesh makes the color too fluffy and causes a great deal of dust and waste. In order to get uniformity the color is ground into large mixers holding 2,000 lb. or more. It can then be strengthened if weak, or cut down if too strong. As a rule a composite of several batches of pigment are mixed at one time, as it is practically impossible to make every batch of pigment identical and this method strikes a good average. Standards for comparison purposes should be taken the same way. Too often the enthusiastic color man, on seeing a remarkably fine batch come through the factory, adopts it as the standard, sends out samples and then has tough sledding to duplicate it, whereas if he had taken an average of eight or ten factory batches he would be nearer the true standard. Another dangerous practice is to send out samples of laboratory lots before they have been duplicated in the plant.

The improvement the last two years in the quality of the dyes and pigments produced in this country has been remarkable. Old standards adopted during the war look dull and muddy by contrast with colors produced with improved dyes and intermediates. Along with the improvement in colors has come an increased discrimination upon the part of the printer and color user.

Ink Manufacture

After the varnish and pigments have been prepared they are sent to the mixing room. Here they are weighed into mixing cans and the color is thoroughly wet with the varnish on a pony mixer. This is a machine so geared that the can turns in one direction while four prongs, dipping into the mixture, turn in the opposite direction. The ink is then sent to the mill room, where it is run over the ink mill. This mill is composed of three steel rollers with carefully ground surfaces, set in a frame. The rolls are usually 9 or 12 inches in diameter. Their highly polished surfaces roll in contact with each other. The ink is fed into the rear roller, which rotates clockwise, and is ground between it and the middle roller, which moves in a counter-clockwise direction. The ink is taken from the front roller by means of the knife-edge of the apron, which fits tightly against the roller. (See illustration.) A great deal of heat is generated during grinding and the rollers are made hollow so that cooling water can be passed through them. Many colors change on grinding if the rolls are not so cooled. The light shade of paranitraniline red will develop quite a bluish shade on grinding or may even turn brown if too much heat is developed.

Proving and Testing

The number of runs through the mill which an ink requires is determined by the pigment. Some colors, like the chrome yellows, are ground in three runs, while the iron blues will often take five or six. The question of determining whether or not an ink is properly ground is largely a matter of experience. An experienced ink-maker can tell by rubbing the ink about under his fingers. Spreading the ink out under a spatula will often show up particles of grit.

As the last run of the ink is coming out of the mill, a small sample is sent to the testing department, where it is drawn down on a sheet of paper against the standard to get the overtone, or mass-tone, and the undertone, or shade. A small portion is then carefully weighed out with an opaque white mixing ink in the proportion of 10 of white to 1 of color; the standard is treated in the same way. This test shows the tinctorial or coloring power of the ink and gives a very good way to determine any fine differences in the shade, since slight variations are easily discernible in the bleach test.

It has been found by experience that whenever possible it is best at this point to make a proof of the lot of ink and of the standard and allow them to stand over night to notice the effect of drying. Any change in shade will likewise be noticed. The body of ink should be examined the following morning, as often an ink will appear to have the right body when warm from grinding, but on cooling over night may become too heavy or may "liver up." A case was recently called to the writer's attention where a green made from an iron blue and a chrome yellow had changed to a decidedly yellow tone over night due to the action of

the paper on the blue. The remedy was to make the pigment several shades bluer.

Printing Requirements

Printing ink is put to such a variety of uses that the ink-maker must use a great deal of discrimination in the choice of his pigments and varnishes, but most especially of the former. For instance, an ink may be wanted for a hand-press, for a flat-bed press, for a rotary press, for offset work, for a bread label, soap wrapper, butter wrapper, poster, bag or bottle. Each use calls for a different body and drying quality of ink and in addition, the coloring matter must have certain properties. One color may be permanent enough for a circus poster but might bleed in hot paraffine and therefore be unsuitable for a bread label, or the color might make a beautiful ink for an art calendar or a book illustration but be utterly useless on a soap wrapper.

The question of fastness to light is of vital importance in many cases. It is a sad day for the billboard advertiser if the ink maker has been careless in the choice of his pigments and after three or four days his advertisements have bleached out or changed color decidedly. Of course, the best test for permanency to weather conditions is to put the color on a billboard for a period of one month. Often quicker tests must be had and resort is made to artificial devices. One of the best of these consists of a constant-arc light surrounded by a metal cylinder containing openings and brackets on which the colors to be tested are exposed. One half of the sheet is kept covered and one half exposed. A pan of water acts as a humidor and with the aid of a fan, which draws a current of air through the apparatus, prevents baking. To simulate atmospheric conditions the proofs are wet every morning. Proofs are left under the light for a time depending upon the conditions which must be met. One hour under this light equals six hours of sunlight. Sometimes a qualitative test of colors to determine the dye used can be made by this exposure test. For instance, a malachite green lake can be distinguished from an acid green lake by the fact that lakes from the former dye turn darker under light, while lakes from the acid green fade out entirely.

Three Classes of Printing-Inks

Printing-inks may be divided roughly into three classes: typographic, lithographic, and depressed surface inks. Typographic inks include all inks for labels, catalog and book work and general job-printing. The inks of this class are much softer and thinner in body than the lithographic inks and in the preparation of them, pigments can be used which "bleed" in water.

Lithographic inks are heavy in body. They are used in the presence of water and therefore must be water resistant. Accordingly great care must be exercised in the selection of varnishes and pigments. Inks which absorb water and become short and greasy are worthless for lithographic work, as they tend to smear and do not give clear-cut impressions. An ink which when rubbed with water on the lithographer's stone becomes pasty or stringy is unfit for use as a lithographic ink.

Depressed surface or plate inks are used for copper-plate engraving, for calling and announcement cards, in making season and greeting cards, and similar examples of fine printing. One kind of ink which can probably be classed under depressed surface ink is rotogravure ink. This type of work, wherein a half-tone effect can be had on machine finish paper, was just coming into prominence before the war. The demand for illustrated material brought this process into great favor as evidenced by the fact that today nearly every large newspaper carries a weekly rotogravure supplement. In this process the design to be reproduced is etched on copper cylinders. These cylinders dip down into the ink and are wiped off by a steel blade, leaving the ink in the depressed surfaces while the high lights have no ink on them. The paper is then passed over the cylinder, and after running about 25 feet, the reverse side is printed. Hence for this type of work ink must be a rapidly drying one.

The highest grade ink of all is the process ink. In this work, three, four and sometimes more colors are superposed upon one another. The colors used in four-color work are yellow, red, blue and black, printed in the order named. Each color except the yellow must be transparent or semi-transparent to get the effects of the colors beneath it. In this way, reproductions of painting are made. A separate plate is made for each color by photographing the painting four times. Each time only the color value desired is photographed the others being kept out by suitable light filters. Colors like green, orange, violet, etc., are formed by combinations of the four principal colors. For instance, blue over yellow gives a green; or a dark purple would be produced by blue over red intensified by black and so on. The colors entering into these inks are of very pure tone and must be of fine grain, otherwise the cuts would be filled up and ragged outlines result. Only the very highest grade linseed-oil varnishes are used in process inks.

The one universal ink is black. There are innumerable kinds of black inks. Blacks which dry by penetration may be made from cheap carbon blacks and mineral oil. Rotary blacks for process work, which dry by oxidation, are made from very good rosin-oil varnishes or linseed-oil varnishes.

New Developments

New developments in printing machinery must be met by the ink-maker. One of the latest improvements is a press doing what is called simultaneous color-printing, that is, three colors are printed, one on top of the other, before the sheet leaves the press. The ink manufacturer is also called upon to meet new conditions arising from change of paper stock or method of working. The printer makes his changes to suit his customer or his purse and then tells the ink-maker to get busy and make an ink to fit his requirements.

It may be seen from this rather cursory review of the materials and manufacture of printing-ink that physics plays as important a part as chemistry. The chemistry of ink-making is comparatively simple even in pigment manufacture, whereas the physical side of the process presents infinite possibilities. Colloidal chemistry, however, is beginning to play an important part in ink-making and many of the ink-maker's difficulties will probably be overcome as our knowledge in this field increases.

Constant research supplemented by the accumulated experience of the ink-maker is the price to be paid for this industry's success.

Cincinnati, Ohio.

Effect of Rate of Loading On Tensile Properties Of Boiler Plate

By H. J. French
Physicist, Division of Metallurgy, Bureau of Standards

Effect of Decrease in Rate of Loading on Steel Is Different Above and Below Blue-Heat, but Little Variation in Tensile Properties Was Observed When Tests Were Performed Thirty Times as Fast as Ordinarily

WHETHER or not steel is susceptible to variations in rate of loading at operating temperatures of steam superheaters, crude oil stills or nitrogen fixation apparatus is of decided interest both from practical and theoretical standpoints, especially as there are comparatively little definite data available in the literature.

In his book on "The Manufacture of Iron and Steel," H. H. Campbell reports the tensile properties of structural steel obtained under pulling speeds of 0.07 to 4.5 in. per minute. Both the yield point and tensile strength were shown to increase with rate of loading, while the elongation and reduction of area remained practically constant. The last two are independent of the accuracy of the beam balance; when high pulling speeds are used it becomes increasingly difficult for the operator properly to balance the testing machine and the tendency toward "overbalancing" often results in high values.

A committee of the American Society for Testing Materials[1] has since shown that the tensile properties of steels at room temperature are independent of the rate of extension within limits of commercial practice—speeds of from 1 to 6 in. per minute.

Hot Steel Resists Rapid Loading

Little exact information is available on variations in speed of loading at elevated temperatures. Hopkinson and Rogers[2] reported that the so-called "time effect," "elastische nachwirkung" or "creeping" increased greatly with temperature. While such effects might be detected at ordinary temperatures, they attained a different order of magnitude at red heat (600 deg. C.).

"Creeping" made the determination of Young's modulus a matter of some uncertainty, for the extension of a bar stressed at 600 deg. C. varied 15 per cent or more depending upon the time of application of the load. For rapid loadings—of the order of 1 second—the strain produced approached a definite limiting value which could be used for the accurate determination of the modulus.

J. E. Howard[3] reported that the "rate of speed of testing, which might modify the results somewhat with ductile material at atmospheric temperature, had a very decided influence upon the apparent tenacity at high temperature." Steel containing 0.81 per cent carbon was ruptured in 5 to 10 minutes and also as quickly as from 2 to 8 seconds. Nearly the same strength was displayed whether slowly or rapidly fractured at temperatures below about 315 deg. C. (600 deg. F.), this being a comparatively brittle metal at moderate temperatures. Above this temperature the apparent strength of the rapidly loaded specimens largely exceeded that of the slowly loaded ones; the higher the temperature the wider the spread. One specimen broken in 2 seconds at 766 deg. C. (1,412 deg. F.) showed a tensile strength of approximately 62,000 lb. per square inch, whereas at ordinary speed of testing a corresponding bar fractured at 33,240.

Howard considered that the forces of cohesion tending to prevent rupture in a plane normal or oblique to the direction of the straining force and intermolecular friction developed during the flow of the metal were controlling elements in the explanation of the behavior of steel under the conditions outlined.

More recently Rosenhain and Humfrey[4] have investigated the strength and fracture of soft steel at temperatures between about 600 and 1,100 deg. C. (1,100 and 2,000 deg. F.). They found a discontinuity at the thermal critical range and an increased tenacity with rapid loading when testing small samples in a vacuum.

Apparatus for Rapid Testing

The ordinary method of determining proportional limit by measuring the deformation under successive increases in load is not sufficiently flexible to allow much variation in rate of extension without loss of accuracy. Obviously, it is impossible to read simultaneously several continuously moving indicators, even with a number of observers. Therefore an ordinary testing machine was modified in some essential details so that instruments indicating stress and strain were placed close together where they could be photographed during the test by a motion picture camera. This arrangement has already been described in *Chemical & Metallurgical Engineering* for Jan. 19, 1921 (vol. 24, p. 131).

Load may be applied at any predetermined rate, and while the beam was at all times kept as nearly in balance as possible by the operator, photographs were taken of the three constantly moving dials at the rate of about one a second. The loading was continuous until the bar was broken and no changes in gears or

[4] *J. Iron and Steel Inst.*, vol. 87, p. 238 (1913).

TABLE I—HOT-ROLLED BOILER PLATE, LOADED AT VARIOUS RATES

Temp. of Test, Deg. C.	Motion Of Grips, In. Per Min.	Proportional Limit, Lb. Per Sq.In.	Tensile Strength, Lb. Per Sq.In.	Elongation In 2-In. Per Cent	Reduction In Area, Per Cent	No. of Tests Averaged
21	0.05	25,000	35,500	43.5	66.2	1
21	0.51	27,050	55,850	43.7	65.5	3
21	0.80	26,000	56,700	43.8	64.3	2
21	1.63	27,100	56,400	42.8	64.8	2
156	0.05	26,000	58,400	35.3	55.4	1
156	0.51	27,600	62,050	25.8	54.7	5
156	0.80	26,000	63,700	29.0	53.8	2
156	1.63	25,650	51,200	27.8	56.0	4
295	0.05	18,400	63,600	33.3	58.9	1
295	0.51	19,250	64,750	30.1	53.8	3
295	0.80	19,350	61,350	31.7	57.8	6
295	1.63	18,750	65,100	30.5	51.9	6
463	0.05	13,800	34,700	42.2	74.3	5
463	0.51	10,600	38,600	41.8	74.9	4
463	0.80	15,100	37,900	43.2	75.0	4
463	1.63	15,800	40,750	41.1	73.0	3

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[1] *Proceedings*, vol. 6, p. 109 (1906).
[2] *Proc.*, Royal Society of London, vol. 76, p. 419 (1905).
[3] *Iron Age*, vol. 45, p. 585 (1890).

TABLE II—EFFECT OF SLOW LOADING ON THE TENSILE PROPERTIES OF FIREBOX BOILER PLATE

Temp. of Test Deg. C.	Temp. of Test Deg. F.	Rate of Loading	Prop. Limit, Lb. Per Sq.In.	Tens. Str., Lb. Per Sq.In.	Per Cent Elong. In 2 In.	Per Cent Red. Of Area	Remarks
156	313	Adopted standard*	26,600	58,100	24.9	49.3	Av. 3 tests
156	313	6½ hr. from 22 to 47,000 lb. per sq.in.	.....	64,350	22.8	45.9	Av. 2 tests
295	563	Adopted standard*	14,330	66,430	25.9	53.1	Av. 3 tests
295	563	3½ hr. from 9 to 20,000 lb. per sq.in.	.....	60,000	36.0	59.2	.....
463	865	Adopted standard*	13,200	47,460	33.6	68.5	Av. 3 tests
463	865	6 hr. from 9 to 30,000 lb. per sq.in.	.....	33,600	42.0	78.4	.....

* Adopted standard averages about 0.05 in. per minute extension.

motor speed were made throughout the test. After development the film was projected on a screen, where images of the dials were enlarged and as much time as was desired might be taken in obtaining individual readings. Under the conditions outlined above more photographs were obtained than required, but these served as an indication of the balancing of the beam; if this is not closely maintained, it results in serious deflections in the resulting stress-strain diagrams.

Moderate Variations in Rates of Loading of Small Importance

A summary of the tests made on railway firebox steel at various temperatures under different rates of extension is given in Table I. The following conclusions may be drawn:

1. The tensile properties of firebox steel at temperatures up to and including the blue-heat range [295 deg. C. (565 deg. F.)] are independent of the rate of loading.

2. At 465 deg. C. (865 deg. F.) the tensile strength appears to increase slowly with rate of loading while ductility as measured by elongation and reduction of area is practically constant.

At this highest temperature the stress-strain diagrams obtained were not satisfactory. The elastic limit is low and is reached soon after the "slack" is taken up in the available geared apparatus. There is, however, a difference in behavior of the metal at or below blue-heat and 465 deg. C. (865 deg. F.) as indicated by variations in the figures for ultimate strength.

Slow Loading

In addition to the foregoing tests, samples of A.S.T.M. firebox plate were broken at about the same temperatures by increasing the applied stress very slowly when passing the proportional limit. The load was increased 100 lb. at 5-minute intervals over a definite range at each temperature and subsequently the test specimen was broken at standard speed. Such slow loading raises the strength and decreases ductility at 156 deg. C. (315 deg. F.), but the steel exhibits decreased strength and higher ductility when so tested at blue-heat or above than when broken in the ordinary manner. Table II contains the figures.

Microscopic Examination

Fractures of steel broken at various temperatures at different rates of loading and under varying conditions of mechanical work were examined under the microscope and were found to be generally transcrystalline. Minor differences appear under certain conditions such as, for example, the apparent tendency for the fracture to follow more deeply along the grain boundaries and particularly at the junctions of ferrite and pearlite when the steel is broken under very slowly increasing stress, but in general no marked differences in behavior were observed.

Tearing Tests on Metals

By Henry L. Heathecote* and C. G. Whinfrey†

THE results of impact tests are sometimes very surprising. A material which may give good results under the tensile test will sometimes give quite the reverse of good results under an Izod impact test. Such test-pieces break like a carrot. The simile is literal; it is not at all easy to break a carrot until the periphery has given way, then it tears across quite easily. This tearing is a point we should like to dwell upon for a few moments.

Metals in structures are figured to resist either tension or shear, and engineers speak of the working stress being so many pounds or tons per square inch. This is convenient and satisfactory so long as that square inch does what is expected of it and carries the load pretty uniformly. But the pious hope that every section will do its duty ought not to close one's eyes to the possibility that some day that whole load may be borne not by the square inch but by a very small part of it. In fact it has recently been shown by Professor Coker that heavy stress concentrations are to be expected in parts where the section changes. Then a load of so many pounds or tons per square inch will become so dislocated as to overstrain the piece badly at the surface and the material will *tear*.

To see this point more clearly consider the behavior of a material possessing no elongation. Such a metal might stand well under static tension and shear; but once a crack started, at the periphery for instance, it would spread right across under a vanishingly small pull for the reason that in such a material the forces at the apex of the crack would be enormously great. Of course, such material is unknown, but many are known which approximate to such a condition.

Some years ago one of us studied the failure of india rubber and observed that although it stood tension remarkably well it *tore* quite easily. A poor specimen required to *tear* it apart only 1/150 part of the energy required to pull it apart. This suggested applying a similar test to metals.

Tested in this way one gets the following results for resistance to tearing:

Thickness Tested, In.	
0.018	Tin plate, 770 to 750 lb. per linear inch.
.015	Brass, as received 651, annealed 530 lb. per linear inch.
.028	Aluminum, 270 lb. per linear inch.
.091	0.40 C steel, 1627 lb. per linear inch.
.018	0.05 C steel, 989 lb. per linear inch.
.013	Copper, 912 lb. per linear inch.
.075	Lead, 220 lb. per linear inch.

We had no difficulty in finding specimens of steel which tore at about 1,000 lb. per linear inch. The energy required to tear 1 sq.in. of such material was about one-fifth as much as to pull a piece 1 sq.in. in two.

Test-pieces for tearing tests have to be cut from thin sheets. The best form we know is made by taking a piece of sheet, about 2x4 in. in area, and slitting it carefully with tinners' snips as shown in Fig. 1. The

*Chief of Research Laboratories, Rudge-Whitworth, Ltd., Bearing Works, Birmingham, England.
†National Lamp Works of General Electric Co., Nela Park, Cleveland, Ohio.

tongue of metal 1x3 in. is turned out square out in front, and the two wings exactly opposite in direction, making a piece as shown in Fig. 2. This bent test-piece is then mounted in a tension machine, one grip taking the tongue and the other the wings. A delicate machine capable of registering accurately loads of a few pounds is required, for even the toughest steel in thickness of a few hundredths of an inch will require only 100 lb. more or less to tear it apart. A machine for testing paper or fabric will usually serve excellently.

Pull is then gradually applied until the metal tears as may be observed under a strong glass. The load is observed and immediately released. Five or six repetitions are made and the average taken for the strength of the metal.

The pull observed is that required to tear metal in two places and bend and unbend a total width equal to that of the specimen. In order to eliminate the work done in bending, it is necessary only to execute a similar test on a narrower or wider test-piece cut from the same material.

If P is the pull required to tear, bend and unbend a piece x in. wide

and p is the pull required to tear, bend and unbend a piece y in. wide

then $P - p$ is the pull required to bend a portion of the piece $2x - 2y$ in. wide

Therefore pull required to bend $2x$ in. $= \dfrac{P - p}{(2x - 2y)} \times 2x$

$$2x = \frac{(P - p)x}{x - y}$$

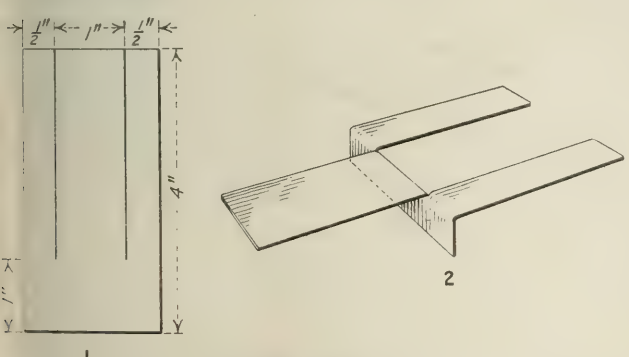
Pull required to tear specimen in two places

$$P - \frac{(P - p)x}{x - y} = \frac{px - Py}{x - y}$$

Tearing force per linear inch $= \dfrac{px - Py}{2t(x - y)}$

Where t is the thickness of the sheet.

It is apparent that the force required for bending will quite overshadow the force required for tearing in a thick piece.



FIGS. 1 AND 2
Fig. 1—Test-piece before bending.
Fig. 2—Test-piece after bending.

So far as we are aware the testing of metals for resistance to tearing is being done only at the Rudge-Whitworth research laboratory, in Birmingham, England.

The impact test on *notched bars* approaches the tearing test more closely than the ordinary tension test does, for the rupture of the metal in notched bar impact is by rapid tearing. By testing two specimens with different cross-sectional areas, it is possible to obtain simultaneous equations and to solve for the energy required to *bend* the test-piece and the energy required to *tear* it. In applying this method to some tests done at the National Physical Laboratory by Dr. Stanton and Mr. Batson, the resistance to tearing of one of the steels tested is found to be 1,580 lb. per linear inch, which is in close agreement with the figure for medium steel already referred to, obtained by tearing a sheet of thin steel and measuring the pull required.

We may reasonably expect tearing tests to throw light upon the suitability of materials for constructional purposes and that they will be of interest to metallurgists in throwing light upon the physical constitution of microstructure of metals and alloys. From the appearance of the fractures which occur during the life of metals in use it is obvious that they are for the most part tear-fractures, or, as they are more commonly called, "fatigue-fractures." Indeed, "fatigue fractures" doubtless start from some internal notch where the stress concentration is above the ultimate strength of the material. Probably all hardened steels break by tearing, as also do high tensile alloy steels such as nickel-chromium steel.

On the other hand, it would not do to assume that resistance to tearing should always be as high as it is possible to make it. When material is machined the ease with which it is removed by the tool depends upon the ease with which it tears apart forward of the tool point; and a high machining speed will be obtained only when the Brinell hardness and resistance to tearing are relatively low.

Calcium Silicide as a Deoxidizer

According to a recent number of *The Iron and Coal Trades Review*, the use of calcium silicide for deoxidizing liquid steel is increasing in favor among English steel makers. This fact is due to the very powerful deoxidizing characteristics of calcium, and will, under conditions where silicon alone is not sufficiently powerful, usually completely deoxidize the metal. Calcium metal has a very powerful affinity for oxygen, and while the oxide, as well as silicon oxide, melts only at extremely high temperatures, mixtures of the two form silicate slags which melt at temperatures existing in the steel furnace. Such slags are insoluble in the metal, rise to the surface, and are easily incorporated in the normal slag, which is of the same nature.

The use of calcium as a deoxidizer under normal conditions should be quite safe, as any excess calcium left in the steel after the reaction is completed will be rapidly oxidized from external sources of oxygen in the surrounding air or volatilized, consequently there is little risk of leaving any trace of calcium in the steel.

Like silicomanganese, it is a ladle addition, and preferably made in powdered form. French alloy containing Si 60 to 65 per cent, Ca 30 to 35 per cent and Al 2 to 3 per cent is mostly used in Great Britain. It is reported that the violence of the reactions cause small explosions to take place if lump material is added to gassy steel. This phenomenon has not been noticeable in American experiments with the alloy.

Two grades are available in the United States, manufactured by the Electro Metallurgical Co. in the electric furnace:

	Grade 1	Grade 2
Ca	24 to 28	18 to 22
Si	65 to 70	55 to 60
Fe	3 to 5	15 to 20
Al	About 1	About 1

An alloy of calcium, silicon and manganese has also been recently developed by the American concern which may prove superior, in some cases, to the simple ferros.

The Technology of the Carbon-Electrode Industry—V Baking and Baking Furnaces

A Critical Study of the Baking Process as Carried Out in Electric and Gas-Fired Furnaces—A Review of the Principles Underlying Their Construction and Design — American Operating Practice—Comparative Advantages of Different Types of Furnaces*

By Charles L. Mantell
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BAKING in the carbon-electrode industry has for its object the conversion of a highly resistant "green" electrode into a low-resistance finished product; the conversion of a material with qualities and properties which vary with temperature changes into one whose properties remain fairly constant over a wide range of temperatures; and lastly, the conversion of a material with low tensile strength into one which is strong and capable of withstanding hard service.

Baking accomplishes these results by a distillation-cracking action on the binder. As the temperature increases the binder successively softens, melts, loses its lighter constituents by distillation, and finally is converted into coke. At the end of the baking process, even the coke has lost whatever volatile matter it may have retained during its actual formation. According to the speed of temperature rise in the process, the volatile portions of the binder may or may not be "cracked"—that is, broken down into simpler compounds and carbon. As the result of the coking of the binder, the whole mass of the electrode is held together very strongly. Each small particle that had been covered by a film of binder is bound to the adjacent particles by an extremely thin layer of coke.

The change that has taken place during baking is easily demonstrated. A green electrode, if struck on a stone or concrete floor, causes a sound much like a thud. The same electrode after baking, if struck in the same manner, gives out a resonant bell-like tone.

The furnaces used are of two kinds, those in which the heat for baking is generated by the electric current, commonly called electric furnaces; and those in which the heat for baking is obtained from the burning of a combustible gas, commonly called gas furnaces.

Electric Baking Furnaces

The rise of electrode manufacture has paralleled that of the electrochemical industries. The electrochemical industries naturally gravitated to sources of cheap power, which were the great hydro-electric developments. Electrode plants soon located near their electrochemical customers and they themselves became users of cheap power for heating purposes. As a result, during the earlier stages of the development of carbon manufacture, the electric current was used entirely for electrode baking to the exclusion of other methods of heating. Now, however, the electric baking of amorphous carbon electrodes is becoming an obsolete procedure. Its value from the point of view of the development of the electrode industry, as well as its significance to other lines of manufacture, is believed to be sufficient to warrant its consideration in the present discussion.

The electric furnaces used for carbon baking are of the horizontal Acheson resistance type, heating the contents of the furnace by the resistance of the charge. They consist simply of two ends, which are brick walls in which the electrodes for carrying the current to the charge are supported, and two removable sidewalls of brick set up by hand without mortar or cement. The bottom of the furnace is insulated by filling it with some cheap dielectric, such as broken concrete, gravel, brickbats, etc. The appearance of the built-up furnace is that of a rectangular box. Furnaces usually are operated on single-phase alternating current at twenty-five cycles frequency with 30 to 60 volts.

The sketch in Fig. 24 shows the principal features of a standard baking furnace. Power is supplied from

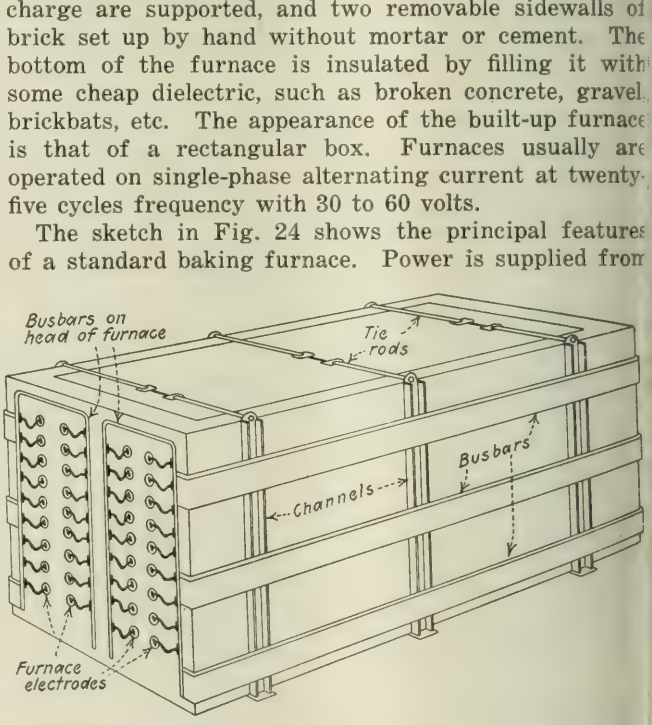


FIG. 24—SKETCH OF ELECTRIC CARBON ELECTRODE BAKING FURNACE

transformers to the furnace through copper or aluminum busbars, both heads of the furnace being connected by furnace busbars to the main set from the transformers.

Details of Construction

The sidewalls are of refractory clay brick, built in such a manner that the bricks in the wall "lock" one another in position by continuously crossing, layer after layer. Either one or both walls are torn down at the end of a run so that the baked carbons may be unloaded from the furnace. The sidewalls are held up and supported against undue pressure from the inside by channel irons placed at definite intervals. The ends of the furnaces are built of fireclay brick laid in place with mortar or cement

*The preceding articles of this series were published in *Chem. & Met. Eng.*, vol. 27, Nos. 2, 4, 5 and 6.

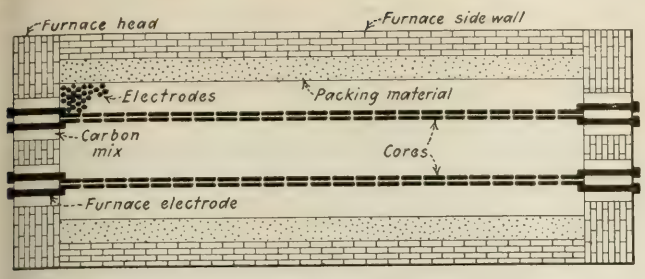


FIG. 25—PLAN OF ELECTRIC BAKING FURNACE

Transformers used are normally of the single-phase, twenty-five cycle, oil-filled type with a voltage range on the low side of 30 to 60 volts. The capacity of transformer used depends upon the size of the furnaces connected to it. Usually electrical connection is made so that four furnaces are "hooked up" to a single transformer. This is done so that the transformer may be operated at all times except when a change of connection between furnaces is being made. Switches are not provided for the furnaces, but only for the transformers. When a furnace is not "on power" (that is, not having power passing through it), the side busbars are removed so that the heads of the furnace are disconnected. Operation is such that one furnace of a group is always on power, the others are cooling, loading or unloading.

Loading the Furnace

Either one or both sidewalls have been torn down during unloading. All old packing dust is removed from the furnace. Any electrode cable, clamp or busbar replacements are made before loading is started. The furnace is opened at one or both sides so that large quantities of electrodes may be run in by trucks or handled by overhead cranes. Finely ground packing dust is then sifted between the individual carbons to fill all voids, and between the outside row and the furnace walls.

After the furnace has been completely loaded, the channel irons strengthening the sidewalls are put in place and connected with the tie rods across the top of the furnace. Just as soon as a transformer is available, the side busbars are put in place. They are supported and held in position by small arms fastened to and extending from the channels. The busbars are insulated at points of contact with the channel irons.

The Baking Process

All of the busbars of the furnace being in place, power is turned into the furnace by running the voltage regulator up to its highest point and closing the transformer circuit through the oil switch in the transformer switch room. The transformer switchboard panels are each equipped with an ammeter connected in on the primary side, a voltmeter connected to the secondary side, a power factor meter and an integrating wattmeter. Furnace log sheets are kept.

The core of the furnace, being of much lower resistance to start with, naturally takes most of the current at the beginning of the run. As a result, it heats up at a faster rate. Fig. 26 shows a comparison of the rate of heating of an average core, and the rate of heating of the temperature points. The core curve does not bear out the statement of some electric furnace men that the cores reach a temperature as high as 2,000 deg. C. during the run. The curve seems to agree with the fact that core carbons are seldom found to be graphitized, which would be the case if the core were to reach a temperature of 2,000 deg. C.

The cores, heating up at a more rapid rate, reach final temperature sooner than the rest of the furnace, which is gradually heated by radiation from the core until it conducts of its own accord. From the fact that the resistivity of the carbons just inside the core is lower than that of any other portion of the carbon pile, the indications are that this portion of the carbon pile reaches the highest temperature.

Insulation and Packing Materials

Insulation of the carbon pile depends for its effectiveness upon four things: (1) The condition of the bottom of the furnace, (2) the age of the brick sidewalls, (3) the time the sidewalls have remained intact, and (4) the width of the packing material insulating layer. The bottom becomes soaked with the pitch and tar distilling off from the binder in the electrodes during baking. With an old bottom, considerable heat will be radiated off. In this case the bottom itself ceases to act as an insulator and becomes a conductor. The brick of the sidewalls are also penetrated with tar and pitch fumes, which gradually coke inside and on the surface of the brick, thereby seriously lessening their insulating power.

It may be said that up to a certain point, the thicker the packing material layer the better the insulation.

The packing material which is principally used is pulverized calcined petroleum coke, ground in a mill of the swing hammer type, to pass a 10-mesh screen. This material has almost entirely supplanted magnesia, carborundum and fireclay, which were formerly used as packing materials. Petroleum coke does not adhere to the electrodes, making them difficult to clean, as do

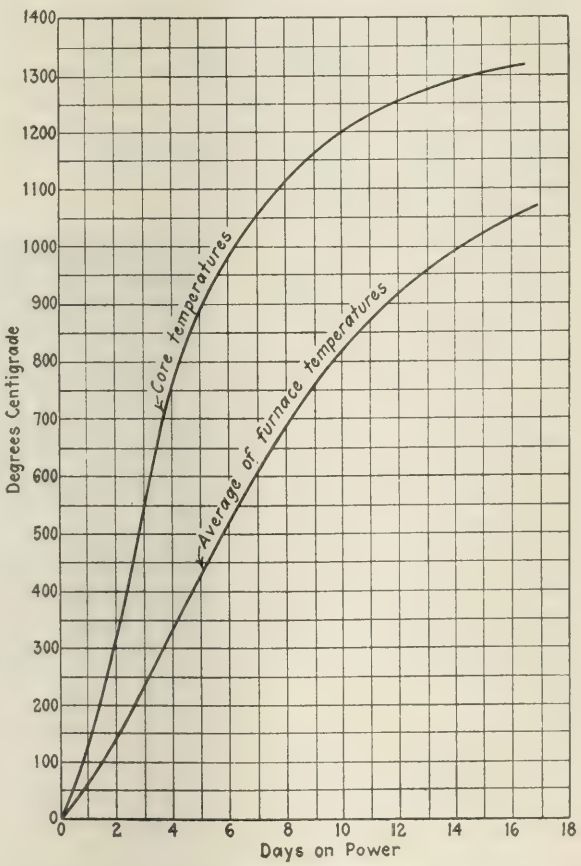


FIG. 26—COMPARISON OF CORE AND FURNACE TEMPERATURES

magnesia and carborundum. Being of the same material as the electrodes, it does not contaminate their surfaces, and furthermore is easier on the grinding mills.

During baking there is a tendency for the ash of the packing material to fuse as a result of the high temperature. Coming in contact with the sidewalls and bottoms, the packing material becomes more and more contaminated with fireclay and silica with each run. Tarry matters distilling from the electrode binder are "cracked" when they come in contact with the hot packing material on their outward passage. As a result they tend to bind together the packing material particles, and at the end of the run it is necessary to send the packing material to the grinding mills for pulverization before it can be re-used. It leaves the furnace in the form of a very friable clinker. Practically all of the packing material, save what is lost by oxidation and handling, is recovered at the end of the run.

Unloading the Furnace

As soon as the furnace has reached final temperature (1,000 to 1,100 deg. C.), the transformer circuit is opened, the side busbars of the furnace removed and placed on a furnace which is ready to go on power and the transformer circuit is closed. The furnace is then permitted to cool to a sufficiently low temperature to permit of unloading. Of course, it is understood that even if it were feasible to unload the furnace at such a high temperature, the electrodes would oxidize very rapidly and cause a large loss of material. Permitting the furnace to cool before unloading keeps the red hot carbons away from the air and prevents oxidation losses.

After the furnace has cooled, the tie rods across the top of the furnace are removed and the top layer of packing material is shoveled off. The electrodes are still appreciably hot at this time. In order to expedite the process, either one or both sidewalls are torn down. All packing dust is removed for regrinding preparatory to re-use. The electrodes are handled with the aid of tongs, for they are usually too hot to be removed by hand.

With the proper packing material, electrodes will be produced with a fairly clean surface requiring little further work on them. The most desirable baked charge is one that almost unloads itself—that is, the baked electrodes are loosened and removed with little effort. Packing dust grains larger than the No. 10 screen size are liable to sink into the carbons during the plastic stage of baking and be baked in place. This causes an extremely rough carbon to be produced, requiring much surfacing work to be done on it.

An average furnace under good operating conditions and control has approximately the following cycle: Loading (including time for making repairs if any), 2 to 4 days; on power, 12 to 20 days; cooling, 20 days; unloading 3 to 5 days; giving a minimum cycle of 37 days and a maximum of 49.

Graphitizing Furnaces

Graphitizing furnaces may be considered as modifications of the standard amorphous electrode-baking furnace. Their general construction is the same, the furnaces being about the same length, but with heads somewhat narrower and not as high. In the Acheson furnace, shown in Fig. 27, busbars, rising through the floor, are connected directly to the electrode heads, the connection being broken at these points when the furnace is off power. Loading and unloading are accomplished as with the amorphous carbon baking furnace, with the exception that a central core of larger cross-sectional area is used. Power consumption is much higher, being from 3 to 5 kw.-hr. per pound of graphitized carbon. Temperature control, being relatively difficult above 1,100 deg. C., is normally dispensed with, and the run of the furnace is regulated by power input. Packing material, sidewall and top insulation are thicker, for the furnace reaches a temperature of approximately 2,000 deg. C.

The theory of the production of graphite is that carbides are formed by reaction of the amorphous carbon and the metallic and siliceous oxides present as impurities. The furnace, however, soon reaches the temperatures at which these carbides are decomposed, distilling off the metals and metalloids, leaving graphite behind as a result of the decomposition. Packing dust used in graphitizing furnaces becomes contaminated much more readily than in amorphous baking furnaces. The packing material layers serve as a cold blanket, in which the metallic and siliceous vapors condense, re-forming carbides to some extent in the layers nearer the center of the furnace and oxidizing in the cooler outer portions. It can be seen, then, that relatively impure material may be used in the manufacture of very pure graphite electrodes inasmuch as nearly all of the contamination is volatilized.

A graphite furnace cycle is approximately as follows: Loading, 1 to 2 days; on power (depending upon capac-

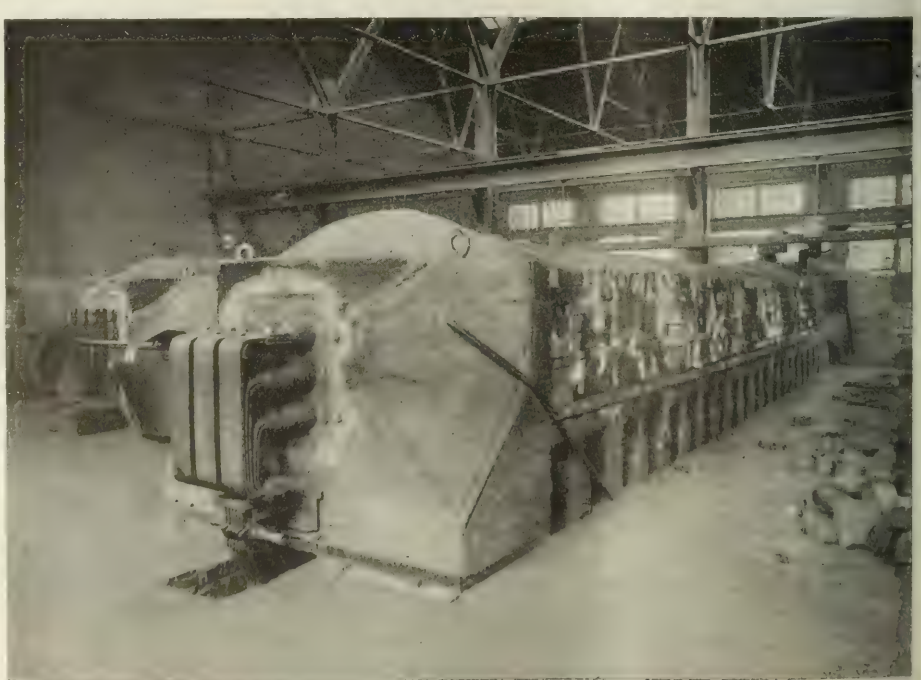


FIG. 27.—ACHESON GRAPHITIZING FURNACE

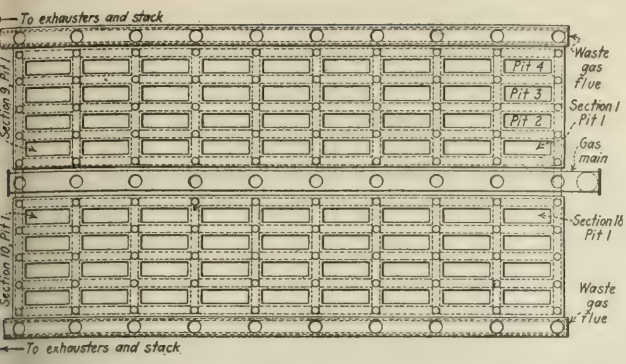


FIG. 28—PLAN OF 18-SECTION LONGITUDINAL PIT TYPE OF GAS-FIRED ELECTRODE BAKING FURNACE

ty of transformer and size of furnace), 3 to 6 days; ooling, 20 to 30 days; unloading, 1 to 2 days, giving minimum cycle of 25 and a maximum of 40 days.

Graphitized carbons are generally cleaner than amor hous electrodes when taken from the furnace; they ave fairly smooth surfaces and require relatively little urther work on them. The reason is that the tempera- ure rise is so great that the ash and vapors from the inder are distilled away from the carbons very rapidly nd are condensed in the insulating packing material ayers only and not in the packing dust between the arbons. The removal of the layers of insulating pack- ng material is more difficult than in the case of the morphous carbon furnace.

Well-graphitized electrodes have approximately one- ourth the resistivity of the corresponding amorphous arbon. Graphite carbons run from 0.00032 (Acheson, ompletely graphitized) to around 0.00080 ohm per nch cube (partly graphitized carbon, commonly called verbaked amorphous), depending upon the complete- ess of the graphitization of the amorphous carbon. he greater conversion to graphite the lower the resis- ivity.

Gas-Fired Baking Furnaces

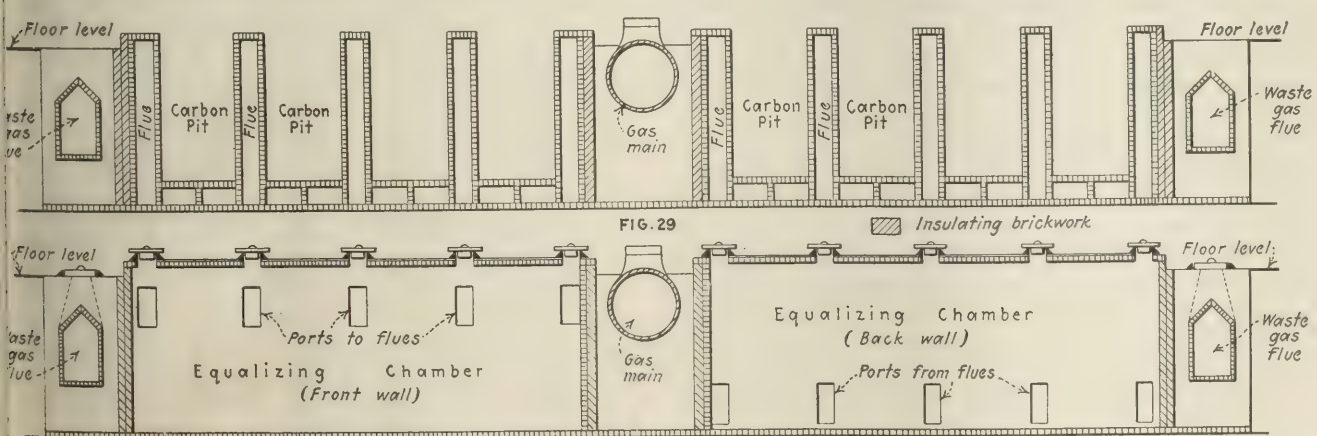
Gas-fired electrode baking furnaces are all built on he "ring" principle—that is, they are in the form of n endless chain of individual units. They are regen- rative, without having regenerators. They consist ssentially of brick chambers, in which the green elec- rodes are placed, heated by gas, burning in flues along he ends and sides, and in some cases under the bottom f the chambers.

The gas-fired furnaces may be classified in four different ways: First, in reference to the position the chambers or "pits," as they are termed, occupy in respect to each other which gives us the *longitudinal furnaces*, in which the pits are end to end, and the *latitudinal*, in which the pits are side by side. A second classification, in reference to the baffles in the flues heating the pits, gives the two classes *horizontal* and *vertical baffle furnaces*. A third, in respect to the pits, yields the *continuous* and *non-continuous pit furnaces*. The last classification is in respect to the tops of the chambers, as to whether they are covered or not. This acounts for the two classes *open-* and *closed-top furnaces*.

Construction of a Typical Furnace

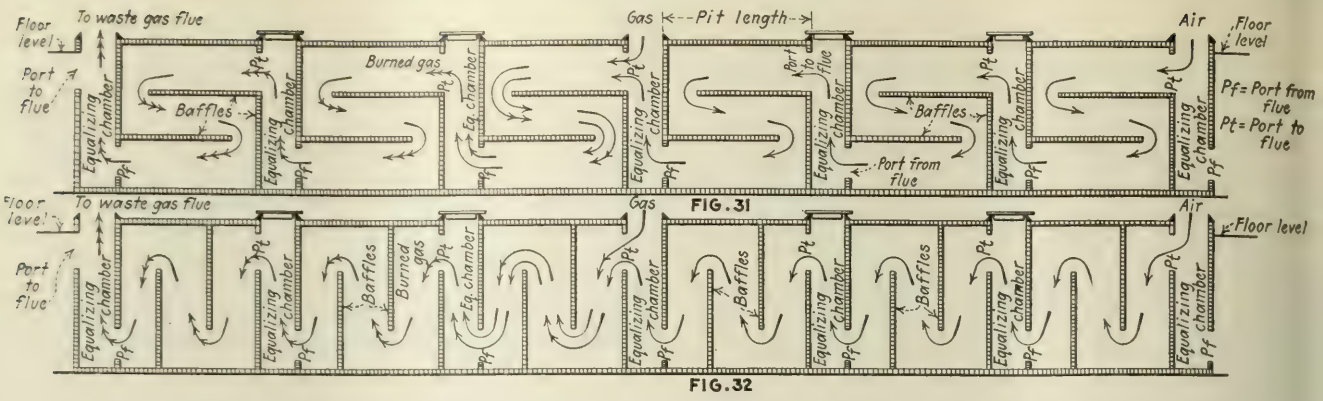
The general construction will probably be best understood in connection with the drawings of a typical furnace. Fig. 28 shows the plan of an eighteen four-pit-section, longitudinal, non-continuous pit, open-top furnace. The entire furnace forms a rectangular "ring" around the centrally located gas main. The dotted lines show the position of the flues, which are continuous for the entire furnace. The flues for the burned gases, which are usually termed waste-gas flues, are on the outside of the furnace and parallel to the gas main. Offtakes from the gas main and openings into the waste-gas flues are shown by the larger circles. Lines joining the centers of the openings in the gas and waste gas mains are parallel. Openings into the flues heating the pits are shown by the smaller circles. Connections between the gas main and flues and waste gas and flues are not permanent, but temporary and portable. When not in use, the gas-main, flues and waste-gas flue openings are closed by heavy cast-iron covers, fitting in rings or seals so that they can effectively and easily be "luted" with sand or fireclay. Fig. 29, a sectional elevation across the furnace and through the pits, affords a good conception of the relative positions of the gas-main, flues, pits and waste gas flues. The pits are separated from each other by so-called equalizing chambers with which the flues along the sides of the pits connect, as shown in Fig. 30. These chambers serve to even up pressures and volumes of gases passing through the five different channel flues.

The portion of the furnace located between two gas-main offtakes and the corresponding waste-gas flue entrances is termed a "section." Equalizing flues extend over the width of the section.



FIGS. 29 AND 30—SECTIONAL ELEVATIONS OF GAS-FIRED LONGITUDINAL PIT TYPE FURNACE

Fig. 29—Through carbon pits. Fig. 30—Through equalizing chambers, showing location of openings into chamber and ports from flues into equalizing chambers. In the rear wall the ports are below and in front above the flue level.



FIGS. 31 AND 32—SECTIONAL ELEVATIONS THROUGH MIDDLE OF FLUE SHOWING HORIZONTAL (FIG. 31) AND VERTICAL (FIG. 32) TYPES OF BAFFLES

Arrows show flow of air, gas and waste gas; P_f, port from flue; P_t, port to flue.

Gas mains are usually cylinders of steel plate lined with a highly refractive firebrick. Waste-gas flues are generally built of brick, rectangular in cross-section save for the top, which is closed over by corbelling the brick. However, no brick flue, no matter how well built, is gas tight for any considerable length of time. As a result there is a growing tendency to build waste-gas mains in a manner similar to the central gas main.

The carbon pits are formed by the brick walls of the flues, which are built of tongue-and-groove brick. The ends of the pits are tied in by the use of tongue-and-groove corner brick. All of the brickwork is laid with a refractory bond, being rubbed into place with a minimum of mortar, in order to obtain the tightest joints possible.

The reader has probably inquired of himself by this time, "Where are the gas valves?" There is a slide in the gas main at its entrance to the furnace, but this is used only when operation of the entire unit is started or stopped. There are valves of the bell or gate type in the so-called "gas elephants," which are the portable connections between the gas main and the flues.

Connection between the flue openings and the waste-gas flue is affected by the use of waste-gas elephants, built of steel plate.

In order to cause the burning gases to give up as much of their heat as possible to the section in which they are burning, baffles in the flues are used to lengthen the distance the gas must travel. Two types of baffles are employed, horizontal and vertical. Figs. 31 and 32 show sectional elevations through the middle of flues and illustrate horizontal and vertical types of baffles. In each of these the gases leave the flue of each section at the bottom, pass into the equalizing chambers, and enter the next section's flue at the top.

The Latitudinal Pit Furnace

Fig. 33 shows the plan of a latitudinal pit furnace. Flues are shown by the dotted lines. In this case the section and pit are identical. The gases advance from one section to the next by passage under the section. When baffles are used that cause the gas to pass from left to right, then right to left, and from the top to the bottom, an even number of baffles along the sides of the pit requires that there be an even number under the pit in order to bring the gases back alongside the gas main for the following section. In a like manner, an odd number of baffles along the side will call for an odd number. With vertical baffles, the gases passing up and down, and from left to right, the gases must then pass from right to left under the pit to come back alongside of the gas main for the next section. As there is but a single flue for each section, no equalizing chambers are needed.

The Isbell-Porter Co., of Newark, N. J., has patented a gas-fired latitudinal pit furnace in which it uses clay cylinder burners spaced along the bottom of the flues between the sections. Gas and air rise through these, burning in chambers above the burners. The gases rise and pass around vertical baffles set parallel to the gas main, one on each side of each burner. As a result one-half of the gases from each burner pass around the baffles on the right hand side and one-half around the baffle on the left hand side, each meeting the gases from the burners adjacent to the one they came from. Here they burn down, pass under the pit and come up through the burners of the flue of the next section.

Present practice is to build only open-top furnaces—that is, furnaces in which the tops of the pits are exposed. In the older type furnaces, covers for the tops were used made of firebrick arches held together by channels and tie rods. The arches were portable and interchangeable for any pit or section. Often the flue system was such that the gas burned over the top of the pit under the arch in addition to burning at the sides and ends. A large number of arch or covered top furnaces have outlived their usefulness, and in-

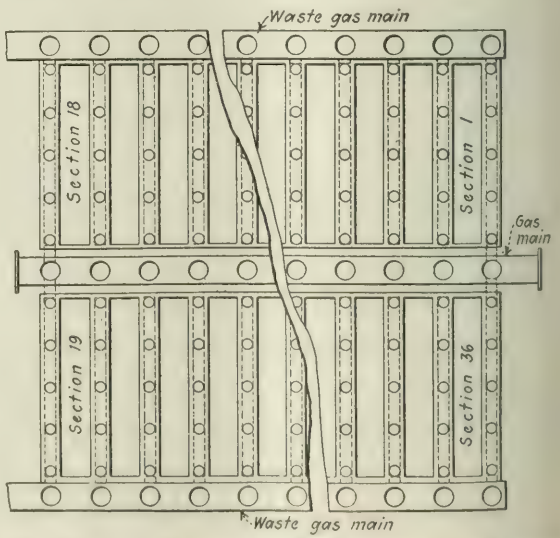


FIG. 33—PLAN OF LATITUDINAL PIT TYPE OF GAS-FIRED ELECTRODE BAKING FURNACE

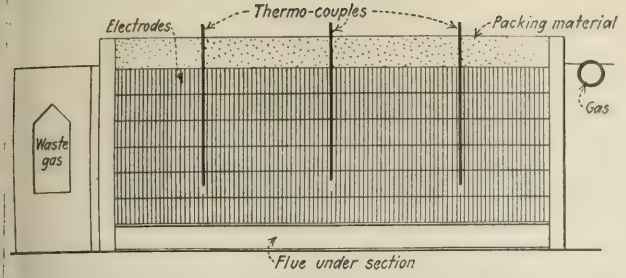


FIG. 34—ELEVATION OF SECTION OF LONGITUDINAL TYPE OF FURNACE, SHOWING LOCATION OF THERMOCOUPLES

stead of being rebuilt in the same manner, were replaced by the open-top variety.

Operation

The operation of all of the different types of gas furnaces is the same. It is always considered on the basis of an individual section in connection with its preceding and succeeding section. The cycle of operation for each section is: (1) Loading, (2) on waste gas (preliminary heating), (3) on fire (on gas) (heating), (4) on air (cooling) and (5) unloading. For an example, let us suppose that the furnace has been in operation for some time and we find a section ready for loading. It is loaded in a manner similar to the loading of an electric furnace. The carbons are placed on end as closely as possible, with packing dust sifted between them, thermocouples placed in desired positions and a covering of packing material placed over the top layer of carbons. Fig. 34 illustrates the loading of the latitudinal and longitudinal pit types.

It is to be understood that the five operations mentioned in the preceding paragraph are all going on at the same time, but in different portions of the furnace. The section now loaded is ready to go on waste gas. Operation is ordinarily so arranged that a little time allowance is made so that sections can be loaded a short time in advance.

Unloading is accomplished by "stripping" the pit—that is, removing the layer of packing material on top of the carbons. The layers of carbons at the top are "pulled" by means of short-handled tongs and the lower layers by long-handled ones. The pits are normally too hot for workmen to go down in them during unloading. After the carbons are removed and the pits have cooled considerably, the workmen enter and remove the packing dust from the bottom of the pit and any that has been baked in place and is adhering to the side and end walls of the pit.

Furnace Temperatures

Fig. 35 shows a typical curve of pit temperatures. From fourteen to eighteen cycles per year are completed per section, with an average of sixteen.

Flame temperatures are generally 200 or 300 degrees higher than the final pit temperatures, and often go as high as 1,400 deg. C. when using well-heated air and hot gas of higher B.t.u. value. Air temperatures at the point where the air meets the gas are between 500 deg. and 600 deg. C. Waste gas temperatures fall to as low as 350 deg. C. at the entrance to the waste-gas main, but are usually 100 or 200 degrees higher than this.

Spacings

In the design of baking furnaces the term "spacing" is used to refer to the number of furnace sections through which the air must pass during preheating before it meets the incoming gas. This spacing of air and gas depends upon the rate of cooling of the sections on air, the temperature required of the air for combustion and the available suction. The air temperature desired is the highest possible, as the hotter the air the hotter the flame temperature. The greater the spacing the longer will be the distance that the air passes over previously heated sections and the closer the temperature of the air will approximate that of the section next to the one on fire. The longer the air passes through a section the cooler the section will become. Usually, however, the suction available limits the number of sections through which the air can be drawn for preheating. The cycle of operations is lengthened by increased time interval of greater spacing as any given section is on air a longer time.

The spacing of the gas and waste gas is determined by the drop of the waste-gas temperature and the available suction. It is desired to bring the waste-gas temperature to as low a point as possible with a minimum loss of the sensible heat of the waste gas.

From the foregoing description it can be readily seen that any furnace is not limited to a single fire, but may have many more. In this case we must make allowance for another spacing, that of fire to fire. It

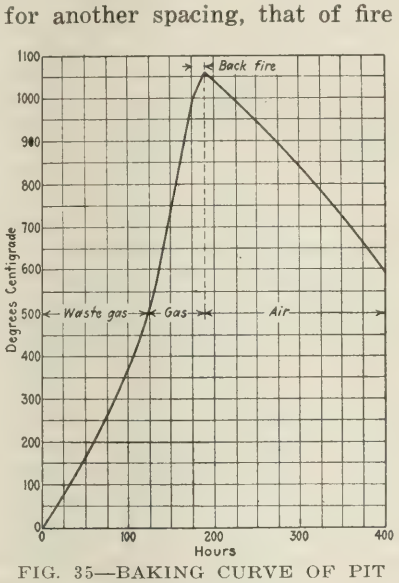


FIG. 35—BAKING CURVE OF PIT TEMPERATURES IN TYPICAL GAS-FIRED FURNACE

must be great enough to allow time for the preparatory operations, loading, unloading and repairs to take place before the cycle of one firing follows the cycle of another. The number of sections to a furnace and pits to a section is theoretically unlimited. The number of fires is fixed by the number of sections to the furnace and the spacing of the fires.

The fuel used for firing the furnace is generally raw producer gas. The producers in present practice are located as near the furnace as possible so that all of the sensible heat of the raw gas may be utilized. Producers operate on bituminous gas coal, and are of the updraft pressure type.

At first glance at a gas-fired electrode baking furnace it seems strange that only an extremely small amount of gases, from the distillation and cracking of the green carbon binder, is given off through the uncovered tops of the pits. The walls of the pits are not gas-tight and as the flues are under suction, the pits come under suction through the crevices of the walls.

As a result the vapors and tarry matters arising from the distillation-cracking action of the binder are drawn off into the flues and become a portion of the waste gas. For this reason waste gas is usually of a heavy greenish-yellow color, having a marked deleterious effect on vegetation. In the earlier stages of the industry, when electrode plants were located at places sparsely populated, this condition was not important. With increases in population, the necessity of eliminating the nuisance of the waste gas became apparent. Electrode works started to scrub waste gas and to recover, as a product of the scrubbers, a thin liquid tar.

Control

Control on the furnaces is obtained by regulation of the cross-section of the air openings, by regulation of the gas-elephant valves, and waste-gas valves or "dampers." Additional control on individual sections is obtained by regulation of the ports from and to the flues in the equalizing chambers.

A more or less unsuccessful attempt has been made to replace the electric thermocouple pyrometer in this industry by the optical pyrometer. However, the relative unreliability of the optical instrument at lower temperatures, the difficulty of training unskilled workmen in its use and the trouble in procuring black body conditions in pipes in the pits have prevented a general adoption of this instrument. The rapidity with which readings can be obtained by the use of an optical pyrometer is a strong point in its favor in the operation of the type of furnaces used in electrode manufacture.

Furnace Design

As gas-fired ring furnaces for electrode baking have not as yet been definitely standardized, their design involves a considerable amount of cut-and-try procedure. The entire field of gas baking, however, is a promising one, and the possibilities of its development are relatively great.

In general the length of the pit will have to be a multiple of the average electrode diameter. The waste-gas flue must be large enough to take care of all products of combustion, plus excess air, plus the vapors distilled and cracked from the electrode binders. Allowance must be made in designing the waste-gas flues to take care of the products of the maximum number of fires possible on each side of the furnace. The latest furnaces built have been of the longitudinal pit, vertical baffle, open-top variety. Vertical baffles, with openings through the top of the flues, permit the possibility of cleaning the flues by blowing them out with compressed air or sucking out dust, pieces of brick or mortar, etc. Horizontal baffles do not permit this.

In the design of the flues (and equalizing chambers if any) such combinations must be used as will give as intimate a mixture of the air and gas particles as possible, for the better this mixture the better will the gas be burned and the greater the heating power obtained from the gas. Having the gas and air come from opposite directions, meeting, and continuing at right angles to their previous flow, provides a good and intimate mixture.

A comparison of gas and electric baking shows that both types have low thermal efficiencies.[22] The cost of a unit of energy obtained from electrical sources i much greater than that obtained from the gasificatio of coal and the combustion of the resulting gas. A though the electric unit is ten times as large as the ga section unit, the yearly production of the electric unit i not more than one and a fourth times that of the ga unit. This is because of the greater number of cycle possible with the gas furnace. In the electric furnace there is no heat recovery of any sort, while in the ga unit the heat of the waste gas and baked electrodes ar both partly recovered.

Comparative Advantages of Gas and Electric Baking

Gas baking is gradually but surely replacing electri baking because of its cheaper cost. All of the recen installations of electrode baking furnaces, except fo graphitization, where gas baking is not a competito have been of the gas-fired variety. The greater eas and closeness of control of the gas-type furnace is decided advantage over the electric. The gas type pe mits the more or less valuable products of electrod baking to be recovered. In the electric type all sensibl heat of the finished baked electrodes is entirely los while in the gas type it is almost entirely recovere and used to give preliminary heating to the other mat rials. The maximum temperatures are much greate in the case of the electric type than in the case of th gas type, and the latter is limited by the softening poi of the furnace brickwork and the possible air tempera tures obtainable. Both types use about the same amoun of absolute energy in baking and a large part of th difference in cost may be shown to be due to the fa that a heat unit from gasified coal is much cheaper tha one from electric power. The average life of an electri furnace is about three or four times that of a ga furnace.

Finished electrodes from electric furnaces are mo difficult to clean than from gas-fired ovens, but th electric baked have the advantage of having a somewha lower resistivity. Packing dust after being used i electric furnaces is more difficult to grind and prepar for re-use than is the case with the dust from gas-fire units where fusing temperatures for the ash of th packing material has not been reached. Electric fu naces are generally very dirty, as the products of bakin burn on the outside of the furnace. Gas-fired unit on the other hand, have the baking products drawn o in the stack along with the waste gases and as a resu properly operated gas units are comparatively clean.

Editor's Note: *The concluding article of this serie which will discuss the cleaning, machining, testing an shipping of carbon electrodes, will be published in subsequent issue.*

Anti-Corrosion Association

An "Association of Manufacturers of Non-Corrodib and Anti-Corrosive Products" (a name reminiscent Dr. Herty's organization) is being organized in Englan by firms making stainless steel, acid-resisting chemic plant, anti-corrosive paints, boiler preservatives and th like. It is proposed that the association should act an Institution of Anti-Corrosion Engineers and also a Chamber of Commerce for firms making any materi or appliance connected with the prevention of corrosio It is further suggested that a public exhibition of no corrodible and anti-corrosive products should be held the near future.

[22] The heat necessary to raise the material to the required temperature (calculated from the specific heat of the material) divided by the actual heat used. See Richards, "Metallurgical Calculations."

Book Reviews

ELEKTROCHEMIE WASSERIGER LOSUNGEN (Electrochemistry of Aqueous Solutions). By *Dr. Fritz Foerster*, professor of the Institute of Technology of Dresden. Third edition, revised and enlarged. 900 pp. with 185 illustrations. Leipzig, 1922: Johann Ambrosius Barth. Series of Applied Physical Chemistry Manuals edited by Prof. Dr. G. Bredig.

The first edition of this work appeared in 1905, and the second in 1915 during the early part of the World War. The advances in electrochemistry, both theory and practice, stimulated by the demands of war were of such consequence as to make a third edition, enlarged and improved, highly desirable. In this third edition Dr. Foerster has covered a very broad field in an exceedingly comprehensive manner. The arrangement of the text follows the second edition closely, with the more recent additions to the book coming under their proper chapter headings.

An idea of the broad scope of the field of electrochemistry covered may be had from the following chapter titles, as they appear in the text: 1. Electrical energy and direct current electricity in general. 2. Faraday's law and its practical deductions. 3. Theoretical deductions from Faraday's law. The electrolytic dissociation theory. 4. Migration of ions. 5. Both voltage and energy efficiency. 6. Resistance of electrolytes. 7. Electroosmosis. 8. Production of electrical energy in galvanic elements. 9. General theories of electrolysis. 10. Electrolytic evolution of oxygen and hydrogen. 11. Special electrochemistry of metals. 12. Applications of electrochemistry to the metals. 13. Electrolytic reduction. 14. Special electrochemistry of the halogens. 15. Electrolytic oxidation.

Dr. Foerster endeavors to show the value of theoretical electrochemistry as applied to practice, and in this he is especially successful in the chapters on Faraday's law and its practical deductions, applications of electrochemistry to the metals, and special electrochemistry of the halogens.

Those interested in the electrochemistry of aqueous solutions will find this book a very up-to-date, comprehensive reference.

"AGGREGATION AND FLOW OF SOLIDS." Being the Records of an Experimental Study of the Microstructure and Physical Properties of Solids in Various States of Aggregation. By *Sir George Beilby*. London and New York, 1921: MacMillan & Co. 256 pp., 106 figures. Price $6.50.

Dr. Beilby's work is well known to chemists, physicists and metallographists. He put forth the amorphous theory of metals pertaining to the films on polished surfaces and amorphous metal generated at slip planes by plastic deformation. The present book deals not only with metals but with all solids, and is in eleven sections.

The section on the microscope is interesting, because in it is illustrated how the microscope can be utilized to determine the type of surface on a solid. Dr. Beilby devised a method of observing very small particles some years before the ultra microscope was described.

In the section on surface tension a number of experiments are described on the character of oil films and of thin metal leaves. When a water surface is touched with a needle which has been dipped in an oily liquid there occurs a definite sequence of changes in the state of aggregation. A continuous film first forms over the surface in all directions. Two forces are present, one which tends to keep the oil in the form of a continuous film and the other which tends to reduce the surface area of the oil and hence to change it into spheres. The spreading continues until the film becomes so thin that the surface tension force of the oil dominates the attractive force between water and oil. The surface then becomes punctured all over with small round holes, which increase in size. At the beginning of the change the oil network is continuous, but the process of gradual change produces a form in which the water surface becomes continuous and the oil concentrated in isolated drops. The state of equilibrium of each drop depends on the surface tension of the oil and the attractive forces between water and oil at the contact. Similar changes take place in thin metal leaves; for instance, if a leaf of continuous gold is mounted on glass and heated to 400 deg., the continuity of the gold completely disappears, and the isolated portions of gold become thicker than the original leaf, due to the forces of surface tension. "The foregoing illustrations show that an increase in the mobility of the molecules of a solid, which is still far short of the freedom of the liquid state, is sufficient to enable the force of surface tension to assemble the molecules of a thin film into new forms of aggregation."

In Section III the author gives the outstanding characteristic of a solid as "rigidity," which implies the retention by the molecules of fixed positions relative to each other so that energy has to be expended to change these fixed relations. A number of types of aggregation are considered. Atoms or an aggregation of atoms forming molecules may be arranged in definite and repeating patterns to form crystals. Such crystals may be perfectly dense or, under certain conditions, may exist in an open formation.

Particularly interesting is the formation of calcium carbonate. Carbon dioxide from the air first forms a thin film of calcium carbonate on a drop of lime water. With the continued addition of CO_2, the film breaks up into particles (which the author calls "spicules") of such small size as to move about with Brownian movement. "If two spicules have an encounter, they at once coalesce and the enlarged unit proceeds to fresh encounters till its mass becomes so large that it sinks to the bottom as a granule and rests there. Its power of absorbing other spicules having increased with its mass, it now acts as a center of attraction to the still active spicules which play around it with swift to and fro movements, ultimately darting into it and being absorbed. By focusing on the bottom of the cell the granules were seen to grow till they took the outward form of rhombs."

Open formation in metals may be caused by exposing them red hot to ammonia. The general effect is a slight increase in weight with a continuous change in structure—holes are developed, increasing the volume enormously. "Rolls of fine wire gauze of copper were heated in a porcelain tube at 800 deg., and a current of ammonia was passed through for 70 minutes. It became so brittle it could not be bent without breaking. Its color was bright pink, and its surface was so completely disintegrated that metallic luster had disappeared. Under the microscope the bubble structure was very obvious. The diameter of the wires had increased two or three times."

Perhaps the author is best known for his work on polish and surface condition of solids. In Section V two fundamental principles of polish are put forth: 1. In every substance sufficiently homogeneous to be polished at all, the fundamental principles on which polishing depends are absolutely identical. 2. The polished surface on a solid substance is as truly due to the presence of a surface tension skin as is the surface of a liquid.

Evidence is given to substantiate these principles. The author holds that amorphous substances like glass have liquid surface tension skins on their cold surfaces, different from the structure at a fracture. The latter surface can be polished cold so as to produce a surface tension skin; in fact, the resistance to polish on a broken surface of glass is much less than on one already polished or one cooled from a high temperature. When a surface of a crystal is polished a surface tension skin many molecules thick is formed. This skin is vitreous-amorphous in character. The surface of calcite crystals can be scratched and these can be completely covered by polish, yet caused to reappear by proper etching.

A sharp distinction is made between grinding and polishing. It was formerly believed that polishing was only very fine grinding and that grinding was the cutting away of a substance by the hard particles of the abrasive. The author shares the old view as regards grinding, but puts forth the hypothesis that polish is the result of surface flow caused by the gripping of the surface molecules by the particles of the polishing powder.

Some interesting experiments are described on the formation of similarly oriented crystals of sodium nitrate.

These crystals permitted to form either on a cleavage plane or polished surface (parallel to a cleavage plane) were oriented similarly, showing that the crystallic attraction of the calcite extended through the supposedly vitreous-amorphous polish film. Realizing that this experiment might cast doubt on the existence of a vitreous film, the author deposited isotropic films of calcium carbonate and oxalate on a polished surface of calcite and then permitted the sodium nitrate crystals to form. Up to a certain thickness of deposited film (many molecules thick) the sodium nitrate showed the parallel growth, but beyond that a perfectly random arrangement.

Sections VI and VII deal with the generation of amorphous metal at the slip planes by plastic deformation of ductile metals. The mechanical properties of metals are considered from the viewpoint of the amorphous theory. The treatment is substantially the same as in the author's May lecture (1911) before the Institute of Metals, and discussed at length by the reviewer in *Chemical & Metallurgical Engineering* for Oct. 12, 1921 (vol. 25, p. 697). It is postulated that plastic deformation produces vitreous-amorphous metal at the slip planes; the amorphous metal is hard and hence the hardening by cold work. The amorphous metal is mechanically stable because of the relatively low temperature. When a cold-worked metal is heated the amorphous metal recrystallizes, restoring softness.

It is the author's opinion that flow by slip takes place in rocks and in ice under conditions of great and unequal pressure, rather than softening by the lowering of the melting point. An ice column nearly 60,000 ft. thick would produce only enough pressure to effect melting at a temperature of —12 deg. C. Therefore, plastic flow and recrystallization seem necessary to account for the flow in glaciers.

In Section IX a tentative hypothesis of molecular "pulsation cells" is offered. "The molecule, which for simplicity we shall take to be monatomic and spherical, is elastic and is capable of responding to ether-borne vibrations by vibrations of a period proper to itself and of an amplitude proper to the temperature attained. Its elasticity may be either of form or of volume; again for simplicity's sake, let us assume the elasticity to be that of volume. The vibration of the spherical molecule will be spherical pulses. The effect of these pulses, the period of which is necessarily rapid, will be to surround the sphere with a 'pulsation cell' the thickness of which will depend on the amplitude of the pulsations. The amplitude of the pulsations will in its turn depend on the temperature, so that for each temperature the cell will be of definite thickness.

"When an aggregate of spheres at the absolute zero is energized by heat, each molecule as it becomes energized will surround itself with a pulsation cell proper to the temperature which it has reached, and the molecules will be pushed apart to a corresponding distance."

In 1857 Faraday gave the Bakerian lecture entitled "The Experimental Relations of Gold and Other Metals to Light." Phenomena of the color of light transmitted through thin gold leaves were described but not explained. In Section X Beilby offers an explanation of these phenomena which he believes agrees with all of the experimental observations. The key to the interpretation is the decrease in density of thin films of metal on mild heating. The particles arrange themselves in "open formation" as the first step in the change in state of aggregation under the influence of surface tension forces. The open formation accounts for the observed decrease in density, enormously reduced electrical conductivity, the optical phenomena and sponginess as shown by the absorption of water and other liquids.

The book contains 106 illustrations, many of which are highly magnified micrographs, a collection which is unique in individuality and variety. A number of excellent colored illustrations are reproduced.

Although the experiments were made during the last 20 years, the author states in the preface that the conclusions are based on mature consideration just prior to publication. Besides containing accounts of many interesting and varied experiments the book is a fine piece of scientific literature.

The greatest value of the book, in the opinion of the reviewer, lies in the experimental methods described. The author combines almost infinite pains in performing with rare ability in planning his experiments; their boldness and originality are equaled only by their simplicity. The author's appreciation of important variables and his skill in controlling them entitles him to a place among the foremost experimenters. It is a pleasure to acknowledge the great indebtedness of metallographic science to the work of Dr. George T. Beilby.

ZAY JEFFRIES.

METALLOGRAPHIE. By *W. Guertler.* Vol. II, Part I, Section 3: Elektrochemische Metallkunde, by *Dr. R. Kremann.* Berlin, 1921: Borntraeger.

Dr. Guertler writes in his preface to this volume that the enormous expansion of scientific knowledge in the field of metals and alloys, in addition to certain unfavorable circumstances growing out of the war, have made it impossible to carry out his original plan of completing the handbook under his own authorship. The present volume is accordingly the work of a collaborator, Dr. Kremann. One finds no difficulty in understanding this change of purpose when it is recalled that several thousand pages of the handbook have already appeared. This undertaking is evidently planned with the intention of assembling under one title in a series of volumes everything pertaining to theory and practice within the metal industries no matter how expansive the effort becomes or how long it may require for completion. Those of us who work in this field should therefore receive these contributions with extreme satisfaction, feeling grateful that so much is being done to chart the progress in a field of growing complexity.

The volume in hand constitutes the third section of the first part of the second volume of the handbook and comprises about 650 pages under the sub-title, "Electrochemical Science of Metals." It is essentially a critical review of published investigations describing the change of potential with concentration in binary alloy systems. Five ternary systems are also included. The literature is treated from the constitutional standpoint and the relations between electrochemical potential and various established types of constitution are set forth in detail. Those who desire to consult the work of individual authors quoted in this volume will run into difficulty, inasmuch as, in harmony with the practice in earlier volumes, no direct references are given. The reader must be content with the bare knowledge and date of authorship until, at the end of the entire undertaking, a table listing the literature appears.

About thirty pages of the book are occupied by introductory statements of theory and methods of potential measurements, including a six-page discussion of passivity.

Following the treatment of binary alloy systems, some attention is paid to the subject of alloying by electrochemical methods. The author's discussion of the use of potential-concentration curves of binary alloy systems as a means of determining the alloy compositions resulting from ordinary electrolytic precipitation reactions should be of especial interest to those generally engaged in alloy investigations. Qualitative or semi-qualitative data defining the character of precipitate produced in many reactions of this sort are included. Thus we read on page 444 that the lead precipitated by cadmium from dilute solutions of lead salts is practically pure and on page 451 that tellurium precipitates a compound of the formula Ag_2Te from silver nitrate solutions. As very little of the data on this general subject is of recent origin it should be used with caution.

The subject of electrolysis, mainly from the standpoint of alloy formation at the cathode, is handled elaborately with reference to a large amount of well chosen data. Important combinations of metals such as Cu:Zn, Cu:Sn, Cu:Ni:Zn and amalgams are discussed.

Other important topics included are the electrolysis of molten salts, anodic behavior of metals and alloys and finally a brief chapter on electrolytic refining of metals.

This volume probably makes use of the largest collection of references relating to the electrochemical properties of metals thus far assembled. It is unfortunate that these references are abbreviated so as to be virtually useless in their present form.

C. H. MATHEWSON.

Synopsis of Recent Chemical & Metallurgical Literature

Internal Stress in Brass Tubes

A method of studying the effect of w-temperatrue reheating on the relief internal stress in metal is used by oore and Beckinsale[1]. If a flat strip metal t inches thick is bent to a dius r, the stress in the outer fiber f below the elastic limit) is equal to $t \div 2r$, where E is Young's modulus. ow while held in this shape, a heat-eatment is given it, after which the rip is released. It will assume a form mewhere between the straight line id an arc radius r, and from the re-ilting curvature the stress relieved iring heat-treatment can be com-ited.

Internal stresses rapidly fall during ie first few minutes of low-temperature nneals, the faster the higher the tem-erature. Thereafter, further relief ecomes slower, almost vanishingly nall. However, internal stresses in ard drawn condenser tubes as high as 3,500 lb. per sq.in. are reduced to 2,000 lb. after 60 minutes at 250 deg. ., a heat-treatment which also im-roves their physical properties with-it softening the metal, as shown by ie following results:

	Original Tube	Annealed 60 Min. at 250 Deg. C.
rinell hardness	164	163
roportional limit	27,000	45,000
ield point (extension 0.2 per cent)	71,200	77,600
ltimate strength	85,000	83,300
longation	11	17
eduction in area	28	51

It has already been found that season-racking probably requires internal tresses of 20,000 lb. per sq.in.; cer-ainly it is very improbable if they are educed to 10,000 or 11,000 lb. per sq.in. ven when submitted to ammonia imes. Pushing the heat-treatment to 00 deg. C. even for 10 minutes will educe ordinary internal stress to be-ow the lower figures, and cause almost qual improvement in the physical prop-rties noted in the above table. Most everely stressed tubes would require 0 minutes at 300 deg. C.

Bengough and Hudson[2] recommend a 0-minute oxidizing heat at 280 deg. C. or aid in resisting corrosion. It is ow seen that such a heat would like-ise be a sure preventive against sea-on-cracking and splitting from internal tresses.

Utilization of Iron Ores Containing Vanadium

Iron ores containing low percentages f vanadium have not yet been used for he production of V with the exception f some converter slags, emanating rom certain Minette ores. Attention as been given to bituminous sub-tances containing vanadium, even though sparingly, because these materials give a high-grade product simply through burning.

Swedish magnetic iron ores containing appreciable amounts of V also generally contain titanium in considerable quantities as ilmenite, according to Björn P. F. Kjellberg, state inspector of mines, Sweden, (*Jornkontorets Annaler*, 1921, p. 147). Magnetite appears to hold the vanadium, but the minerals as a rule occur in such a manner that even after the ore has been finely ground they cannot be completely separated, and it is generally impossible to produce a concentrate containing more than 50 to 55 per cent of iron, up to 1.5 per cent V, and 5 to 15 per cent Ti. A remarkable advantage of these Swedish ores is that they generally are very low in phosphorus.

Rich concentrates having the lowest possible percentage of Ti may be smelted with charcoal in an electric pig-iron furnace, slagging both the V and Ti. The slag consequently contains a considerably higher percentage of these metals than the raw material. It is then given a roast with salt and iron sulphide, and leached with hot water. Vanadium in solution is precipitated as iron vanadate by ferrous sulphate, filtered and washed. After drying it contains 50 to 55 per cent vanadic oxide (V_2O_5).

Another possible method of refining the slag is to smelt it with niter cake and coal, and leach out the sodium-vanadium sulphide with hot water. Excess acid precipitates the V as sulphide, which after calcination becomes V_2O_5.

Low-vanadium, high-titanium concentrates can be turned into color material (red ocher) and vanadium extracted at the same time. The fine-ground dry material is stirred into sulphuric acid and the pulp heated gently under intermittent stirring until the metals are converted into sulphate. This is heated to a comparatively low temperature to drive off the sulphuric acid, which transforms the Fe and Ti into insoluble oxides, a pigment of fine color and superior qualities. Soluble V compounds are extracted by a hot solution of caustic soda, precipitated as vanadium sulphide and calcined.

[1] "Further Studies in Season-Cracking and its Prevention," British Institute of Metals, March, 1922, meeting.

[2] "Fourth Report to the Corrosion Committee," *J. Inst. Metals*, 1919, I, p. 207.

Recent Chemical & Metallurgical Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Zirconia Refractory — By adding a limited quantity of steatite to zirconia and then heating the mixture, a new compound is formed that makes an excellent refractory material for many purposes if the steatite is not less than 15 per cent nor greater than 40 per cent. When the steatite is much less than 15 per cent, the compound lacks strength and uniformity, while if in excess of 40 per cent its fusing point will be too low. The best results are produced when the compound is formed from 80 per cent zirconia and 20 per cent steatite, the resulting material having great physical strength over a wide range of temperatures and having a fusing point but little lower than zirconia, thereby filling all the requirements of a high refractory material.

In making the refractory material, the zirconia and steatite are separately finely ground and then thoroughly mixed in definite proportions by weight. Water is then added in sufficient quantity to enable the mixture to be pressed into bricks, which are thoroughly air dried. After drying, the bricks are fired in an electric or other suitable furnace until they are fused. The fused compound is then cooled, preferably in water, and thereafter ground to such a degree of fineness that the particles will pass through a 30-mesh or finer screen. The object in fusing the mixture is to produce a uniform compound that will not shrink after being molded into final form, the zirconia and soapstone shrinking to a considerable extent when first heated.

The finely ground compound is then mixed with a small percentage of volatile binder, preferably 1½ per cent of gum arabic and a very small quantity of water, and pressed under high pressure into final shape as bricks, crucibles, insulators and the like. They are then fired at a temperature that will completely volatilize and drive off the binder and soften but not fuse the compound. The resulting articles after cooling are hard, dense and smooth and of their original shape and size, there having been no warping or shrinking during the firing.

Among the many advantages of the new refractory material are its high melting point, its great strength at all temperatures up to its softening point, its ability to withstand the cutting action of molten metal, the capability of making a refractory material of varying strength and heat resistance by varying the proportions of the ingredients to meet any requirements. (1,418,372; Charles A. French, assignor to International Harvester Co. June 6, 1922.)

Mold for Hot-Top Ingots—S. E. Hitt of Elyria, Ohio, and J. I. Peyton of Chicago, Ill., propose an ingot mold whose topmost part is hollow cast. A vacuum is maintained in this space and it is claimed that by this means the top part of the solidifying ingot will remain liquid much longer than the lower, thus acting as a sink-head to fill any pipe or contraction cavity which may be formed. A hollow-cast top may also be bolted to the top of an ordinary mold. Various precautions are mentioned concerning the manufacture of the mold, its design and the maintenance of the proper vacuum. (1,422,572; July 11, 1922.)

SO_2 From Smelter Smoke—G. C. Howard of Tacoma, Wash., patents certain improvements in the process of recovering SO_2 from dilute mixtures, such as smelter smoke. He delivers cooled smoke to the bottom of an open

"enriching" tower, passing upward through sprays of SO_2 solution. From this tower the smoke then goes through a packed absorption tower. A water current in closed circuit is circulated in a contrary direction through both these towers, sufficient being drawn off to supply the gas plant. Here part of the solution passes through a heat interchanger and thence to a boiler, where the SO_2 is driven off. This gas passes to a cooling tower, where it is cooled by the remainder of the solution from the absorption plant. Thence the cool gas is dried in a scrubber through which H_2SO_4 is circulated, when it is ready for liquefaction. Warmed solution from the cooling tower just mentioned passes to the boiler either direct or through the heat interchanger at the entrance of the gas plant. Spent liquor emerging cool from the heat interchanger is returned to the enriching tower. Thus the operation requires a minimum of make-up water and a minimum amount of heat. (1,417,066 and 67; assigned to American Smelting & Refining Co.; May 23, 1922.)

Electric Smelting Furnaces for Zinc—Filip Tharaldsen, of Trondhjem, Norway, patents such a furnace which is essentially a smelting chamber inclosing an arc. Charging is effected through a tall shaft, whereby much volatile matter is driven from the raw materials before it enters the smelting chamber. Zinc vapor is conducted to a series of inclined condensers, each one air-jacketed to absorb the heat from liquefaction and to regenerate the temperature. Slags are drawn from the furnace periodically, and further treated, if their zinc content warrants. (1,417,953; May 30, 1922.)

Manufacture of Butyric Aldehyde—According to British patent 166,249, which has recently been taken out in this country, butyric aldehyde is prepared by passing normal primary butyl alcohol in a vapor state over a fused cupric oxide catalyst. The temperature of the catalyst and vapor is maintained at between 200 and 350 deg. C., although the preferable temperature range is between 280 and 320 deg. The vapors pass through a condenser, and are there separated from hydrogen. The resultant butyric aldehyde may be separated from the unchanged butyl alcohol by distillation, and the latter returned to the catalyzers.

A particularly high percentage conversion is claimed for this process. Thus, in a ¾-in. copper tube packed for 26 in. of its length with fused cupric oxide it is possible, while working at 300 deg. C., to pass through 240 c.c. per hour of normal butyl alcohol, and obtain 75 per cent conversion in one passage. (1,418,448; David A. Legg, assignor to Matthews Atkinson Adam; June 6, 1922.)

Separation of Petroleum-Oil Sludges—Sterling H. Diggs, assignor to the Standard Oil Co. of Indiana, has been granted a patent for the treatment of the acid sludge such as is normally obtained in the manufacture of lubricants from petroleum oil. The method consists of treating this sludge with an intimate mixture of water and the sludge sulphonic acids of the character usually derived from the fuming-acid treatment of mineral oil. The fuming-acid sludge referred to is produced by the action of relatively large quantities of fuming sulphuric acid from heavy petroleum oil of the character used for medicinal purposes. Prior to the mixing, the fuming-acid sludge has usually had the bulk of its sulphuric acid separated from it. This may be readily accomplished by the addition of water to the sludge, followed by the thorough boiling of the mixture and settling.

The mixture of oil sludge, fuming-acid sludge, gas oil and water or weak acid having been made, this is now steamed until it is nearly at boiling temperature. The sulphuric acid contained in the sludge separates out at the bottom of the tank in a form of about 30 deg. Bé. acid. This is drawn off, more water or weak acid added, and the mixture again steamed, after which a second stratification takes place. The process may be repeated until the gravity of the acid recovered is from 8 to 10 deg. Bé., beyond which stage it is unnecessary or unprofitable to carry the concentration. (1,418,781; June 6, 1922.)

Preparing Size for Paper Making—The resin size ordinarily used in the manufacture of paper is a mixture of resin soap with varying amounts of free resin. In dissolving such a mixture, the resin soap acts as an emulsifying agent for the free resin, and it is evident that the facility with which emulsification will take place must decrease with an increase in the proportion of free resin. The ordinary size used by paper makers contains about 25 per cent of free resin, but it is often desirable to use proportions of free resin amounting to about 45 per cent of the total resin.

Dr. Oliver Kamm, assignor to the American Writing Paper Co., of Holyoke, Mass., has patented a method which consists in heating the size with an exactly sufficient quantity of water to form a clear emulsion of size-in-water at a given temperature and in diluting this emulsion by pouring it into a large volume of water. The preferred temperature for the preparation of the first concentrated emulsion is the boiling point of the solution. Cold water may be used for the subsequent dilution.

In preparing dilute resin emulsion containing 30 per cent of free resin, one part of F grade resin is treated with one part of water containing sufficient quantity of sodium hydroxide in water to convert 70 per cent of the resin into resin soap. This mixture is heated until a clear homogeneous solution is obtained. Four to five parts of hot water are then added and the mixture heated practically to the boiling temperature until a clear homogeneous solution is again obtained. The actual quantity of water to be added is dependent to some extent upon the particular grade of resin used. This clear emulsion is then diluted by pouring it into 45 parts of water, thus producing a diluted solution containing approximately 2 per cent of total resin. (1,415,363; May 9, 1922.)

Paint Pigment—LeRoy Baker of St. Louis, Mo., has received a patent for the production of a sunproof zinc white pigment, the particles of which are claimed to be of uniform size and of microcrystalline formation. A solution of zinc sulphate is heated with steam and subjected to air under pressure. At the same time a solution of a metallic peroxide, such as calcium or barium peroxide, is added in the proportion of about 1 per cent by weight of the zinc present. The hydrated zinc oxide thus formed is filter-pressed and mixed with a solution of barium sulphide. The precipitated pigment is dried and calcined. It is then reground while wet, again washed, filter-pressed and finally dried and packed for the market. The inventor claims that the properties of this pigment are the result of the precipitation from basic solutions. Reference is also made to application filed July 16, 1919, Serial No. 311,296. (1,413,565; April 25, 1922.)

Recovery of Volatile Solvents—A number of interesting improvements have been outlined by G. W. Coggeshall and T. M. Rector in their recently patented process for the recovery of volatile solvents such as alcohol and the like from material in or with which they have been used in the coating of fabrics. The general process with which these investigators worked consisted in passing a current of gas such as air over the coating material, the gas being warmed to a temperature sufficient to volatilize the solvent. The mixture of gas and solvent vapor is then brought into contact with a suitable adsorbent such as charcoal or activated carbon. The volatile vapors are adsorbed by the material and the mass is then heated to volatilize the solvent which may be recovered by condensation. A method is outlined for reducing the volume of fresh air needed, thereby increasing the concentration of solvent vapor in the air-vapor mixture passing to the adsorbers. It has also been shown that if a slow current of air or of a gas of greater molecular weight is passed through the adsorber during the heating of the adsorbent mass to drive off the vaporizable solvent and this incondensible gas is passed along with the condensible vapor through the condenser, a larger percentage of vaporized solvent is removed from the mass of the adsorbent in the same length of time than when no incondensible gas is so used. It has been found to be advantageous to remove such gas from the condenser or collecting vessel, reheat it and again pass it through the heated adsorbent material. (1,418,363; assigned to the Institute of Industrial Research, Inc. of Washington, D. C., June 6, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Potash Bounty Defeated in Senate

Party Lines Swept Aside in Vote of 32 to 30 Against Subsidy Proposal—Small Chance Now of Saving Potash From Free List

THE PROPOSAL of the Senate Finance Committee to substitute a ounty for the protective duties pre-iously prescribed for potash was re-ected by the Senate on Aug. 8 by a ote of 30 to 32. The vote was taken committee of the whole. The first tep was to reject the original pro-osal of the Finance Committee pro-iding various rates of duty upon the nportation of potash. This was done y a vote of 66 to 1, the single objec-on being registered by Senator Short-idge, who apparently was willing to t well enough alone. The next ac-on, therefore, was to subject potash the bounty provision, and that fail-ig it was left upon the free list. An pportunity will be afforded to bring ie matter up again when the bill is onsidered in the Senate proper, but is thought that the chance is slight f saving potash from the free list.

Would Foster Industry

During the discussion of the item it as admitted frankly that the bounty as substituted for the duty when it ecame apparent that the duties pro-osed would be voted down. Senator IcCumber, chairman of the Finance ommittee, in urging the adoption of ie bounty proposition pointed out the nportance of having a domestic potash idustry to curb the monopolistic con-ol of the other sources of supply. He nphasized its importance in both eace and war and expressed the opin-n that the $9,500,000 would prove to e a very good investment for the eople of the United States.

"The committee was faced with this tuation," he told his colleagues. "If e raised the duty on potash undoubt-lly it will be carried on to the con-mer, but while the consumer is pay-ig this added burden for a few years, do not say how many, which under ie provisions of the bill as introduced as carried only for 5 years, we would e developing an industry in the United tates which would operate as a lever t least to preserve our own prices to me extent and to protect them gainst the possibility in another war f increasing from $40 to $100 per n."

German-Alsatian Combine

Senator Smoot of Utah laid before ie Senate the contracts which Ameri-an purchasers were compelled to sign order to secure German and French potash. The contracts show that Germany and France have agreed on this form of contract and have decided to permit Germany to take 75 per cent of all American orders, while the French producers are to fill the remaining 25 per cent. This led Senator Reed to remark that France and Germany have no difficulty in getting together when it is a case of "skinning" America in a commercial transaction.

Lenroot Leads Opposition

The committee failed to explain to the satisfaction of the Senate why the bounty policy, if applied to potash, should not be applied to manganese, tungsten and other products of which the domestic production can supply at best only a small percentage of the country's requirements.

Senator Lenroot of Wisconsin expressed the hope that the Senate would not "embark upon the sea of bounties." "If it does," he said, "and the door be opened, as is proposed by the committee, the Treasury of the United States will have to be enlarged, because there will be demands for bounties from every quarter. If the precedent be set here today, we will have in the future pork-barrel bills composed of bounties compared to which river and harbor bills will seem as nothing. I am amazed that this committee, which has under its care the protection of the Treasury of the United States, should bring to the Senate such a proposition as this."

"If the farmer is not sufficiently interested, why does the chairman think the people of the United States as a whole are willing to do what the farmer himself is not willing to do?" he inquired.

Nebraska Deposits Sufficient for Only 10 Years

The Wisconsin Senator quoted from the Tariff Commission's report to show that the Nebraska deposits will be exhausted in 10 years. He said Nebraska would absorb 50 per cent of the bounty for an industry that would have to go out of business anyway in 10 years. He suggested that it would be better insurance for another war not to exhaust the Nebraska potash. Outside of Nebraska, he said, the $9,500,000 would go to three or four companies only. In addition to the question of policy, he pointed to opinions of the Supreme Court which he interprets as an indication that a bounty is unconstitutional.

Bounty as Aid to Agriculture

Senator Smoot, supporting the bounty, urged the Senate to free American agriculture from the clutches of two powerful syndicates, one in Germany and the other in France, "both working in complete harmony in the control of the potash of the world." He said the German potash syndicate is back of the propaganda designed to influence American farmers against the use of American potash.

Senator Reed said that it is intolerable that American concerns be permitted to sign such contracts with foreign producers. "That is a trust practice in its worst form," said the Missouri Senator. "My judgment is that any American manufacturer who will do it ought to be sent to jail for a long term."

Senator Simmons of North Carolina predicted that with so large a bounty enough potash would be made to require the payment of many times $9,500,000. "At the end of 5 years," he asserted, "if that bounty be withdrawn, the industry will go to pieces in the face of this same foreign competition. It is impossible for us to make in the United States by expensive processes a potash that can be sold in competition with the potash that is found abroad in inexhaustible quantities and needs only to be dug up, as we would dig up sand."

Arsenic Goes on Free List as Essential to Boll Weevil Control

White arsenic and arsenious acid were put on the tariff bill's free list on Aug. 8 when the Senate, by a vote of 29 to 25, struck out the amendment of the Finance Committee, proposing to make each commodity dutiable at the rate of 2 cents per pound. The amendment, which overrode the Finance Committee, was offered by Senator Smith of South Carolina. His principal argument in support of his amendment was that arsenic is the basis of insect control and is essential to agriculture. He presented a report from an agent of the Department of Agriculture in which it was stated that great difficulty is being experienced in securing calcium arsenate.

American Peat Society Plans Annual Meeting

The American Peat Society will hold its sixteenth annual convention at South Bend, Ind., Aug. 29 to 31. The activities of this society are devoted to the diffusion of knowledge concerning the farming of peat and muck and it is made up of men from all parts of the United States and Canada.

The program will extend over 3 days and will cover many phases of intensive agriculture and peat and muck utilization. Papers illustrated by lantern slides of interest to intelligent practical farmers and persons concerned with fuel will be presented by representatives of the Departments of Agriculture, Commerce and Interior, by representatives of state agricultural and geological institutions and by private professional and business men. Excursions will be made to experimental plants near South Bend.

There are 12,000 square miles of muck and peat land in the Great Lake and New England States that can be used for the production of truck and general farm crops, fertilizer and fuel. Fourteen billion tons of fertilizer or fuel is available. The fertilizer is worth $10 per ton and the fuel can be produced for $1.50. In some parts of the country the proceeds from the cultivation of muck soils amount to over $500 per acre per year.

Among the papers to be presented are the following:

"Peat Resources of the United States," by C. C. Osborn, formerly in charge of peat investigations for U. S. Geological Survey.

"Technologic Aspects of Peat," by a representative of the Bureau of Mines.

"Peat Fuel Industry of Foreign Countries," by a representative of Department of Commerce.

"Classification of Peat and Muck Soils," by Milton Whitney, chief U. S. Bureau of Soils.

"Peat as a Fertilizer Ingredient," by Fred Wiedmer, president Wiedmer Chemical Co.

Cellulose Section, A.C.S., Plans Symposiums

The cellulose section of the American Chemical Society is arranging for two symposiums to be held at the time of the Pittsburgh meeting. The subjects—"The Constitution of Wood Cellulose" and "The Adsorption of Salts by Cellulose"—should prove of particular interest to pulp, paper and textile chemists. Among other scheduled speakers are Professors Bancroft, Holmes and Wise, and Doctors Johnson, Hawley, Esselen, Rue, Sherrard and Tingle.

Papers which are likely to arouse much interest and discussion are one by E. Sutermeister on "Research Problems in the Paper and Pulp Industry," and two by Alfred Tingle on "The Process in the Beating Engine and at the Wet End of the Paper Machine," and "The Reaction Between Aluminum Sulphate and Rosin-Size Solutions."

American Valuation Adopted for Dyes

Senate Accepts Flexible Tariff Proposal as Substitute for Embargo

American valuation as a basis for the application of import duties on coal-tar dyes and chemicals covered in sections 25 and 26 of the chemical schedule of the tariff bill was adopted by the Senate Aug. 11, without a record vote. Under the provisions of this so-called elastic tariff, the President has the power to transfer the basis of evaluation of these chemicals from foreign to American valuation, which is equivalent to an increase of more than 50 per cent of the duties in some cases.

It is provided that the President shall consider the difference in the wholesale selling prices of domestic and foreign merchandise in the principal markets of the United States, in ascertaining the difference in the costs of production here and abroad. The President is also directed to take into consideration the "advantages granted to a foreign producer by a foreign government or by a person, partnership, corporation or association in a foreign country." Senator Walsh of Montana declared that it would not be possible to obtain information as to wages, cost of raw materials and other items of production costs for the foreign products and offered a motion to strike out the whole paragraph. The motion was defeated by a vote of 42 to 20. Senator Smoot of Utah, a member of the Finance Committee, also acknowledged the difficulty of fixing the duties on patented products under the chemical schedule. "In fact," he said, "it is an utter impossibility to find the cost of production. In such a case, the only thing to do is to use the plan as outlined by the committee and get as near to the production cost as possible." He intimated that the determination of costs might be carried into the courts.

A Substitute for the Embargo

Senator McCumber, chairman of the Finance Committee, explained that the subdivision of section 315 covering the flexible tariff provision was intended to apply more specifically to dyes. "This method of meeting certain specified cases—not specified in the bill, but well understood by the Finance Committee—was in the first instance to prevent the necessity of continuing an embargo," said the North Dakota Senator. "It was intended to cover some of the chemicals and dyestuffs which might require a greater expansion of the duties than would be provided by increased duties on the foreign valuation basis.

"Of course, we have voted out the embargo proposition entirely and we have left the bill in such shape that it would be impossible to maintain an industry that we regard essential under the general rule which is provided in this amendment. That was the real purpose. It may be that the President might abuse that purpose. I do not think we will nor that anyone else will."

Chemistry Part of Curriculum of Every Course at Penn State

A course in chemisty is a requiremen in all the schools of the Pennsylvania State College, according to an announce ment made at that institution recently For most of the professions for whic the college offers training, a consider able knowledge of chemistry is neces sary.

In the school of agriculture, genera chemistry, agricultural chemistry, phys iological chemistry, food chemistry soil and fertilizer analysis, dairy chem istry, the chemistry of milling, and th chemistry of forest products, are amon the courses given. In the school o engineering, among the courses offere are general chemistry, the chemistry o sanitation, electrochemistry, industria chemistry, and a course in carbon com pounds. In the school of liberal art only a course in general chemistry i required, though others may be electe In addition to the general chemistr required in the school of mines, phys cal chemistry and other courses bearin on the subject of mining are give Chemistry, of course, plays the mos important part in the curriculum of th school of natural science. Househol chemistry and the chemistry of foo and nutrition are given for the depar ment of home economics.

Bureau of Standards Announces New Samples and Renewals

A new standard sample of tin-bas bearing metal No. 54 is now being i sued by the Bureau of Standards, wit a provisional certificate. This samp has the approximate composition: ti 88 per cent, antimony 7 per cent an copper 4 per cent. In addition, it co tains small amounts of lead, iron, bi muth and arsenic. The price of th sample per 140 grams is $2 prepa or parcel post C.O.D.

Benzoic acid No. 48a and benzoic ac No. 39a have been discontinued. Be zoic acid No. 39b replaces both of the and is issued for use both in acid metric and calorimetric work. Th price of this sample is $2 per 30 gram

The following renewals are al ready for distribution at the price $2 per 150 grams: Renewal No. 14b basic 0.8 per cent C steel No. 14 renewal No. 19b of acid 0.2 per ce C steel No. 19a; renewal No. 20b acid 0.4 per cent C steel No. 20a.

Sodium Nitrate Barge Fire En dangers Ships and Stores

Several ships and large quantities merchandise were endangered by t burning of a lighter loaded with sodiu nitrate in Erie Basin, New York Cit Aug. 11. The lighter was being load with the saltpeter from the Unit States Shipping Board freighter W Jaffrey when the fire broke out. T crew attempted to extinguish the flam with a hastily formed bucket briga but were forced to abandon the light and cast her off from the freight vess Shortly after the barge was abandon an explosion occurred which sank it.

Fraud Alleged in Salvage Deal for Old Hickory Powder Plant

Former Director of Sales of War Department and Business Men Indicted on Charge of Bid Containing "Joker"—Defendants Protest Innocence and Charge Politics

AN INDICTMENT has been returned by the special Grand Jury charging conspiracy in connection with the disposal of the Old Hickory Powder Plant at Jacksonville, Tenn. The indictment alleges that by an unlawful conspiracy among the three defendants, they participated in the sale and purchase of the plant for about $1,000,000 less than other bidders offered.

Largest Smokeless Plant

It will be recalled that the Old Hickory plant, the largest smokeless powder plant in the world, was erected for the government in 1918 by the du Pont Engineering Co. At the time of the armistice the plant was producing over 300,000 lb. of smokeless powder per day. It may also be remembered that a mild sensation was caused about two years ago by the theft of some of the platinum contact mass which was being recovered from the dismantled sulphuric acid units.

The plant was sold to the Nashville Industrial Corporation by the government. This corporation was organized by Ernest C. Morse, former director of sales for the War Department, said to be at present in Poland on business for the Foreign Export Supply Company, and Everly M. Davis and Alexander W. Phillips, trading under the name of the E. M. Davis Chemical Company of New York.

Charge "Trick" Bid

The method by which the defendants are alleged to have conspired to defraud the government is in the bid sent in by Davis and Phillips. It is charged that this bid contained many reservations and deductions which tended to make it appear that these two defendants were offering more for the plant than they actually offered. This so-called "trick" bid, the indictment charges, was, through Morse as sales director, approved by Secretary of War Baker on Oct. 9, 1920.

The contention of the government is that had it not been for the alleged unlawful acts of the defendants, the sale would have brought $4,700,000. The indictment has nothing to do with the sale of about $5,000,000 worth of surplus property at the plant which was disposed of before the plant itself was put on the market.

Outrage, Says Davis

Everly M. Davis, who claims to have been instrumental in bringing together certain business and financial interests in Nashville, Denver and New York for the purpose of purchasing the plant, is emphatic in his denial that there was anything criminal or even improper in the transaction. He accuses the government of making him and his associates the scapegoats in an attempt to impress the public with the results of its war fraud investigation.

"These indictments are an abominable outrage," said Mr. Davis. "There is no reason why I should be indicted. What we did was perfectly clean.

"As soon as I have a chance to read the indictment and see exactly what I am charged with I will make a statement giving the facts of the transaction in question, for I beleive the public should know the facts. An important public question of national interest is involved, in my opinion, and I think it will be interesting for the public to know how these so-called war frauds are being investigated.

Denies Bid Had "Joker"

Mr. Davis declares that the bid which was accepted by the government and which is now denounced as intentionally misleading was the result of painstaking efforts on the part of himself and capable associates. "It was our idea," he says to leave nothing to chance. We made our bid complete to the smallest detail."

As is well known, the government had already sold and contracted for the sale of a considerable quantity of the Old Hickory equipment and Mr. Davis claims that his bid very carefully stipulated that the returns from this property were to be deducted from the lump sum which was offered for the whole plant. "In other words," said Mr. Davis, "we did not want to buy a cat in a bag so we protected ourselves in the provisions of our offer. That is the grounds for calling ours a 'trick' bid."

Says Testimony Was Refused

Mr. Davis states that when he learned that the case was under investigation and that witnesses were being examined about it, he wired the District Attorney asking to be permitted to go before the Grand Jury and offering to waive immunity. Mr. Phillips did the same thing. This request was refused. They then asked the District Attorney for an opportunity to state the facts to him personally for any use he wished to make of them. This was likewise refused.

"From the unwillingness to hear the other side," says Mr. Davis, "the conclusion would seem to be unavoidable that the representatives of the government charged with making this investigation are more concerned with the obtaining of this indictment at this time than in establishing the truth; more interested in being able to emphasize to the public the fact that an indictment has been brought than in knowing themselves whether they have a proper basis on which to indict."

Government Action Against Foundation Proceeds Slowly

That the Attorney General has encountered more obstacles than he anticipated in his proceeding against the Chemical Foundation was indicated on Aug. 10, when in explaining the delay in filing the suits, he remarked facetiously that he is confronted in the Chemical Foundation matter with a "powerful combination of self-constituted and indefatigable philanthropists." Mr. Daugherty stated that he personally devoted three intensive hours on the bill of equity on Aug. 9. He did not say when the suit would be filed, but declared that the department was making haste slowly.

The office of the Alien Property Custodian is furnishing the Department of Justice detailed data on each of the patents, and it is estimated that in all they will cover at least seven thousand pages.

Since the administration's effort to secure the return of the patents several attempts have been made to obtain an expression from the National Research Council as to whether or not the Foundation has lived up to that portion of its charter that provides that the free net earnings of the corporation above 6 per cent are to be "used and devoted to the development and advancement of chemistry and allied sciences in the useful arts and manufactures in the United States."

The position of such officers of the Council as are in Washington is that this is a matter for the Interim Committee of the Council to pass. The Interim Committee will not meet until some time in September.

Chicago Section of A.C.S. Enters Plea for Dye Embargo

The executive committee and the councilors of the Chicago Section of the American Chemical Society have sent a telegram to the two Illinois Senators, McCormick and McKinley, urging them to support the proposed embargo on dyes. The telegram reads:

> Chicago Section American Chemical Society is thoroughly convinced that dye embargo is absolutely necessary for proper development of chemical industries and that it is to the decided advantage of American users of chemicals. Before it is too late we urge you to reopen the matter and do your utmost in action and support for the embargo.

The signers of the telegram included some of the most distinguished scientists in the West. Dr. Leech, chairman of the section, commenting upon the telegram, said that the executive committee and the councilors of the Chicago group of chemists feel that the interests, first, of public health demand the establishment of an organic chemical industry, which is "only possible if German unfairness is barred at our shores; second, national security and third, the economic returns and benefits from having our own industry and being free from a foreign monopoly."

Ellis Oil-Cracking Patents Subject of Suit

Standard Oil of New Jersey Charges Infringement in Cross Process of the Pure Oil Co.

The Standard Oil Co. of New Jersey has brought suit in the U. S. District Court, Southern District of Ohio, against the Pure Oil Co. of New York in order to restrain an alleged infringement of the Ellis patents for the cracking of petroleum distillates. The latter company is claimed to have been engaged in cracking oil at its plant at Heath, Ohio, under the Cross patents, which are controlled by the Gasoline Products Co., of 52 Broadway, New York City. The Standard Oil Co. claims that this process is an infringement on its so-called tube and tank method of oil cracking, which is broadly covered by the Ellis patents of 1913.

That the litigation may prove of considerable consequence to the petroleum industry is indicated by a statement from the Gasoline Products Co., which by agreement with the defendant is to bear the expenses of the suit. Officials of that company declared that the validity of the Cross patents had been passed on by some of the country's foremost patent authorities and that subsequently the process had been adopted by several of the independent refineries. The suit they believed to be nothing more than an attempt to hamper independent gasoline production.

Deny Monopolistic Control

The existence of any monopolistic control of cracking processes was immediately denied by the Standard company, which indicated that it was willing at all times to grant licenses under these patents. Its statement, in part, follows:

> It is not to be understood that the bringing of this suit indicates any intention or desire on the part of the Standard Oil Co. of New Jersey to monopolize the use of cracking processes of the type in question. The suit was deemed to be necessitated by the fact that certain interests in the oil industry have been persuaded to refuse to respect the rights vested in this company by the grant of the broad Ellis patents. Under the circumstances, this company felt compelled to seek legal redress.
>
> With regard to that considerable proportion of the industry which has evidenced that it intends to respect our patent rights, there is no disposition on the part of the company to maintain a monopoly of the use of the type of process in question or to impose burdensome or discriminatory terms of license. The company is, and has been, willing to grant licenses under its cracking patents on fair and reasonable terms.

Outline of Cross Process

The operation of the Cross process embraces the following features:

1. Heat is applied to the oil in tubes arranged in series. The tubes are placed horizontally in a heavily constructed, well-insulated furnace in such manner that should a tube fail the only damage is from loss of the tube, as the small amount of oil discharged is burned and mostly goes up the chimney or is discharged into a tank.
2. The oil is pumped through the tubes in one direction only and no oil that has undergone reaction with the separation of carbon is returned to the tubes.
3. Decomposition does not take place in the tubes sufficiently to deposit an appreciable amount of carbon.
4. The heated oil is passed from the tubes to a reaction chamber, where conversion of the heavy oil into gasoline takes place and where the carbon is deposited.
5. No heat is applied to the reaction chamber, but this chamber as well as all parts of the plant are heavily insulated against losses of heat to the atmosphere.
6. No distillation takes place from the reaction chamber or from any portion of the system, as this would retard the conversion by reason of its cooling effect.

Both processes are claimed to be particularly well adapted for use by the small refiner, since capacity and outlay for equipment are much less than for the better known Burton process.

Organic Chemical Manufacturers Pledge Support to New Chemical Division

That the chemical industry has already recognized the new Chemical Division of the Department of Commerce as a valuable aid to business is shown by the support accorded to C. R. DeLong, its recently appointed chief. Several representative organizations have offered their assistance in organizing and carrying on the work.

On Aug. 3 Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association of the United States, pledged the whole-hearted support of the seventy-seven member firms of that organization. Furthermore he testified as to the value of the monthly statistics being compiled by the bureau and offered to assist in their dissemination while the work of organization is still under way. Dr. Herty's letter to Mr. De Long in part reads as follows:

> On behalf of the seventy-seven member firms of this organization I want to tender our whole-hearted support in the work of building up this division of the bureau, which I am confident will be of unlimited value in the development of the organic chemical industry in this country.
>
> Among the valuable pieces of information issued by the bureau in the past have been the monthly bulletins of statistics on imports and exports of dyes. Our manufacturers are very anxious to receive this information regularly and it occurs to me that while your work of organization is under way we could distribute this information to our members from this office if that were agreeable to you, later turning over our mailing list to your division so that the matter could go direct to our members.

The letter expressed the further hope that it would be possible to extend the statistical service to cover all synthetic organic chemicals.

Liquid Oxygen as an Explosive

Such promising results have been obtaned in the course of the experiments conducted by the Bureau of Mines in the use of liquid oxygen as an explosive that there is a widespread demand for further work along the same line. The demand is coming largely from the building and city improvement industries where there is need for an explosive possessing the minimum handling hazard.

Engineers Advocate National Hydraulic Laboratory

Would Create Facilities for Study of Problems of Water Supply and Flood Control

A national hydraulic laboratory, in which studies relative to the country's problems of water supply and flood control would be carried out, is to be advocated by Mortimer E. Cooley, president of the American Society of Civil Engineers, before a Senate sub-committee the latter part of this month.

A bill to create such a laboratory is now before the Senate. The sub-committee is composed of Senator Ransdell of Louisiana, Senator du Pont of Delaware and Senator McNary of Oregon, representing the Gulf, Atlantic and Pacific coasts. Dean Cooley and J. R. Freeman, of Providence, R. I., will make the initial presentation of the case for the laboratory, contending in behalf of the engineering profession and other national agencies that the laboratory would make it possible to concentrate attention on the scientific side of flood control and other hydraulic problems. Mr. Freeman is a national authority on water power and a year ago, as a member of the John Fritz Medal Board deputation, studied at first hand the power situation in European countries, particularly France.

At the last meeting of the executive board of the American Engineering Council, the Council's committee on water power, of which Colonel J. H. Finney of Washington is chairman, was directed to place before President Harding the facts of the situation with regard to water-power development in this country. The board's action, it was stated, was prompted by "the Federal Water Power Commission's lack of effective and permanent personnel." The water-power plan coincides with the American Engineering Council's reforestration movement, in which the engineers are co-operating with the U. S. Forestry Service, the Forestry Services of the states, universities and technical schools, and other groups such as farmers, railroads, the movies and lumbermen to conserve the country's forests.

The executive board of the Council, which is to meet in Boston, Sept. 8 and 9, has adopted a resolution declaring that stream flow conditions in many sections of the country vitally affect the welfare of the people in many ways. Loss of life and property damage resulting from floods, economic significance of water-power developments, industrial utilization, quantity, quality and possible contamination of municipal supplies, and interstate subsurface water supply were some of the ways by which, it was declared, grave problems are arising.

Dean Cooley, who has been holding a series of conferences with engineering leaders in New York, said that the whole question would come before the executive board of the Council in Boston next month.

Technical Photographic Society Announces Exposition Program

Preliminary announcement has been made of the program and exhibition plans of the Technical Photographic and Microscopical Society. In addition to other features of the program of interest to the technical photographer and microscopist as an adjunct of chemistry, the following papers have been scheduled:

"The Photomicroscopy of Paint and Rubber Pigments," by Henry Green of the New Jersey Zinc Company, Palmerton, Pa.

"Photomicrography in Pulp and Paper Research Problems," by Miss Eloise Gerry and Dr. E. M. Diemer of the Forest Products Laboratory, Madison, Wis.

"Handling of Motion Picture Films," by Dominic S. Mungillo of the Craftsmen's Film Laboratory, New York.

"Mechanics of Motion Picture Apparatus," by Clarence W. Gibbs of the Victor Animatograph Company, New York.

"The Motion Picture as an Art in Industry," by Alfred B. Hitchins, director of the Ansco Research Laboratory, Ansco Company, Binghamton, N. Y.

"Microscopy in Leather Tanning," by Guido E. Daub of A. F. Gallun Sons Company, Milwaukee, Wis.

"The Use of the Microscope in Textile Work," by Albert H. Grimshaw, of the Textile School, New Bedford, Mass.

"Protozoa and Rotifers: Studies in Microscopic Animal Life," by Philip O. Gravelle, South Orange, N. J. This paper will be illustrated with motion pictures.

In addition to the meeting sessions of the society at the Exposition, the organization will have an exhibit at which the advance in technical photography, microscopy, and in chemistry as a result of these two sciences, will be demonstrated. Many of the problems of the chemical consuming industries, particularly regarding the physical nature of raw materials and finished products, have received the attention of a number of members of the society and can be discussed with the investigators at the Exposition.

Will Establish Engineering Museum

Plans for the establishment of a national engineering museum, the first of the kind in the United States, are announced by the American Society of Mechanical Engineers. The collection, which will be part of the Smithsonian Institution's National Museum at Washington, will be started with various models, drawings, diplomas and medals that once belonged to Captain John Ericcson and Cornelius H. DeLamater, builders of the Monitor, and the pioneer engineers of America.

All the engineering societies in America have accepted the Mechanical Engineering Society's invitation to participate in assembling material for the museum.

Fire Prevention Exposition Planned in New York

Loss of $1,300,000 Daily by Fire Arouses Organizations to Educational Steps

Manufacturers of fire-resistive materials and of fire fighting and retarding apparatus will have the opportunity of taking part in a Fire Prevention Exposition to be held Oct. 2 to 7 at the Twenty-second Regiment Armory, New York City, where will be shown, by exhibit and demonstration, the vital part in the fight against the great annual fire loss played by fire-safe materials and apparatus.

The Exposition originated with the fire prevention committee of the National Association of Insurance Agents as part of its program of fire prevention activities. It has been endorsed by the National Fire Protection Association, the National Association of Credit Men, the International Association of Fire Engineers, the National Board of Fire Underwriters and other associations.

The problem of reducing the terrific strain on business caused by preventable fires that seem to be increasing each year is one that has engaged the attention of these organizations. At the present rate of burning, property worth $1,300,000 is being destroyed each day. So great has the strain on business become that on June 26, at the request of these organizations, Governor Ritchie, of Maryland, called a conference of the Governors of New York, New Jersey, Maryland and Virginia. This conference adopted a motion to present the matter of fire waste and conservation to the Chamber of Commerce of the United States and on July 12 a conference of representatives of the four associations named above and of the American Institute of Electrical Engineers, Railway Fire Protective Association, American Institute of Architects, American Society of Mechanical Engineers and the Boy Scouts of America was held at Washington. The Chamber of Commerce of the United States was asked to undertake the responsibility of educating organized business men to the huge annual tax caused by fires. The Chamber accepted this responsibility and plans are now under way for a national citizens' fire prevention campaign.

The peak of this year's effort will be reached during National Fire Prevention Week, Oct. 2 to 7, and the First Fire Prevention Exposition will be its greatest educational feature. It is purposed to show the latest ideas in fire-safe construction and also to demonstrate to the public the proper appliances to be used in fighting and preventing fires.

A lecture hall is in the armory building and it is planned to make each day of the Exposition a special day, with lectures and motion pictures in the lecture hall. A. E. MacKinnon, of 405 Lexington Avenue, New York, is chairman of the exposition committee.

Alpha Chi Sigma Members Will Register at Exposition

Members of Alpha Chi Sigma, the national chemical fraternity, who attend the Exposition of Chemical Industries in New York, Sept. 11 to 16, are invited to register at the booth occupied by *Chemical & Metallurgical Engineering*. The dinner which is planned for Thursday evening of that week will attract a number of members who will be in town for the Exposition. In order that arrangements may be made all members are requested to sign up in the register that will be available for that purpose at the *Chem. & Met.* headquarters on the first floor of the Grand Central Palace.

Meat-Packers Deny Control of Tanning Industry

Denying the charge that the tanning industry is controlled by powerful meat-packers, and resenting the inference that the meat-packers would destroy competition, the Institute of American Meat Packers has issued the following statement:

"The Institute of American Meat Packers is not concerned one way or the other in the proposed tariff or the absence of a tariff on hides but is very much interested in remarks about the packing industry made by Senator Walsh and published throughout the United States. Senator Walsh said that the big packers virtually control the tanning industry and that if there was a duty the small tanners would be driven out of business. This statement is erroneous; the packers big or small do not have any control of the tanning industry. The big packers, through tanneries in which they are interested both directly and indirectly, handle less than twenty per cent of the leather made in the United States and they are in keen competition with each other even in the handling of this small proportion.

"If there should be a duty on hides and this duty raised their price, the competition among the packers would result in passing the benefit along to cattle raisers. The effect would be slight, it is true, but cattle values fluctuate 5 and 10 cents per hundredweight at a time depending on the value of the meat and byproducts. Hence a slight increase in hide values would result in a slight increase in cattle prices and a proportionate increase in cost to to consumer. Competition keeps the packers' profit at a minimum. It is therefore unfair to say that small tanners will be squeezed out.

"The Institute resents any inferences that the packing companies could or would crush or destroy any industry. The charges that the packers have a monopoly power over the price of cattle, hides, meat or other products have been disproved again and again. This statement is issued not so much in criticism of Senator Walsh as it is to correct published inferences which reflect upon the commercial integrity of one of America's most important industries."

Pyrene Fire Extinguishers Reported Safe in Subway

New York Transit Commission Exonerates Tetrachloride in Recent Accident

After an investigation of the circumstances attending the fire in the New York subway some weeks ago, the Transit Commission has reported that all the illness and suffering of passengers was caused by smoke from burning insulation aggravated by the panic and haste with which they climbed 75 feet to the street, and that no serious amount of poisonous gases was generated by the Pyrene fire extinguishers. What fumes did come from the carbon tetrachloride used in the extinguishers were so diluted as to be negligible.

In preparing this report the commission had the services of experts from the Bureau of Mines and of consulting electrical engineers. The results of their investigations are summed up as follows:

There were apparently no really serious cases resulting from the effects of possible toxic gases.

The symptoms given in the hospital records can all be accounted for by the known effects of gases resulting from the burning of insulating materials, rubber, varnish and paint.

The symptoms are not characteristic of phosgene or tetrachloride poisoning.

The report calls attention to the work of the Materials Inspection Division of the commission in connection with the Bureau of Mines, which points out that Pyrene is particularly adapted to fires produced by electric short circuits because it is not a conductor. After stating that experiments will be made to find a better extinguisher, the report says:

"In the meantime our study of the results of the use of Pyrene in this instance conclusively shows that its use was in no way dangerous or even discommoding. The continued efficient operation of the subways is essential to the life of the city, and this efficient operation requires the use of some immediately available fire extinguisher in case of electric short circuits, which are always possible of recurrence. Tetrachloride is the best known and most universally accepted extinguisher for this purpose. Nothing has been discovered by the investigation to justify ordering its discontinuance."

Walter Bauer, president of the Pyrene Manufacturing Co. has asked the Transit Commission, President Frank Hedley of the Interborough, and Mayor Hylan to permit a public demonstration of the efficiency of the Pyrene fire extinguisher.

Civil Service Wants Food Chemist

The United States Civil Service Commission announces an open competitive examination for assistant chemist in the chemistry and physics of food preparation under the Department of Agriculture. The entrance salary will range between $1,980 and $2,400 a year.

Non-Metal Industries Appeal for Government Research Funds

Members of Congress from the states having deposits of the non-metallic minerals are receiving many letters urging that Congress provide money for certain fundamental statistical and research work in connection with the non-metals industries. Since the government is conducting such work in connection with many other industries, those interested in the non-metals feel that proper recognition has not been accorded them.

During the last fiscal year, the Bureau of Mines appropriation carried an item of $35,000 for work in the non-metals. The item was eliminated from the appropriations for the current fiscal year. Realizing that steps to secure an appropriation for the fiscal year beginning July 1, 1923, must be taken long in advance, the industries concerned with the non-metals are agitating the matter thus early in the hope that Congress may be so impressed that at least the $35,000 item will be inserted in the appropriation bill covering expenditures during the next fiscal year. There is a demand for statistics and research covering such minerals as clay, granite, trap rock, chalk, emery, corundum, garnet, phosphate rock, sulphur, mica, asbestos, limestone, molding sand, glass-sand, dolomite, barium, graphite, gypsum, and slate.

Personal

EDWARD F. BEALE, president of the John T. Lewis & Bro. Co., Philadelphia, Pa., manufacturer of paints, colors, oils etc., has been elected vice-president of the National Lead Co.

GEORGE T. BRISTOL, who has been with E. I. du Pont de Nemours & Co. for the past 10 years, specializing in matters pertaining to Fabrikoid, has been appointed manager of the company's Fabrikoid plant at Newburgh, N. Y.

H. A. BROWN, assistant sales manager of the trade sales division, paint department, of E. I. du Pont de Nemours & Co., has just returned from a 4 weeks' trip through the South.

L. T. BRYSON has joined the staff of Ivan Jones, Ltd., Calcutta, India, in the capacity of consulting chemist in charge of feed-water treatment.

J W. COCHRAN has resigned his position with the Wenger-Armstrong Petroleum Co. to become vice-president and director of the Gavin Oil Co., Chicago, Ill.

PHILIP T. DODGE, president of the International Paper Co., and ALLEN CURTIS, vice-president of that organization, sailed recently for a 2 months' tour of Europe. They will visit most of the big paper-making companies while abroad.

Dr. H. D. GIBBS, formerly chief of the Color Laboratory, Bureau of Chemistry, has severed his connection wit the Jackson Laboratory of E. I. d Pont de Nemours & Co., Wilmingto Del. His plans for the future have n been announced.

WILLIAM J. GRIER, of the North Bri ish & Mercantile Insurance Co., Ltd has accepted the invitation of the off cers of the Insurance Society of Ne York to deliver two lectures on "Chen ical Fire Hazards" before the senic class of the Insurance Institute America on Feb. 15 and March 1, 192

Dr. ARMIN R. GROB, formerly a dy stuff patent expert with the Society Chemical Industry in Basel, Switze land, has resigned from E. I. du Po de Nemours & Co., Wilmington, De His plans for the future have not bee announced.

Dr. ELLWOOD HENDRICK, consultin editor of *Chem. & Met.*, who sailed June 10 to attend the meeting of th Society of Chemical Industry in Gla gow, is not expected back until Sept.

Dr. EDWARD C. L. KRESSEL, former president of the Active Chemical C Camden, N. J., will act in the san capacity with the Consolidated Pro ucts Co. of New Jersey, which he h been instrumental in organizing manufacture a similar line of specia ties.

E. W. MCCULLOUGH has resigned director of the division of mining a metallurgy, Republic Creosoting Co., accept a position as consulting engine for refuse disposal with the India apolis City Sanitary Commission to d sign and construct a new garba reduction plant.

J. S. NEGRU, managing editor *Chem. & Met.*, who has been in Euro for the past 6 months, sailed fro Antwerp on Aug. 10. He is expect to arrive in New York about Aug. 1

Dr. WILLIAM H. NICHOLS, chairm of the board of the General Chemic Co., is to represent the chemical indu try on a joint committee composed members of the Society for the Prom tion of Engineering Education and the National Industrial Conferen Board which is planning to take the general problem of engineeri training for the industries. Amo others who have been selected to ser on behalf of industry are FREDERICK FISH, formerly president of the Ame ican Bell Telephone Co. and the Ame ican Telephone & Telegraph Co.; E. HERR, president of the Westinghou Air Brake Co. and of the Westinghou Electric & Manufacturing Co., a HENRY D. SHARPE, treasurer of t Brown & Sharpe Manufacturing Dr. F. W. MCNAIR, president of t Michigan College of Mines, has be appointed to represent the Society f the Promotion of Engineering Edu tion. Other educators will be chos from technical schools of the country.

WALTER C. TEAGLE, president of t Standard Oil Co. of New Jersey, N York City, has returned from a t to Europe.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Marketing Problems of the Sulphur Industry*

Production, Consumption and Distribution of a Raw Material for Many Important Industries—Price Range and Trend Toward Enlarging the Market

By Albert G. Wolf
Texas Gulf Sulphur Co.

MORE THAN 99 per cent of the sulphur mined in the United States and 75 per cent of the world's production comes from three mines on the Gulf coast. In the order of their present and probable future importance as sulphur producers these are the Texas Gulf Sulphur Co., Matagorda County, Tex.; the Union Sulphur Co., Calcasieu Parish, La.; and the Freeport Sulphur Co., Brazoria, Tex. These three mines supply practically all the sulpur used in this country. In this article the word "sulphur" is used to designate crude sulphur or brimstone, and not sulphur produced from sulphides of metals. Wherever tons are mentioned in connection with sulphur the unit of weight is the long ton or 2,240 lb.

Uses of Sulphur Are Many

It is no exaggeration to say that sulphur is a constituent of, or a necessary reagent in, the manufacture of a large proportion of the articles in common use today.

The list in Table I, though probably far from complete, gives a good idea of the multiplicity of specific uses of sulphur. Every item either contains sulphur or requires sulphur in its manufacture.

The industries that use sulphur most are those which burn it to form sulphur dioxide, and employ that gas in their operations. These account for 75 per cent of the sulphur consumption in this country; the principal ones are the sulphuric acid, paper, chemical, and fertilizer industries.

TABLE I—LIST OF PRODUCTS IN THE MANUFACTURE OF WHICH SULPHUR IS REQUIRED

Acids	Hose
Alum	Insecticides
Aniline	Leather
Artificial silk	Livestock food
Belting	Lubricating oils
Binding medium	Matches
Bleaching materials	Medicine
Celluloid	Paints
Cements	Paper
Chemicals	Photo supplies
Dyes	Plastic (wood pulp)
Ebonite	Poison (rat and other)
Elastics	Preservative for food
Explosives	Reagents, laboratory
Fabrics	Rubber products
Fertilizers	Shoe polish
Films, moving picture	Soap
Fire extinguishers	Sodium thiosulphate
Fireworks	Steel (pickling)
Fumigating reagents	Storage batteries
Fungicides	Sugar
Gasoline	Textiles
Galvanized iron	Tires
Glue	Weed killer
Glycerine	

The industries, in the order of their commercial importance, that purchase sulphur as a "raw material" are:

1. Acid phosphate.
2. Paper.
3. Chemicals (other than sulphuric acid).
4. Sulphuric acid (other than for industries enumerated in this list).
5. Agriculture (other than acid phosphate).
6. Rubber.
7. Galvanizing.
8. Explosives.

This order, of course, is subject to change from time to time; and data for a more detailed tabulation of the sulphur-using industries are difficult to obtain. Furthermore, some of the industries are so interrelated that it is difficult to segregate the figures of consumption. The manufacture of sulphuric acid, under item 4 above, is by far the most important sulphur-consuming industry in the United States.

Geographic Distribution

Sulphur is sold to consumers in almost all the Eastern and Southeastern states, most of the Central, and some of the Western states; likewise in several provinces of Canada and states in Mexico. In the United States, by far the largest proportion is sold east of the Mississippi River. The major buyers may be divided roughly into three groups: The paper manufacturers of the New England states and eastern Canada, the chemical manufacturers of the Eastern states, and the acid posphate manufactures of the Southeastern states.

Lesser groups consist of the various industries of the Great Lakes region; the zinc, powder and chemical companies of the Central states; the powder, pulp and spray manufacturers of the Pacific coast; and various industries of British Columbia. Some shipments reach South Africa, the Hawaiian Islands and Australia.

The Mines Are the Principal Marketing Points

The primary marketing points are the three mines. From these, shipments are made directly to consumers. Secondary marketing points are the Gulf ports of Galveston, Texas City and Sabine, from which shipments are made to various foreign countries; and the Atlantic coast ports, whence shipments are again made by rail.

In the past the annual consumption of sulphur has been variable. As only 3 years has passed since the war, three

Editor's Note.—This article is abstracted from one of an important series on the marketing of minerals which is now appearing in the *Engineering & Mining Journal-Press.*

TABLE II—STATISTICS OF SULPHUR PRODUCTION AND CONSUMPTION

Year	Production in Tons World	United States	Domestic Shipments	Gross Value	Per Ton Value
1909	804,690	273,983	258,283	$4,783,000	$18.52
1910	775,286	247,060	250,919	4,522,000	18.02
1911	764,358	205,066	253,795	4,573,000	18.02
1912	773,436	287,773	305,390	5,289,000	17.32
1913	793,645	491,080	319,333	5,614,000	17.58
1914	863,143	417,690	341,985	6,214,000	18.17
1915	846,412	520,582	293,803	3,955,000	13.46
1916	1,199,842	649,683	766,835	12,247,000	15.97
1917	1,548,023	1,134,412	1,120,378	23,987,000	21.41
1918	1,655,629	1,353,525	1,266,709	27,868,000	22.00
1919	(a)	1,190,575	678,257	10,252,000	15.12
1920	(a)	1,255,249	1,517,625	(a)	(a)

(a) Statistics not available.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	150.87
Last week	152.08
August, 1921	158
August, 1920	264
April, 1918 (high)	286
April, 1921 (low)	140

Notwithstanding slight advances in the prices for glycerine, caustic soda and linseed oil this index number has continued its downward trend. The decrease in cottonseed oil, which is one of the most sensitive of the index commodities, is principally responsible for the decline.

TABLE III—SULPHUR EXPORTS AND IMPORTS OF THE UNITED STATES

Kind of Imports	1916 Tons	1916 Value	1917 Tons	1917 Value	1918 Tons	1918 Value	1919 Tons	1919 Value	1920 Tons	1920 Value
Crude	21,510	$364,787	973	$20,176	55	$1,692	77	$1,997	46	$1,722
Flowers	425	18,408	.....	.....	.....	.....	.....	.....	.....	.....
Refined	455	15,020	.....	.....	.....	.....	.....	15	50	2,530
Precipitated	66	12,940	37	9,164	27	7,850	24	6,621	42	22,576
Total	22,456	$404,784	1,010	$29,340	82	$9,542	101	$8,633	138	$26,828
Exports	128,755	$2,505,857	152,736	$3,500,819	131,092	$3,626,638	224,712	$6,325,552	477,450	$8,994,350

abnormal years, and as complete statistics are not yet available for 1921, it is difficult to form an estimate of future requirements. It is probably safe to say that the normal consumption in the United States and Canada will be 750,000 tons per year, and by the rest of the world 250,000 tons of sulphur.

Yearly and Seasonal Fluctuations

The fluctuations in the demand for sulphur are of two kinds, yearly and seasonal. The former is influenced chiefly by general business conditions.

Seasonal fluctuations in demand are not great except in a few industries. The most important of these is the paper-pulp industry. Many of the mills accumulate their supply during the summer months because of the closing of navigation later by ice. Acid-phosphate manufacturers take between 15 per cent and 20 per cent of the total sulphur mined in the United States; as their product is sold largely during the early spring months, their manufacturing season, and consequently their purchasing of sulphur, is most active in the fall and winter months.

Problem Is to Enlarge the Market

The great marketing problem of the sulphur producer is to find an outlet for a sufficient tonnage of his product to permit operating at a profit when selling at a price per unit that will make the crude sulphur more desirable than pyrite. The potential production of the domestic mines is 2,500,000 tons per year, whereas the actual production, at present, is not over half that. In the near future the largest annual consumption of American sulphur, both domestic and foreign, that can be expected is approximately 1,000,000 tons.

In addition to this main problem each producing company has its own individual problem in obtaining its share of the sulphur trade without resorting to "cut-throat" tactics, which would lead to the undoing of all of them. The market is not influenced by middlemen, because almost all crude sulphur is sold directly to the consumer.

The one great influence on the price of sulphur, in addition to the general demand, is the price of pyrite. Sulphur is in direct competition with pyrite in the acid-making industry of the United States and Europe and in the paper-pulp industry of the Scandinavian countries. One-half the 1,000,000 tons sold in this country in 1920 was used in sulphuric-acid manufacture. It is possible that sulphur from the United States may replace pyrite to a greater extent than at present in the manufacture of sulphuric acid in Europe.

Table III, from *Mineral Industry*, vol. 29, gives the exports and imports of all classes of sulphur of the United States, and shows clearly that foreign competition has no influence on the price in this country now.

The efficient methods of production which have enabled the American producer to compete successfully with pyrites, both domestic and Spanish, in certain industries, have also made it possible to invade to an increasing extent the European market, formerly supplied entirely by the Sicilian mines.

The New York Market

New York, Aug. 14, 1922.

The continued shortage of coal has brought about additional changes in the chemical market during the past week. Producers have curtailed production to a considerable extent and the alkali export market for caustic soda was sharply advanced. The domestic price, however, has remained practically unchanged, although the demand has shown a decided improvement. Prices on yellow prussiate of potash were fractionally higher, under a better consuming demand and reduced spot supplies. White powdered arsenic was advanced by leading producers and importers. A large volume of business was reported transacted during the interval. Bichromates of soda and potash have maintained recent advances, and the market is in a very tight position for spot material. White granular sal ammoniac is rather unsettled on spot. The gray variety, however, is exceedingly strong, with domestic factors asking up to 8¼c. per lb. Acetate of soda is very firm and several producers report a well sold up condition. Bleaching powder is another item that has shown exceptional improvement and is meriting added interest from the consuming industries. Oxalic acid is being held at the recent advance and buyers are showing an eager desire for available spot goods.

General and Special Chemicals

Acetate of Soda—The market is very strong on spot and factors report a well sold up condition. Odd lots range from 6@7¼c. per lb., depending upon seller. A much higher market is expected shortly.

Arsenic — Leading producers named higher figures at 8¼c. per lb. The consuming demand has been very brisk of late. Shipments from abroad are quoted around 7½c. per lb.

Bleaching Powder — Although prices have not advanced from former levels, the demand continued very strong. Prices ranged around $1.60 per 100 lb. f.o.b. works.

Caustic Potash—Material on dock is held around $5.60 per 100 lb. for the 88-92 per cent. Shipment goods are quoted at 5½c. per lb. c.i.f. New York. The demand is somewhat limited.

Caustic Soda — Export prices were noticeably advanced presumably in order to conserve the supplies for domestic consumption. Spot goods are very limited. The export price is around $3.65@$3.70 per 100 lb. Odd lots for domestic use are held at $3.75 per 100 lb.

Prussiate of Potash — Quotations were advanced early in the week and spot goods brought 32¼c. per lb. Local stocks were reduced considerably.

Prussiate of Soda — Prices during part of the week were up to 21½c. per lb., but later were heard around 20c. per lb.

Sal Ammoniac—Imported white granular was fractionally lower on spot at 6⅛c. per lb. The gray material was rather scarce and the market was firmly maintained. Domestic producers of gray reported 8¼c. per lb. as the general quotation.

Vegetable Oils

Linseed Oil — Spot material during the early part of the week was offered as low as 84c. per gal., but was again advanced to 88c. per gal. by leading crushers. The stronger feeling was attributed to the prospects of an early tariff adjustment and a revival of interest from consumers. Imported oil was offered for August shipment at 82c. per gal., present rate of duty, c.i.f. N. Y.

Castor Oil — Producers advanced prices ¼c. per lb. on all grades of oil, establishing the market on U.S.P. at 13c. per lb. and the No. 3 grade at 12¾c. The advance was due to the higher cost of castor beans. Demand was rather active.

Coconut Oil — Although the market was somewhat unsettled, prices were steady in all quarters, due to the absence of any selling pressure. Resale offerings were not plentiful. Ceylon type oil in barrels was held around 8¾c. per lb., with the Cochin at 9c. per lb.

Corn Oil — There were offerings of August shipment of the crude at 8¼c. per lb., sellers' tanks, f.o.b. Chicago. The demand was of a routine nature.

Peanut Oil — The market for the crude oil was quiet because of the scanty offerings. Mills quote 9@9¼c. per lb., crude oil, tank cars for prompt shipment. Refined oil on spot was held around 12c. per lb.

The Chicago Market

CHICAGO, ILL., Aug. 10, 1922.

But little change could be noticed in the local chemical market during the past 10 days. Prices were a little stronger and the inquiry was reported as better, but no one had more business than he could take care of. Incoming freight was being delayed, which doubtless had much to do with the firmer prices, and again, stocks in some quarters were quite limited. An improvement in consumers' business was reported which was not to any extent reflected in the raw material markets. One of the most noteworthy developments is that the buyer is no longer haggling over prices to the extent that he did in the past.

General Chemicals

Caustic soda in the face of short supplies showed signs of firmness. Ground 76 per cent material was available at $4.35 per 100 lb. and the solid at $3.80. *Caustic potash* was also very firm, with only moderate supplies on spot at 6½@7c. per lb., basis 88-92 per cent. There was a fair inquiry for *soda ash*, and 58 per cent material in single-barrel lots was quoted at $2.35 per 100 lb. *Sal soda* also enjoyed a fair inquiry and was available at $1.90.

The movement of alums was reported as slow, with no change in prices. *Potash alum* lump was quoted at 4½@5c. per lb. and the powdered at 5½@6c. *Sal ammoniac* was firmer, with supplies lighter than for several weeks. The white granular 98-100 per cent material was quoted by leading interests at 7¾@8c. per lb. *White arsenic* displayed signs of firmness and the shortage of supplies forced the price to 8½@9c. per lb. *Barium chloride* was available in small or moderate lots at $100@$105 per ton. *Copper sulphate* was quite scarce and the price was very firm at 7@7½c. per lb. *Carbon bisulphide* was also quite firm at 7@7½c. per lb. *Carbon tetrachloride* moved only in a sluggish way and the price was weak at 9½@10c. per lb. *Formaldehyde* showed no change for the better and moved only in a small way at 9c. per lb. in single barrel lots. *Furfural* was quoted at 35c. per lb. in thousand-pound lots. *Glycerine* was very firm, and supplies were reported to be moving very well at 16½@17c. per lb. for the c.p. material in drums. *Lead acetate* was in poor demand and only small lots moved at 11@12c. per lb. *Red phosphorus* moved only in a small way at 25@26c. per lb. *Phosphorus pentoxide* was offered at 35c. per lb.

Bichromates were quoted higher by most holders, although the movement showed no improvement. *Potassium bichromate* was quoted at 11¼@11¾c. per lb., and the soda at 8¾@9¼c. in single-cask lots. *Red prussiate of potash* continued almost unavailable with only very small supplies on spot at 90c.@$1 per lb. *Yellow prussiate of potash* was in fair demand and the price was steady at 32@35c. per lb. *Permanganate of potash* moved only in a routine way and supplies of the U.S.P. small crystals were held at 16@16½c. per lb.

Linseed Oil and Turpentine

The movement of *linseed oil* was restricted to small quantities for immediate consumption and nearly all factors predicted lower prices. The boiled oil in single-drum lots was offered today at $1.02 per gal. and the raw in similar quantities at $1.

Turpentine was in a position similar to linseed oil, with most factors saying that the price was too high and freely predicting a considerable decline. Only small quantities moved to the consuming trade at today's price of $1.22 per gal. in single-drum lots.

The Iron and Steel Market

PITTSBURGH, Aug. 11, 1922.

Production of steel ingots in July was at an average rate of about 36,000,000 tons a year, against rates of 36,600,000 tons in June, 36,400,000 tons in May and 35,000,000 tons on April 1, when the coal strike started.

Production was not, however, at anything like a uniform rate during June and July. The rate increased toward the close of June, while in the latter part of July it dropped off rather sharply. A fair guess would be that the rate was 37,000,000 tons July 1 and 34,000,000 tons July 31, with a decrease to 30,000,000 tons at present.

Knowledge of Steel Consumption Lacking

The disposition of market reviewers at a time like this, when industrial operations are restricted by physical causes, is to stress the curtailment in production of the commodity being reviewed and to touch lightly on the curtailment in its consumption. If the reviewer were considering agricultural implements or automobiles, he would probably be full of the idea that production of these articles is hampered by the scarcity of coal. That there is a reduction is already established.

Apart from unconscious bias, facilities are lacking for comparing steel production with steel consumption, because there is more or less definite information as to steel production, while the operation of the thousands of steel consumers throughout the country cannot be viewed. Some information is available to steel mills, though it is not freely disseminated, but even this information is far from representative, because the average consumer, observing that steel is scarce, is disposed to retain or perhaps even increase his stocks. After every period of heavy steel demand there is an unexpectedly heavy liquidation of stocks, during which time demand upon the mills is less than the current consumption.

The present demand for early deliveries of steel products, at premium prices, is not necessarily misleading, but it may mislead through its not being studied on a comparative basis.

Buying for late delivery, practically "delivery at mill convenience," is light relative to a normal demand, but not particularly light for this time of year. The Steel Corporation's bookings are on the whole rather large. The unfilled tonnage at the end of July is reported at 5,776,161 tons, representing an increase during July of 140,630 tons, equal to 11 per cent of the month's capacity, and as shipments were about 75 per cent of capacity, the total bookings in the month were about 86 per cent of capacity, bookings in previous months, similarly computed, being 103 per cent in June, 86 per cent in May, 115 per cent in April, 90 per cent in March and less than 50 per cent in each of the 17 months preceding, since September, 1920. July bookings of independents were not nearly as heavy as those of the corporation.

The minimum on bars, shapes and plates has advanced from 1.70c. to 1.80c. in the week and from 1.60c. to 1.80c. within 30 days. This is for delivery at mill convenience, technically, though in all probability the convenience of buyer is fairly well met also. Prompt deliveries are up to 2c. or higher. Hoops narrower than 1 in. are now squarely on a base of 2.75c., other hoops remaining on the 2.50c. base. Railroad spikes are up $2 a ton to 2.35c., while small spikes and boat and barge spikes are up $5 a ton to 2.75c. Cold-finished steel bars are up $2 a ton to 2.25c.

Possible Trend in the Future

The condition of the steel market late in the year, when the strikes will have passed into history, will depend largely on the mental attitude of buyers, formed by guesses as to what is to occur industrially in 1923. Nearly all the business for the remainder of the year, in the purchase and sale of mill products, is already done, and the pressure upon mills for deliveries will depend largely upon whether buyers are disposed to hold or increase their stocks or engage in another drastic liquidation such as characterized the year 1921.

All semblance of a forward market in pig iron has disappeared. Buyers would, of course, be very foolish to attempt to make forward purchases at this time, when there is scarcely any merchant pig iron production and when furnaces have no means of knowing when they will be able to get into blast again. The only pig-iron market is a prompt, practically a spot, market, purchases being from stocks, which are meager. Foundry iron is generally bought in single carloads. Naturally prices have advanced with facility. On the basis of last sales the valley market is quotable as follows: Bessemer, $27; basic, $25.50; foundry, $28; malleable, $29. Freight to Pittsburgh is $1.77 since July 1, not $1.76 as at first computed.

Offerings of Connellsville coke are insufficient to supply anything like a normal foundry demand, not to speak of blast furnace requirements at all. Foundry coke is about $15, but the price varies considerably with quality.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	—	$0.38 – $0.40
Acetone	lb.	$0 13½ – $0 13¾	.14 – .14¼
Acid, acetic, 28 per cent	100 lbs.	2.60 – 2 65	2 70 – 3 25
Acetic, 56 per cent	100 lbs.	5 25 – 5 35	5.40 – 5.75
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		11.50 – 12 00	12.25 – 12.50
Boric, crystals	lb.	.11 – .11½	.11¾ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	—	.45 – .45½
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3 30 – 3 75
Muriatic, 20 deg. (see hydrochloric)		—	—
Nitric, 40 deg.	lb.	.06 – .06½	.06¾ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07¼
Oxalic, crystals	lb.	.15½ – .16	.16¼ – .16½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	—	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 – 10.00	—
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	—
Sulphuric, 66 deg., tank cars	ton	14 50 – 15 00	—
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	—	—
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	—
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32 00	33 00 – 34 00
Tannic, U. S. P.	lb.	—	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	—	.28½ – .29
Tartaric acid, imported, powdered	lb.	—	.29 – .30
Tartaric acid, domestic	lb.	—	— .30
Tungstic, per lb. of WO	lb.	—	1.00 – 1 10
Alcohol, ethyl (Cologne spirit)	gal.	—	4.75 – 4.95
Alcohol, methyl (see methanol)		—	—
Alcohol, denatured, 188 proof No. 1	gal.	—	.31 – .33
Alcohol, denatured, 188 proof No. 5	gal.	—	.31 – .33
Alum, ammonia, lump	lb.	.03¼ – .03½	.03⅜ – .04
Alum, potash, lump	lb.	.03 – .03½	.03½ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08¼ – .08½	.08½ – .09
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	—	2.00 – 2.25
Arsenic, white, powdered	lb.	.08¼ – .08½	.08¾ – .09
Arsenic, red, powdered	lb.	.12 – .12¼	.12½ – .13
Barium carbonate	ton	61.00 – 63 00	64 00 – 67 00
Barium chloride	ton	85.00 – 90 00	91.00 –100 00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	—
Blanc fixe, pulp	ton	45.00 – 55.00	—
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2 50
Blue vitriol (see copper sulphate)		—	—
Borax	lb.	.05¼ – .05½	.06 – .06½
Brimstone (see sulphur, roll)		—	—
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2 40	2 45 – 2 50
Calcium carbide	lb.	.04½ – .04¼	.05 – .05½
Calcium chloride, fused, lump	ton	22 00 – 23 00	23 50 – 27 00
Calcium chloride, granulated	lb.	.01½ – .01½	.02 – .02¼
Calcium peroxide	lb.	—	1 40 – 1 50
Calcium phosphate, tribasic	lb.	—	.15 – .16
Camphor	lb.	—	.82 – 84
Carbon bisulphide	lb.	.06 – .06½	.06¾ – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10¾ – .12
Carbonyl chloride, (phosgene)	lb.	—	.60 – .75
Caustic potash (see potassium hydroxide)		—	—
Caustic soda (see sodium hydroxide)		—	—
Chalk, precip.—domestic, light	lb.	.04¼ – .04½	—
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	—
Chalk, precip.—imported, light	lb.	.04¼ – .05	—
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾ – .06
Chloroform	lb.	—	.25 – .32
Cobalt oxide	lb.	—	2 00 – 2 10
Copperas	ton	20 00 – 22 00	23.00 – 30 00
Copper carbonate, green precipitate	lb.	.19 – .20	.20¼ – .21
Copper cyanide	lb.	—	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6.60	6.65 – 7.00
Cream of tartar	lb.	—	.23 – .25
Epsom salt (see magnesium sulphate)		—	—
Ethyl acetate com. 85%	gal.	—	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	—	.90 – .95
Formaldehyde, 40 per cent	lb.	.08 – .08¼	.08¾ – .09
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00	—
Fullers earth—imported powdered—net	ton	30 00 – 32.00	—
Fusel oil, ref.	gal.	—	2 25 – 2.65
Fusel oil, crude	gal.	—	1 45 – 1 50
Glauber's salt (see sodium sulphate)		—	—
Glycerine, c. p. drums extra	lb.	—	.16½ – .16¾
Iodine, resublimed	lb.	—	4.20 – 4 25
Iron oxide, red	lb.	—	.12 – .18
Lead acetate, white crystals	lb.	—	.10½ – .11½
Lead arsenate, powd.	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	—	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U. S. P.	100 lb.	2 00 – 2.25	2 30 – 2 50
Magnesium sulphate, technical	100 lb.	—	1 00 – 1 80
Methanol, 95%	gal.	—	.57 – 58
Methanol, 97%	gal.	—	.59 – 60
Nickel salt, double	lb.	—	.11 – .11½
Nickel salt, single	lb.	—	.12 – .12½
Phogene (see carbonyl chloride)		—	—
Phosphorus, red	lb.	—	.40 – .45
Phosphorus, yellow	lb.	—	.30 – .35
Potassium bichromate	lb.	.10½ – .10¾	.10½ – .11
Potassium bromide, granular	lb.	—	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb.	—	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	5.60 – 6.00	6.10 – 6.25
Potassium iodide	lb.	—	3.20 – 3.35
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.13 – .13½	.14 – .15
Potassium prussiate, red	lb.	—	.90 – .95
Potassium prussiate, yellow	lb.	.32½ – .32½	.32½ – .33
Rochelle salts (see sodium potas. tartrate)		—	—
Salammoniac, white, granular	lb.	.06½ – .06½	.06¾ – .07
Salammoniac, gray, granular	lb.	.08 – .08¾	.08½ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	18.00 –21.00	—
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06½ – .06¾	.07 – .07¼
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06¼ – .06¾	.07 – .07½
Sodium chloride	long ton	12 00 –13 00	—
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09½ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.70 – 3.75	3.80 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .03	.03½ – .03⅝
Sodium nitrite	lb.	.07¾ – .08	.08¼ – .08¾
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03 – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	—	.18 – .21
Sodium prussiate, yellow	lb.	.21 – .21½	.21⅜ – .22
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 –20.00	—
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	—	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	—
Talc—domestic powdered	ton	18.00 –25.00	—
Tin bichloride	lb.	.09 – .09¼	.09½ – .10
Tin oxide	lb.	—	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.5¾ – .06	.06½ – .06¾
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08½ – .08¾
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.30 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.65 — .67
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lbc	.50 — .55
Beta-naphthol, tech	lb.	.22 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.80 — .85
Meta-phenylenediamine	lb.	.85 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07¼ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15 —	$0.17
H-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.10 —	2.15
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.75 —	.77
Ortho-nitro-toluene	lb.	.10 —	.13
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.25 —	1.30
Para-amidophenol, HCl	lb.	1.30 —	1.35
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.16 —	.18
Pyridine	gal.	1.75 —	2.75
Resorcinol, technical	lb.	1.30 —	1.35
Resorcinol, pure	lb.	1.75 —	1.80
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.23 —	.24
Salicylic acid, U. S. P.	lb.	.25 —	.26
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.14 —	.18
Sulphanilic acid, crude	lb.	.24 —	.26
Toluidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

All prices remain quotably unchanged

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$5.75 —	$6.20
Rosin E-I	280 lb.	6.25 —	6.65
Rosin K-N	280 lb.	6.70 —	7.80
Rosin W. G.-W. W	280 lb.	7.85 —	8.40
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.14 —	1.16
Wood turpentine, steam dist	gal.	.85 —	....
Wood turpentine, dest. dist	gal.	.70 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.36 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.46 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
Blood, dried, f.o.b., N. Y	unit	4.50 —	....
Bone, 3 and 50, ground, raw	ton	37.00 —	39.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.55 —	2.60
Tankage, high grade, f.o.b. Chicago	unit	3.50 —	3.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0.19 —	.20
Upriver coarse	lb.	.13½ —	.13½
Upriver caucho ball	lb.	.13½ —	.13¾
Plantation—First latex crepe	lb.	.14¼ —	.14½
Ribbed smoked sheets	lb.	.14¼ —	.14½
Brown crepe, thin, clean	lb.	.13½ —	....
Amber crepe No. 1	lb.	.14 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12½ —	12¾
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¾ —	.08¾
Cocoanut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
Corn oil, crude, in bbls	lb.	.10½ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08 —	.08¼
Cottonseed oil, summer yellow	lb.	.10½ —	.10¾
Cottonseed oil, winter yellow	lb.	.11¼ —	.11½
Linseed oil, raw, car lots (domestic)	gal.	.88 —	.89
Linseed oil, raw, tank cars (domestic)	gal.	.84 —	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.91
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07¼
Palm, Niger	lb.	.06½ —	.06¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09 —	.09¼
Peanut oil, refined, in bbls	lb.	.12 —	.12¼
Rapeseed oil, refined in bbls	gal.	.82 —	.83
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¼ —	....

FISH

Light pressed menhaden	gal.	$0.53 —	....
Yellow bleached menhaden	gal.	.54 —	.55
White bleached menhaden	gal.	.56 —	57
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1, crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Shellac, orange fine	lb.	71 —	.72
Shellac, orange superfine	lb.	.73 —	.74
Shellac, A. C. garnet	lb.	.67 —	.68
Shellac, T. N.	lb.	.70 —	.71

Other Prices Same as Previous Report

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225 00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
Ferromanganese, 78-82% Mn, German	gross ton	67.00 —	67.50
Spiegeleisen, 19-21% Mn	gross ton	36 00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	1.85 —	2.00
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58.00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	19.00 —	21.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	18 00 —	21.00
Coke, foundry, f.o.b. ovens	net ton	16.50 —	....
Coke, furnace, f.o.b. ovens	net ton	16.00 —	....
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.29 —	....
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.45 —	.50
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.25 —	3.50
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.075
Aluminum, 98 to 99 per cent	19.10
Antimony, wholesale lots, Chinese and Japanese	5.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32 00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32 00
Monel metal, ingots	35 00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	32.25
Lead, New York, spot	5.75
Lead, E. St. Louis, spot	5.525
Zinc, spot, New York	6.60–6.65
Zinc, spot, E. St. Louis	6.20–6.25

OTHER METALS

Silver (commercial)	oz.	$0.69¼
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.15@1.25
Platinum	oz.	93.00
Iridium	oz.	180.00@185.00
Palladium	oz.	55.00
Mercury	75 lb.	55.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

PAPER—The Hinde & Dauch Paper Co., manufacturer of corrugated paper products, has advanced production to full capacity at its Gloucester City, N. J., works, with day and night working forces.

The United Paper Board Co., Wabash, Ind., has resumed operations at its plant with a full working force of about 150 men, following a curtailment since last June. It is expected to maintain capacity production for an indefinite period. The coating mills at the plant are on a full production schedule, giving employment to a large working force. Orders on hand insure continuance on this basis for some time to come.

CERAMIC—The Harbison-Walker Refractories Co., Pittsburgh, Pa., is developing maximum capacities at its different plants in central Pennsylvania, and incoming orders are considerably in excess of production. A scarcity of labor in the vicinity of Mount Union, Pa., is handicapping the output at plants in this district.

Employees of the Toronto Fire Clay Co., Toronto, O., out on strike for 2 weeks past, have returned to the plant. The men have been granted an increase in wages of 5c. an hour.

Lack of fuel in the vicinity of Cleveland, O., has caused the Akron Sewer Pipe Co. to close two of its plants at Urichsville. The Cleveland Builders' Supply & Brick Co. has been compelled to curtail production at three of its local brick-manufacturing plants.

RUBBER—The Lycoming Rubber Co., Williamsport, Pa., has resumed operations at its plant, on a full-capacity basis, following a few weeks' shut down.

Automobile tire production at Akron, O., and vicinity during July broke all previous records, with gross output at the different mills for this month estimated at 2,750,000 tires. Up to the present time more than 11,000,000 tires have been manufactured in this section, dating from the first of the year. The leading companies are maintaining the following daily production schedules: B. F. Goodrich Co., 20,000 tires; Firestone Tire & Rubber Co., 25,000; Goodyear Tire & Rubber Co., 26,000; and the Miller Tire & Rubber Co., 7,500.

IRON AND STEEL—The Tennessee Coal, Iron & Railroad Co. is making ready for the immediate blowing in of its No. 1 blast furnace at Ensley, Ala.

The Follansbee Brothers Co., Pittsburgh, Pa., has resumed production at its sheet and tinplate mills at Toronto, O., and Follansbee, W. Va., following a temporary shut down due to coal shortage.

The Bethlehem Steel Co., Bethlehem, Pa., is maintaining an operating schedule of about 80 per cent of capacity at its local mills.

A shortage of coal and coke has caused the Midvale Steel & Ordnance Co., to bank its No. 2 blast furnace at Coatesville, Pa. It will remain idle until conditions improve.

The Brier Hill Steel Co., Youngstown, O., has resumed operations at six of the eleven open-hearth furnaces recently closed down on account of fuel shortage. Gas burners have been installed to insure continuous service.

Following continuous operation for a number of weeks past, the Illinois Steel Co., has banked two of its furnaces at South Chicago, Ind., and two at Gary, Ind., reducing production to an 84 per cent of normal basis. Fuel shortage is responsible for the curtailment.

The American Steel Foundries, Chicago, Ill., is maintaining production on a basis of from 75 to 80 per cent of capacity at its different plants. The company has a coal supply on hand sufficient to insure continuous operation for about 60 days, and has booked orders to allow production on the basis noted for the remainder of the year.

The Inland Steel Co., Chicago, Ill., is holding operations on a basis of 65 to 70 per cent, the same rate as has been prevailing for some time past.

Coal and coke shortage has caused the Jones & Laughlin Steel Co., Pittsburgh, Pa., to bank one of its Eliza blast furnaces.

The Trumbull Steel Co., Youngstown, O., is maintaining capacity production at its mills, with one furnace now idle on account of fuel shortage.

The Youngstown Sheet & Tube Co., Youngstown, O., is continuing at three of its six blast furnaces, and will increase operations as soon as fuel is available.

METALS—The American Smelting & Refining Co. is running full at its smelter of seven lead furnaces at its plant at Chihuahua, Mexico. The tonnage output is larger than ever before in the history of the plant.

Owing to inability to obtain railroad shipping facilities on account of the strike, the Aluminum Co. of America, Pittsburgh, Pa., has closed down its sheet mill at Alcoa, near Knoxville, Tenn.

The Anaconda Copper Mining Co. is resuming operations at its Emma properties at Butte, Mont., closed down since January, 1921, and devoted to zinc, silver and lead production. About 125 men will be employed. This is the fourteenth property of the company to be reopened in this district.

MISCELLANEOUS—The American Vulcanized Fiber Co., has reached capacity production at its plants at Wilmington and Newark, Del., for the first time in more than a year past.

The Long Valley Paint Co., Hancock, Pa., is arranging for immediate resumption of operations at its local plant, following a long period of idleness.

The Atlas Powder Co., Tamaqua, Pa., has increased operations at its local mills from 5 to 6 days weekly. Incoming orders insure this rate of production for some time to come.

Despite the general custom of closing down among the glass plants at Millville, N. J., the last of July of each year, a number of plants are continuing owing to the heavy orders on hand. These include the Millville Bottle Works, which will keep two furnaces active; and the F. C. Wheaton Co., manufacturer of druggists' glassware.

Construction and Operation

Arkansas

FORT SMITH—The Equitable Powder Co. has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, caused by an explosion, July 28. An official estimate of loss has not been announced.

California

PITTSBURG—The Pioneer Rubber Co., 68 Sacramento St., San Francisco, has taken bids and will soon award contract for the construction of its proposed local building, 1-story, 80x200 ft., estimated to cost about $150,000. Benjamin G. McDougall, 381 Bush St., San Francisco, is architect.

LOS ANGELES — The Egyptian Lacquer Mfg. Co., 5 East 40th St., New York, N. Y., has completed plans and is taking bids for the construction of a new 1-story building, 50x100 ft., on Maple Ave., near 11th St., Los Angeles, for a Pacific Coast works. Mott M. Marston, 533 San Fernando Bldg., Los Angeles, is architect.

SAN FRANCISCO—The Pacific Gas & Electric Co., 445 Sutter St., will construct an artificial gas plant at Army and DeHaro Sts., to cost close to $100,000.

Connecticut

MIDDLETOWN—The Standard Oil Co., 26 Broadway, New York, N. Y., has plans nearing completion for the construction of a new oil and gasolene distributing plant on the Connecticut River, near Middletown. It is said that the works will cost in excess of $3,000,000, with equipment.

Florida

ST. PETERSBURG—The Texas Refining Co. has plans under way for the construction of a new oil plant on site acquired at 8th St. and 2nd Ave. The initial works will cost about $30,000. It is also planned to construct a gas-plant at this same location.

Indiana

TERRE HAUTE—D. R. Ulmer, Terre Haute, and associates, have organized a new company for the operation of a local plant for the manufacture of sewer pipe, tile, conduit and other burned clay products. The initial works will have an output of about 4,000 lengths of material per day, and this will be increased to about 9,000 at an early date. Ernest Cox will be plant superintendent in charge.

Louisiana

HAYNESVILLE—The Standard Oil Co. of Louisiana, New Orleans, will commence the immediate construction of a new distributing plant at Haynesville, near Shreveport, to provide a total storage capacity of close to 3,000,000 bbl. of oil in this district. The plant with equipment will cost in excess of $150,000.

Maryland

ILCHESTER—The Mineral Potash Co., 714 Equitable Bldg., Baltimore, has revised plans in preparation for the construction of a new plant at Ilchester, and will call for bids early in the fall. It will be 1-story, 50x150 ft., and is estimated to cost about $55,000. Louis A. Hazard is president.

SALISBURY—The Hearn Oil Co., 3rd and Commerce Sts., Wilmington, Del., has purchased property on Mill St., and has plans under way for the construction of a new distributing and storage plant with capacity of about 25,000 gal. The initial works will cost close to $40,000.

BALTIMORE—The Edro Richardson Brass Co., 318 North Holliday St., will break ground at once for the construction of a 1-story addition to its brass foundry, to be located on Monument St., and estimated to cost about $40,000. Improvements will be made also in the present building. The general contract has been let to J. E. Stansbury, 2852 Pennsylvania Ave.

BALTIMORE — The Baltimore Concrete Products Co. has filed plans for the construction of a new 1-story building on Kate Ave. and the line of the Western Maryland Railroad, to be 35x80 ft.

BALTIMORE—The board of directors, Loyola College, 700 North Calvert St., has awarded a contract to Henry Smith & Sons, 7 East Redwood St., for the construction of a new 2-story chemistry building, to cost about $200,000. Otto G. Simonson, Casualty Bldg., is architect.

Massachusetts

SALEM—The Wetan Leather Co., Danversport, Mass., has acquired a factory at Hardy St. and Central Ave., Salem, heretofore occupied as an extra works by the Budgell & Harrigan Co., for the establishment of a new plant to replace its Danversport works, recently destroyed by fire. Possession will be taken at once and necessary equipment installed.

PEABODY—The Weber, Laemmle Tanning Co., Salem, has acquired the local plant of the Armstrong Leather Co., and will remove its present works to this location at once. Increased facilities will be provided for production. George J. Laemmle heads the company.

GREENFIELD—The Deerfield Valley Paper Co. has been organized to take over and operate the plant of the Monroe Bridge Paper Co., Monroe Bridge, near Greenfield. Increased manufacture will be arranged.

PEABODY—The Chain Leather Co. has acquired property at 55 Walnut St., for the establishment of a new works.

Michigan

HANCOCK—The chemical laboratory at the Hancock High School was destroyed by fire July 25, in connection with a partial destruction of the building, with total loss estimated in excess of $200,000.

CLAWSON—A filtration plant will be installed by the Common Council in connection with its proposed new water system. Bonds have been voted.

Mississippi

HATTIESBURG—The Hattiesburg Pine Oil Co., recently organized, is arranging a list of equipment for installation at its proposed new local plant for the manufacture of pine oil, tar, rosin oils, turpentine, etc., to include complete refining equipment, two 52 ft. retorts, pumping apparatus, and power house equipment. The mill will cost close to $100,000, with machinery. The company is capitalized at $425,000. Paul S. West is head.

Missouri

ST. LOUIS—The Benjamin Moore Paint Co., 1600 South 2nd St., has awarded a contract to the Hall & Mackay Construction Co., St. Louis, for the rebuilding of the portion of its plant recently destroyed by fire. The work will cost about $75,000. Mauran, Russell & Crowell, Chemical Bldg., are architects.

ST. JOSEPH—Fire, Aug. 2, destroyed the local lard refining plant of Morris & Co., Union Stock Yards, Chicago, with loss estimated at about $100,000, including equipment. It is planned to rebuild the works.

Montana

GREAT FALLS—The Anaconda Copper Mining Co., 25 Broadway, New York, N. Y., has tentative plans under consideration, for the construction of a new brass fabricating plant at its mills at Great Falls. It is estimated to cost in excess of $500,000.

New Jersey

GLOUCESTER CITY—The Armstrong Cork Co., 24th St., Pittsburgh, Pa., with district plant at Camden, N. J., will remodel and improve the local building at Delaware Ave. and Ellis St., formerly used by the Ancona Printing Co., recently acquired. For the present the structure will be used as a general service and operating building, and later machinery will be installed to convert into a manufacturing works.

TRENTON—The Panelyte Board Co., Smith Bldg., 119-25 North Montgomery St., lately organized with a capital of $300,000 in preferred stock and 4,000 shares of common stock, no par value, has acquired property on Whitehead Road for the construction of a new plant for the manufacture of fiber board and other fiber products. The initial plant unit, plans for which are being prepared, will be equipped to give employment to about 60 men. D. Manson Sutherland, Jr., has been elected president and manager of the new company; other officials include George G. Connor and S. E. Kaufman.

New York

YONKERS—The Arlington Chemical Co., 100 Hamilton St., is completing plans and will take bids before the close of the month for the construction of a new 4-story plant on Harriett St., Yonkers, to be equipped for a general line of chemicals and chemical byproducts. Timmis & Chapman, 315 5th Ave., New York, are architects. John E. Andrus heads the company.

ROCHESTER—Fire, Aug. 1, destroyed a portion of the plant of the Rochester Composite Brick Co., with loss estimated at about $100,000, including equipment and stock.

BUFFALO—The Upco Petroleum Co. will commence the immediate construction of its proposed new local plant on site recently acquired on Military Road. The company has a tract of about 2 acres of land, and expects to utilize it entirely for different plant units.

LONG ISLAND CITY—The Borough Engineering Department has plans in progress for the construction of two incinerating plants to be located at Woodhaven and Winfield respectively; each plant will comprise two retort units with total capacity of about 100 tons a day, and is estimated to cost about $275,000. Edward Richardson, Flushing, L. I., and Joseph P. Powers, Rockaway, L. I., are architects.

Ohio

DELAWARE—The Delaware Brass Co. has completed plans and is taking bids for the construction of a new 1-story plant on local site, 50x150 ft.

KENMORE—The Palmer Match Co., 9th floor, Second National Bank Bldg., Akron, O., Charles A. Palmer, president, is arranging a list of equipment for installation at its new plant at Kenmore, for which ground recently was broken, to include complete sulphur house apparatus, mixing machinery and other mechanical equipment. The plant will be 2-story and basement, and is estimated to cost in excess of $500,000. Henry & Murphy, Second National Bank Bldg., Akron, are engineers.

Oklahoma

DEWEY—The Co-operative Rubber Co. will commence the immediate construction of a new plant on local site for the manufacture of a general line of rubber products.

DUNCAN—The Pauline Oil & Gas Co. has commenced the construction of a new oil-refining plant on property lately acquired about 5 miles south of Duncan. The plant will be equipped to handle about 700 bbl. of crude oil per day, and is estimated to cost close to $70,000.

CUSHING—The Cushing Refining & Gasoline Co., a subsidiary of the Mulberry Oil Co., capitalized at $500,000, has acquired the local oil refinery of Gustafson & Spencer, with capacity of about 1,500 bbl. per day. The company will make extensions and improvements and will operate the plant in connection with its new 3-unit gasoline compression plant, now in course of construction at Ingalls, Okla.

Oregon

PORTLAND—The Steno Carbon Paper Co. has awarded a contract to the Hurley-Mason Co., Gasco Bldg., for the construction of a new 1-story plant on the Sandy Blvd., for the manufacture of carbon and other papers. It will cost about $60,000, including equipment.

Pennsylvania

LANCASTER—A 1-story foundry will be constructed by the Burnham Boiler Works, Irvington-on-Hudson, N. Y., in connection with its new local plant on the Dillville Road, Lancaster, estimated to cost about $200,000. Frank D. Chase, Inc., 645 North Michigan Ave., Chicago, Ill., is architect and engineer.

PHILADELPHIA—The Philadelphia Paper Mfg. Co., Nixon St. and River Road, will commence the immediate erection of a new 1-story building at its plant.

PHILADELPHIA—The Paper Manufacturers' Co., 526 Cherry St., with plant at 13th and Noble Sts., has purchased property at 408-18 North 5th St., for a consideration of about $72,500, and will use the land for proposed plant expansion.

Texas

NAVASOTA—The Planters' Cotton Mill Co. has tentative plans under consideration for the rebuilding of its local plant, partially destroyed by fire recently, with loss estimated at close to $60,000

NILE CITY—The Kerr Tire Co. has acquired a local site, and has work under way on a new plant for the manufacture of automobile tires, tubes, etc. The initial works will be equipped for a capacity of about 2,000 tires per day.

ROBSTOWN—The industrial department of the local Chamber of Commerce is considering the establishment of a new brick-manufacturing plant near the city. A company will be organized to operate the factory, or arrangements made with an existing brick manufacturing company to construct and operate the works. A fund to provide for the erection is being arranged.

SABINE—The Magnolia Oil Co. will rebuild the portion of its local plant, recently destroyed by fire, with loss estimated at close to $175,000.

West Virginia

NITRO—The Carrier Chemical Co., 604 Kanawha National Bank Bldg., Charleston, W. Va., has preliminary plans under way for the construction of a new plant at Nitro, for the manufacture of a number of chemicals and chemical byproducts. C. F. Carrier, Jr., is chemical engineer.

FALLING SPRING—The F. A. Jones Stone & Lime Co., Zanesville, O., F. A. Jones, president, has acquired a tract of limestone property in this vicinity, and plans for the initial development of over 35 acres of the site. A mill and other mechanical structures will be built.

Wisconsin

RACINE—S. C. Johnson & Son, manufacturer of waxes, polishes, etc., will commence the immediate construction of the superstructure of its new 4-story and basement plant addition on 16th St. J. Mander Matson, Robinson Bldg., is architect.

Canada

ST. JOHN, N. B.—The Nashwaak Pulp & Paper Co. has plans in progress for extensive additions and improvements in its local mills, to increase the capacity from about 60 to 80 tons of pulp a day, with corresponding advance in the paper making division of the works. The project will cost about $500,000, including equipment. The company is operated by officials of the Oxford Paper Co., 200 5th Ave., New York, and the Bryant Paper Co., Kalamazoo, Mich.; Hugh J. Chrisholm and Felix Pagenstacher are presidents of the respective companies in the order noted.

Capital Increases, Etc.

THE REFINERS' OIL CO., Dayton, O., has filed notice of increase in capital from $400,000 to $700,000.

THE SAVOY DRUG & CHEMICAL CO., 28 East Kinzie St., Chicago, Ill., has filed notice of increase in capital from $12,000 to $75,000.

THE WATAB PAPER CO., Sartell, Minn., is disposing of a bond issue of $1,250,000, the proceeds to be used in part for extensions, general expansions, etc. David E. Town is president.

THE CONTINENTAL RUBBER CO. OF NEW YORK, 120 Broadway, New York, N. Y., has filed notice of increase in capital from $50,000 to $370,000.

THE JAMES BOLAND RENDERING & FERTILIZER CO., Jackson, Mich., has filed notice of dissolution under state laws.

THE UNITED GLUE CO., Indianapolis, Ind., has filed notice of dissolution under state laws.

THE DIAMOND BRICK & TILE CO., Cleveland, O., has filed notice of increase in capital from $50,000 to $100,000.

THE VIRGINIA-CAROLINA CHEMICAL CO., Richmond, Va., has arranged for a bond issue of $12,500,000, the proceeds to be used for additions to working capital, expansion, etc. C. G. Wilson is president.

THE CHESAPEAKE PAPERBOARD CO., Baltimore, Md., has arranged for an increase of $150,000 in capital for proposed expansion.

THE LINCOLN MILLS, LLD., Merritton, Ont., manufacturer of paper products, has arranged for a bond issue of $1,000,000, the proceeds to be used for additions to working capital, general operations, expansion, etc.

Arthur H. Wood and S. Edward Murray, Jr., receivers for the EMPIRE TIRE & RUBBER CO., Trenton, N. J., will offer the plant and property of the company at a public sale to be held in September, the exact date to be soon decided.

W. R. Shaffer, Henry W. Brooks, Jr., and P. P. Nelson have been appointed receivers for the HALLTOWN PAPER BOARD CO., Halltown, W. Va.

New Companies

THE FIBER PRODUCTS CO., Newark, N. J., has been incorporated with a capital of $100,000, to manufacture fiber specialties. The incorporators are Edward E. and Arthur F. Felsberg, and Cyrus H. Vail, 784 Broad St., Newark.

THE NEW ENGLAND BRASS MFG. CO., Danbury, Conn., has been incorporated with a capital of $12,000, to manufacture brass products. The incorporators are Frank Perlin, M. E. Krebs, and M. M. Quamruddin, 100 White St., Danbury.

THE SURE LIVE TRANSPLANTER CO., New York, N. Y., care of L. A. Safian, 291 Broadway, representative, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are C. H. Donner, A. Abt and E. Schwab.

THE BURDSAL-BAXTER PAINT CO., Indianapolis, Ind., has been incorporated with a capital of $25,000, to manufacture paints, oils, etc. The incorporators are Oliver P. Ensley and Malcolm Baxter, both of Indianapolis.

THE OZARK OIL CO., Detroit, Mich., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated with a capital of $250,000, to manufacture petroleum products. The principal incorporator is H. M. Senter, Detroit.

THE BARKER-BRIGGS CHEMICAL CO., Louisville, Ky., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are Daniel Briggs, Rowland A. Barker and Herbert F. Boehl, all of Louisville.

THE ROYAL BRASS FOUNDRY CO., 39 New York Ave., Newark, N. J., has field notice of organization to manufacture brass, bronze and other metal castings. Gothar B. Elsner, 20 Beech St., heads the company.

THE SIMPSON LEATHER CO. INC., Boston, Mass., has been incorporated with a capital of $25,000, to manufacture leather products. Charles A. Simpson, Trenton St., Melrose, Mass., is president and treasurer.

THE MANATEE COUNTY FERTILIZER CO., Bradentown, Fla., has been incorporated with a capital of $25,000, to manufacture commercial fertilizer products. J. H. Humphries is president; I. T. Williams, vice-president; and H. O. Horner, secretary, all of Bradentown.

THE DELEVAN SMELTING & REFINING WORKS, INC., Brooklyn, N. Y., care of J. M. Cleary, 25 Henry St., Brooklyn, representative, has been incorporated with a capital of $100,000, to operate a metal smelting and refining plant. The incorporators are A., I., and S. X. Toorock.

THE DIXIE WAX PAPER CO., Dallas, Tex., has been incorporated with a capital of $20,000, to manufacture waxed and other papers. The incorporators are R. G. Smythe, J. Irwin and G. C. Embry, all of Dallas.

THE JOHN L. MORRIS OIL CO., Cuyahoga Falls, O., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated with a capital of $150,000, to manufacture oil products. The incorporators are L. E. James, John L. Morris and Maurice Betts.

THE NEW ERA MICA CO., Penland, N. C., has been incorporated with a capital of $10,000, to manufacture mica products. The incorporators are Paul Willis and John V. Cox, both of Penland.

THE UNITED STATES PAPER MFG. CORP., 543 Calvert Bldg., Baltimore, Md., has been incorporated with a capital of $3,000,000, to manufacture pulp and paper products. The incorporators are Johnston V. Best, Wendell D. Allen and Lewis C. Merryman.

THE HERCULES RUBBER PRODUCTS CORP., Brooklyn, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, has been incorporated under Delaware laws, with a capital of $7,600,000, to manufacture rubber products. The incorporators are Paul M. Richards, and George W. Bryan, Brooklyn; and Winfield Clearwater, Rutherford, N. J.

CONLEY & STRAIGHT, INC., Providence, R. I., has been incorporated with a capital of 250 shares of stock, no par value, to operate a metal refining plant. The incorporators are John A. Straight, George W. Bugbee, and T. H. Conley, 50 Lillian Ave., Providence.

THE TALMAGE MFG. CO., 3825 Ogden Ave., Chicago, Ill., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are Maurice M. Talmage, I. Wineberg and Joseph Kampner.

THE COLUMBIA STEEL & TUBE CORP., New York, N. Y., has been incorporated with a capital of $25,000, to manufacture steel tubing, etc. The incorporators are H. Lipton, L. Bardi, and A. Wynehouse, care of Slade & Slade, 200 Broadway, New York, representatives.

THE INTERSTATE CHEMICAL FOUNDATION, INC., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under state laws, with capital of $2,500,000, to manufacture chemicals and chemical byproducts.

THE SOL CASTING CO., Linden, N. J., has been incorporated with a capital of 100 shares of stock, no par value, to manufacture iron, steel and other metal castings. The incorporators are Raymond F. Sturges, Joseph Oxman, and Henry Lipp, Linden. The last noted represents the company.

THE ECONOMY SOAP CO., Buffalo, N. Y., care of William O. Shields, Morgan Bldg., representative, has been incorporated with a capital of $15,000, to manufacture soaps and kindred products. The incorporators are J. F. Wagner and S. S. Knaier.

EL DORADO SPRINGS DEVELOPMENT CO., El Dorado, Mo., has been incorporated with a capital of $300,000, to manufacture zinc products. The incorporators are William True, A. B. Stricklett and M. A. O'Connor.

THE PURITAN OIL & REFINING CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., representative, has been incorporated under Delaware laws, with a capital of $10,000,000, to manufacture petroleum products.

E. J. TODD, INC., New Haven, Conn., has been incorporated with a capital of $50,000, to manufacture rubber products. The incorporators are Alonzo P. Adams, Great Barrington, Mass.; R. H. Cameron, Hamden, Conn.; and T. C. Hadden, 195 Church St., New Haven.

THE OHIO VALLEY SHALE OIL & DEVELOPMENT CO., Huntington, W. Va., has been incorporated with a capital of $150,000, to manufacture petroleum products. The incorporators are H. H. Brown, C. B. Hill and R. E. Petty.

HENRY SHAPNER, SONS & CO., INC., Springfield, Mass., has been incorporated with a capital of $125,000, to manufacture leather products. Henry Shapner is president, and Sidney Shapner, 149 Summer Ave., Springfield, treasurer.

Manufacturers' Catalogs

THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis., has issued two new bulletins. "Synchronous Motors" is the title of Bull. 1124, in which there are numerous illustrations of this type of motor suited to various industrial applications, and their use for belted, coupled or direct-connected service. Particular attention is called to the use of these motors for driving air compressors, motor generator sets, also their use for rubber mill drive, flour mill drive, ice-making and refrigerating machinery, paper-making machinery, and for driving mine fans, pumps, etc. Bulletin 1109 is on "Distribution Transformers" having ratings of 200 kva. and smaller, suitable for lighting and power purposes and of the oil immersed self-cooled outdoor type.

THE FULTON CO., Knoxville, Tenn., calls attention to its first general catalog on Sylphon Heating Specialties, in which are listed only those articles that relate to heating and temperature regulation.

THE ELECTRO-ALLOYS CO., Elyria, O., has just issued a pamphlet on ThermAlloy, high-temperature castings.

THE CONVEYORS CORP., Chicago, Ill., has issued an illustrated booklet entitled "Cut Ash Handling Costs," which should be of interest to the power plant executive. The booklet is an exposition of the steam jet conveyor method of ash handling and contains a description of the conveyor and its method of operation. It also gives a list of guarantees offered by the company, which include: Cost per ton of ash handled; cost of repairs per ton of ash handled; nonpacking of ashes in the ash storage tank; absence of dust at discharge and nonfreezing of ashes in the tank. Copies can be obtained on application.

THE SCIENTIFIC MATERIALS CO., Pittsburgh Pa., has published a special bulletin on the F and F Optical Pyrometer. The bulletin contains a discourse on the general theory of optical pyrometry, with a description of the F and F device and its practical industrial applications. This instrument is well adapted for use in determining temperatures at coke plants, ceramic plants, steel mills, iron furnaces and in other cases of high-temperature measurements where contact with the heated body cannot be made, where the position of the pyrometer must be distant from the heated object or where the temperature to be measured is above the range of thermocouple pyrometers.

THE CENTRAL SCIENTIFIC CO., Chicago, Ill., has issued Catalog R, which is a price list of chemicals and reagents, including Cenco certified chemicals and other standard makes of c.p. and U.S.P. chemicals, certified biological stains, certified rare sugars, culture media, indicators and commercial chemicals for general laboratory use.

THE SURFACE COMBUSTION CO., industrial furnace engineer and manufacturer, of 366 Gerard Ave., Bronx, New York City, is issuing a series of bulletins pertaining to industrial furnaces. Bulletin 3-D is devoted to Surface Combustion Low-Pressure Air-Gas Inspirators, which are readily applicable to any make of gas furnace. Bulletin 5 is entitled "Surface Combustion Oven Furnaces," and describes furnaces for the heat-treatment of both carbon and high-speed steel. Bulletin 6 is devoted to Surface Combustion Pot-Hardening Furnaces. Bulletin 7 is entitled "Surface Combustion Soft Metal Furnaces." Bulletin 8 is devoted to Surface Combustion Galvanizing Baths. Bulletin 16 is entitled "Surface Combustion Shipyard Furnaces." Bulletin 17 is about Surface Combustion Rivet Heaters. Bulletin 18 is entitled "Surface Combustion Small Forges." Bulletin 24 is entitled "Surface Combustion Laboratory Furnaces for High Temperatures."

THE COMBUSTION ENGINEERING CORP., New York, calls attention to a new booklet relative to its powdered coal installation at the River Rouge plant of the Ford Motor Co., which contains some interesting information on operating results at the plant, which has been in operation slightly over a year.

THE AMERICAN NICKEL CORP., Clearfield, Pa., is distributing a booklet, Bull. 101, on "Pure Malleable Nickel" giving a résumé of its properties and uses.

THE NORTHERN EQUIPMENT CO., Erie, Pa., has issued a booklet entitled "Regulating Boiler Feed Water." The subject has been treated in an entirely new way, the object being to cover the subject of boiler feed water regulation completely and yet very briefly. To accomplish this purpose, free use has been made of a graphical method of presentation, charts showing the effect of feed water temperature, etc.

THE HYDRAULIC PRESS MFG. CO., Mount Gilead, O., has recently issued two bulletins which have been got up especially to meet the demands of radio manufacturers for presses for forming and molding such materials as Condensite and Bakelite.

THE JEFFREY MFG. CO., Columbus, O., calls attention to Bulletin 369, dealing with the Jeffrey portable belt conveyor. This conveyor has been designed to meet a demand for a light inexpensive loader that would handle both bulk and package material. This bulletin illustrates and describes this machine. Two or more of the conveyors may be used together to extend storage pile, or the portable belt conveyor may be used as an extension conveyor to storage pile in connection with the Jeffrey portable car unloader. It can be operated by either electric motor or gasoline engine.

THE SHEPARD ELECTRIC CRANE & HOIST CO., Montour Falls, N. Y., has issued illustrated pamphlets on the Shepard Electric Liftabout; Bull. M-3, on Form IX Hoist With Geared Trolley From ½- to 20-Ton Capacity; Bull. M-4, on T-bar Insulator; Bull. M-5, Form 36W Back-Geared Motor Winch From 800- to 3,500-lb. Capacity; Bull. M-7, Form 23 Hoist With Geared Trolley From 1- to 6-Ton Capacity; Bull. M-8, Form 8 Hoist From ¼- to 6½-Ton Capacity, and a pamphlet on Hoisting Equipment for Ice Plants. This company has also issued a catalog illustrating and describing the Shepard Electric Hoist equipped with Zobell electric motor.

THE INTERNATIONAL NICKEL CO., New York, in Bull. 103 gives some of the uses of Monel metal in the textile industry, including bleaching and dyeing machinery, carpet, felt and hat making, centrifugals, extractors, dehydrators, tanks, warp mercerizing machinery, drying machinery, shaping clips, etc., on spinning machines, rolls and cylinders, carbonizing and scouring machinery, jack-spool heads, drying cans and textile pins.

THE HERCULES POWDER CO., Wilmington, Del., calls attention to a 56-page booklet illustrated with photographs and diagrams, entitled "Eliminating Waste in Blasting." It tells how some progressive companies are preventing waste in blasting, together with recommendations of the Hercules Co. In this book the company endeavors to give users of explosives the benefit of information gathered on the best methods for reducing blasting costs. They will be supplemented with bulletins from time to time. Copies will be sent to anyone interested, upon application to the Advertising Department, Hercules Powder Co., Wilmington, Del.

Coming Meetings and Events

ALPHA CHI SIGMA dinner, during the Chemical Exposition, will be held Thursday, Sept. 14, at 6:30 p.m. at Keen's Chop House, 107 West 44th St., New York City. Members are requested to register at *Chem. & Met.'s* booth at the Exposition.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NATIONAL SAFETY COUNCIL will hold its Eleventh Annual Safety Congress in Detroit, Aug. 28 to Sept. 1.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

CHEMICAL & METALLURGICAL ENGINEERING

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Volume 27 — New York, August 23, 1922 — Number 8

The President's Views On the Industrial Crisis

PEACEFUL and law-abiding citizens must have felt a bond of sympathy with the President as he recounted to Congress the story of his voluntary, but unsuccessful, efforts at mediation in the industrial crisis that faces the country. It is a record of patience under repeated rebuffs. If this were all, it would be disheartening; but there is ample evidence that the Chief Executive not only has his feet firmly on the ground but has his head high enough above the clamor and turmoil of industrial dispute to be able to see clearly and think straight on principles involved in the troublesome issues that treaten the nation. A strong advocate of respect for law and constituted authority, he logically seeks legal measures to insure the freedom and promote the peace and prosperity of the people.

Above all else President HARDING'S recent message to the Congress was a brief in the interest of the American people. Incidentally it did point the way to the only lasting solution of the coal problem and also pledged the powers of the government for maintaining transportation; but far transcending these matters in importance was the assurance that "no matter what hardships may attend or what sacrifice may be necessary, government by law must and will be sustained."

The President's demands for Congressional support and assistance are only those which an understanding people recognize as indispensable. There is no request for laws that will accelerate or force the settlement of present difficulties, for, wisely, the President is most concerned with righting a situation that will make their recurrence impossible. The message strikes at the very fundamentals of our trouble in the coal fields. Only by the elimination of evils that have led to the grossly excessive number of mines and miners can this industry be put on a sound economic basis. The fact-finding commission is the logical agency for attacking these basic problems. But this commission should, in our opinion, be vested with broadest powers, not only to investigate but to act and demand the necessary reformation and economic reorganization of the industry. The sooner this commission can function the better, for unless quickly forestalled further trouble is inevitable either next spring or at the expiration of whatever wage agreements are now to be effected.

With respect to the proposal of a "temporary national coal agency" to control the purchase and distribution of coal, there will be less accord. It is to be regarded only as a measure of final resort in case the operators are unable or unwilling to serve the public at a fair price. Fortunately the latter class is but a small proportion of the industry, which for the most part has loyally cooperated with the government.

In the opinion of those well informed on the subject the emergency would be passed before a commission of this kind could begin to function effectively. Developments immediately following a resumption of coal mining are likely to indicate whether or not a government agency of this kind is necessary.

It is hoped that present negotiations pointing toward a settlement of the rail strike will include some mutual agreement for observance and respect of the decisions of the Railroad Labor Board. Nevertheless the need for strengthening legislation has been clearly shown by the developments of the past year. When the Esch-Cummins law was enacted it was without precedent on the statute books and naturally after a considerable period of operation Congress may well consider a number of perfecting amendments.

In concluding his message the President laid down the broad principles on which the government purposes to act in putting an end to lawlessness and violence. For these principles we have nothing but commendation and approval. With him we thoroughly believe: "It is fundamental to all freedom that all men have unquestioned rights to lawful pursuits, to work and to live and choose their own lawful ways to happiness." Once this principle is universally recognized there will be no class domination nor will the public welfare be surrendered to a small minority that has the temerity to oppose the organized forces of law and order.

The Senate Raises Rates In the Chemical Schedule

DETAILS of the Senate's final action on the chemical schedule of the tariff will be found in the news pages of this issue. Our correspondent states that debate waxed warm at various stages in the consideration of the bill, with opponents and proponents lined up as they have been throughout the tariff debate.

The general result of the Senate's deliberations on coal-tar chemicals was a rejection of the proposed embargo and substitution of an amendment by Senator BURSUM offering higher rates on coal-tar intermediates, dyes and chemicals. Not only was the ad valorem rate on intermediates raised from 50 per cent to 75 per cent, but the fixed duty was increased from 7 cents per pound to 10½ cents. Similarly rates on coal-tar chemicals and dyes were increased from 60 per cent and 7 cents per pound to 90 per cent and 10½ cents per pound. This amendment, coupled with the provision for so-called flexibility in the rates to July 1, 1924, represents the limit of the Senate's protection of the chemical industry.

The bill will now go to conference, where an effort will be made to harmonize rates in the House and Senate bills. The outcome cannot be foretold, because the Senate has made radical modifications in the Fordney bill. There are, however, in both houses of Congress warm advocates and strong supporters of the chemical industry to whom we can look with confidence for a strong fight in support of protection.

A Naïve Confession

PROMINENTLY displayed on the front page of a metropolitan daily last Friday was a press dispatch from Chicago featuring a statement by the dean of the College of Liberal Arts in Northwestern University to the effect that henceforth married instructors will not be engaged in that institution unless they have independent means. It seems that although "salaries at Northwestern are as high as in any other university," the cost of living in Evanston is unusually high and the social demands are greater than in most university towns. The terrible consequence is that instructors are unable to live and support a family on their meager salaries of from $1,600 to $2,500. Hence their wives seek positions in the peaceful Chicago suburb in order to eke out the family budget. All of this induces worry and leads to such a distracted state of mind over debts and other little domestic problems that the instructor is unable to concentrate upon his work and his educational value suffers accordingly.

And all this is given out in a sober, academic statement, apparently without regard for the number and variety of jokes it contains. First, there is the naïve confession that Northwestern is not giving its married instructors even the "living wage" which is scorned by all well-informed and intelligent labor leaders. Next is the paradoxical reference to college instructors with independent means. Why be a college instructor at Northwestern or any other school if one has independent means? But the remedy proposed is still more unique. Dismiss married instructors altogether, rather than meet a patent obligation and keep happy, contented workers. Perhaps this simple expedient will not be immediately appreciated outside of the department of sociology and economics—but what a ghastly joke the whole thing is on a married instructor in that department!

Perhaps the new ruling at Northwestern does not apply in the departments of science and engineering, but wherever applied it must inevitably have the effect of lowering the quality of instruction through the employment of immature instructors. In business the married man is more likely to be regarded as an asset than a liability. It is recognized that he has not only assumed duties and obligations that make for stability but also that he has reached a state of maturity that implies greater ability. But not so in the College of Liberal Arts at Northwestern. Here one must have a wealthy wife or riches in his own right, although we hope that the new ban on married instructors will not apply in technical courses, where it is recognized that immature instructors should not be employed. One of the conclusions reached by the committee on chemical engineering education of the American Institute of Chemical Engineers was that graduate students should not be used as major instructors in chemical engineering, even in the freshman year.

If universities want quality in instruction, as in other lines of human endeavor, they must pay for it. Recently we ventured the opinion that colleges would have to compete with industry in order to hold on their faculties men of exceptional promise. It begins to look as though the humble instructor is in greater need of our solicitude. It is from the ranks of instructors that universities recruit their professors of high and low degree. Brilliant students, who give promise of an equally brilliant academic career, expect to travel the familiar route to a professorship via the humble instructor's job, meanwhile working for a higher degree and earning enough to live on. If the first step in this customary routine is made so unattractive that a man must be a bachelor in domestic affairs as well as one of arts or sciences, the range of candidates from which faculties are to be recruited is narrowed not only in quantity but in quality also. Educational institutions generally must wake up to the necessity of competing for men on a business basis.

Wanted—Competition In the Coal Industry

IN OUR ISSUE of April 12, 1922, we pointed out that the waste in the coal-mining industry due to idle labor and idle capital is much greater than the waste in mining methods, about which so much has been said in the plea that we should think of posterity. It is only lately, through the prompting of the greatest strike in the history of the bituminous coal industry, that much has been said about the waste of workmen's time and of capital.

Now the subject is really up. F. S. PEABODY, a prominent coal operator and member of the A.I.M.E., uses particularly plain language in expressing the thought that is prominent in the minds of many men —that what is wanted is competition in the coal industry. Mr. PEABODY says there must be a weeding out of coal mines by competition, leaving the fittest to survive and work practically full time. He takes the conservative basis that the developed capacity is fully one-third greater than any possible demand, sets the excess capital at $400,000,000, the excess in miners at 200,000 and the excess cost of all this at $400,000,000 a year, 80 cents per ton of coal, which the country is paying in an excess coal bill.

The question is how to produce competition. It is a question that has never been up in a large way. Experience in human affairs shows that as a general rule there is a strong tendency for competition to arise, while men are disposed to devise artificial means to restrict competition. Hence we have been more or less busy with the problem of preventing the stifling of competition. We have the common law, converted into precise form by the Sherman law of 1890, and lately we have had the Clayton and Trade Commission acts.

Our general policy has been that if we prevent the restriction of competition we do enough. The question now is whether this policy is wrong or we have overlooked something in endeavoring to carry it out. Studying the history of the coal industry in the past quarter century or more, we find little suggestion that the familiar methods of trade restraint have been practiced, and we find furthermore that it would be particularly difficult to operate a price agreement in coal. There are many operators, of various sizes, and they are plainly difficult if not impossible to "control." Then there is the nature of the business, coal-mining districts being scattered over a large part of the country, each with its tributary consuming territory, and each with its own price.

Nevertheless, the plain fact is that competition, as a means of keeping prices down to a fair average level, has failed in the case of coal. The reason is conspicuous and simple. Our law forbids coal operators as well as other producers of commodities to agree with

one another to restrict production. The law does not forbid the coal operators to disagree with the United Mine Workers. Thereupon the United Mine Workers go on strike, and sometimes even close non-union mines, as they did this time in the Connellsville and some other districts.

It is seldom that the answer to a great problem is in advance narrowed down so precisely. It may be difficult of execution, but its general character is predetermined. The study must be prompt and vigorous, for while there have been biennial scales in the bituminous coal industry in the past, the recent "settlement" of the United Mine Workers runs only to April 1, 1923, seven months hence.

On Casting Steel, Copper And Other Things

MANY a foundryman will contend that the hardest casting to run in gray iron is not an intricate thing like a valve body, but a simple straight round bar. Many an argument has arisen over the proper way to mold it, and where the gates and risers ought to be. How to produce sound, perfect castings of this shape seems never to be settled to everybody's satisfaction.

Those same questions constantly confront the caster of ingots or slabs. He continually must make bars of solid metal in unexceptionable surface condition, especially when they are to be rolled into thin sheets. Furthermore, such is the kinship among metals that the precautions necessary for casting fine steels, so ably described by Colonel BARBA before the Mining Engineers last winter, are paralleled in non-ferrous practice.

To illustrate, consider the pouring of a long round "billet" of copper, to be pierced and worked into seamless tubing or bands. Assume that delicate furnace refining has put the metal into the exact "pitch" to solidify with a flat surface. A laborer dips a big ladleful from the bath, keeping some of the glowing charcoal floating on top to prevent oxidation of the metal en route, and trundles his load to the molds. Each one of these consists of a series of copper rings bored to a mirror finish and machined at the grooved joints; the lowest section has a pouring gate entering the bottom. A second workman empties a small hand ladle through this runner, and when the metal wells up, covering the bottom of the mold, the bull-ladle starts pouring from the top. In this manner all splashing is prevented. As the first section fills, the next ring is placed in position smartly, the ladle of hot copper meanwhile being raised by chain block, and pouring is resumed with the slightest delay. For such practice, the copper of course must be hot, so that fresh metal strikes a liquid pool and the stop-pour causes not the slightest defect. And so on until the 4-ft. bar is completed.

By the time the first section is poured the metal in the small gate is chilled, and by the end of the pour the billet is solidified possibly for half its length. The mass of the mold sections is most carefully adjusted for this rapid chilling effect; indeed the rate of solidification is balanced against the temperature of the metal, the temperature of the mold, the pouring rate and the "pitch" or gas content in the bath. It is therefore only the matter of a minute before the billet freezes with a flat top and without internal cavities or pipe of any sort. The molds are lifted straight up, section by section, off the red hot bar, and the lowest one opens on a parting. After partly cooling in water, they are slushed with bone-black, and are ready for another pour.

Here are seen the essentials of correct ingot pouring: Most carefully refined metal; correct temperature of metal and mold; the surface of the mold perfection indeed; absolute prevention of splashing, close control of pouring rate; quick stripping of molds. These things attended to, no difficulty is had in producing as a matter of course ingots of this shape—undoubtedly the most difficult yet devised to worry the caster—and of a quality so excellent that most exacting specifications covering the interior and exterior surface of tubing can be met with ease.

Illustrations need not be multiplied. This one perhaps suffices to convince that melters of copper, brass, bronze and aluminum could profit equally with steel makers from a study of the principles set forth on page 350, so ably enunciated by Colonel BARBA and the lamented Dr. HOWE.

Prehensility— Comprenez Vous?

WE REFERRED the word to one of our colleagues, who said he thought it must be the property of having a long and waving tail. We informed him that he was wrong, whereupon he said that it must be the property of having a short straight one.

It is neither. In fact it is a term applied to adsorbents in producing high vacua. It is the conception of seizing hold of the gas molecules rather than retaining them. It is greatest with plum-stone charcoal and less with birch charcoal, coconut charcoal, German charcoal, etc. Mathematically it is the slope of a curve about which the reader can discover more details by referring to the *Proceedings* of the Royal Society of Edinburgh.

The word, however, will serve admirably as a text. It represents a tendency—and not a healthy one—which may perhaps be described as the desire to coin a vocabulary. Of course, a definite and specialized vocabulary is necessary in chemistry and physics to express and co-ordinate the knowledge which those sciences have given us. And yet we feel that too little care and thought have been given to the niceties of language and the demands of good literature. In the case of "prehensility" the word is so definitely associated with the ability of monkeys to seize an object with their tails that it seems grotesque to develop a new application with reference to adsorbents. Language is already too complex, and words are too lightly added to an already overextended vocabulary. In fact, if we were not protesting against the practice, we might offer a dissertation on "nomenitis," the disease of naming things.

According to MARK TWAIN, NOAH had a simpler and more logical method which he applied when he was called upon to name the animals. As they passed in review he named them according to their appearance. Thus the lion looked so much like a lion that there seemed to be no chance of naming it anything else; and the giraffe—who could mistake that long neck and peculiar shaped body? It must be a giraffe, no other name would fit. And so on through the whole list. There is much to commend in the simplicity of NOAH'S system. Try it in the case of "prehensility" and see if you can visualize an adsorbent wrapping its tail firmly around a gas molecule, seizing it beyond the possibility of escape!

Readers' Views and Comments

Acid-Proof Material for Arsenic Acid Manufacture

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to my contribution in your issue of July 26 on "Calcium Arsenate Manufacture," which on account of haste I did not see in proof before publication, my attention has been called to one slight inaccuracy which requires notice.

In the description of acid-proof material used for arsenic acid manufacture my article as written referred to Duriron, as this is the only alloy, to my knowledge, which has been successfully used for the apparatus described. Your editor in changing the wording (I assume to eliminate from a technical article reference to a commercial name) substituted for the word "Duriron" the words "high-silica iron." This phrase is not correct according to my understanding, as Duriron is properly termed a "high-silicon iron" or a "ferro-silicon."

The alloy was referred to in this article not in any broad or generally descriptive sense, but to indicate definitely the material already proved suitable for a requirement permitting radical improvement in the production of this acid. To my own knowledge costly failures have resulted from efforts to use other kinds of iron kettles for this particular purpose and I would naturally prefer not to appear to write authoritatively on the subject with such phraseology as might be misconstrued.

With the desire for accuracy which I know you have and which from my personal standpoint is equally desirable I am suggesting this correction.

New York City. H. W. AMBRUSTER.

Dezincification of Brass

To the Editor of Chemical & Metallurgical Engineering

SIR:—I should like to take issue with the investigators of the Corrosion Committee of the British Institute of Metals[1] upon their conclusion that true dezincification of brass never occurs. Microscopic examination of dezincified samples of Admiralty alloy submitted to me indicates very clearly that zinc has been removed and the copper left in place. Spongy, brittle copper remains, occupying exactly the same space and position, and in every way apparently exactly what should be left, provided the zinc had been dissolved out of the brass. Small particles of brass are frequently found in this mass in the form of crystals or islands of the original metal. I have seen corroded tubes where copper has apparently been re-deposited, but the experience of the American Brass Co. with condenser tubes does not lead us to think that this can be anything but a very extraordinary case resulting from abnormal conditions of exposure.

We very seldom find tubes in the same condenser differing in the character or amount of adhering deposit. In some condensers the tubes have a very hard, one might say "stony," deposit. Such tubes have lasted for a long period in sea water service. On the other hand, where condenser tubes fail in a very short time they generally do not possess such a deposit. The deposit is either partly wanting or is very soft and apparently slimy when wet, and after being dried out it has not the continuous enamel-like appearance referred to.

Waterbury, Conn. W. H. BASSETT.

[1] See "Results Achieved by the Corrosion Committee, British Institute of Metals," *Chem. & Met. Eng.*, Feb. 15, 1922, vol. 26, p. 301.

A New Vessel for the Absorption of Hydrochloric Acid

To the Editor of Chemical & Metallurgical Engineering

SIR:—Under the above title in your issue of Aug. 2 Stephen L. Tyler states that "The tower has been used extensively for the absorption of hydrochloric acid gas, but from this it is possible to produce only acids of low strength, as it is not practicable to construct absorption towers with sufficient cooling to keep the tower temperature down to a point where high strength acid may be produced."

In my report on the operation of the plant at Emporium in *Chem. & Met.*, Nov. 2, 1921, page 834, it is shown that 20 deg. Bé. acid is regularly produced without the use of any absorption apparatus but towers and from gases running as low as 3 per cent HCl. The necessary cooling is obtained by circulating a large volume of acid with pulsometers. M. A. LAURY.

Rockville Center, L. I.

To the Editor of Chemical & Metallurgical Engineering

SIR:—In my article on "A New Absorption Vessel for Hydrochloric Acid" which appeared in your Aug. 2 issue a number "1" is omitted from Fig. 4. It should be placed opposite the upper layer of air-cooled coils. It is referred to in the text and without it there might conceivably be some confusion. I would appreciate your calling this to the attention of your readers.

New York City. S. L. TYLER.

The Technology of the Carbon-Electrode Industry

To the Editor of Chemical & Metallurgical Engineering

SIR:—The fourth article of the series on "The Technology of the Carbon-Electrode Industry" contains two rather unfortunate errors of typography, the effect of which, in one case at least, is entirely to reverse the writer's original meaning. Thus on page 259, under the heading "Comparison of Molding and Extrusion," the word "not" has crept into the fourth paragraph and should, of course, be omitted. The paragraph would then read: "In the case of large electrothermal electrodes, the high density and low resistivity of the electrode are as important as when smaller currents are used."

Again on page 260 it would seem that the captions for the illustrations had been reversed. The press shown in the cut on the right has a capacity of 750 tons and not 350 tons. It is obvious, I believe, that the comparative sizes of the presses do not agree with the capacities which you have indicated.

I shall be obliged to you if these corrections are brought to the attention of your readers.

Brooklyn, N. Y. CHARLES L. MANTELL.

Ido, the Universal Language

To the Editor of Chemical & Metallurgical Engineering

Sir:—As a subscriber for *Chem. & Met.* I take the liberty of presenting one reader's views and comments on the synthetic language Ido.

Ido

(How is it pronounced?)

There once was a pup dog named Fido
Who became quite proficient in Ido,
For German and French
Gave his tongue such a wrench
As to force him to cut quite a dido.

His master, a likeable kiddo,
When of age fell in love with a widow.
Though she came from far Burma,
Their love was the firmer
Because they could say it in Ido.

In movies the next thing that he do
Is to come to a clinch just like she do.
'Twas a suitable match
For they came to the scratch,
And whispered soft nothings in Ido.

Her father, whose wealth was his credo,
Soon asked of the young man had he dough.
"I've houses and land,
And coin plenty as sand,"
He answered quite glibly in Ido.

Washington, D. C. C. E. WATERS.

The Chemical Industry in Chile

FROM OUR SANTIAGO CORRESPONDENT

SANTIAGO, CHILE, AUG. 1, 1922.

CHILE has developed a flourishing industry by means of obtaining and preparing chemicals in their original state which are especially intended for the export trade. The names of these products, with the amounts produced during the past 3 years, are given in the following table:

	1918	1919	1920
Sodium nitrate, metric tons	2,875,902	1,703,240	2,523,458
Iodine, kg	1,078,760	243,167	350,066
Calcium borate, metric tons	6,603	10,116	15,823
Sulphur, tons	19,557	18,910	13,340
Perchloride of potassium, kg	118,327	20,696	33,487
Sodium sulphate, metric tons	1,220	.....	.....
Sodium chloride, metric tons	54,536	29,454	33,951

During 1921 interesting deposits of sodium carbonate were discovered, 50 per cent pure, the remainder being mostly moisture and organic matter. The extraction of these products is destined to develop an extensive industry, as the deposits are important and the transportation lines now under construction will permit of the products being moved with ease for shipment to foreign markets.

MANUFACTURE OF CHEMICAL PRODUCTS

The manufacture of chemical products has had a slow development in Chile owing principally to the small consumption, the variety of products which are needed in the work and the difficulty of transportation due to the configuration of the country. The manufacture of sulphuric acid, which is a vital industry, has not thrived. A premium of $0.05 (Chilean gold) per kilo of 66 deg. acid was allowed and a factory was opened in Guayacan, Coquimbo, using the contact process, but it shut down as soon as the payment of the premium was withdrawn. At present there are several factories producing sulphuric acid by the chamber process. Of these, two are operated solely for the purpose of supplying the mining camps of Teniente and Chuquicamata, which depend on them for their supply of sulphuric acid, and three to supply the public demand. In almost all of these factories, with the exception of Teniente mine, native sulphur is used. Chamber acid and 66 deg. acid are the only forms produced at present, no fuming ever having been made. Hydrochlorate and nitric acid for commercial use are also manufactured. Small quantities of acetic acid are manufactured, notwithstanding the fact that sodium acetate is exported.

In the line of basic chemistry, development has been confined to the crystallization of sodium carbonate. In the nitrate regions an impure sodium carbonate, called "natron," is produced by burning nitrate with carbon. This is used for the manufacture of solutions of bisulphite used to extract iodine.

The deposits of sodium sulphate in the northern part of the country and the consumption of caustic soda and salts there would serve as an economic basis for establishing a factory to produce Leblanc carbonate in Antofagasta and its environs.

Among the ordinary chemical products locally manufactured are boric acid, iodide of potassium and sodium, nitrate of silver, sulphate of copper, iron and aluminum, refined cream of tartar, ordinary ether, glycerine, compressed oxygen and carbon dioxide, naphtha and other products of minor importance.

The wood-distillation industry is still in its infancy, several small factories having been established which produce methylene and calcium acetate. There is a large factory which produces tannic extracts, using the bark of the elm tree, and also a factory producing paste for mechanical purposes, using the bark of the *Araucaria imbricata.*

There are five factories producing illuminating gas, two of them having tar distilleries, although they only separate the raw products without crushing or refining them.

There are several oil factories producing olive, castor, cottonseed, linseed and other similar oils. Industries utilizing fats are only beginning to be built and the manufacture of soap is carried on along very primitive lines. There are some plants for the recovery of glycerine.

The manufacture of all kinds of fermented products is conducted on a large scale, excellent wines and beers being made, and alcohol is produced in greater quantity than that needed to supply the requirements of the country. There are several small starch and gluten factories. The tanning and allied industries are very much developed, local material being used from which a very good grade of hides is produced.

The Record in Pulverized Coal Installations

Chemical engineers have followed the extensions in the use of pulverized coal for fuel with much interest. Combustion is primarily the province of the chemical engineer and the extension of improved combustion methods affects him in many ways.

In this connection it is worth while to note the equipment which is to be used in the Cahokia Station of the Union Electric Light & Power Co., St. Louis, Mo. This plant, an eventual 240,000-hp. development, will raise steam with B. & W. boilers fired by the "Lupulco System" of pulverized coal burning, installed by the Combustion Engineering Co. The coal will be powdered in a battery of ten Raymond Six-Roller Low-Side Mills. This pulverizer installation will comprise, so far as can be ascertained, the largest single coal pulverizing installation so far made for any purpose whatever.

What's in a Name?

The Moot Question, Does the Trademark Belong to and Protect the Business or Does It Protect the Consumer? Is Discussed and Illustrated by Recent Celebrated Cases—The Effect of This Point on Commercial Transactions Between Americans and Foreign Corporations

By Wellington Gustin
Of the Chicago Bar

THE rights carried by a trademark covering one's products appear to be not very definitely defined in the rules of law, nor settled by decisions of the courts. "What's in a name?" in a business sense is of grave concern to business from more than one angle. Is a trademark and trade name something to be protected by the laws for the benefit of its claimant or for the benefit of the public? Is it a right or property for the protection of the business and products of private individuals, or is it a right to be enforced by the laws and rules of equity for the prevention of frauds upon the public? Some recent cases in the federal courts show a state of uncertainty as to these matters.

The Purchase of Exclusive Rights to Foreign Trademarks

The question chiefly involved in this article concerns the importation and sale in the United States of products manufactured under a trade name or mark in a foreign country, where the manufacturer has sold his rights to the name or mark in this country. Under one line of decisions the tendency is to permit an importer to sell foreign trademarked goods in this country, though an American firm may have purchased and owns the trademark rights in this country, provided, of course, the importer has purchased the products from others than the manufacturer. The proposition has not been passed on by the United States Supreme Court, and there are other points of law connected with the rights to a trademark not yet settled. The importance of the subject is obvious, when we remember the chemical products and their trade names of German manufacture sold to American interests during the late war.

The Java Poudre Case

A case now pending in the United States Supreme Court on a writ of certiorari to the United States Circuit Court of Appeals for the Second Circuit concerning trademark rights and unfair competition is of great importance to all users of trademarks and trade names, A. Bourjois & Co., Inc., vs. Anna Katzel (42 Sup. Ct., 92).

A. Bourjois & Co., Inc., a New York corporation, brought suit for an injunction against Anna Katzel. The company is the exclusive owner of certain registered trademarks for face powder, these trademarks consisting of the word "Java" and the various labels which are carried by its boxes and serve to identify them as its products. Anna Katzel's boxes are, with two differences, exact duplicates of plaintiff's boxes.

In 1912 the firm of E. Wertheimer & Cie. of France, successors of A. Bourjois & Cie., also of France, had established in the United States the business in Java face powder in boxes under labels substantially the same as those in controversy. The plaintiff New York corporation, mentioned above, was organized in 1913, and for a consideration involving, *inter alia*, the obligation to pay $400,000, bought the entire business then and theretofore carried on by A. Bourjois & Cie., E. Wertheimer & Cie., successors, in the United States—namely, the entire good will of said business in the United States, and any and all trademarks, trade names and trademark rights relating thereto in the United States, and also the sole and exclusive right to manufacture and sell in the United States any and all toilet preparations then or theretofore made by the French concern. This transfer of trademarks included the transfer of the registered trademark "Java," the top and other labels of the boxes, and all of the trademarks which the plaintiff had subsequently used and registered. Thus, the District Court says, all of these trademarks and labels are, so far as the United States is concerned, exclusively the property of the New York corporation.

Promotion and Development of Market

It appeared that the company in suit has expended substantial sums of money for advertising and has created a wide market in the United States for its products, building up not only an extensive and important business, but also an excellent business reputation for the character of its products, and that it depends in greatest measure upon its trademarks to prevent invasion of its rights.

Plaintiff buys the powder in bulk from the French firm, A. Bourjois & Cie., and then puts up this powder in the boxes containing the trademark inscription. The District Court says, however, that plaintiff may buy its powder from any house, and will obviously do a favorable business in connection with its trademarks, so long as it satisfies the public, which it has done in the past. Two outstanding features of its packages consist of the words "Poudre Java" and "A. Bourjois & Cie."

Defendant Imports the Same Material

The facts further showed that the package sold by the defendant, Anna Katzel, was the genuine box or package of the French firm of A. Bourjois & Cie., and that defendant had bought abroad the products contained in the genuine packages and same were imported into this country.

On the back of plaintiff's box or package are the following words: "Trademarks Reg. U. S. Pat. Off. Made in France—Packed in the U. S. A. By A. Bourjois & Co., Inc., of New York, Succ'rs in the U. S. to A. Bourjois & Cie. and E. Wertheimer & Cie."

As the defendant's box or package is manufactured and sold in France, the words just quoted do not appear upon it. It was urged by defendant that plaintiff's product is a misrepresentation and in the nature of a fraud upon the public, in that it gives the impression that it is manufactured and put up in the original packages in France. But the court found that

the public had full notice of the facts due to the quotation above on plaintiff's packages.

From the above facts the United States District Court regarded the important question in the case to be whether, because defendant's package is a genuine article made and sold by the French concern, it can be said to constitute an infringement of the trademarks of plaintiff, when plaintiff is the exclusive owner of these trademarks in the United States.

The court points out that a trademark has come to be recognized as a property right of immense and incalculable value, and that the proprietor of a trademark by virtue of the manufacture or offering for sale of his goods is entitled to the protection which the highest powers of the court can afford.

In another case the Supreme Court of the United States holds that redress is based upon the party's right to be protected in the good will of the trade or business and the English rule that a trademark is not the subject of property, except in connection with an existing business, prevails in the United States. However, the court has held in Scandinavia Belting Co. vs. Asbestos & Rubber Works (169 C. C. A., 87) that the owner of a registered trademark can restrain its use by another, though no loss of sales is shown and though there may be no fraud between the original seller and buyer of the infringing article.

Judge Mayer's Able Opinion Supported Plaintiff

The District Court found that defendant's trademarks was genuine, in the sense that it was not spurious at the place of origin, and that no change has been made since it was sold; but it says it is genuine as matter of law only if defendant has the right to sell within the territory where plaintiff is the exclusive owner of the trademark, and also where plaintiff has established a business in the product in connection with the trademark.

The court further found that plaintiff has expended a large sum for the acquisition of the trademark title and rights and for the advertisement of its business. Further it had corralled the American market before defendant's boxes were brought into this market. If now, says the court, the original French boxes or packages can lawfully be permitted to compete with plaintiff's boxes and packages, it is seen that plaintiff's business may be destroyed, and in any event impaired.

The question, says the court, is one involving business interests in a large way. If an American business concern buys all the rights of a business established here by a foreign concern, and then the foreign concern is nevertheless at liberty to compete with the American concern, the result will be that the purchase of rights, under such circumstances, will give little or no protection, and the foreign concern as well as the domestic concern will be seriously injured in the long run, because American capital certainly will not be invested, and foreign concerns will find it difficult to sell the rights which they have developed in this country.

Defendent Believed She Was Within Her Rights

The court says in justice to A. Bourjois & Cie. of France that nothing in the record of the court proceedings would justify the conclusion that this competition has been undertaken with their knowledge or consent, and in justice to defendant that she has relied upon what she regarded her legal rights. The question is one of law which calls for definite and prompt settlement.

In support of her position in importing the original article and selling it, the defendant cited the case of Fred Gretsch Manufacturing Co. vs. Schoening et al., 238 Fed., 780. But the trial court in the case at bar shows that case involved a construction of section 27 of the act of Feb. 20, 1905 (Compiled Stat., section 9513). This section was in the nature of a customs regulation, to prevent the American public from being deceived by simulated name. Simulated trademarks were to be excluded from importation, so as to safeguard the American public. Under this law the customs authorities may only exclude an article "of imported merchandise which shall copy or simulate the name of any domestic manufacture. . . ."

Not a Question of Genuineness of the Article

Thus, says the court, if an article is genuine, in the sense of defendant's box, it may be imported into this country and cannot be stopped at the door of the custom house; but whether the article may be marketed here under a particular trademark is a question to be determined in ascertaining the rights of parties, quite irrespective of section 27. Section 27 concerns the action of the government, through its proper officials, in carrying out the safeguarding measures erected by Congress. The case at bar concerns the rights of private parties, and those rights depend wholly upon different rules of law. Therefore, in this case, wherein the original owner of the business and its trademarks had completely parted therewith to a vendee, who had proceeded upon the strength of his ownership to develop an American market, the court was of opinion that plaintiff is entitled to have defendant's product excluded from the American market and so granted an injunction to plaintiff.

Circuit Court of Appeals Reversed the Decree, 2 to 1

Despite this well-reasoned opinion by District Judge Mayer of the Southern District of New York the United States Circuit Court of Appeals has reversed the decree, in an opinion handed down by Judges Ward and Manton, but with Judge Hough dissenting.

Analogy to Hunyadi Janos Case

In this opinion the Court of Appeals assumes that it would be a breach of the French firm's obligations to the New York corporation to sell its face powder in the United States. Its products are imported and sold, however, by defendant herein. The question, as this court saw it, is whether the defendant has not the right to sell this article under the trademark which truly indicates its origin. And it decides that she has this right. It supports this view by the case of Apollinaris Co. vs. Scherer, 27 Fed., 18. Here the proprietor of the Hunyadi Janos spring in Hungary gave to the Apollinaris Co. the exclusive right to sell the water under the trademark "Hunyadi Janos" in the United States. The Apollinaris Co. registered the name and labels as trademarks in the United States Patent Office. Scherer applied to the proprietor, Saxlehner, to sell him the water for importation into the United States, which Saxlehner refused to do because of the granting of such exclusive rights to the Apollinaris Co. Thereafter Scherer purchased the

water from other parties in Germany, imported it into the United States and sold it under the name Hunyadi Janos and with the same label as the Apollinaris Co.'s. Herein the court says the defendant was selling the genuine water, and therefore the trademark is not infringed. There is no exclusive right to the use of a name or symbol or emblematic device except to denote the authenticity of the article with which it has become identified by association. The name has no office except to vouch for the genuineness of the thing which it distinguishes from all counterfeits; and until it is sought to be used as a false token to denote that the product or commodity to which it is applied is the product which it properly authenticates, the law of trademarks cannot be invoked.

Le Page's Glue Also Quoted

The Court of Appeals cited another case, Russian Cement Co. vs. Frauenhar, 66 C. C. A., 500. Here the defendant bought in bulk of third parties glue made and sold by the plaintiff under the trade name of Le Page's Glue and bottled and sold same under that name. The labels on defendant's bottles contained no statement as to whether the glue put up by it was either of a superior or inferior quality, but merely that this glue was manufactured by the plaintiff and bottled by defendants. The complainant urged that this was a fraud upon the public and that defendants should be enjoined from applying the name "Le Page" to a glue, though made by itself, which is inferior to the most expensive brands sold by complainant under that name. The court here said that if the public does get an inferior quality of glue when it purchases that bottled by defendants, it is because the complainant itself has seen fit to sell such glue under the same trade name as it had applied to a superior article. In the absence of an attempted fraud a court of equity will not enjoin a person from affixing to goods sold by him their true name and description. Here the label tells the truth and nothing but the truth, says the court. There is no fraud upon the public, for it gets the genuine, identical thing described by the label; and there is no fraud upon the manufacturer, for its vendees resell its manufacture, to which it has applied its name, coupled with the statement that it (the vendee) is responsible for the manufacture.

Eternelle Violin Strings

In another case the Gretsch Co. had the exclusive agency for the United States of the sale of violin strings made in Germany by Mueller under the name "Eternelle," and with Mueller's approval registered the name as the trademark in the U. S. Patent Office. Schoening purchased such strings in Germany and imported them into the United States. The case arose under section 27 of the trademark act (Comp. Stat., section 9513) as to the importation of merchandise copying or simulating a trademark registered in the U. S. Patent Office. Here the court says, "Assuming that Congress could protect the owner of a registered trademark against the importation by third parties of the genuine article under that trademark, has it done so? We think not. The act prohibits the entry of imported merchandise which shall 'copy or simulate' a trademark registered under it. The obvious purpose is to protect the public and to prevent any one from importing goods identified by their registered trademark which are not genuine. In this case, however, the imported goods were the genuine articles identified by the trademark."

But Trademark Is Not a Patent and Should Only Protect the Public

Returning to the case of Bourjois & Cie. vs. Katzel, the Court of Appeals points out that the analogy between patents and trademarks is not complete. A patent gives a patentee a monopoly to make, sell and use and grant to others the right to make, sell and use the subject patented in the United States for the term of the patent. Hence articles lawfully made, used and sold in foreign countries cannot be sold in this country if they infringe the patent. Trademarks, the court says, are intended to show without any time limit the origin of the goods they mark, so that the owner and the public may both be protected against the sale of one man's goods as the goods of another man. If the goods sold are the genuine goods covered by the trademark, the rights of the owner of the trademark are not infringed.

Judge Hough, Dissenting, Holds Trademark Primarily Protects Business

In his dissenting opinion Judge Hough points out that the proposition "whether a trademark is to be primarily regarded as protecting the trademark owner's business from a species of unfair competition, or protecting the public from imitations," is not yet settled. He thinks the decision in this case leans the wrong way, because it is his opinion that a trademark is primarily a protection to the owner's business.

Continuing, he says that if the primary function of the trademark is to protect this plaintiff's business in his own country, it makes no difference at all that the genuine French article is the thing offered by defendant. That genuine article has become an infringement because the business of dealing in that article within the United States is the plaintiff's business.

Thus there are two federal Circuit Judges holding one way and one federal Circuit Judge and one federal District Judge holding another in this case.

Referred Now to Supreme Court

On a petition for a rehearing the Circuit Court of Appeals denied the petition. This court was asked to certify the question involved to the United States Supreme Court on the ground of its supreme importance in view of the many businesses with their accompanying trademarks of German citizens, bought during the European war by citizens of this country from the Alien Property Custodian. On this occasion the court says it is not doubted that an American citizen may buy the business of a foreigner in the United States, with its accompanying trademarks, and, having done so, may subsequently change the character and quality of the goods at pleasure.

The decisions on one side would open competition in the sale of the trademarked products, a thing usually accorded for the benefit of the public generally; the decision on the other side would tend to create a legal monopoly, a thing abhorrent to the general policy of law. Yet the latter view would tend to greater stabilization of business, in giving certainty to the rights and to the values in marks and names purchased from foreign manufacturers.

Industrial Alcohol for the Chemical Engineer

By James M. Doran

ad, Industrial Alcohol and Chemical Division, Prohibition Unit, Bureau of Internal Revenue

HE chemical engineer or factory superintendent working on a new process or perfecting an old e frequently finds that he needs alcohol for some irpose. It may be that he has been using benzene, her or acetone as a solvent and finds for reasons of onomy, such as minimizing factory losses, obtaining greater degree of purity or a finer appearance of the oduct being manufactured, that alcohol will serve s purpose better than other solvents. It may be that preparing some new organic compound, such as a dye a pharmaceutical, alcohol is necessary in order to oduce and place upon the market the product in commercially paying quantity. Again, the production of me new ethyl ester may open up a new field of profit r the chemical manufacturer.

"How Can I Get Alcohol?"

In all of these contingencies and countless others e question at once arises: "How can I get alcohol? there not a high tax on it and does not the national ohibition act make it difficult to obtain without a lot expense, red tape and endless trouble?" An inquiry made possibly from some associate or business quaintance who uses industrial alcohol and in due urse of time a copy of the internal revenue regulations obtained and read over. It looks formidable; maybe would mean trouble and worry and perhaps not be good business venture. This is not an unusual experice and in this short article an attempt will be made explain in as simple terms as possible the operation the present industrial tax-free alcohol laws as they fect the industrial chemist.

Alcohol, pure or denatured, is the subject of tax laws d governmental regulations in practically every vilized country. The United States in many respects ads other countries in its liberal industrial alcohol ws. Congress has consistently favored and encourged the use of tax-free industrial alcohol through naturation provisions from the first denatured alcohol t of June, 1906, down through the national prohibion act now in effect. Under this last-named act the dustries of the country using denatured alcohol are nply provided for. In so far as the user of denatured cohol is concerned, the present regulations drawn nder the national prohibition act undoubtedly provide r a more liberal encouragement of industry than gulations in effect before the Eighteenth Amendment came operative. It is safe to say that the attitude the officials of the Internal Revenue Bureau who dminister the national prohibition act was never more iendly to industrial alcohol honestly and legitimately ed than at present. So, generally speaking, there no more red tape, burden or trouble imposed upon the er of alcohol in this country than in any other coun-y. The same governmental regulations are in effect ractically everywhere and there is no handicap in that gard peculiar to the United States manufacturer.

Denaturation of alcohol is accomplished generally at e place of manufacture under the supervision of inrnal revenue officers and in addition the denaturants used are of specified quality and in most cases tested by an authorized chemist before use. Broadly speaking, there are two classes of denatured alcohol: completely denatured alcohol and specially denatured alcohol.

Completely Denatured Alcohol

There are six authorized formulas for completely denatured alcohol. The denaturants used are wood alcohol, benzene, pyridine, kerosene, ether, gasoline, nitrobenzene and orthonitrotoluene. In each of these six formulas there are combinations of one or more of the above denaturants that impart odor and taste and, in addition, make a recovery of potable alcohol from the mixture extremely difficult. The six formulas offer a rather wide range of choice and can be purchased without permit or bond. They are useful for many technical solvent purposes where the added denaturants offer no serious chemical or physical objections. The chief uses are: Fuels; anti-freezing solutions; cleaners; certain grades of shellacs, varnishes and paints; and technical purification processes.

The only restrictions on the use of these formulas are that they be not sold or used for beverage purposes or used for purposes for which tax-free denatured alcohol cannot be lawfully employed. For example, the use of tax-free denatured alcohol is prohibited in any medicinal product for subsequent internal use. If the manufacturer desires to recover completely denatured alcohol incident to any purification process he is required to give a bond to the Collector of Internal Revenue of his district and also register any recovery still employed in the process.

The blended motor fuel of the future will undoubtedly be worked out through the medium of a completely denatured alcohol formula.

Specially Denatured Alcohol

There are seventy authorized formulas for specially denatured alcohol. A number of the more recent ones are applicable to the perfumery industry and certain parts of the pharmaceutical manufacturing industry. It is with the more properly called technical formulas that this article deals.

Application and Bond. To obtain one or more of these special formulas the manufacturer must make an application to the Collector of Internal Revenue of his district, the same officer to whom he pays his income tax. This application states the formulas desired, the products or processes in which they are to be employed and the total quantity in wine, or measured, gallons which will be used in a period of 30 days. If the process involves recovery and re-use of the denatured alcohol, a brief description of the apparatus to be employed must accompany the application. A sample of the product manufactured is required in certain instances and the general formula, if it be a mixture, is frequently necessary. This requirement is in effect in order that the Internal Revenue Bureau may be in a position to determine whether the product or process is one in which tax-free denatured alcohol may be used. The regulations also provide that certain formulas may only be used in a restricted manner and the information set forth in the application is necessary in order to determine these points.

The application must be accompanied by a bond, either a personal bond or a surety bond. The minimum bond that may be filed is $500, which will provide for a purchase and use of not to exceed 99 gal. in a 30-day

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period. Increased quantities of alcohol require increased bonds in the same proportion, but the maximum bond that may be filed is $100,000, under which a manufacturer may use practically an unlimited quantity of specially denatured alcohol, subject to the limitations for its use laid down in the application.

The regulations also provide for a locked storeroom in which the specially denatured alcohol is to be kept before use. This provision is only such as would be complied with by any prudent manufacturer in the storing of articles of value.

The Collector of Internal Revenue transmits these papers to the Treasury Department in Washington, where they are acted upon. If approval can be given, under the law and regulations, to the application, the Collector of Internal Revenue is instructed to issue to the manufacturer a permit to use specially denatured alcohol and a withdrawal permit to procure the required quantity in a period of 30 days from any one or more denaturers or bonded dealers in specially denatured alcohol that the manufacturer may designate.

This permit and bond remain in effect until withdrawn or canceled, for cause, and need not be renewed annually. The manufacturer is required to render to the Collector of Internal Revenue a report at the end of each month which will show the amount of denatured alcohol on hand the first of the month, the amount purchased and received during the month, the amount used in manufacturing and the amount remaining on hand at the end of the month. All of these requirements have been made as simple as possible and still enable the department to have knowledge of the movement of tax-free alcohol.

Principal Formulas and Their Uses

An outline of the principal formulas available, and showing a few of their main uses, will be given merely to indicate the scope of the present authorizations.

First, we have the general solvent formulas. They are:

No. 1 — 100 gal. of ethyl alcohol
5 gal. wood alcohol

No. 3A — 100 gal. of ethyl alcohol
5 gal. pure methyl alcohol

(No. 3A differs from No. 1 only in the degree of purity of the methyl alcohol)

No. 10 — 100 gal. ethyl alcohol
2 gal. methyl alcohol
2 gal. benzene

No. 12A — 100 gal. ethyl alcohol
5 gal. benzene

No. 44 — 100 gal. ethyl alcohol
10 gal. normal butyl alcohol

These formulas are widely used in shellacs, varnishes and extraction processes. They have been authorized for over a thousand specific products and it will be necessary to refer to Internal Revenue Regulations No. 61 for the details showing their wide application.

Formula 2B (100 gal. ethyl alcohol and ½ gal. benzene) is widely used as a solvent for nitrocellulose products embracing the manufacture of smokeless powder, artificial silk, artificial ivory and pyroxylin plastics. This formula is restricted as to the uses which will be permitted and this is one of the cases where the manufacturer is required to submit some additional detail as to his process and apparatus.

Formula 13A (100 gal. ethyl alcohol and 10 gal. ether) is used in the manufacture of ether. It also has considerable application as a purifying and recrystallizing medium for certain organic compounds and dyes.

Formula 4 (100 gal. of ethyl alcohol and 1 gal. of a 40 per cent nicotine solution with added coloring matter) is widely used in tobacco products, such as the manufacture of cigars, smoking tobacco, etc.

Formulas No. 5 — 100 gal. ethyl alcohol
65 lb. sulphuric ether
3 lb. cadmium iodide
3 lb. ammonium iodide

No. 11 — 100 gal. ethyl alcohol
100 lb. sulphuric ether
10 lb. cadmium iodide

and No. 19 — 100 gal. ethyl alcohol
100 gal. ethyl ether

are principally used in the photo-engraving industry as carriers or vehicles for sensitized collodion.

Formula No. 18 — 100 gal. ethyl alcohol
100 gal. vinegar containing not less than 9 per cent acetic acid

No. 21 — 100 gal. ethyl alcohol
100 gal. of a solution containing not less than 4½ per cent acetic acid

are used for the manufacture of vinegar, acetates and acetaldehyde.

Formula 20 (100 gal. ethyl alcohol and 5 gal. crude chloroform of a specific gravity not less than 1,400 at 25 deg. C.) is used in the manufacture of chloroform.

Formula 30 (100 gal. ethyl alcohol and 10 gal. of pure methyl alcohol) is used for analytical laboratory purposes.

There are many formulas available for toilet articles and external pharmaceutical preparations, but the reader will have to be referred again to Internal Revenue Regulations No. 61 for the details, as they are too extensive for this article. These formulas are available for the manufacture of lotions and liniments, tincture of iodine, tooth pastes, dentifrices, toilet waters and perfumes. They are of interest chiefly to the pharmaceutical and perfumery industries.

It is not possible to cover the many thousands of authorized uses of denatured alcohol, but a manufacturer who is unable to obtain the information necessary from the Regulations is urged to communicate with the department. New processes are being continually developed that make it desirable for other formulas to be authorized. Data are continually being assembled showing the need of the modification of some of the present formulas.

The Treasury Department is very much interested in obtaining all the information and suggestions possible that will enable it to administer these provisions of the national prohibition act with the greatest possible benefit to industry.

What Is a Chemical Engineer?

At a meeting of the Provisional Committee for the formation of a British Institution of Chemical Engineers the following definition was agreed upon: "The chemical engineer is a professional man experienced in the design, construction and operation of plant in which materials undergo chemical or physical change."

Fundamental Physical and Chemical Properties of Commercial Lime I—The Available Lime Content

The First of a Series of Articles Describing the Experimental Work in the Laboratories of the National Lime Association—Variations in Available Lime Content and Their Significance

By M. L. Holmes and G. J. Fink
Chemical Department, National Lime Association

THE extensive ramification of the uses of lime[1] in our industrial life and the enormous increase during recent years in the use of lime[2] by the chemical industries and in technical processes have served to show the lack and to emphasize the urgent need of comprehensive information about the fundamental physical and chemical properties of this material. Before the most intelligent use can be made of such a chemical as lime we must first know its properties and how it will function.

The National Lime Association undertakes to serve the user of lime in every possible way and in accordance with that policy has under way an extensive investigation in which limes from every section of the country are being studied for the purpose of obtaining, upon one set of samples, comparative data on all of the important characteristics of this material. This work should have an important bearing upon every industrial use of lime.

Although there may be abundant data concerning the chemically pure oxides and hydroxides of calcium and magnesium, there are very little published data on the commercial limes as now found on the market. By the term commercial lime, we refer to the three and one-half million tons of product made yearly in this country by calcining limestone and which is placed on the market without any further processes of chemical purification. That this material may be quite different from corresponding c.p. chemicals is evident from the following definitions as adopted by the American Society for Testing Materials:[3]

"Quicklime is a calcined material, the major part of which is calcium oxide or calcium oxide in natural association with a lesser amount of magnesium oxide capable of slaking with water.

"Hydrated lime is a dry powder made by treating quicklime with enough water to satisfy its chemical affinity under the condition of its hydration. It consists essentially of calcium hydroxide or a mixture of calcium hydroxide and magnesium oxide and magnesium hydroxide."

Commercial limes are further classified by the A.S.T.M. on the basis of the alkaline-earth oxide ratio as calcium and magnesium limes. In common practice calcium lime is one containing 85 per cent or more total CaO and magnesium lime is one containing more than 30 per cent MgO. In case the CaO content is very high, it may be called high-calcium lime and in case the magnesium oxide is considerably more than 10 per cent it may be called high-magnesium lime.

Method of Manufacture

Most of the quicklime produced in this country is made in shaft kilns in which the selected limestone is subjected to the temperature of the decomposition of calcium carbonate for a time sufficient to drive off all the carbon dioxide. Details of the precautions observed in producing a high-grade material of uniform quality may be found in previous publications.[4]

Hydrated lime is now made by mechanical processes which vary somewhat, but all involve the thorough mixing of the quicklime with the predetermined quantity of water required for complete hydration and the maintenance of the most favorable conditions for such hydration. The actual process of hydration is followed by storage and mechanical purification such as air separation or screening. Further details are given in the above-mentioned references.

TABLE I—LOSS ON IGNITION AND AVAILABLE LIME CONTENT OF COMMERCIAL QUICKLIME

N.L.A. Quicklime No.	Per Cent Loss on Ignition	Per Cent Available Lime (Non-Volatile Basis)	N.L.A. Quicklime No.	Per Cent Loss on Ignition	Per Cent Available Lime (Non-Volatile Basis)
2	0 70	94.02	63	0.32	90.15
3	0.95	90.12	64	2.69	95.87
4x	0.75	94.00	65	1.18	48.98
4y	0.82	95.78	66	4.64	77.62
5	0.64	96.44	69	2.65	60.35
6	0.62	95.47	71	0.52	53.73
7	1.27	91.36	72	2.64	86.17
9	0.12	80.54	73	0.56	84.22
10	0.16	89.77	74	0.55	51.77
12	0.55	88.12	75	0.74	59.45
17	0.31	89.91	76	1.00	93.18
18	0.38	86.12	78	0.88	91.30
22	1.09	87.32	79	0.55	90.51
23	1.22	54.91	81	0.71	87.03
25	0.59	81.63	82	0.57	77.44
26	0.70	96.42	85	0.44	88.58
27	0.65	93.19	86	0.64	77.79
28	0.72	93.57	87	0.90	94.00
34	0.53	88.93	89	0.95	92.95
35x	4.32	93.12	92	0.84	55.35
37	0.48	89.73	93	1.17	93.88
37x	0.48	94.69	94	0.72	92.43
38	0.48	96.27	95	1.21	97.53
40	0.68	48.45	96	0.52	93.71
41	0.68	82.43	102	1.97	93.13
42	0.61	82.85	103	0.85	55.35
44	0.66	91.95	105	0.76	80.51
45	0.46	83.88	107	0.72	87.09
46	0.34	90.45	109	0.34	94.87
47	0.44	92.00	111	0.73	66.33
49	0.45	90.45	112	0.36	53.59
51	0.72	92.81	115	0.53	55.64
52	1.78	55.18	117	0.58	54.21
53	11.67	33.42	118	0.87	53.08
57	0.95	88.23	119	0.66	47.56
59x	0.52	95.33	121	0.88	50.24
59y	0.60	92.29	125	0.80	50.15
62	0.50	88.49	127	1.01	88.54

Samples Used in These Investigations and Handling

The samples of lime used in these investigations were obtained from lime plants located in practically all sections of the country and representing all types of lime varying widely in physical properties and ranging in chemical composition from the high-calcium to the high-magnesium type. The samples represent the average quality furnished continuously to the trade by these companies.

The samples were received and stored in airtight tin cans, each being assigned a key number.

The quicklimes were crushed to pass a quarter-mesh sieve and samples for all determinations were obtained by quartering in the usual manner as specified by the

[1] *Chem. & Met. Eng.*, vol. 26, p. 294 (1922).
[2] National Lime Association Lime Brief No. 252.
[3] 1922 Report of Committee C-7 of the American Society of Testing Materials.
[4] *Chemical Age*, vol. 29 p. 227 (1921), "Manufacture of Lime." N.L.A. Lime Brief 250, "Outline of the Process of Lime Manufacture." Bureau of Standards Technologic Paper 16.

TABLE II—LOSS ON IGNITION AND AVAILABLE LIME CONTENT OF COMMERCIAL HYDRATED LIMES

N.L.A. Hydrated Lime No.	Loss on Ignition, Per Cent	Available Lime (Non-Volatile Basis), Per Cent
2a	24.10	85.63
3a	24.06	82.61
5a	24.84	89.44
21a	23.22	82.50
23a	19.18	52.91
25a	21.02	77.75
27a	24.46	91.34
35xa	24.32	90.84
38a	21.66	77.37
39a	23.96	79.06
45a	21.72	68.52
46a	23.98	78.36
47a	24.84	89.47
51a	24.88	82.24
52a	17.74	44.15
58a	23.74	83.71
59a	24.66	90.16
63a	23.84	82.90
65a	18.78	48.59
71a	16.64	51.01
72a	18.80	60.20
73a	24.90	75.65
74a	19.42	49.55
75a	19.60	58.35
78a	23.64	73.11
79a	24.48	87.73
81a	23.76	83.03
86a	24.66	90.29
87a	24.24	80.70
88a	28.00	19.54
93a	23.46	77.57
94a	24.46	80.12
96a	22.86	80.14
98a	16.58	53.06
99a	16.66	51.11
101a	27.28	71.87
103a	17.92	48.25
105a	19.62	49.70
107a	25.42	76.24
120a	15.36	45.95

A.S.T.M. The hydrated limes were quartered directly to obtain a sample of proper size for each determination.

The hydrated lime samples were not made from the particular samples of quicklime used in these tests, but the hydrated lime and quicklime designated by the same key number were obtained from the same plant and are products of the same quarry.

The condition of these samples as tested is indicated by the low loss on ignition as given in Table I of this paper, showing that the samples were in good condition when tested.

The results of these investigations will be reported in a series of articles, of which this, on the available lime content, is the first. The series will include papers on specific gravity, per cent pore space, rate of settling, volume in water, fineness, slaking characteristics, volume, weight and water content of putty, plasticity, sand-carrying capacity, colloidal properties, optical properties, chemical reactivity toward solutions, solids and gases, chemical composition, etc. The interrelationship of these various properties will be pointed out as they are taken up and a final article will summarize all of the data.

TABLE III—CALCIUM LIMES

N.L.A. Lime No.	Available Lime: Quicklime	Available Lime: Hydrate	Difference	Per Cent Difference
2	94.02	85.63	8.39	8.92
3	90.12	82.61	7.51	8.33
5	96.44	89.44	7.00	7.25
25	81.63	77.75	3.88	4.75
27	93.19	91.34	1.85	1.98
35x	93.12	90.84	2.28	2.45
38	96.27	77.37	18.90	19.63
45	83.88	68.52	15.36	18.31
46	90.45	78.36	12.09	13.36
47	92.00	89.47	2.53	2.75
51	92.81	82.24	10.57	11.38
59x	95.33	90.16	5.17	5.42
63	90.15	82.90	7.25	8.04
72	86.17	60.20	25.97	30.14
73	84.22	75.65	8.57	10.17
78	91.30	73.11	18.19	19.92
79	90.51	87.73	2.78	3.07
81	87.03	83.03	4.00	4.59
86	77.79	90.29	−12.50	−16.07
87	94.00	80.70	13.30	14.15
93	93.88	77.57	16.31	17.37
94	92.43	80.12	12.31	13.31
96	93.71	80.14	13.57	14.48
107	87.09	76.24	10.85	12.45
Average	90.31	81.31	9.01	9.84

I. The Available Lime Content

During recent years it has become more and more the practice to base specifications for lime for certain uses upon the available lime content, although there seems to have been very little information bearing directly upon this property of commercial lime. This investigation was undertaken to supply this much-needed information, having in mind particularly the relative amounts of available lime in quicklime and hydrated lime on the one hand and calcium and magnesium limes on the other hand.

By the term available lime is meant that portion of the total oxide content of the lime, either quicklime or hydrated lime, calculated as CaO, which is easily soluble in water and is thus available as a source of hydroxyl ions. All figures for available lime are expressed in terms of percentage of the non-volatile portion.

After considering the various methods which have been proposed for determining available lime, it was decided to use the Bureau of Standards modification of the Scaife method,[6] recently adopted by the American Society for Testing Materials, which is quoted as follows:

"Place 1.4 grams of the carefully prepared and finely ground (passing 100 mesh) lime in a 400-c.c. beaker, and 200 c.c. of hot water, cover, heat carefully and then boil for 3 minutes.

TABLE IV—MAGNESIUM LIMES

N.L.A. Lime No.	Available Lime: Quicklime	Available Lime: Hydrate	Difference	Per Cent Difference
23	54.91	52.91	2.00	3.64
52	55.18	44.15	11.03	19.98
65	48.98	48.59	0.39	0.80
71	53.73	51.01	2.72	5.62
74	51.77	49.55	2.22	4.28
75	59.45	58.35	1.10	1.85
103	55.35	48.25	7.10	12.79
Average	54.19	50.40	3.79	6.99

"Cool, wash down cover, add two drops of phenolpthalein and titrate with *N* hydrochloric acid, adding the acid dropwise as rapidly as possible and stirring vigorously to avoid local excess of acid. When the pink color disappears in streaks, retard the rate of addition of acid somewhat, but continue until the pink color disappears entirely and does not reappear for 1 or 2 seconds. Note the reading and ignore the return of color.

"Repeat the experiment, substituting for the 400-c.c. beaker a 1-liter graduated flask carrying a one-hole stopper fitted with a short glass tube drawn out to a point. Cool and add dropwise and with vigorous stirring 5 c.c. less acid than before. Call the number of c.c. used *A*. Grind up any small lumps with a glass rod flattened at one end, dilute to the mark with freshly boiled distilled water, close the flask with a solid stopper, mix thorougly for 4 or 5 minutes and let settle for half an hour.

"Pipette a 200-c.c. portion, add phenolphthalein, and titrate slowly with 0.5 *N* hydrochloric acid until the solution remains colorless on standing 1 minute. Call this additional number of c.c. *B*. Then the percentage of available CaO equals $2A + 5B$."

The available lime data tabulated in Tables II, III

[6] *Chem. & Met. Eng.*, vol. 25, p. 740 (1921).

and IV are recalculated to the non-volatile basis, by application of the following formula:

$$\text{Percentage available lime on non-volatile basis} = \frac{\text{Percentage available lime in samples as used}}{100 - \text{loss on ignition}}$$

The figures therefore represent the percentage of the non-volatile portion of the sample, which is water-soluble under the conditions as described.

In Table I are given the data obtained on commercial quicklimes and in Table II the corresponding data for hydrated limes. In Table III is given the available lime content of typical calcium quicklimes in their corresponding hydrates, and in Table IV similar data are given for typical magnesium limes.

Discussion and Conclusions

The data in Table I show that there is a large variation in the available lime content of commercial quicklimes and that in a few special instances it is possible to obtain at the plant where made a lime running as high in available lime as 96 per cent of the non-volatile portion.

The data in Table II show a variation for hydrated limes similar to that in Table I with certain hydrates running somewhat higher than 90 per cent.

It is evident from the data in Tables III and IV that calcium limes have a much higher available lime content than magnesium limes and on the other hand that the reduction in available lime content by the hydration of magnesium limes is less than that of calcium limes.

It is also evident from the averages in Tables III and IV that the tendency for the quicklimes, both calcium and magnesium, is to have a higher available lime content than the corresponding hydrates as determined by the A.S.T.M. method. This difference is not large and is insufficient to outweigh the obvious advantages of hydrate for certain purposes. It is, however, consistent enough to warrant the conclusion that certain conditions obtain in modern mechanical processes of hydration which tend to reduce the available lime content. The data for several of the samples, on the other hand, show that it is possible to hydrate so as greatly to minimize this tendency.

There are several causes which may possibly contribute to a reduction in the available lime content during the process of mechanical hydration and mechanical treatment. These causes may be chemical or they may be physical. It has been suggested that it may be a case of molecular aggregation whereby a portion of the lime is rendered physically unavailable, or it may be a case of molecular transformation by local burning during hydration which might change some of the lime into a less soluble form. The state of moisture and local temperatures in the hydrator may also be conducive to certain chemical reactions between the constituents in the lime which would produce a small percentage of an insoluble product. Further work to be reported later will add more information on this subject.

Protection of Aluminum

Much work has been done in recent months by the corrosion committee of the British Institute of Metals on the preparation and testing of protective coatings of molybdenum compounds and aluminum hydroxide for use in aluminum and light alloys. This work is still in progress, and will eventually be published.

Etching to Develop Overstrain

An etching process originated by A. Fry, of Krupp's research laboratory, Essen, Germany, develops new markings in overstrained steel bearing close relations to lines of maximum shear as determined mathematically.[1] Fig. 1 gives the appearance at natural size of a piece of boiler plate, bent flat upon itself cold.

Specimens are prepared for microscopic or macroscopic examination in the usual manner, care being taken particularly to avoid any distortion of the specimen during grinding and polishing. Before examination they must be "suitably" reheated, ½ hour at 200 deg. C. being suggested.

For microscopic investigation the etching medium is prepared as follows: Concentrated HCl 400 c.c., H_2O 30 c.c., ethyl alcohol 25 c.c., cupric chloride crystals 5 grams. The carefully polished specimen is etched briefly and if necessary repolished and re-etched until the desired results are obtained. The etching medium

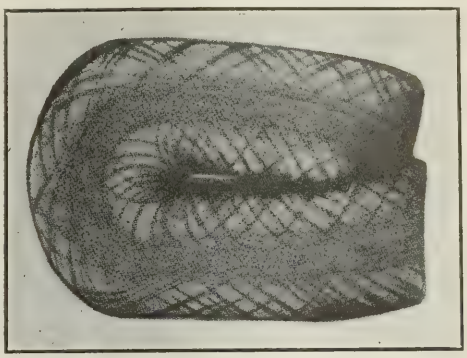


FIG. 1—PIECE OF BOILER PLATE, BENT FLAT UPON ITSELF COLD

for macroscopic investigations consists of concentrated HCl 120 c.c., H_2O 100 c.c., cupric chloride crystals, 90 g.

The specimen is immersed in this solution for from 1 to 3 minutes, then removed and rubbed with finely pulverized cupric chloride on a rag moistened with the etching medium until the desired contrast is maintained. The specimen is then dried without rinsing, washed with ethyl alcohol and then thoroughly dried.

Both solutions are too strongly acid to deposit copper upon the iron. The etched pattern should consist of dark and light bands, the dark color being ascribed by Fry to the formation of iron hydride. These bands correspond to the location of maximum shearing stresses in the material and by their presence indicate how much of the material has received cold-work—that is, has been plastically deformed.

List of Petroleum Laboratories Being Compiled

A list of commercial laboratories specializing in the analysis of petroleum products is being compiled by the United States Bureau of Mines. Laboratories are being asked to indicate the particular tests outlined in Technical Paper 298, "Methods of Testing Petroleum Products," which they are prepared to perform. Inquiry is being made especially as to whether laboratories are equipped (1) to make analyses of natural gas, especially the determination of gasoline content, (2) to examine crude oils, oil shales and oil sands, and (3) to undertake petroleum problems of a research nature.

[1] *Stahl und Eisen*, 1921, p. 1093. See also "Forging and Heat-Treating," 1922, p. 99.

Pouring Sound Ingots of Fine Steel*

Americans Teem Cool Steel in Bottom-Cast Ingots—Surface Cracks Controlled by Shape and Condition of Mold—Pipe Reduced by Retaining Hot Metal in Ingot Top and Slow Cooling—Ingot Should Be Stripped Fairly Early and Buried in Ashes

ON PAGE 929 of *Chemical & Metallurgical Engineering* for May 17, 1922, was presented an article on "Fine Steels From the Acid Open Hearth," wherein was explained in detail the method of making fine nickel steel and getting it into the ladle at the proper temperature. The present article is a continuation of the subject matter, and deals with the proper procedure to convert the liquid steel into sound ingots.

American practice is to pour large ingots of nickel steel with fairly cool metal, avoiding surface cracks at the risk of retaining inclusions in the metal. Europeans purposely pour very hot, holding that the advantages accruing to the method counteract the surface cracks which form; cracks which can be chipped out and which are regarded by the workmen as signs of a quality ingot.

Surface Cracks

Hot metal entering a cold mold is chilled and a crust rapidly solidifies, thicker at the bottom. As this crust cools it contracts; as the mold heats it in turn expands; the solidifying ingot therefore loosens in the mold and loses its outside support. If the steel is poured so rapidly or so hot that the crust grows more slowly than necessary to resist the interior pressure of liquid metal, it will burst. To avoid this, American metallurgists pour "cold" and slow. Surface cracks are also affected by the condition and shape of the molds, as will be shown later.

However, if pouring is too slow, the top edges of the steel may crust over, and this crust may be folded back against the mold as the level rises; it either remains unmelted or is remelted; if the former, it forms a scab which must be cut out; if melted, it puts oxidized iron into the ingot. Spittings and splashings from the ladle stream striking and sticking to the mold are sources of similar defects in top-poured ingots.

Cold pouring, on the other hand, certainly retains in the ingot any inclusions which the steel possessed on being tapped from the furnace or picked up subsequently from its containers. Large ingots which will not surface crack must be poured in the mushy stage (where the metal consists of low-carbon austenite crystals growing from a higher carbon mother liquor), a state which does not permit many lighter solids to rise to the surface. An obvious corrective is to make clean steel and handle in clean containers.

Hot-poured metal solidifies slowly and causes columnar crystallization in the outer layers of steel, a condition known as "scorched," and to Europeans not especially disliked, except that such an ingot is quite tender under forging.

If a prism of metal could be cooled so that the temperature was the same, surface to axis, it would solidify into a denser mass, without internal cavities. But ingots freeze from the outside in, and from the bottom up. Consequently the interior may be still molten when the shell is relatively cold and fairly rigid. As the whole mass continues to cool, the outer zones also cool and contract, but their contraction is not as great as demanded by the contraction to be endured by the hotter inner zones. What results is a mass of compressed metal toward the surface, gradually changing through a zone practically unstrained into a mass of interior metal strained in tension. If at any time—even long after the entire mass has solidified—the inner material is stretched beyond its resisting ability, a cavity opens up, immediately closed by (in fact anticipated by) hotter metal sagging into place if the temperature is high enough to allow viscous or plastic flow under the force of gravity. Otherwise a permanent cavity or pipe remains. Evidently it is necessary to feed the interior portions of the ingot with hotter metal to the very last if the pipe is to be restrained. Other things being equal, this is better done in big ingots than in small.

Hot Tops

Various well-known devices are used to keep the top of a solidifying ingot hot. Among these are "hot-tops" to the molds; sinkheads; placing the large end of the ingots uppermost; pouring slowly at a low temperature and at the top of the ingot (especially at the last); and making the mold walls thicker below than above so that they may cool the bottom of the ingot faster than the top. Fig. 1 gives details of this practice. Lagging the upper part of the mold with insulating material also helps retain the necessary heat at this region.

Sink-heads of sand are likely to be the source of many inclusions if the ingot is top cast. Tops kept hot by coke or charcoal fires will be carburized and this extra carbon is likely to be carried down to considerable depths by diffusion or feeding.

Eventually from 20 to 30 per cent of the steel will be discarded from the top, as being fundamentally unsound from pipe, or containing segregated impurities (sulphur and phosphorus). The lower figure is sufficient for well-made thoroughly deoxidized clean steels properly cast with hot tops.

Since steel cools more rapidly in the mold than in the ladle, slow top pouring *shortens* the pipe by furnishing liquid metal to the top long after the metal in the base has chilled. For the same reason, cold pouring *raises* the pipe. Suppose the extreme case where metal would solidify almost immediately on entering the mold. This approximates the condition of uniform cooling, and tendency to pipe is eliminated because there is small difference in temperature, sides to axis, and consequently small difference in the internal stresses.

Molds should taper just enough so that the ingots can be stripped easily when the faces are at about 85

*A digest of a paper entitled "Acid Open-Hearth Process for Manufacture of Gun Steels and Fine Steels," presented by W. P. Barba and Henry M. Howe before the February meeting of the American Institute of Mining and Metallurgical Engineers.

eg. C. (1,560 deg. F.) and the corners black. Any xcess taper causes difficulties when attempting to reeat an ingot uniformly, and usually involves extra ork in forging. Simultaneous contraction of the cooling ingot and expansion of the heating mold might be xpected to leave a gap between the two, even with no aper. But much of the contraction is counteracted by he internal ferrostatic pressure. Furthermore, the old is not truly smooth, even though it is carefully repared, coated with a graphite wash and polished. Diminishing the diameter $\frac{1}{16}$ in. to the running foot is ood practice, for both large and small ingots. The xtra contraction in a large ingot (resulting from its igher average temperature when the outer layer is omewhat rigid) would lead one to expect that it could e poured in a mold with a somewhat slighter taper. ut this extra contraction seems to be restrained by xtra internal resistance.

If a round gutter pipe is filled with water and frozen t will burst. If a fluted gutter pipe is treated similarly. he curved sides buckle a little and do not burst. For imilar reasons, ingots are fluted to prevent longitudinal urface cracks.

Transverse cracks are often caused by the top of the ngot being hung from the mold by a fin or by some oughness before the sides are cold and strong enough o bear the weight of the metal below. Conditions are ggravated, of course, if the metal is seized and held ast at both ends. Slightly protruding corners on the ngot are of advantage in counteracting these cracks, ince they cool more rapidly and quickly form solid pilars to support the weaker portions.

A fluted octagon seems to be the best cross-section. t possesses eight protruding corners, protruding nough to cool somewhat quicker than the faces, and yet ot enough to fold over when being forged or to be urned during reheating. To avoid this last contingency a square ingot must have rounded corners, but ven so, there is a pronounced tendency to develop diagonal planes of weakness corresponding to the junction of columnar crystals growing in from adjacent sides, a tendency which is counteracted in part by thinning the mold, as shown in Fig. 2. Square ingots designed for rolling are shaped in this fashion to facilitate blooming and manipulation; forging ingots are frequently made with convex sides.

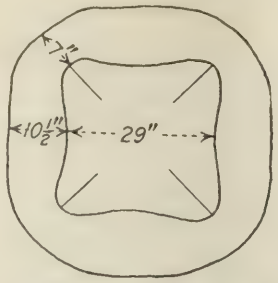


FIG. 2—ROUNDING AND THINNING THE EDGE OF A SQUARE MOLD

The ratio of length to thickness for ingots of tender alloy and high-carbon steels is approximately as follows:

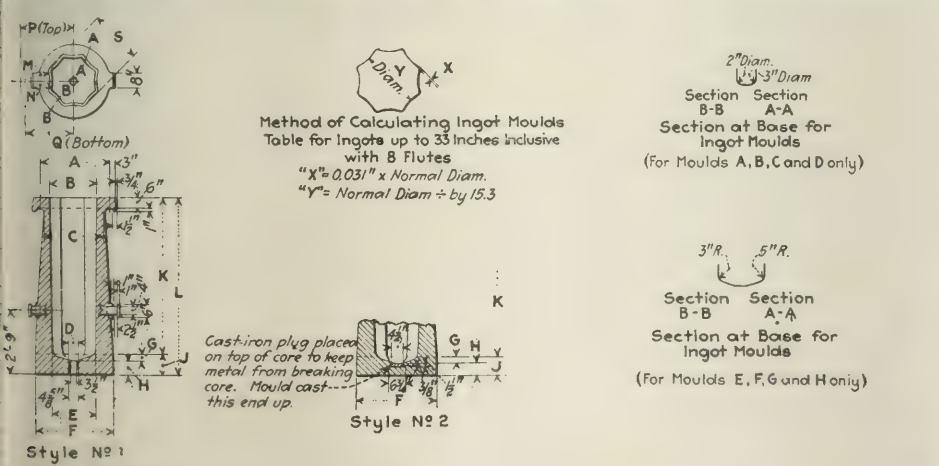
Size	Length ÷ Diameter	Size	Length ÷ Diameter
4 in.	Up to 9	40 in.	Not more than 2½
18 in.	3.5 to 5	60 in.	Not more than 1¾

If the 40- and 60-in. ingots are intended for shafts, the length may be increased somewhat beyond these ratios, because inclusions are not so harmful in shafting as in guns.

Top Versus Bottom Pouring

Though bottom pouring requires more apparatus, more equipment and more time for setting up than is usual for top pouring, it has the greatest outstanding advantage that each individual ingot can be watched during its making, and the speed of the incoming stream of metal adjusted in exact conformity with the requirements of the temperature and composition of the metal and the size and shape of the mold. These and all the other factors governing the production of a successful ingot are found to be under much more thorough observation and control in bottom pouring than has as yet been possible in top pouring, except when pouring from a lip or teeming through a head box.

The disadvantages attending bottom pouring, noted above, together with the prohibitive proportion of scrap metal from runners, cause small crucible-steel ingots to be top poured; larger ingots of fine steel from 9 to 55 in. in diameter and weighing up to 150,000 lb. are bottom poured, often in groups from a central gate, thus giving great uniformity among small ingots of a given lot. Still larger ingots, especially when very high and requiring more than one ladle of metal, are half or one-third bottom poured, and the upper part teemed from above. In the latter case, the pool already formed prevents splashing and scouring against the bottom of the mold, a great drawback to top pouring any but the shortest ingots. Furthermore, the surface of large or wide ingots may be observed even when top pouring, and its indications are not so much disturbed by the impact


P (Top)
Q (Bottom)
Style No 1
Diam.
Method of Calculating Ingot Moulds
Table for Ingots up to 33 Inches Inclusive
with 8 Flutes
"X" = 0.031" x Normal Diam.
"Y" = Normal Diam ÷ by 15.3
Cast-iron plug placed on top of core to keep metal from breaking core. Mould cast this end up.
Style No 2
2" Diam.
3" Diam
Section B-B
Section A-A
Section at Base for Ingot Moulds
(For Moulds A, B, C and D only)
3" R.
5" R.
Section B-B
Section A-A
Section at Base for Ingot Moulds
(For Moulds E, F, G and H only)

MARK	NOMINAL SIZE OF INGOT	MOULD DIMENSIONS A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S TOP	S BASE	AREA OF MOULD SECTION TOP	AREA OF MOULD SECTION BOTTOM	AREA OF MOULD WALL TOP	AREA OF MOULD WALL BOTTOM	MEAN WT. OF INGOT PER INCH OF LENGTH	MAX LENGTH OF USEABLE BODY OF COLD INGOT
A	10"	22"	10½"	18"	4"	9⅛"	22"	2"	7"	9"	72"	8⅛"	6"	4¾"	11¼"	9½"	5"	11 15/16"	10⅛"	955 Sq.In.	785 Sq.In.	1605 Sq.In.	302 Sq.In.	24 lbs.	68"
B	13"	25"	13½"	21"	4"	12⅝"	25"	2"	7"	9"	72"	8⅛"	7¾"	6⅝"	14⅝"	12⅝"	7"	15 7/16"	14 1/4"	160 "	137 "	186 "	353 "	40 "	68"
C	14"	26"	14½"	22"	4"	13⅛"	26"	2"	7"	9"	72"	8⅛"	8¼"	7¼"	15⅝"	14⅝"	7⅞"	16⅛"	15 5/8"	188 "	160 "	200 "	370 "	47 "	68"
D	16"	28"	16½"	24"	5"	15½"	28"	2"	7"	9"	72"	8⅛"	9¼"	8⅛"	17¾"	16¼"	1"	18¾"	17 11/16"	236 "	210 "	216 "	405 "	60 "	68"
E	18"	31"	19"	27"	5"	18"	31"	2"	7"	9"	72"	8⅛"	10"	9⅜"	21⅜"	18⅜"	1⅛"	21 3/4"	20 1/16"	315 "	282 "	257 "	472 "	83 "	68"
F	20"	35"	20½"	31"	5"	19½"	34"	2"	7"	9"	72"	8⅛"	11¼"	9¾"	24½"	19½"	1⅛"	23 1/4"	22 1/4"	366 "	333 "	388 "	575 "	96 "	68"
G	23"	38"	23½"	33½"	5"	22½"	40"	2½"	7"	9½"	74"	8⅜"	11¾"	11¼"	23⅜"	22⅛"	1 1/16"	26 1/16"	25 3/4"	483 "	443 "	398 "	813 "	130 "	68"
H	30"	48"	31"	41½"	7"	29"	48"	3½"	7"	10½"	78"	8⅜"	15"	13⅝"	32½"	29"	2"	35 1/16"	33 1/16"	834 "	735 "	518 "	1074 "	218 "	72"

FIG. 1—DIMENSIONS OF MOLDS THICKENED AT BASE AND THINNED AT TOP

of the metal. Lastly, the top of a slender ingot of any weight or of a mold having brick-lined sink-heads should be filled from above, because this puts hot metal directly where it is needed (to reduce pipe) with the minimum disturbance to the cooler underlying metal. In fact the churning of the axial regions of a bottom-poured ingot hemmed in by the already solidified walls leaves behind an inverted cone of mushy metal up the axis of an ingot of practically uniform temperature. An entire lack of temperature gradient bottom to top would produce a deep pipe because the fissured lower metal is not overlain by hotter, more plastic metal which can sag into the cavity. Fortunately temperature uniformity does not persist long after pouring has ceased in large ingots, on account of the much slower solidification of the upper part of the inverted cone of fluid metal.

If the requisite degree of care is given to the selection of the brickmaker, the material from which the bricks are made, the nature and the burning of the bricks, and the care with which they are fitted together into gates and runners and the joints protected, it will be found that there is only a negligible amount of inclusions due to fluxing of the inner surface of the bricks by the stream of metal entering the molds.

Very high molds are sometimes spoiled by "run outs." In every case great care must be taken to insure that the passageways are stout enough not to be burst by the internal pressure. During the top pouring of the last portions of very high ingots, however, the runners used at the start freeze and effectually prevent leakage from the mold.

Precautions During Pouring

Metal near the ladle stopper is chilled and often contains inclusions. Therefore about 400 lb. of steel is first teemed to scrap, the stopper carefully closed, the ladle centered over the regular mold, and teeming started as soon as possible. The top hole, stopper plug and lining of the ladle bottom should be as refractory to the scour of rushing metal as possible, for fluxing of these parts is a fruitful source of non-metallic inclusions in fine steel.

The interval between tapping and teeming and the rapidity of teeming are governed by the melter's judgment as to the temperature at which the steel left the furnace, and by the size and number of ingots into which the charge in the ladle is to be poured. The length of time occupied in teeming each ingot should be recorded carefully for the melter's guidance in future cases. If today's ingots show external cracks and are tender to forge, he will infer that he should pour a little cooler. If on the other hand, laps, scabs and cold shuts show, especially at the corners, the ingot was poured a little too cool. Another source of information is the condition of the ladle after pouring. A slight skull should remain after cold pouring, representing material too pasty—too near the solidus—to flow to the nozzle. Rate of pouring and temperatures are therefore regulated by the melter's judgment, skill and experience with former ingots and heats.

The above indications are derived from conditions existing after the job is done, and any trouble can be corrected only in future casts. The most important evidence *during* the casting is the appearance of the top of the metal in the mold. It is a common saying that the appearance of bottom-poured steel as it rises in the mold should be that of "breaking cream." This is readily understood when we remember that the meta poured at the proper temperature is an emulsion muc like that of the suspended butter fat of thick crean Both are subject to crusting over with a very thi crust. In steel, this crust, caused by the cooling effec of the air in the neighborhood of the mold, is quickl remelted by the hot steel rising from below if the pour ing temperature is proper.

If cold pouring is stopped, even for a very short time a defect known as a "stop pour" forms where the uppe surface slightly freezes, oxidizes and is not remelted This defect extends into the metal an unknown depth Stop pours are fit cause for rejection in gun steels and in other fine steels the ingot should be sheared a the defect. Slight stop pours may not be detectable i the ingot, and are often glossed over in rolling, showing up only when machining starts. Forging is more likely to make them evident.

Stripping, Cooling and Reheating

As soon as the solid walls have grown thick an strong enough to support the interior fluid safely, th molds are stripped. Removal of this "chill" causes th surface to cool at a slower rate, the temperature gra dient, surface to axis, becomes less and the pipe-forming tendency is therefore reduced. Liability to interna and external cracks is also decreased. Further retarda tion in cooling may be had by burial in ashes or bitu minous coal; still slower cooling in soaking pits passes to another danger—viz., growth of very large primary crystals. Top-poured ingots may advantageously be stripped somewhat earlier than bottom-poured, and permitted to cool in the air until the solidification of the wall has progressed to such a point that the outer surfaces are under a fairly high stress. They should then be buried. Such practice safely expedites the cooling.

Reheating of ingots and blooms of fine steel should be done extremely slowly, so that differential expansion caused by one zone or region being hotter than its neighbors may not strain the metal beyond its strength and cause internal cracks.

Summary

After the metal has been properly made and thoroughly degasified, it is poured relatively cold in order to restrain segregation, columnar and coarse crystallization. Piping is reduced by inverted ingots, and by rapid pouring at the end.

External cracking, occurring when the surface regions are just solidifying, or later when passing through the "blue heat" (especially in coarse-grained steel), may be guarded against (*a*) by tapering the mold so the ingot will free itself and not hang and (*b*) by fluting the mold.

"Internal cracks including flakes must be restrained:

(*a*) "By interrupting the relatively rapid cooling in the mold and replacing it with slower cooling in ashes as soon as the ingot has solidified sufficiently to be moved without danger of cracking.

(*b*) "By saddening (giving a succession of light reductions under the hammer or press, or in a rolling mill) and thereby substituting strong cohesion and toughness for its initial fragility due to its having a very coarse crystalline sugar-like structure.

(*c*) "By retarding the heating of the ingot for forging and that of the forgings themselves, so as to lessen the thermal stresses.

(*d*) "By as great freedom from inclusions as possible."

The Technology of the Carbon-Electrode Industry—VI Cleaning, Testing, Machining and Shipping

In Concluding This Series of Articles the Author Reviews the Finishing Steps in Electrode Manufacture and Discusses the Properties and Other Factors Affecting Requirements for Use in Electrolytic and Electrothermic Applications—Economics of the Industry and the Trend of Developments

By Charles L. Mantell
Division of Industrial Chemical Engineering, Pratt Institute, Brooklyn, N. Y.

IN THE articles which have preceded this one the discussion of carbon-electrode manufacture has been carried through the baking process.* The green electrodes, which are made of a combination of carbonaceous materials, the properties and qualities of which vary widely with temperature changes and which have a high electrical resistance and a low tensile strength, have now been changed into baked electrodes, consisting of material with uniform properties over a wide temperature range and with lower electrical resistance and higher tensile strength than the green electrode.

The electrodes as they come from the baking furnaces are dirty—that is, they have adhering to their surfaces some of the packing material in which they were baked. In the case of carbons with which a correctly graded packing material was used, most of the packing dust can be easily removed by knocking or brushing. Sometimes, however, cases of carelessness occur when use has been made of a low fusing packing dust, high in ash content. As a result, large lumps of packing material are attached to the surfaces of the carbons and are removed only with difficulty. At other times sufficient care may not have been taken in placing packing between all of the surfaces of the carbons when loading the furnace. The result is that when the carbons are softened in the early stages of baking, they become welded together and when baked in this manner give malformed electrodes. These, of course, go to the scrap pile.

The Methods of Cleaning

Methods of cleaning differ according to the shape of the finished electrode. They may be divided into three general methods—(1) brushing, (2) stoning and (3) tumbling. Although the method used depends primarily upon the shape or form of the finished electrode the amount of packing material to be removed must be adjudged a factor of secondary importance. Plates, of course, could not be tumbled in a tumbling barrel without an excessive breakage loss. The same holds true for long, small-diameter electrodes. Electrodes with square or rectangular cross-section cannot be tumbled, as their edges would be rounded off as a result of the process.

Usually two or all three methods are employed in conjunction with one another. Carbons as they come from the furnace are sent to some sort of power-driven brush with steel wire bristles. Plates can be cleaned quickly with a pair of brushes somewhat wider than the width of the largest plate, mounted horizontally and rotating in opposite directions. The plates are cleaned by passing them between the brushes. Square and rectangular shapes are often brushed on a similar type of machine, but in which the brushes are mounted vertically and the carbon passed through twice, or through two successive machines, being given a quarter turn in the plane of its cross-section between the first and second brushings so that all sides may be cleaned. Round electrodes are often cleaned on the periphery of horizontal or vertical wheels, and in some cases by steel brushes mounted on the inside of revolving rings.

Carbons which cannot be completely cleaned on the brushes are finished on the stoning wheels. These are large wide-faced wheels of emery or other similar abrasive material. Small round electrodes whose length does not exceed more than six times their diameter can be very successfully and readily cleaned by tumbling in steel tumbling barrels loaded about seven-eighths full. Cast-iron, star-shaped jacks (about $\frac{3}{4}$ to 1 in. size) are used to assist in the cleansing operation. The tumblers are horizontal steel cylinders with removable covers, for loading and unloading, mounted on hollow shafts connected to each end. One end is open to the air through the hollow shaft, and the other is connected to piping leading to the exhauster of a dust-collecting system which discharges into some sort of collector, often of the cyclone type. Electrodes which have not been sufficiently cleaned by tumbling go to the brushes and stones for final cleaning.

Cleaning practice in the various electrode plants differs materially even when the same type and size of product are being handled. In the case of small electrodes it was formerly the practice to brush all electrodes, and tumbling barrels were used to clean only those which were too dirty for the brushes. In some modern plants, as a result of scientific management, this procedure has now been completely reversed and considerable saving effected. All electrodes are tumbled for a short while and only those still unclean after this procedure are brushed and stoned. Records of this method with small round electrodes show that all but a small percentage are cleaned without brushing.

It is general practice to equip all cleaning apparatus with suction hoods, connected to a dust collector. This is done with the view of supplying better working conditions, and also to recover as much as possible of the packing material removed from the carbons.

Mention has been made in a previous article[23] of the

*For Parts I to V, see *Chem. & Met. Eng.*, vol. 27, Nos. 3, 4, 5, 6 and 7, pp. 109, 161, 205, 258 and 312.

[23]See Part V, *Chem. & Met. Eng.*, vol. 27, No. 7, p. 312, Aug. 16, 1922.

resistivity of the carbon electrode. Its discussion, however, has been delayed to this point, since its determination is usually made in the plant testing laboratory, which is generally located in or near the cleaning and shipping departments. In general two methods of testing are used:

1. Measurement is made of the voltage drop, with a given current, through a known distance of an electrode having a uniform cross-section. Direct current is passed through the whole electrode. Resistivity or specific electrical resistance is then obtained by the use of Ohm's law and the formula for specific, calculated from total resistance. The formula[24] $\rho = SE \div lI$ gives a result in ohms per inch cube when S and l are expressed in square and linear inches respectively, or per centimeter cube when S and l are expressed in square and linear centimeters.

For ordinary purposes it is sufficient to measure resistance to 0.0001 ohm, a precision of about 5 per cent. By this method the voltmeter will show a voltage drop due to resistance through the whole potential circuit—that is, it will include voltage drop due to resistance of the potential contacts and the lead wires. The resistance of the potential contacts may be practically eliminated by drilling small mercury cups in the carbon or pressing the contact pins against the carbon at a pressure of about 3,000 lb. to the square inch when using a millivoltmeter having a resistance of 1.07 ohms.

2. Measurement is made directly of the resistance of an electrode or a portion of an electrode by comparing it with a standardized resistance by means of a resistance bridge. This method is more accurate than the first, because it is a zero method and comparison is made directly with a standardized resistance the accuracy of which can be made very high. The instrument generally used is the Leeds & Northrup Kelvin double bridge ohmmeter.

Resistivity is calculated from the formula $\rho = (S \div l)R$, where ρ = resistivity, l = length, S = cross-section, R = scale reading of resistance.

Where measurement is made of the circumference in the case of round electrodes, this formula becomes $\rho = \text{cir } R \div 12.57\,l$.

[24] ρ = specific resistance, S = cross-section, E = voltage drop, I = current in amperes and l = length or distance.

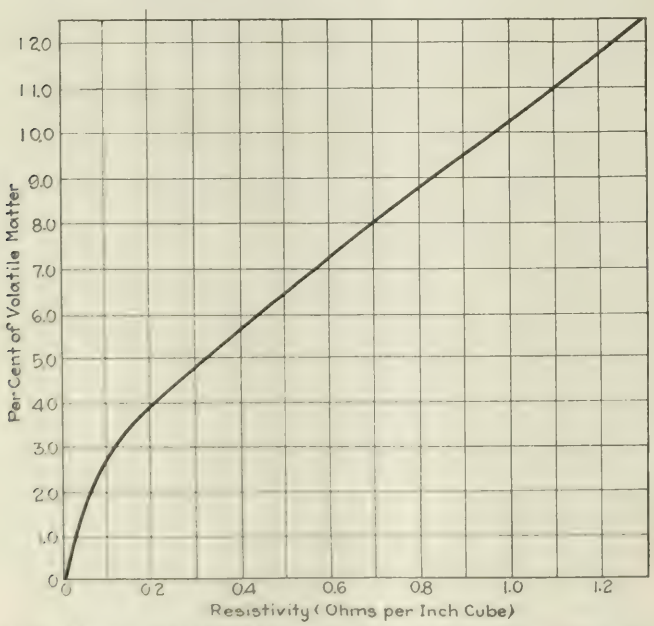


FIG. 36—RESISTIVITY-VOLATILE MATTER RELATION OF CARBON ELECTRODES

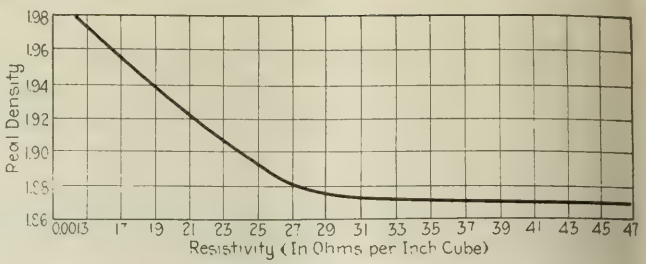


FIG. 37—RESISTIVITY-REAL DENSITY CURVE FOR CARBON ELECTRODES

In plants where large numbers of the same sized electrodes are being made and tested, it is usual practice to provide permanent potential and current contacts. Potential contacts are often V-shaped, made of copper, brass or steel, with knife edges on the inside of the V. While making the measurement, the electrode is supported in a horizontal position by the knife edges. The pressure of the weight of the electrode against the knife edges of the V is sufficient to afford good contact. Current contacts are often copper, brass or steel plates in which there are imbedded short cylindrical rods, pointed at the ends. The points of the rods are pressed against and into the ends of the electrode by pressure exerted against the plates in which the rods are imbedded.

Factors Affecting Resistivity

The electrical resistivity of carbon electrodes varies inversely as the elemental carbon content, directly with the ash content, directly with the percentage of volatile matter and inversely as the apparent and real densities. As the percentage of elemental carbon increases, the percentage of ash and volatile matter will decrease and the resistivity will decrease. As the percentage of ash increases, there will be more and more of materials whose known resistances are greater than that of carbon, and the resistivity of the material as a whole will increase.

The curve in Fig. 36 shows the resistivity-volatile matter relation of carbon electrodes. The relation between real density of electrodes to resistivity is shown in Fig. 37.

Resistivity increases with decreases in apparent density; and as a result, increases with increases of porosity. As the percentage of graphite in electrodes increases, the resistivity will decrease, since graphite has a resistivity of about one-fourth that of amorphous carbon. The real density of an electrode is the density of the material of which it is composed, free from pores or voids. It may be considered as a measure of the chemical composition of the material and increases as the amount of hydrogen in the hydrocarbons in the electrode decreases. It is thus an indication of the relative rate of oxidation of the electrode, it being a general rule that hydrocarbons high in hydrogen are most readily oxidized.

The apparent density—that is, the density of the carbon including the pores or voids—may be considered as a characteristic of the mechanical structure. It is influenced by every process through which the carbon goes in the manufacture of the electrode and is in general a measure of the relative rate of disintegration of the electrode in use. For large electrodes the most

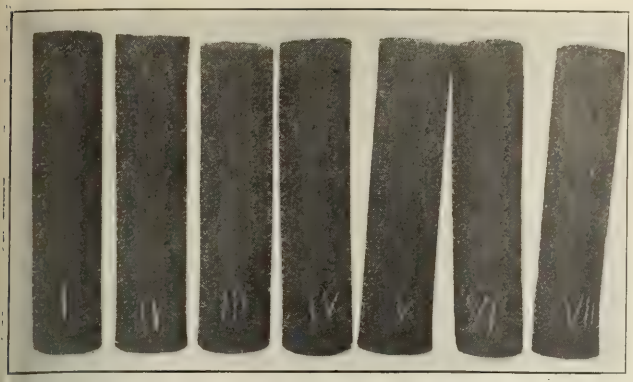


FIG. 38—ROUGH-SKINNED ELECTRODES
(No. 1 is smooth-skinned for comparison)

FIG. 39—OTHER EXAMPLES OF DEFECTIVELY BAKED ELECTRODES

atisfactory method is to weigh the whole electrode and alculate its volume from its dimensions. Where W quals weight and V volume, then

$$\frac{W \text{ (in lb.)}}{V \text{ (in cu.in.)}} = A.D. \text{ (apparent density) in lb. per cu.in.}$$

r more commonly

$$\frac{W \text{ (in grams)}}{V \text{ (in c.c.)}} = A.D. \text{ in grams per c.c.}$$

To obtain a precision of 2 per cent, the weight and ength should be measured to 1 per cent and the diam- ter or periphery to 0.5 per cent.

Physical Inspection

The cleaned carbons are inspected for cracks, flaws, hape, surface roughness and uniform hardness through- ut the length of the electrode. Cross checks, splits nd die rings, discussed previously in reference to the reen carbon,[25] may have been developed during the aking process either as a result of defects which lipped by the green inspection or originated in the aking furnace. Misshapen electrodes go into the scrap ile. Occasionally the furnaces may produce electrodes which are perfect except for an end which is so soft that it can be cut off with a knife or easily knocked off. Such carbons are rejected. Unusually rough-surfaced carbons, resulting from a blistered or rough condition in the green or from adhering packing material which has become a portion of the electrode and cannot be removed, are thrown out. All scrap resulting from the inspection of cleaned electrodes is returned to the manufacturing process by being used as calcined material in the grinding and pulverizing mills. Figs. 38 and 39 show some finished small round electrodes with rough surfaces.

It is at this point, along with physical inspection, that electrodes are rejected for resistivity above the standard and apparent density below the standard. Carbons of high resistivity are termed "re-bakes" and are returned to the furnaces to be again submitted to the baking process. Electrodes very much below the standard for apparent density because of excessive porosity are thrown into the scrap pile, to go back into process as unground calcined material.

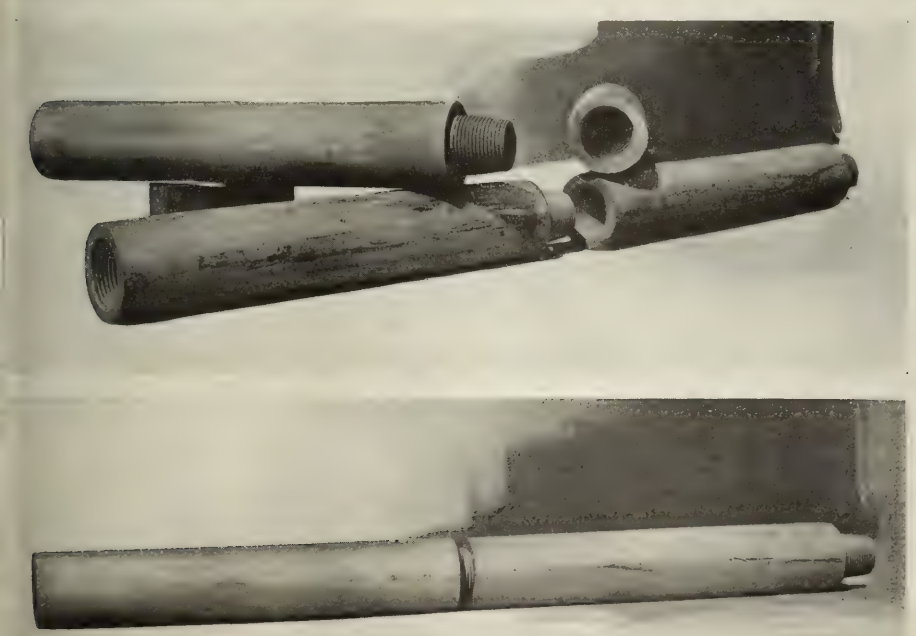
Machining Electrodes

Cleaned carbons, after passing inspection, are sent directly to the shipping room if they are to be used in their present form. If they are to be threaded or tapped, they are sent to the threading or machining departments.

Good amorphous electrodes are comparatively hard and more or less difficult to machine. High-grade machine-steel working tools are required and the threads are cut, holes drilled and tapped in the same manner that a piece of metal might be worked. Amorphous electrodes have a marked abrasive effect on the tools used in machining them—a fact which necessitates frequent regrinding and replacement. It is the opinion of the author, however, that the comparative difficulty of machining amorphous electrodes has been somewhat overstressed and made to seem more difficult than it really is.

Fig. 43 shows the threading and inspection departments of the Niagara Works of the National Carbon Co.

[25] See Part V, *Chem. & Met. Eng.*, vol. 27, No. 7, p. 312.



FIGS. 40 AND 41—GRAPHITE ELECTRODES THREADED FOR CONTINUOUS FEED

There are two methods by which electrodes may be joined. In the first, both ends are drilled and tapped so that a small threaded plug of electrode material may be screwed in the end of one electrode and the adjacent end of the next one. This method of joining electrodes is now largely used[26] for large electrodes. In the case of small electrodes, it is replaced by one in which one end of the electrode is threaded, and the other drilled and tapped so that the end of one electrode can be screwed directly into the end of another. This method will be better understood by referring to the illustrations of graphite electrodes threaded for continuous feed as shown in Figs. 40 and 41. The last illustration shows the method of assembly.

Shipping

After machining, the electrodes are inspected, those at fault returned to be re-machined if the fault can be corrected, or if not, are sent to the scrap pile to be used in the process as unground calcined material. The next step in process is shipping the finished product.

When a through shipment can be made, electrodes in carload lots are carefully packed and braced in the car without being boxed. In less than carload lots, it is usual practice to employ wooden boxes, the sizes of which vary according to the size of the electrodes. Sawdust is used to hold the carbons in place and prevent breakage. The Acheson Graphite Co. uses a case having a gross weight of 350 to 360 lb., containing a net electrode weight of approximately 300 lb. In the case of amorphous carbons, case sizes and weights will vary with electrode sizes.

Trade Usages

The requirements of the trade for both graphite and amorphous carbon electrodes vary between very wide limits. For this reason, the different electrode companies make no attempt to carry in stock all of the various sizes and shapes.

Carbon electrodes are manufactured in any size and shape desired. For ordinary use, the cylindrical or square shapes satisfy all requirements. Graphite electrodes may be obtained with any cross-section between the limits of $\frac{1}{16}$ in. to 12 in. in diameter and with any length up to 60 in.

The ease of machining graphitized electrodes is too well known to require any extensive discussion. They are easier to machine than the softest iron and may be finished with the same degree of nicety. Threads can be cut, holes drilled and tapped or the electrodes surfaced, sawed or shaped in any way desired by the use of ordinary wood-working tools.

The tendency in the industry is to make larger and larger electrodes to satisfy the requirements of electric furnaces, the dimensions and capacities of which are ever increasing. The largest single electrode which the industry has produced was made recently by the National Carbon Co. It is 24 in. in diameter, 180 in. long and weighs approximately 4,500 lb. If the demand existed this company is equipped to make electrodes up to 36 in. in diameter. Certainly, it is a long cry from Bunsen's first little sticks of carbonized wood to the mammoth high-density electrode of the present day! Bunsen's electrodes would float on water, the modern electrode has a density more than 1½ times that of water.

[26] See page 27 of "The Carbon Electrode," published by the National Carbon Co., Inc., New York, 1922.

Because of the inherent difficulty of manufacturing plates of great width by the extrusion method and the relative inferiority of molded plates for electrolytic work, it is often found much cheaper, as well as more convenient, to obtain wide electrode surfaces where necessary, by placing two or more graphite plates edge to edge and connecting them with graphite dowel pins.

Joining Electrodes

The desirability of using joined electrodes in any process is mainly a matter of calculation; the cost of power, the cost of electrodes and their length will decide the question. Offsetting the many advantages of continuous or joined electrodes are these disadvantages: (1) Machining operations (drilling, threading and tapping) increase the cost of the electrode. (2) The contact resistance between the portions of a built-up electrode causes loss of energy. (3) The joint is apt to loosen and to increase these energy losses, or the end of the electrode in the furnace may drop off, causing short circuits or other troubles.

On the other hand, the joint in a built-up electrode length serves as a very good thermal valve and lowers the thermal conductivity of the electrode, lessening the amount of heat conducted out through the electrode from the furnace.

In cases in which the furnace and the electrode holder permit the use of the electrode down to a small butt, in many cases it will be found more advisable not to join the electrode.

A good electrode paste is always used in practice to cut down the joint resistance losses. Experiment has shown that this joint resistance decreases as the electrode heats up and the paste dries or bakes. With the well-made electrodes the joint resistance, expressed in equivalent electrode length resistance, is very small.

The electrode manufacturers put up electrode pastes ready for use. They are usually thick suspensions of pulverized carbon or graphite in some medium that will be quickly volatilized by the heat at which the electrode is used. The chief difficulty with pastes is that precautions must be taken to prevent their drying out and hardening, after which they are almost useless.[27]

Economies and Economics

The complete flow sheet of electrode manufacture is introduced at this point to complete the discussion of processes. (See Fig. 42.) A glance will show that the industry loses practically nothing as waste and produces no byproducts. Green electrode scrap is re-used in process, gases from calcination are burned to heat the retorts to calcine additional material. Wherever possible, dust recoveries are made. Tar produced in the industry is used again as a binder; even producer gas soot from the soot legs is used as packing material. Recuperative and regenerative heating systems are the foundation of the present-day calcining retorts and baking furnaces. Scrap from the cleaning departments is re-used as unground calcined material; adhering packing material is recovered and carried back into process. The unconsumed portions of finished electrodes are sometimes used as raw materials. The circle is complete and endless.

Graphite electrodes cost three to four times as much

[27] For a very comprehensive discussion of the various methods of joining electrodes, the reader is referred to *Stahl und Eisen* for March 20 and April 3, 1913, translated into English in *Chem. & Met. Eng.*, June, 1913, p. 321.

TABLE I—COMPARISON OF AMORPHOUS AND GRAPHITIC CARBON ELECTRODES

	Acheson Graphite Electrodes	Amorphous Carbon Electrode*	Gas-baked Amorphous Carbon Electrode†	Large Elec ro-thermal Electrodes	Copper	Aluminum	Iron
Specific resistance (ohms per inch cube)	0.00032	0.00124	0.00161	0.00220	0 00000065	0.00000120	0.00000380
Specific resistance (ohms per cm. cube)	0.000813	0.00325	0.00400	0.00550			
Comparative section area for same voltage drop	1	3.8	4.4	6.8			
Weight, lb. per cu.in.	0.0574	0.0564	0.0560	0.058	0 320	0 090	0.280
Weight, lb. per cu.ft.	99.0	97.5	97.0	100.0	554	155	484
Apparent density, grams per c.c.	1.585	1.558	1.55	1.60			
Tensile strength, lb. per sq.in.							
Lengthwise	800–1,000	1,000–1,500	1,000–1,500	.....	20,000–30,000	24,000–30,000	30,000–50,000
Crosswise	500– 600	600– 900	600– 900	.....			
Temperature of oxidation in air, deg. C.	640	500	500	500			

*Very good electric baked electrode (small). †Typical small electrode.

per pound or per piece as corresponding amorphous carbons. This might be explained by the fact that electrodes to be graphitized cannot be baked in gas-fired furnaces, which, it will be recalled, has been shown to be far cheaper than the electric method. In the second place, in order to graphitize a carbon article, several times as much power is used as would be needed to convert it into a good grade of amorphous carbon. By far the largest cost item in graphite electrode manufacture is the baking to graphitization.

The cost of any particular size of electrode to the trade will depend upon several factors: (1) The difficulty of forming that particular shape in the green. (2) The percentage of scrap normally resulting and necessary to reprocess. (3) The difficulty or ease of loading, baking and cleaning the particular shape and size. (4) The percentage of breakage, replacement and excess necessary to complete the order. In the case of both graphite and amorphous carbons the percentage of breakage during and after baking is a serious item.

Comparison of Amorphous and Graphitic Carbons

A comparison of the two forms of carbon of which electrodes are made, amorphous and graphitic, is given in Table I. Good graphitic electrodes have about one-fourth the resistance of good amorphous electrodes of the same size. The apparent density of graphite electrodes is usually two or three points higher than that of fine-grained petroleum coke electrodes. The tensile strength of amorphous carbons is about 50 per cent greater than that of graphitic carbons of the same diameter. It will be found that ordinarily graphite electrodes are much purer—that is, have a lower ash—inasmuch as almost all of the metallic and metalloid oxides were volatilized by the temperatures reached during the baking to graphitization. Copper, aluminum and iron are included in the table to permit of a comparison with carbon electric conductors. The comparative size of graphitic and amorphous carbon electrodes of equal ohmic resistance is shown in Fig. 45. Graphite and amorphous carbon electrodes are not competitors. The properties of each particularly fit it for distinctly different fields. The field of the amorphous carbon, used in large quantities, is that of electrothermal work, where the fact that its cost is only one-third to one-fourth that of graphite off-

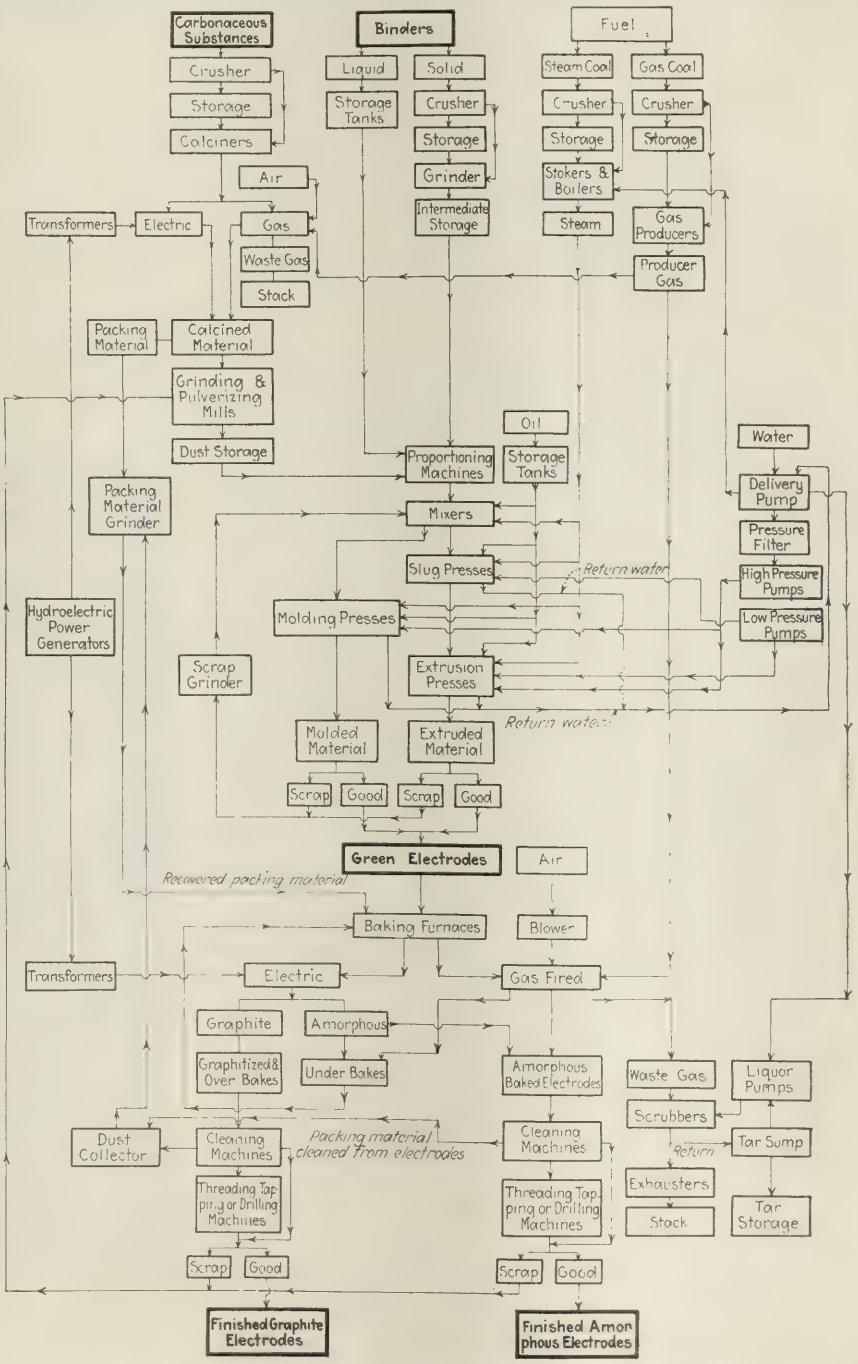


FIG. 42—FLOW SHEET OF CARBON ELECTRODE MANUFACTURE

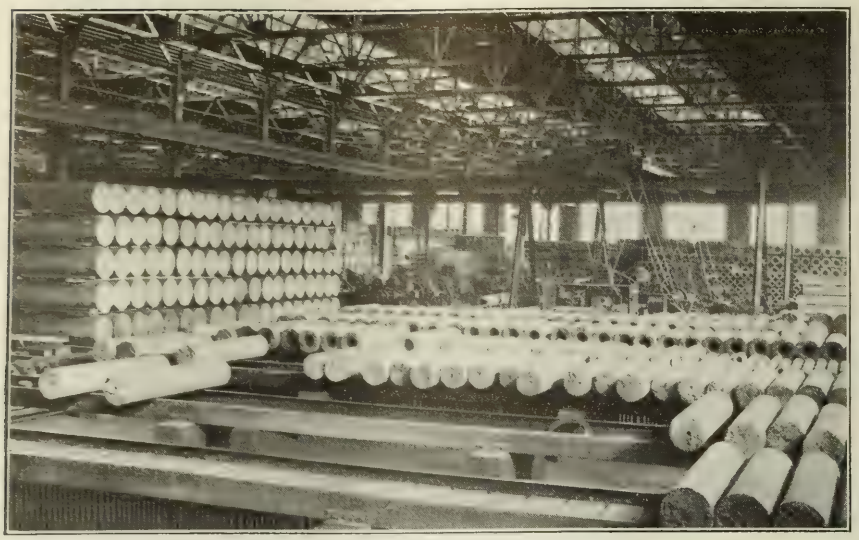


FIG. 43—THREADING AND INSPECTION DEPARTMENTS, NIAGARA WORKS, NATIONAL CARBON CO.

sets any advantages graphite might have. The particular field of graphite is that of electrolytic work, where its low resistance and long life are very important. Graphite electrodes are extensively used in the electrolytic production of chlorine and caustic, the chlorination of gold ores, the recovery of copper, nickel and zinc, the production of hypochlorites and many other similar applications.

Electrode Requirements

At the present time most of the carbon electrodes now manufactured are used in electrothermal work. In the United States, graphite has gained a well-deserved distinction for electrolytic work. In Europe, although graphite has also obtained due recognition, because of many adverse conditions amorphous carbon electrodes are still used in electrolytic work to a considerable extent.

For electrolytic work a low resistivity is both desirable and essential. In this case, low voltages and high amperages are used per cell. The higher the resistance of the electrodes the greater the voltage that must be applied to the cell and the higher the dead cost of electrolysis. With large currents even slight increases in resistance prove costly.

The apparent and real densities are both of importance. The first gives an idea of the porosity of the electrode, which to a certain extent is an advantage, inasmuch as it increases the active surface of the electrode, but if in excess, the bath liquid will enter the pores and cause a rapid generation of gas, which would tend to break off small chips, especially at the less porous edges. This would mechanically shorten the life of the electrode. An apparent density lower than 1.54 is undesirable, although from 1.4 to 1.6 is used.

Electrodes for electrolysis should not have more than 2.5 per cent of ash, and 4 to 5 per cent, as often found on the Continent, is distinctly disadvantageous. Higher ash content invariably means higher resistivity, with resulting electrical losses. The life of the electrode will suffer in consequence of the higher ash percentage.

In electrolytic work the electrodes are not consumed chemically or oxidized by surrounding air, but are eventually displaced through wear and tear. Impurities in the electrode do not therefore get into the cells in any great quantity through consumption of the electrode. In electrothermal work, however, the electrode is consumed largely by oxidation. The higher the apparent density the greater will be the amount of material packed in a given volume and the greater will be the length of time necessary to consume that volume. A carbon with a low apparent density offers a greater surface for oxidation per unit of weight than one with a high apparent density.

In summing up the requirements, it may be said that the following properties are necessary for the satisfactory performance of an electrothermal electrode:[27] (1) High electrical conductivity (low resistance). (2) Slow rate of oxidation (high apparent density). (3) Great mechanical strengths (particles well bonded together, suitable aggregate and thoroughly mixed). (4) Good shape and accuracy of dimensions. (5) Precise machining. (6) Low-heat conductivity.

Present and Future Developments

The Niagara Falls works of the National Carbon Co. was built in 1911. At the 1914 meeting of the American Electrochemical Society at Niagara Falls, that company exhibited a carbon 20 in. in diameter, 84

[28]Electrothermal electrode specifications may be found in "The Carbon Electrode," p. 34, published by the National Carbon Co. (1922), and "Operating Details of Electric Furnaces," by E. T. Moore, *Chem. & Met. Eng.*, vol. 24, No. 4, pp. 171-6, Jan. 26, 1921.

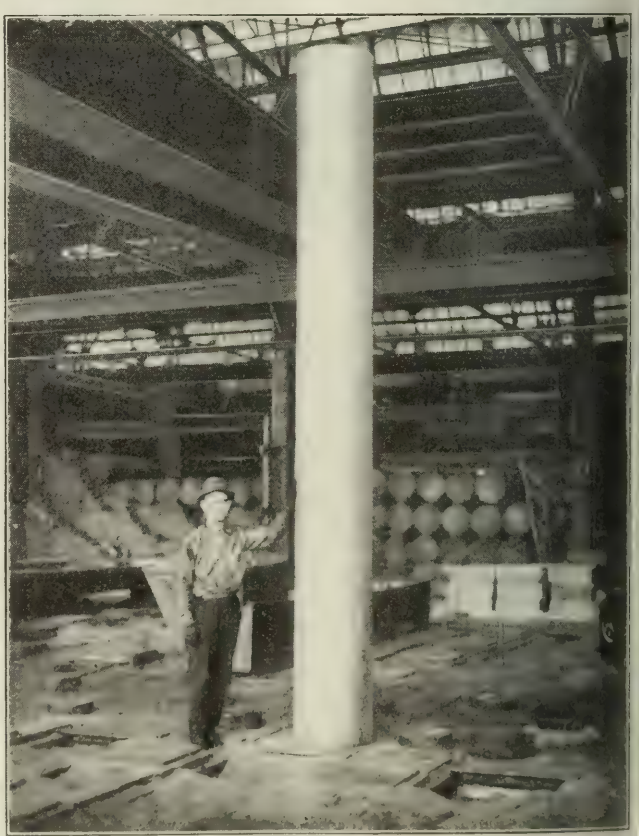


FIG. 44—ONE OF THE LARGEST ELECTRODES EVER MANUFACTURED. LENGTH 180 IN., DIAMETER 20 IN. WEIGHT 3,180 LB.

FIG. 45—GRAPHITIC AND AMORPHOUS CARBON ELECTRODES OF EQUAL RESISTANCE

in. long and weighing 1,450 lb. In 1921 the same company produced electrodes of larger diameter and 180 in. ong. Such has been the progress in the United States nside of less than 10 years.

While there have been many developments in the electrode industry in the past 10 years, the coming decade should bring forth even greater progress. It s possible here only to hint at some of the lines of development along which this progress will be made. Pitch coke is being developed as a raw material as a result of the possible shortage of petroleum coke. Probably there will be developed a tar or pitch still in which t will be possible to produce coke of such a fineness and of such a low content of volatile matter that the operations of calcining and pulverization will be unnecessary.

Developments along the line of the newer ring-type of gas furnaces have made possible the reduction of the cost of the baking process. The hydrocarbon gases generated from the binder in baking are used as fuel for heating sections of the furnace, thus making a considerable saving in producer gas. There have been some minor small developments along the lines of continuous electric furnaces (which is the superior but costlier baking method), with a view to recovering some of the enormous heat losses of radiation and cooling.

And last, but not of least importance, is the growing tendency for technical men in the industry to exchange information regarding the fundamental principles underlying the technology of carbon-electrode manufacture. Eventually this will result in greatly benefiting the industry as a whole and making it less and less of the "black art" which has characterized it in the past.

ACKNOWLEDGMENT

For their assistance in various ways in the preparation of this series of articles, the author wishes to acknowledge his indebtedness to W. H. Arison and Atwood B. Oatman, of the Acheson Graphite Co.; F. L. Zimmerman and C. S. Kinnison, of the Hoskins Manufacturing Co,; J. S. DeHart and J. A. Williamson, of the Isbell-Porter Co.; H. L. Goddard of the Jeffrey Manufacturing Co.; P. P. Huffard and his associates in the National Carbon Co.; W. A. Koren and S. B. Kanowitz, of the Raymond Bros. Impact Pulverizer Co.; John Robertson, of John Robertson & Co.; E. J. Smith and S. H. Farkas, of Edward J. Smith, hydraulic engineers, and finally, A. M. Redding, of the Leeds & Northrup Co.

For their kindly and helpful criticism of these articles, the author desires to thank F. J. Vosburgh and A. T. Hinckley of the National Carbon Co.

French Specifications for Impact Test

No particular type of testing machine or test-bar is specified by the French Committee on Standardization, but brief instructions concerning proper methods of testing are given below:

"The bar shall rest on bearers, 40 mm. apart, and shall be accurately placed before the blow is applied. The bearers shall have their upper surfaces rounded to a radius of 1 mm. A clearance in accordance with that shown in Fig. 1 shall be allowed in order to reduce friction at the extremities and to avoid the wedging of the bar.

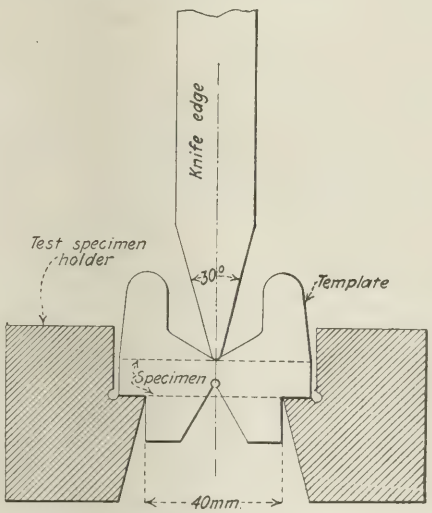


FIG. 1—TEMPLATE FOR LOCATING IMPACT TEST-PIECE

"The knife-edge fixed to the falling weight shall have a triangular section, the angle at the apex not being greater than 30 deg. The striking edge shall be rounded to a radius of 1 mm. It is absolutely necessary that the distance between the bearers shall be very frequently verified with a special template, and it is also necessary to insure that the knife-edge fixed to the falling weight is exactly in the middle of this distance.

"The position of the test specimen on the bearers must also be very carefully verified for each test with a special template, the position of the notch being taken into account. The speed of the blow shall not be less than 5 m. per second. Unless any figure is specially prescribed for the temperature, it shall lie between 15 deg. and 20 deg. C. The influence of the temperature is much more marked than in any other method of testing."

Two styles of test-bars are in use, the Mesnager and the Charpy. The former is 10x10x55 mm., notched 2 mm. by 2 mm. and round at the bottom; the Charpy bar is the same size, notched 5 mm. deep by a cylindrical hole 1.3 mm. in diameter and opened by a saw cut 1 mm. wide.

"Modification" of Aluminum-Silicon Alloys

By James J. Curran
Metallurgist, The Henry Souther Engineering Co., Hartford, Conn.

RECENT publication of articles on the alloys of aluminum and silicon has stimulated considerable interest in this subject. Three articles published within the last few months describe at some length the alloys containing from 5 to 15 per cent of silicon, and all call attention to the fact that alloys of this group may possess either one of two entirely dissimilar structures, spoken of as "normal" and "modified" or "refined." Some of the conditions under which either type of structure occur or may be obtained are stated by the various writers, who also remark on the superior tensile strength and elongation observed in alloys possessing the "modified structure. No reasonable explanation for the difference in structure and physical properties is suggested.

Previous to the appearance of these articles, the writer had occasion to examine a casting of "normal" alloy containing about 11 per cent silicon. This was a hydraulic casting and was stated to have withstood a hydraulic pressure of approximately 200 lb. without leaking, whereas the same casting made of the ordinary No. 12 aluminum-copper alloy leaked at 40 lb. pressure. This impervious state makes the alloy extremely desirable for hydraulic castings. More recently a sample showing the "modified" structure came to our attention, causing some speculation as to the reason for the difference in structure.

According to Jeffries[1], when the alloys were prepared by melting together commercially pure aluminum and silicon, the normal structure always resulted, whereas simultaneous electrolytic reduction of the two metals always produced the "modified" structure. This structure was also produced when the alloys were prepared by fusion of aluminum and a double fluoride of silicon and potassium (Wöhler's method), and alloys exhibiting the "normal" structure were converted to the "modified" form by fluxing with fluorides of the alkali metals.

[1]"Aluminum-Silicon Alloys," *Chem. & Met.*, April 19, 1922.

FIG. 1—STRUCTURE OF CASTING AS RECEIVED. "NORMAL." × 100. ETCHED WITH NaOH SOLUTION

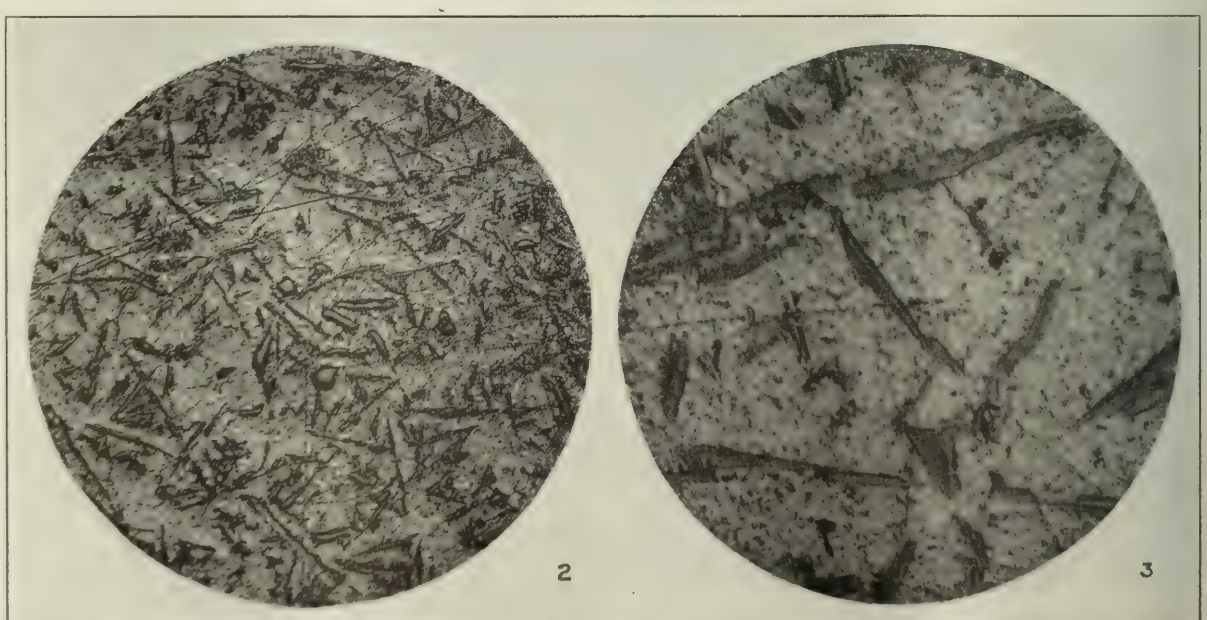
All of these alloys, however, reverted to the "normal" form on remelting and holding in the molten condition for some time.

According to Guillet[2] and R. E. Search[3], the change in structure produced by the action of alkali fluorides on the melted alloys was ascribed to the removal of oxides, etc., or, in other words, simple fluxing.

The radical change in structure produced seemed to the writer to have a much deeper meaning than that ascribed, however. Examination of the historical data given in Jeffries' article indicates that the "modified" structure results only when alkali fluorides enter into the preparation of the alloy. For instance, the reaction between an aluminum-silicon alloy and NaF may form a small amount of Na and SiF_4. The SiF_4 formed is immedi-

[2]"Les Alliages Aluminium-Silicium et leurs emplois industriels," *Revue de Métallurgie*, May, 1922.

[3]"New Aluminum-Silicon Alloys," *Metal Industry*, May, 1922.



FIGS. 2 AND 3—STRUCTURE OF INGOT AFTER REMELTING. "NORMAL." × 100 AND × 500 RESPECTIVELY. ETCHED WITH NaOH SOLUTION

FIGS. 4 AND 5—STRUCTURE OF INGOT AFTER REMELTING AND ADDING SODIUM. "MODIFIED." × 100 AND × 500. RESPECTIVELY. ETCHED WITH NaOH SOLUTION

ately removed from the sphere of action, due to its gaseous state. The reaction takes place in a bath of aluminum which may be regarded as either a neutral or reducing medium or atmosphere, with the result that the Na produced cannot react to form any compound or salt, but is immediately dissolved in the aluminum.

It seems probable that alkali chlorides would give a similar reaction with evolution of $SiCl_4$, although it is possible that higher temperatures would be necessary. Other salts of the alkali and alkaline earth metals might also be selected to give similar effects under similar conditions.

If the alloy is prepared by simultaneous electrolytic reduction, we would expect a small amount of the alkali metal to be produced. This has been reported as a serious drawback to several of the early electrolytic methods of producing aluminum. Kahlenberg and Trautman (*Trans.*, Am. Electrochem. Soc., vol. 39) were apparently unable to produce the alkali and alkaline earth metals or silicides by reduction of their salts by silicon, although they quote Askenasy and Pounay as producing barium silicide by this means. Their failure was undoubtedly due to the fact that these metals, and probably also the silicides, oxidize rapidly in air. If the reduction were carried on in a neutral or reducing atmosphere, such as is afforded by a bath of aluminum, the results would have been different.

Remelting of a "modified" alloy—assuming it contained a small amount of alkali metals—would undoubtedly result in the elimination of the latter, thus explaining the reversion to "normal" structure noted by the writers quoted.

Having thus established a case for the alkali metals, the writer attempted to synthesize the "modified" alloy without the use of fluorides, as follows:

A casting possessing the "normal" structure shown in Fig. 1 and having the composition aluminum 88.32 per cent, silicon 10.72, iron 0.70, copper 0.16, manganese 0.01, carbon 0.09, was cut into small pieces, some of which were melted in a small crucible at a temperature of about 1,350 deg. F. The crucible was then removed from the furnace and the melt permitted to solidify in the crucible. The resulting alloy was then examined microscopically. The structure observed is shown in Figs. 2 and 3 at magnifications of 100 and 500 diameters respectively. This structure is characteristic for the "normal" alloy.

The remainder of the original casting was then melted as before in a small crucible at about 1,350 deg. F. and a small piece of metallic sodium was stirred into the metal, then the crucible was removed from the furnace and the melt permitted to solidify. Microscopic examination disclosed a characteristic "modified" structure—shown in Figs. 4 and 5.

Since the only difference in the preparation of the two melts was in the addition of sodium to the second melt, we believe that this is conclusive proof that the "modification" is caused by the absorption of sodium to form a ternary alloy. This would explain the failure of the "modified" alloys to behave according to the usually accepted binary aluminum-silicon diagram. No attempt was made to determine the amount of metallic sodium in the alloy, but its presence was indicated by an evolution of gas when the polished specimen was washed in water before etching.

In alloys for hydraulic purposes, resistance to corrosion is a very desirable property. The aluminum-silicon alloys are reported to be quite resistant to corrosion, and curves are given by Guillet in which one of the alloys is compared with others on the basis of resistance to corrosion. It is not stated definitely, however, whether the alloys were tested in the "normal" or "modified" condition. We would expect that the "normal" condition would show the greater resistance to corrosion and that the "modified" alloy, due to its content of alkali metal, would show inferior properties. The presence of small amounts of alkali metals caused rapid corrosion in aluminum produced in the early days of the electrolytic method, and one might expect similar results in the aluminum-silicon alloys, depending on the amount of alkali metal present. Comparison tests on the resistance to corrosion of the commercially prepared "normal" and "modified" aluminum-silicon alloys would therefore be instructive.

Commercial Furfural— Its Properties and Uses—II*

Part II of a Paper Describing the Rise of a Laboratory Curiosity to Industrial Importance — General Uses of Furfural — Complete Bibliography

By Carl S. Miner, John P. Trickey and Harold J. Brownlie
The Miner Laboratories, Chicago, Ill.

EARLY in the investigation of furfural, its property of discoloration was noted especially when exposed to light, the change taking place more rapidly in the anhydrous material than in the technical, which contains about 4½ per cent water. When technical furfural is distilled at atmospheric pressure to separate impurities, the color change in the purified product is quite rapid, changing in the course of a day from nearly colorless to a deep amber color. However, by using the method as given by R. Adams, this color change is retarded to a considerable extent. This method is briefly as follows: The technical furfural is distilled under diminished pressure (26 to 28 in. of vacuum) using a paraffine bath, the temperature of which is kept below 130 deg. C. At first water and furfural distill and separate in two layers. After about 15 per cent of the initial volume is collected the distillate coming over is pure furfural. The next 65 per cent is then collected as pure material. It should be stored in amber colored bottles.

Those who require a highly purified furfural for experimental work will obtain very satisfactory results by distilling technical furfural in accordance with the above directions just at or near the time it is desired for use.

Resins

Recently there has been an active interest taken in the manufacture of resins from furfural. Quite early in the history of furfural it was noted when working with the pure product or very concentrated solutions that instead of the desired reactions taking place, a tarry mass resulted. Stenhouse, in 1840, and Fownes, in 1845, in their earliest work on furfural, observed the formation of a brown resinous mass when furfural was boiled with alkali or acid. In 1887 L. Claisen attempted to prepare compounds from β-naphthol and furfural, using glacial acetic acid as the solvent and hydrochloric acid as the condensing agent. He obtained no well characterized compounds, obtaining only a brown resinous mass. No particular notice was taken of these products until the production of the phenol-formaldehyde resins became of commercial importance. Meunier (262) prepared a fusible, soluble resin by action of commercial aniline with an equal part of furfural in presence of alkalis. The product was a black resin, soluble in benzene and alcohol, giving a black enamel. Beckman and Dehn (261) made a rather extensive investigation of the condensation products of furfural with the phenols. They reported on the products obtained from 24 different phenolic compounds. They obtained their best results with phenol, raw cresol, guiacol, carvacrol and β-naphthol, using 5 per cent of hydrochloric acid as the condensing agent and equal parts furfural and the phenol.

Their work using basic catalyzers such as sodium carbonate, sodium hydroxide, etc., seemed to show that the reaction as well as the final product was not as desirable as the acid resins. In the experience of the authors this is at variance with the facts, as in our experience the alkali resins are much more easily controlled and the final product much superior to the acid resins. A paper is being prepared covering our work on these resins.

Mains and Phillips (258) prepared a series of resins from furfural with amines. In all cases they were fusible and soluble, the solutions forming excellent enamels.

Quite recently Novotny has patented a process for preparation of phenolfurfural resins using both furfural and furfuramide in its preparation. These are molding resins forming hard, infusible, insoluble products. We are informed that molding resins now are being successfully prepared on a commercial scale from furfural.

Varnish

Besides the preparation of the fusible, soluble resins which may be used as varnish resins, investigations have been made which seem to show the applicability of furfural either alone or in admixture with oil of turpentine in the preparation of varnishes. Claim is made of a much lower acidity than in the common methods of varnish manufacture.

Rubber

Some work has been done on the use of furfuramide in the rubber industry as a substitute for hexamethylenetetramine. The results of this work show some promise of its adaptability. It has been found to have decided accelerating effects. Further work is being done on this phase of its application.

Dyes

Practically all of the compounds reported on in the section of this paper devoted to the chemistry of furfural which are formed by the action of furfural on aromatic amines are either highly colored compounds or become so by oxidation. Many of these have decided staining or dyeing properties and in the light of recent investigations furfural gives promise of becoming of importance in the preparation of commercial dyestuffs.

Anesthetics

Dr. Gilman, at the Birmingham meeting of the American Chemical Society, reported on the preparation of an anesthetic from furfural. This opens up an entirely new field in the application of furfural.

Antiseptics and Germicides

Furfural has decided antiseptic and germicidal properties, as is brought out by the work of McGuigan. The authors of this paper studied the effect of furfural on the keeping qualities of bacteria infected glue. They found that glue that "went bad" in 18 to 24 hours after

*Part I of this article, describing the occurrence, manufacture and properties of furfural appeared in *Chem. & Met.*, vol. 27, No. 7, Aug. 16, 1922.

placing in solution would keep for several days when the solution was made in a 1:500 furfural:water solution, and that the solutions would keep for several weeks when made in a 1:250 furfural:water solution.

Solvent

The authors have under way an investigation of the solvent action of furfural. Among the interesting data developed to date are the facts: that furfural is an excellent solvent for both nitrocellulose and the hydrated cellulose acetates; that while linseed oil is very slightly soluble in furfural, chinawood oil is miscible in all proportions; that stearic acid is quite soluble in hot furfural, but is only soluble to about 1 part in 50 at 25 deg. C., while oleic acid is readily soluble at 25 deg. C.

Larger production and increased efficiency of manufacturing process will make possible the reduction in the price of furfural to a point where it can compete on a parity, or better, with formaldehyde and the high boiling point solvents. In view of the many possibilities of commercial utilization already indicated, it seems highly probable a vastly greater number of profitable methods for its use will be developed. Since it can be made from any of the pentosan-bearing roughages now either wasted or sold at extremely low price, it seems reasonable to predict that a considerable percentage of those millions of tons of what is now virtually waste material will ultimately form the basis of a new industry of enormous proportions.

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Magnetic Analysis of Metal

In any study of the physical properties of materials the effect of temperature is of great importance. It is well known that at a certain temperature ferromagnetic materials lose their ferromagnetic properties and become very feebly magnetic. It is not so well known, however, that certain more or less abrupt changes in magnetic properties take place at lower temperatures during heating and cooling and that these changes are often indicative of structural transformations in the material. The Bureau of Standards has designed and constructed apparatus for the purpose of investigating these phenomena. Little work of this nature has been done in this country, although valuable results have been obtained by this method abroad, especially by Japanese investigators.

Endurance Studies on Alloy Steel

Dr. H. W. Gillett, at the Ithaca station of the Bureau of Mines, has embarked upon an extensive program of endurance tests, using molybdenum and other alloy steels. About 600 test-pieces have been prepared, and two testing machines will be kept constantly in operation.

A New Tiering Truck

THE tiering truck equipped with electric motor and storage battery has a wide field of possible utility. It would have met with much greater favor from industry in general in the past, except that the models offered had certain defects of design which tended to curtail their usefulness. Many industries that could have effected real economy by using tiering trucks have held off making purchases of this type of equipment until one was offered which they considered dependable.

For this reason the "Eleveyor," a tiering truck recently placed on the market by the Electric Industrial Truck Co. of Brooklyn, N. Y., is considered noteworthy.

FIG. 1—ELEVEYOR WITH PLATFORM LOWERED

The makers of this truck claim to have eliminated numerous disadvantages found in some of the older models. One of the principal improvements claimed for the "Eleveyor" is in the design of the frame. This frame, as shown in the accompanying photographs, is made of structural steel throughout and is so designed as to increase greatly the strength and stability of the truck. Another advantage lies in the elimination of parts and in the unobstructed dash and operators step which results from this.

One of the chief features of the truck is the use of standard equipment, largely that developed in the automotive industry, wherever possible. The differential is a Brown-Lipe-Chapin. The main drive is through a Morse silent chain. All bearings are standard SKF deep grove ball bearings. The hoist is a triplex-geared chain hoist, operated by a G. E. motor. The driving motor is also a G. E. motor. The main controller is a G. E. heavy duty drum-type controller, so designed that the necessity of the "safety" switch found on most other designs of truck is eliminated, thus saving many adjustments and complications.

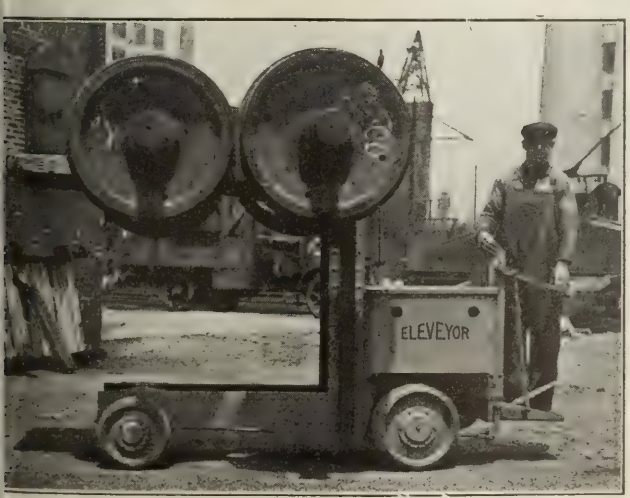


FIG. 2—ELEVEYOR WITH PLATFORM RAISED

One of the new departures presented in this truck is the use of a chain hoist for elevating the platform. A chain hoist is constantly engaged, so that the load is safely held at all times. Its mechanism possesses great strength, few parts and high efficiency and is felt to be superior to gear train, planetary system, cable, or screw such as has been used in former designs of tiering trucks.

A summary of the advantages claimed for this truck comprises the following:

1. Exceptionally large platform and wheels.	For bulky material and rough roadways.
2. Platform spring suspension.	Relieves load and frame from injurious shocks.
3. Platform track construction.	Provides great strength and a short truck.
4. Parallel link drive axle suspension.	Provides ideal spring action with simplicity.
5. Battery compartment free of all overhead obstruction.	Battery easily watered or removed.
6. Shortest possible truck length for a given size platform.	Turns in close places.
7. Most efficient gearing in transmission and hoist.	Operates longer with given battery capacity.
8. Neutral return controller.	Facilities starting on a grade and keeps driver's hand on lever.

A New Pipe Wrench

Those who have had anything to do with plant construction or operation are likely to be familiar with the "Little Giant" line of screw plates, taps and dies. The Greenfield Tap & Die Corporation, of Greenfield, Mass., has recently added to this line the "Little Giant" pipe wrench, a cut of which is here shown.

This wrench is of the end opening type, like the familiar machinists' wrench. It is claimed that this construction makes the new tool particularly applicable to use in corners and other confined places.

Among the advantages claimed for this wrench are the small number of parts, there being only three; the unusual strength, combined with light weight; and the double set of teeth on the main jaw, which doubles the life of the tool.

This wrench will be made in 8, 10, 14, 18 and 24 in. sizes, the three smaller sizes being now procurable.

Book Reviews

THE PRINCIPLES OF ORGANIC CHEMISTRY. By *James F. Norris.* Second edition, 632 pages. New York: McGraw-Hill Book Company, Inc., 1922. Price $3.

There has been a tendency among authors of college text-books of chemistry to expand them into volumes of formidable size, and the reviewer feels that Professor Norris is to be congratulated on resisting this temptation.

The book contains about fifty pages more than the earlier edition, but the new matter which has been included will certainly add to the student's interest in the subject. The author has not hesitated to include a brief description of industrial processes as frequently as could be expected in an elementary work of this kind. Among the new subjects included, the reviewer notes the manufacture of isopropyl alcohol from petroleum still gases, some notes on the manufacture and toxicity of phosgene and its use as a war gas, a brief description of mustard gas and its methods of preparation, a brief reference to the Bucher process, the catalytic oxidation of benzene to maleic anhydride, the manufacture of ethylene glycol from ethylene and the intermediate ethylene chlorhydrin.

The chapter on dyes has been somewhat extended, and the chapter on proteins has been amplified and brought up to date as far as is consistent in a book of this kind. It is inevitable that the subject matter included in a text-book of this kind will be nearly identical with other books of the same scope and purpose. The quality which distinguishes works of this kind is the clearness of the exposition and in this particular case the interjection of many statements which cannot help but impress upon the mind of the student that the science of organic chemistry is a live, growing subject, not a dead one. There is a dynamic quality in this work of Professor Norris' which is difficult to inject in a work of this kind. It reflects the art of an extraordinary expositor.

B. T. Brooks.

PROTEINS AND THE THEORY OF COLLOIDAL BEHAVIOR. By *Dr. Jacques Loeb.* New York: McGraw-Hill Book Co., 285 pp. 1922. Price $3.

Besides presenting in convenient and coherent form his ingenious and extensive researches on proteins (chiefly gelatine, albumin and casein) which have appeared in journal articles over a long period, the author in this book gives many hitherto unpublished experiments to support his views.

The first part of the book "furnishes proof of the stoichiometrical character of the reactions of proteins"; the second part gives a "theory of colloidal behavior based on Donnan's theory of membrane equilibria." "Any rival theory which is intended to replace the Donnan theory must be able to accomplish at least as much as the Donnan theory—i. e., it must give a quantitative mathematical and rationalistic explanation of the curves expressing the influence of hydrogen-ion concentration, valency of ions and concentration of electrolytes on colloidal behavior and it must explain these curves not for one property alone but for all the properties, electrical charges, osmotic pressure, swelling, viscosity and stability of solution, since all these properties are affected by electrolytes in a similar way."

But "such an application of Donnan's theory would have been impossible without the stoichiometrical proof that proteins form true ionizable salts with acids and alkalis. What was at first believed to be a new type of chemistry—namely, colloid chemistry—with laws different from those of general chemistry, now seems to have been only an unrecognized equilibrium condition of classical chemistry; at least as far as the proteins are concerned. This does not detract from the importance of colloidal behavior for physiological and technical problems, but it completely changes the theoretical treatment of the subject." Evidently then, as the title indicates, Loeb accepts colloids and offers a theory of their behavior. His book should be read by all interested in the subject.

Because of the high reputation of the author, many scientists will be prone to accept his conclusions without submitting his experiments and arguments to critical examination. Your reviewer feels constrained therefore to point out what appear to him to be some basic errors, both experimental and rational, which strike at the very root of Loeb's conclusions.

Loeb's whole thesis is based on the formation of true ionizable protein salts—e. g., gelatine chloride and sodium gelatinate. This naturally assumes that gelatine is a definite chemical entity, which no one has ever demonstrated. In fact the existing evidence is to the contrary. Thus, the analyses of Levene, Skraup and von Biehler, Dakin, Bogue and others differ widely. But Loeb has failed to define exactly the *quality* of the gelatine he has used. He describes it (p. 35) as "commercial powdered Cooper's gelatine, which happened to have a *pH* of 6.0 to 7.0," but before using it he brought it to the isoelectric point and purified it by treatment with M/128 acetic acid. Nothing is stated of the percentage of gelatoses or of gelatones in the purified product, nor is the jelly-strength or mutarotation (after C. R. Smith) given, from which a rough idea of their percentage might be formed. The gelatine apparently lost 20 to 25 per cent during purification, which introduced a like error into some of Loeb's earlier experiments. (See e. g. Harvey Society address, *Science*, N. S., vol. 52, p. 451 (1920); *J. General Physiol*, vol. 3, p. 89 (1920); also the present book, (p. 58).

Again Loeb has failed in each case to define exactly the ash and moisture content of the gelatine used, both being essential (especially the latter) in fixing the percentage of gelatine in solution. C. R. Smith, *J. Am. Chem. Soc.*, vol. 43, p. 135 (1921) and Miss A. M. Field, *ibid.*, vol. 43, p. 667 (1921), had shown how to prepare ash-free gelatine, which is by no means identical with isoelectric gelatine. Loeb gives (p. 35) "a result of an ash determination made by Dr. D. I. Hitchcock on a sample of gelatine selected at random" from one of Loeb's stock solutions containing 12.69 per cent gelatine. The analysis showed about 0.1 per cent ash, apparently $Ca_3(PO_4)_2$. Loeb says this amount of ash is without influence, but since C. R. Smith has shown that Ca may exert a powerful influence, it would have been better had Loeb determined the ash of every specimen of gelatine the ash of *every* specimen of gelatine he actually used. The paper of Oakes and Davis (*J. Ind. Eng. Chem.*, vol. 14, p. 706, 1922) also shows the importance of "ash."

Loeb's experimental results are reported mainly in curves or graphs which your reviewer believes are incorrectly plotted and drawn. This is quite evident in the graphs of Chapter VI, where *equal* increments on the axis of abscissas are given M/2, M/4, M/8, M/16, M/32, etc. It is not so obvious in the other chapters where equal increments are given *pH* values of 1, 2, 3, 4, 5, 6, 7, etc., because most readers do not stop to consider the real meaning of *pH*. This abbreviation of Sorensen is an inverse logarithmic value deprived of its minus sign. The following table will give an insight:

pH value	Number of Times the H (or OH) Ion Concentration Exceeds That of Pure Water
1	1,000,000
2	100,000
3	10,000
4	1,000
5	100
6	10
7	i.e. conc. H and OH = 10^{-7} mols per liter. . . . . 0 (pure water)
8	10
9	100
10	1,000

Thus, decrease in *pH* value means increase in acidity, not in an arithmetical but in a logarithmic ratio. Curves plotted on an arithmetical basis, as are Loeb's, are thus logarithmically compressed and deviations there appearing as experimental errors may really obscure cusps or inflections. Loeb's method of plotting is furthermore apt to make the reader forget that values of about *pH* 6 to *pH* 7 represent an extremely slight acidity. *N*/10 HCl has a *pH* = 1.07 and ordinary distilled water in the laboratory (containing CO_2) has a *pH* = about 5.5.

Therefore values of about *pH* 2 to *pH* 3 represent a very high acidity. Curves which Loeb shows with equal branches, resembling parabolas, should rise sharply, almost asymtotic

to the *pH* 4.7 ordinate, and after turning, gradually approach to axis of abscissas. Some other points may be epitomized as follows:

The view (Chapter II) that proteins fix acids by their free NH_2 groups and acids by their free COOH groups, while simple, does not accord with the observation that deaminized gelatine (Blasel and Matula) and highly hydrolyzed gelatine (T. B. Robertson) both fix about as much acid as the original gelatine. Jordan Lloyd and Mayes (*Proc. Roy. Soc.*, B. vol. 93, p. 39, 1922) give additional evidence that disproves this appealing but incorrect chemical explanation.

Loeb's interesting qualitative experiments (Chap. II) show, as Bancroft remarked, that acid or plus-charged gelatine (*pH* less than 4.7) fixes only anions, while alkaline or minus charged gelatine (*pH* less than 4.7) will fix only cations, which is only to be expected. Clay or fine silica might act similarly.

His quantitative experiments (Chap. V) show e. g. that the number of c.c. of different *N*/10 acids required to bring isoelectric gelatine to the same *pH* varies roughly in accordance with the *pH* (available or effective acidity) of each acid at that *pH*. Thus at *pH* 3 the effective acidity of HCl and H_2SO_4, oxalic, and phosphoric acids are about 3, 2 and 1 respectively and Loeb found that to bring one gram of isoelectric gelatine to *pH* 3, it took (in c.c. of *N*/10 acids) 7.2 HCl, 7.5 H_2SO_4, 13.15 oxalic, 20.7 phosphoric. Most of his experiments stop at about *pH* 2, which represents an acidity equal only to *N*/100 HCl (*pH* 2.02).

Assuming that deviation from the curves is due only to experimental errors, these results, while not inconsistent with the view that chemical compounds have been formed, may simply be due to the fact that within the *pH* range of the experiments, gelatine has, at each *pH*, a more or less definite free adsorptive surface and adsorbs acids in proportion to their free field of force. The fact that material chemical changes (see above) in gelatine do not affect its acid combining capacity appreciably favors the adsorption rather than the chemical view. Even W. B. Hardy (see Loeb, p. 9), who utterly expressed belief in salt formation, stated that the reactions are not precise. No one has ever prepared chemically pure gelatine, and estimates of its combining weight vary from about 768 (Proctor and Wilson) to about 96,000 (C. A. Smith). Jordan Lloyd gives chemical evidence that it cannot be less than about 10,300 and Loeb apparently believes it to be between 12,000 and 25,000. As Hardy indicates, it depends upon conditions, and your reviewer believes it will also vary with the kind of gelatine. It is still to be demonstrated that these compounds possess the definiteness which is at present connoted by the expression "chemical compound."

The *pH* (that is, the effective reaction) of acids is controlled by the specific nature of their anions; the *pH* of alkalis by the specific nature of their cations. The *pH* of *N*/100 HCl is 2.02, but the *pH* of *N*/100 acetic acid is 3.37. Why? Because in aqueous solution Cl releases H+ more readily than does CH_3COO-. This means that HCl is a strong acid and acetic a weaker one.

Hofmeister, Ostwald and M. H. Fischer observed the effect on proteins, of *equal molar concentrations* of various acids and alkalis and then compared the consequences of their *differing pH or effective reaction.* Loeb, on the other hand, uses enough of various acids and alkalis to make their *effective reactions* (*pH*) *equal* and then compares the *varying quantities required.* What he considers "practical identity"—e.g., in curves of Figs. 19 and 20 (pp. 79 and 80)—may appear differently if the curves are correctly plotted. He even comments (p. 80) on the anomalous behavior of acetic acid, probably caused by sol formation (see below).

That the problem of the swelling of gelatine in acids is not as simple as a Donnan equilibrium formula would indicate is evident from the work of A. Kuhn (*Kolloidchem. Beihefte*, vol. 14, p. 202, 1921), who found it to be dependent upon four factors:

A (*1*) Hydration (simple swelling)
B (*2*) Sol formation (incidental peptization)
(*3*) Hydrolysis
C (*4*) Dehydration (flocculation)

The maximum is reached when, with increasing concentration of acid, hydration is overbalanced by sol formation and hydrolysis. Probably it was sol formation that caused Loeb to lose about 20 per cent of his gelatine in his earlier experiments (p. 58). Since sols (as Graham distinctly pointed out) do diffuse, albeit though slowly, we have here another factor working contrary to the Donnan equilibrium. Experimenting with 50 organic acids, Kuhn could not decide if the combination was chemical or adsorption.

Loeb argues (p. 16) that "if the addition of a salt to a protein solution diminishes its osmotic pressure by causing an increased formation of aggregates, the same addition of salt should increase the viscosity of such a solution. The reverse, however, happens, the viscosity of the solution being decreased by the addition of salt." Loeb here entirely overlooks the existence of the zone of maximum degree of colloidality. (See *J. Am. Chem. Soc.*, vol. 43, p. 434, 1920.) Viscosity does often increase as particles aggregate, as in cooling gelatine solutions, but viscosity may also increase as particles are dispersed, as when cream is homogenized, or karaya gum dispersed.

Loeb makes the sweeping assertion (p. 278) that "there is only one source of colloidal behavior—namely, the Donnan equilibrium—at least as far as the proteins are concerned." Donnan can hardly believe this, for Loeb quotes him (p. 22) as saying (*J. Chem. Soc.*, vol. 105, p. 1963, 1914) that in the comparatively simple case of a copper ferrocyanide membrane and potassium ferrocyanide solutions, "the phenomena are not so simple as supposed in the theory." The great danger of applying mathematics to chemical and physical problems lies in the fact that we may be blinded by the logical perfection of this mere tool and make erroneous assumptions, or else neglect important factors which so often crop up unexpectedly in nature. The fact that some of the assumptions involved in Donnan's equations do not apply to gelatine has been pointed out by Jordan Lloyd—e.g., the gelatine "ion" does diffuse. The basic assumption that a true hydrolyzable "salt" is formed is, to say the least, doubtful.

A word in defense of Thomas Graham is necessary, for his classic papers are seldom consulted in the original. Loeb states (p. 275): "Graham had suggested the distinction between colloidal and crystalloidal substances, but it was found later that one and the same substance—e.g., NaCl, may behave when in solution either as a crystalloid or a colloid. It was then proposed to drop the distinction between colloidal and crystalloidal substances, and distinguish between the colloidal and crystalloidal state of matter." This is surprising, for Loeb on page 1 quotes from Graham the very paragraph wherein the word "colloid" was born; the particular sentences of Graham are: "As gelatine appears to be its type, it is proposed to designate substances of the class as colloids and to speak of their peculiar form of aggregation as the colloidal condition of matter. Opposed to the colloidal is the crystalloidal condition. Substances affecting the latter form will be classed as crystalloids. The distinction is no doubt one of intimate molecular constitution." Further on in the same paper, "Liquid Diffusion Applied to Analysis" (1861), Graham says: "The mineral forms of silicic acid, such as flint deposited from water, are often found to have passed during the geological ages of their existence from the vitreous or colloidal into the crystalline condition (H. Rose). The colloidal is in fact a dynamical state of matter, the crystalloidal being the statical condition." And still further: "The inquiry suggests itself whether the colloid molecule may not be constituted by the grouping together of a number of smaller crystalloidal molecules and whether the basis of colloidality may not really be due to this composite character of the molecule." So Graham did know that the same substance can exist in both colloidal and in crystalloidal state. Modern research has fixed dispersion into particles between about 100 $\mu\mu$ and 5 $\mu\mu$ as the criterion of the colloidal condition, and the particles may be crystalline or consist of random clusters. But these statements of Graham still hold true.

It is to be regretted that Loeb did not review, discuss and consider the results of many important workers in

this field. Thus he does not mention Blasel and Matula, Arisz or Jordan Lloyd and dismisses C. R. Smith with mere mention in a footnote (p. 36) and Wo. Ostwald and Martin H. Fischer in a brief quotation from Zsigmondy (p. 76). He quotes and demolishes Pauli, with whom Ostwald and Fischer likewise disagree. All told, Loeb's book is written from the standpoint of an advocate pleading his cause, rather than from that of a judge deliberately weighing all the evidence, and this brings inherent weakness. JEROME ALEXANDER.

Recent Chemical & Metallurgical Patents

American Patents

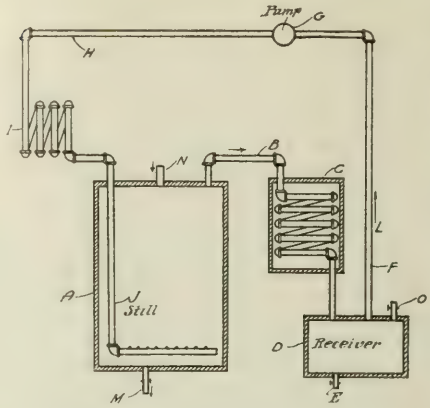
Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Tar Distillation—In the distillation of tar, the progressive decomposition which takes place results in the formation of "free" carbon and pitch. The greater the amount of these products formed the less the amount of tar oils recovered and hence, the less the value of the products. For the purpose of assuring the highest possible yield of these more valuable tar oils, John M. Weiss of New York has invented the distillation method shown in the accompanying drawing.

The basis of this process is the agitation of the tar during distillation with a large amount of some gas chemically inert toward tar and containing little if any oxygen. The gases available include nitrogen and CO_2, which are the principal constitutents of air after the oxygen has been used. This type of agitation has been found to increase the oil yield materially.

For best results an amount of gas not less than 1 cu.ft. (measured at ordinary temperatures and atmospheric pressure) per minute per 100 gal. of original material introduced in the still should be recirculated and an amount greater than 20 cu.ft. per minute per 100 gal. of original material to be distilled does not seem to present any substantial advantage in obtaining a higher yield of oil than the lesser amounts. The gas should also be heated before being introduced into the still.

As illustrative of how the process can be applied to tar-distillation reference may be made to the appended illustration. A still *A* heated by any suitable means and provided with a drawoff *M* and a filling line *N* is connected by a pipe *B* to a condenser *C*, which delivers into a receiver *D* with a drawoff *E*. From the top of the receiver a pipe *F* leads to a pump *G* and thence by a pipe *H* to a superheater *I* and by the pipe *J* to the bottom of the interior of the still communicating with it through a perforated pipe. The inlet pipe *O* serves as a vent or for the introduction of gas into the system. The arrows *L* show the direction of gas flow.



The still is charged with the tar to be distilled and the pump *G* started and a suitable gas is drawn in through pipe *O* until the system is filled. The system is then closed and heat applied, the gas being circulated at the desired rate. Distillation starts and is continued with the circulation maintained until the residue in the still is of the desired consistency, the volatile constituents being carried off by the circulating gas from still *A* and condensed in the condenser *C*. The heat and gas circulation are then discontinued and the residue is removed from the still *A*.

The following results illustrate the advantage which may be obtained by the use of this process in the distillation of a byproduct coke-oven tar. The particular tar used had a free carbon content of 8.5 per cent. Passage of gas in all cases was made at the rate of about 15 cu.ft. per minute per 100 gal. of material introduced in the still.

	Per Cent by Wt., Oil Obtained	Per Cent by Wt., Pitch Obtained,	Pitch Air Melting Point, Deg. F.	Pitch per cent Free Carbon
Distillation without agitation	40.1	57.8	280	40.7
Air used not recirculated	33.0	63.0	286	35.1
Nitrogen recirculated	52.0	46.4	277	27.2
Carbon dioxide recirculated	51.2	46.7	270	28.2
Mechanically stirred	40.0	57.9	300	46.5

(1,418,893—John M. Weiss, assignor to The Barrett Co., June 6th, 1922.)

Retort—In many manufacturing operations where retorts, furnaces and the like are subjected to a high temperature it is desirable to employ iron or other similar relatively cheap and plentiful metal as the retort or furnace material. For example, in the manufacture of coal gas, oil gases and in certain processes employed to effect the fixation of atmospheric nitrogen, iron retorts or furnaces would be highly desirable were it not for the fact that corrosion is quite rapid at the high temperatures required in these processes. The rapid deterioration and destruction of retorts or furnaces consisting of iron or other similar metal involve in many cases a prohibitive maintenance cost and a consequent or necessary elimination of iron as a furnace material for such purposes.

This invention consists in coating the iron or other cheap basic material with a coating which offers substantial resistance to the corrosive action of the gases generated. In this way the life of the retort is greatly prolonged, and the upkeep expense appreciably reduced. An alloy of nickel and chromium in the proper proportions with or without the addition of smaller quantities of other metals serves as a protective coating for the iron retort or furnace. Such an alloy may consist of 85 per cent nickel and from 10 to 15 per cent chromium, the variations in the latter depending upon the amount of impurities which may be present such, for example, as iron, manganese and carbon. This alloy should be sprayed on the base metal in a molten state or coated on in some other form so that a uniform, dense and compact coating is formed over all surfaces of the retort. (1,422,878; Floyd J. Metzger, of New York, N. Y., assignor to the Air Reduction Co., of New York. July 18, 1922.)

Refractory Silica Brick.—It is a well-known fact that ordinary refractory silica bricks show a tendency to swell or expand when used in high-temperature furnaces, this gradual increase in volume resulting in disintegration and destruction of the furnace structure. In the endeavor to do away with this disadvantage, it has been discovered that a long-continued baking process at a temperature approximately 1,400 deg. C. obtains at least the partial transformation of the quartz in the brick material into tridymite and results in the production of a brick of approximately constant volume. This process is expensive, however, and the present invention is offered as a cheaper and surer way of accomplishing the same end.

In this process, small quantites of a phosphate or similar material such as boric, tungstic or molybdic acids or their salts are introduced during the process of mixing the quartz with the clay cement or lime. If, then, the brick is heated to a temperature of about 1,300 deg. C. for about 8 hours, it is found that most of the quartz is transformed into allotropic forms of lower specific gravity.

It is claimed that in this way refractory silica brick may be manufactured from quartz which will have substantially constant volume under high temperatures. (1,420,284; Orazio Rebuffat, Naples, Italy, assignor to Pomilio Bros. Corporation, New York. June 20, 1922.)

Gas Producer—The producer is a downwardly widening chamber provided at the base with a steam-generating space located laterally or in an annular ring above the lower section of the combustion chamber. The air for combustion is so directed past the outlet of this steam-generating chamber as to carry moisture into the fuel bed with it. The object sought is durability of construction and higher gas production efficiency because of the generation of small quantities of water gas mixed with the producer gas. (1,414,109; F. M. E. Blass. April 25, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Last Minute Changes in Tariff Bill Boost Items on Chemical Schedule

enate Passes Fordney-McCumber Bill by Vote of 48 to 25—Bursum Amendment Replaces Dye Embargo—Flexible Provision Extends to 1924

WHEN the Senate concluded its consideration of the tariff bill in ommittee of the whole and took up the easure in the Senate proper, no fur- er vote on the chemical embargo ature of the bill was taken. This was ue to the fact that the necessary votes reverse the decision reached in the mmittee of the whole could not be unted. Apparently three votes were cking to insure the adoption of the nbargo. It then was decided that the ursum amendment would be the next st thing and the friends of the chemi- l industry reluctantly decided not to sk another roll call on the embargo.

Some are of the opinion that the ursum amendment is preferable to an nbargo, since it will last through the e of the act and obviates the necessity making the whole fight over again at e end of the year.

While the average of the specific tes are admittedly high in the bill as whole, Chairman McCumber of the inance Committee contends that the erage ad valorem rates are lower an in any Republican tariff bill acted heretofore. The Senate ma- rially reduced the rates prescribed in e House bill, with the exception of ose on coal-tar products and those in e agricultural schedule. These rates re increased materially.

Flexible Provision

One of the very important phases of e bill is its provisions for flexible riff. This is the first time any asticity in tariff rates has won the proval of either house. While the endment proposing to enlarge the riff Commission did not prevail, the mmission is authorized to hold hear- gs and to conduct continuous investi- tions with the idea of remedying any equities that may be found in tariff tes. The Tariff Commission will sub- t its finding of facts to the President, o is empowered until July 1, 1924, to ange rates, provided that no change, her up or down, is to exceed 50 per nt. The date of July 1, 1924, was se- ted by the majority party so that in e event of a change of administration e power would not be conveyed to a mocratic President.

The most drastic change made by the nate in the tariff bill came in the al week when an amendment pro- sed by Senator Bursum of New Mexico was accepted, increasing the rates of duty on coal-tar products and changing the basis of valuation on these dyes and chemicals from foreign to American.

Acceptance of the Bursum amendment in the committee of the whole was by a vote of 38 to 23 and this action was sustained by a vote of 39 to 31 when the bill was reported to the Senate proper. This is in contrast to the vote of 32 to 38 by which the proposed extension of the dye embargo failed of approval July 15.

Dye Rates Increased

The Bursum amendment increases the duty on coal-tar intermediates from 50 per cent ad valorem and 7 cents per pound based upon foreign valuation to 75 per cent ad valorem and 10½ cents per pound based upon American valuation. It increases the duty on coal-tar chemicals and dyes from 60 per cent ad valorem and 7 cents per pound on foreign valuation to 90 per cent ad valorem and 10½ cents per pound on American valuation. The increase amounts to more than 100 per cent, due to the change in figures and in the basis of valuation. It is provided that whenever there is no competitive American article affording a means of computing the American valuation, the ad valorem rate shall be based upon the foreign value or the export value, whichever is the higher. A proviso was included that in the exercise of the powers to change rates given to the President in the elastic tariff sections of the bill, no increase in rates may be made on coal-tar products.

Senators Moses and Smoot vigorously opposed the Bursum amendment, which was advocated by its sponsor and by Senators Wadsworth, Sterling, Lodge, Ransdell and Jones. Debate at times waxed warm, especially during the consideration in committee of the whole.

Senator Wadswoth introduced a letter written by Secretary of War Weeks, urging protection of the chemical industry of the United States as a matter of national defense. The letter, addressed to Senator McCumber, chairman of the Finance Committee, advocated extension of the embargo, but was read to the Senate in connection with the fight for higher rates.

Senator Moses of New Hampshire had previously demanded a separate vote on these rates before their final adoption, but when the matter was presented he declared that in view of the very decisive vote he would offer no further objection to their retention. His withdrawal from the fight against the dye provisions in such manner was the cause of much speculation and apparent discomfiture on the part of the proponents of the embargo provisions.

Embargo Abandoned

With the high rates of duty written into the bill it became apparent from the start that all chances of the embargo being adopted were eliminated. The rates were denounced on the floor of the Senate by varions Senators, but it was evident that the change of front was due to the knowledge that the flexible tariff provisions of this same measure will operate to lower excessive levies on many coal-tar products.

Senators Sterling and Lodge both contended that the increases were necessary to protect the American chemical industry from the standpoint of national defense. They asserted that under the elastic tariff provisions of the bill, the President undoubtedly would find it necessary and advisable to increase the rates on coal-tar products, but that an investigation by the Tariff Commission, necessary to present the facts to the President, would consume 8 or 10 months, then 60 days would have to elapse before a proclamation increasing duties could become effective and that in the meanwhile there would be a flood of German imports which would put the American industry out of business.

Acetaldehyde and Related Products

Several important changes in the chemical schedule of the tariff bill were made before the measure was passed by the Senate and sent to conference. After having first accepted an amendment by Senator France reducing the duty on acetaldehyde and allied chemicals from 6 cents per pound and 30 per cent ad valorem, to 20 per cent ad valorem, the Senate on motion of Chairman McCumber of the Finance Committee two days later reversed itself and restored the higher rate. Senator France, in securing adoption of his amendment, stated that these chemicals are not produced in the United States. In securing reversal of the action, Senator McCumber declared that there is production of these chemicals. Acetaldehyde and its related products—aldol, aldehyde ammonia, butyraldehyde, crotonaldehyde and paracetaldehyde—are finding an increasing use as intermediates, in manufacturing pig-

(*Continued on page* 375)

Chemical Foundation Defended in Senate

Senators Underwood and Wadsworth Express Support in Dye Tariff Discussion

As a result of the publicity which has been given to the Chemical Foundation matter and the speeches made in the Senate by Messrs. Underwood and Wadsworth, it is believed that the public has been convinced that there are two sides to the case. The fact that the Foundation has been defended by outstanding Senators of each party has had the effect of indicating that the defense is not being made for partisan political reasons.

Senator Wadsworth brought his defense of Francis P. Garvan, president of the Foundation, into his spirited support of the Bursum amendment to the dye schedule. He declared that if ever there was a deliberate attempt to break down and weaken the power of American self-defense, it has been made in connection with the American organic chemical industry. Senator Wadsworth's words were, in part, as follows:

> From what I have been able to learn of the history of organic chemistry in this country, especially in the dye industry, prior to our entrance into the World War, during our participation in the war and since the war, I am convinced that long before the United States actually declared a state of war the German Government and the cartel were in effect, although slyly, waging war against the peace and the safety of the people of the United States. We did not wake up to that situation until we ourselves got into the fight. The letter of the Secretary of War points out very briefly—all too briefly, according to my view—but sufficiently for the purposes of this discussion the predicament in which this republic of ours found itself when we were called upon to engage in our own defense.
>
> We went into the war and we learned the lesson at the cost of billions of dollars and many thousands of lives. We participated in the great victory and at the conclusion of the contest we asked for no territory; we asked no reparations; we asked for nothing of value to be taken from the vanquished, and we received nothing.
>
> We have the opportunity, as the result of the contest, an opportunity seized upon legally to maintain our public health with our own resources and without depending upon any foreign government or any foreign cartel, corporation or trust. We have secured the opportunity—and have secured it legally and properly as a result of our sacrifice and our efforts in the war—to maintain our national defense without depending upon any other nation, government, trust or cartel of any kind whatsoever. That is the prospect which confronts the American people today.
>
> It does not do, Mr. President, in discussing this matter, to drag the names of American citizens into the discussion and accuse them of dishonest motives because, forsooth, they take an interest in the perpetuation of this chemical industry here in America. It does not do, Mr. President, to bring inferences and insinuations against Francis P. Garvan; not by any means. I care not what his politics are; I understand he is a Democrat; I have known him since 1895 and known him well. He is an honest man, and he has no thought in his mind or motive in his heart except the safety of this country.
>
> I shall not discuss upon this occasion the wisdom or the unwisdom of the policy adopted by the last administration in the handling of the patents covering the dyes through the Chemical Foundation as trustee; that is not a part of this discussion; but I know full well, if I know anything about the psychology of this situation, that the attack upon the Chemical Foundation had a most material influence upon the votes cast on the question of the tariff on dyestuffs. It is for that reason that I deplored it at the time, although not publicly, for I had no opportunity to do so, but I deplore it now. It is not the question at issue.
>
> This organic chemical industry lies at the bottom of nearly everything we use. I firmly believe that the progress of the race from now on will be measured more by the progress in organic chemistry than in any other human effort. I believe that in organic chemistry lies the solution of the secrets of the past and of the future. I believe that its establishment and maintenance in this country, even under an embargo, mean the happiness, the progress, and the security of 100,000,000 people.
>
> I want to see the chemical laboratories of this country multiplied again and again. They cannot be multiplied, they cannot be maintained, no student will attempt to attend their courses, unless there is a chemical industry in which those students upon graduation may find a career.
>
> The two things—research in the laboratory and the successful conduct of a chemical industry—go hand in hand. Neither can proceed without the other.

The New York Senator concluded by expressing regret at the defeat of the embargo and a plea for the passage of the Bursum amendment.

Steel Treaters Announce Detroit Convention Plans

A preliminary program has been issued for the joint meeting of the American Society for Steel Treating and the American Drop Forging Institute, Oct. 2 to 7. The exposition of equipment will be held in the General Motors Building, and is open each day from 10 a.m. to 10 p.m. Technical sessions will be held in adjoining rooms, as follows:

Monday, Oct. 2, 2:00 p.m., general business meeting of the society.

Tuesday, Oct. 3, 10 a.m., Carburizing; 4 p.m., Metallurgical Education; 9:30 p.m., smoker.

Wednesday, Oct. 4, 10 a.m., General Heat-Treating; 2 p.m., Drop Forging; 4 p.m., Round Table on Practical Hardening; 9 p.m., carnival, frolic and dance.

Thursday, Oct. 5, 10 a.m., Tool Steels; 2 p.m., Alloy Steels; 4 p.m., Round Table on Practical Hardening; 7 p.m., banquet at Hotel Statler.

Friday, Oct. 6, 10 a.m., Non-Ferrous Session; 2 p.m., research.

A number of Detroit manufacturing establishments have extended an invitation to inspect their operations. Parties will be formed, and leave the General Motors Building daily at 10 a.m. and 2 p.m. During the week the committee on hardness testing of the National Research Council will also hold a symposium on hardness testing.

Accuse Janitor of Platinum Theft From Bureau of Standards

Responsibility for recent thefts of platinum from the laboratories of the Bureau of Standards is thought to have been fixed by the arrest of a negro janitor. Most of the stolen platinum was recovered from a Washington jeweler, to whom the janitor is said by the police to have sold the platinum in the very small amounts which he is said to have taken from time to time.

Rapid Strides in German Industrial Standardization

American Engineer Reports Inten Interest and Hearty Support of Standardization

"The day may not be far dista when American manufacturers w receive inquiries from oversea cou tries to furnish goods according to t German national standards, and behooves us to plan in time to me such conditions."

This statement is contained in a co munication to the American Engine ing Standards Committee from Osc R. Wikander, an American engine who has just returned from Germa where he represented that commit in conferences concerning the int national standardization of ball bearin

Describing the great strides standardization that have been made German industries. Mr. Wikander sa

"There is no doubt in my mind t one of the main reasons why forwa looking Germans force their standa ization work is because they want introduce German standards in great importing countries, and p sibly in the whole world. Holla Switzerland, Austria, Sweden many other European countries foll the German lead very closely.

"It was only a few years ago t the Normenausschuss der Deutsc Industrie, an organization corresp ing to our American Engineeri Standards Committee, was formed, the amount of work which it has ready accomplished is stupendous. Normenausschuss has already iss several hundred sheets of appro standards, and about twice as many already published as proposed sta ards. This enormous output of German organization has led many believe that it was merely a fact producing 'paper standards' and that work was not to be taken very serious A personal investigation convinced that this is not the case, and I fo that the great output of standards merely due to the enormous efforts forth and to the enthusiasm of great majority of the interested part

"This enthusiasm is due to a m or less general recognition, crea under the pressure of war conditi of the great economic value of standa ization and to the very generally cepted opinion that a standardi industry would be one of the strong weapons in Germany's struggle economic rehabilitation."

Centrifugal Casting Equipme Installed at Pipe Works

The United States Cast Iron Pip Foundry Company has recently eq ped its North Birmingham plant four machines to be used in the ma facture of cast iron pipe by de Lavaud centrifugal method.

It is stated that this type of pipe can be made much lighter t pipe made by the old method and at same time will stand greater press

Denies Fraud in Sale of Nashville Powder Plant

Purchasers of Old Hickory Smokeless Plant Plead Not Guilty of Conspiracy to Defraud Government

Ernest C. Morse, former director of ...es of the War Department and now ...sident of the Foreign Sales Supply ... of New York, pleaded not guilty ... the District of Columbia Supreme ...urt to the indictment charging con...racy to defraud the government in ...nection with the sale of the Old ...ckory plant at Jacksonville, Tenn.

Over the protest of government ...nsel the court granted the defend...t until Sept. 20 to file a motion to ...ash the indictments. He furnished ...000 bail on each of the two charges.

Everly M. Davis, president of the ... M. Davis Chemical Co., and Alexan...r W. Phillips, associated with Davis, ...th of New York, who were indicted ... the Old Hickory case with Morse, ...re also arraigned and pleaded not ...ilty.

Attorney Mayer, who accompanied ...rse to Washington, later made the ...llowing statement:

"Mr. Morse appeared today in the ...ited States Court and pleaded not ...ilty to the indictments found against ...m. At the time of the investigation ... the Graham committee, Mr. Morse ...peared voluntarily, waived all im...nity and under oath answered all ...estions of the members of the com...ttee.

"It is regrettable and surprising that ...r. Morse, who occupied the position ... director of sales of the War Depart...ent and who, under instructions of ...e Secretary of War, directed the sale ... more than two and one-half billions ... dollars' worth of government prop...ty, should not have been called before ...y other government agency or official ...vestigating the sale of war surplus.

"The indictments having been found ...der such circumstances, Mr. Morse ... obliged to wait until the trial of the ...dictments, to place before the public ...cts which will completely vindicate ...m of the charges made."

Open-Hearth Patent Complications Relieved

All patents and patent applications ...lating to combustion in regenerative ...rnaces, known as the McKune, Dan...rth and Engler systems, have been as...gned to the Union Trust Co., of Cleve...nd, by the Miami Metals Co., Blair ...ngineering Co., and Arthur G. McKee ... Co. Acting as trustee, the Union ...rust Co. has appointed the Blaw...nox Co. of Pittsburgh agent for ...e exclusive sale and manufacture of ... equipment by these patents. This ...nsolidation will assure to the steel ...dustry the best that has been devel...ed under all of the above mentioned ...sic patents, combined in one design, ...d will also remove the possibility of ...y patent interference in the use and ...eration of these equipments.

American Engineers Represented at Rio de Janeiro Exposition

The appointment of Calvin W. Rice, secretary of the American Society of Mechanical Engineers, as official delegate to the Engineering Congress to be held in connection with the International Exposition at Rio de Janeiro is announced at the national headquarters of the society in New York City. Mr. Rice, who goes as the emissary of organized engineering in the United States, and who for purposes of representation at the Congress has been elected an honorary vice-president of the society, will sail from New York Aug. 23 on the steamship Pan-America, which will convey Secretary of State Charles E. Hughes and his party to the Brazilian capital.

Mr. Rice's journey was called by officials of the society the opening of a new chapter in international relations among engineers. For many years, it was stated, this society has been active in laying the groundwork of a close union of thought and effort among the engineers of the world as a part of an elaborate plan of public service which is being gradually linked to the technical activity of the organization. In addition to the American Society of Mechanical Engineers, Mr. Rice will represent at the Congress the Federated American Engineering Societies, the American Institute of Electrical Engineers, the Engineering Foundation, the John Fritz Medal Board, the Engineering Division of the National Research Council, the Engineers' Club of New York City and other organizations.

A dinner in honor of Mr. Rice was given at the Engineers' Club, New York City, Aug. 21. Distinguished engineers, publicists and educators from many cities were present. John W. Lieb, vice-president of the New York Edison Co., acted as the toastmaster. The committee of arrangements included Charles F. Rand, chairman of the Engineering Foundation; W. F. M. Goss, president of the Railway Car Manufacturers' Association, and Roy V. Wright, of the Simmons-Boardman Publishing Co.

Chemical Warfare Gas Used as Fumigant

The work of the Chemical Warfare Service on the use of cyanogen chloride as a fumigant for ships and on the use of toxic materials in anti-fouling paints was described in these pages July 5, 1922. It was stated that this work was done in co-operation with the navy's marine biological laboratory at Beaufort, S. C. This statement was in error, as the laboratory is located in Beaufort, N. C.

The work in question was under the direction of Captain H. Williams of the Bureau of Construction and Repair, Navy Department, Washington, D. C. Captain Williams is a specialist on the use of toxic materials in anti-fouling paints.

Predicts Growth of Chemical Export Trade

C. R. DeLong, Chief of New Chemical Commodity Division, Optimistic on Prospects for Development

Expressions from American consuls in many countries as well as from other agents of the Department of Commerce, coupled with conclusions being reached in the course of economic studies being made at Washington, lead C. R. De Long, chief of the Chemical Commodity Division, to predict a gradual expansion of the chemical export trade. He expects American manufacturers to hold many of the markets supplied by them during the war and expects to see them compete successfully with the Germans in many fields. He does not believe that German competition in Latin America and in some other countries is as formidable as many think.

As internal readjustment in Germany catches up with the depreciated mark, German manufacturers will have to advance their prices, but judging from the reports on file in Mr. De Long's office, purchasers of chemicals in many countries have had unfortunate experiences with materials of poor quality and are more ready than ever to listen to quality arguments. Mr. DeLong thinks the danger from retaliatory duties, likely to grow out of the passage of the pending tariff bill, have been over-played. Since practically all countries have been forced to increase their tariffs recently, there is a much more general realization of the need for such action.

Plans of New Division

One of the first steps Mr. DeLong will take in the effort to make his division serviceable in the development of the export trade will be to obtain the appointment of advisory committees with whom he can keep in close contact. He will ask each individual trade concerned with exports to designate such a committee. At the present time, the lists of firms engaged in the exportation of chemical commodities are being revised carefully so that advance notices of probable needs abroad may be sent to them.

Plans now are being formulated for a statistical service covering those commodities where the need is apparent. The great mass of reports which reach the department daily from all parts of the world will be carefully scanned for current information which has a bearing on the demand for chemicals. In addition special economic studies of purely chemical interest will be undertaken from time to time. In some cases this will cover the world situation as it pertains to some chemical commodity and in others the possibilities of extending the market for American chemicals in a single country will be studied.

A number of important industrial groups have already offered their co-operation in this work and Mr. DeLong is hopeful that the industry will stand squarely behind the new division.

Electrochemical Society Meeting Promises Well

Symposiums on Electrodeposition and Industrial Heating Features of Technical Sessions

Final arrangements for the forty-second general meeting of the American Electrochemical Society, at Montreal, Que., are being made and indications are that the meeting will be a success.

The meeting will be opened by President Schluederberg on Thursday morning, Sept. 21. The technical program will include the presentation and discussion of papers on electrolysis and electroplating. The recently organized division on electrodeposition, of which G. B. Hogaboom is chairman, will be well represented and take active part in the discussion of these papers. One of the papers of the Thursday morning session will deal with the physical properties of electrolytic iron—a product which is being turned out commercially, contrary to all predictions of 10 years ago. There will also be papers on zinc, brass and other metals.

Industrial Heating Symposium

On Thursday afternoon and Friday morning a very interesting symposium on "Industrial Heating" will be in progress. The electrothermic division, of which Bradley Stoughton is chairman, held a most successful symposium on "Electric Cast Iron" at the Baltimore meeting last April, and will be in charge of this discussion. Twelve papers especially prepared for this session and dwelling on industrial heating in electric furnaces, other than fusion and melting furnaces, will be open for discussion. There will be papers on the following subjects: "History of Industrial Heating," "Principles of Design of Furnaces," "Comparison of Fuel Costs in Different Types of Electric Furnaces, and With Combustion Furnaces," "Resistor Materials," "Specific Heats," "Electric Conductivity of Insulating Materials at Industrial Furnace Temperatures," and "Heat Transfer."

An excursion to Shawinigan Falls has been arranged, affording members a rare opportunity to inspect the various industrial plants of one of the most progressive centers on the continent.

A popular lecture on the "Progress in Physical Science" is scheduled for Thursday evening. Section Q will be in charge of an old-fashioned smoker on Friday evening.

Headquarters for the meeting will be the Hotel Windsor.

Hoover Denies Report of Metric System Indorsement

Wide publicity has been given a news article to the effect that Secretary of Commerce Hoover has indorsed the metric system. Mr. Hoover states that he is at a loss to understand how such a report originated. He has not indorsed the compulsory use of the metric system, he says.

Manufacturing Chemists' Association Meets

The regular monthly meeting of the Manufacturing Chemists' Association was held in New York, Aug. 16. The association's committee on standardization announced that its report is in preparation and will be printed within a few weeks. The practicability of glass-lined steel carboys for acid shipment was discussed and referred to a committee for further consideration.

Free Port Provision Part of Tariff Bill

Establishment of Free Entry Ports for Reshipping Seems Assured by Senate Support

Establishment of foreign trade zones at a number of American ports practically is assured by the action of the Senate on Aug. 16 in adopting, with practically no opposition, an amendment to the tariff bill which would authorize the creation of such zones. The plan for the so-called free port has been denounced by ultra-protectionists as a free-trade scheme. To meet some of the objections voiced against the proposal, the Senate committee eliminated from the original amendment the authority to establish manufacturing enterprises within the free zone. It will be possible, however, to store, exhibit, break up, repack, assemble, distribute, sort, refine, grade, clean, mix and otherwise manipulate foreign or domestic merchandise in an area where no compliance with the laws and regulations governing the entry of merchandise will be required.

Vexations of Custom House

Under existing law any goods landed in this country must pass through the Custom House. If they are re-exported 99 per cent of the duty paid is refunded. In addition to the loss of 1 per cent of the duty, there is the more important consideration of vexatious and costly delays in complying with the red tape which accompanies entry through the Custom House and the subsequent dispatch of the foreign goods after they have been mixed with domestic merchandise or assembled in different forms.

Should Aid Shipping

The delays and annoyances of this procedure were such as to discourage almost entirely any handling of foreign merchandise in transit. By making this possible it is believed that substantial advantages will ensue to American industry and to American shipping. Many ships come to the United States in ballast it is declared which would bring cargoes for transshipment to various other countries were it not for the difficulties of our customs regulations. One of the great advantages of allowing transit privileges on foreign cargoes is the fact that on their re-assembly at American ports domestic merchandise will be mixed with the shipments of foreign origin.

Demand Action on Water Pollution Bill

Permanent Organization Formed to Push Representative Appleby's Bill Through Congress

Officials of Atlantic seaboard cities and others interested in ending the pollution of navigable waters by oil have formed a permanent organization to be known as the National Coast Anti-Pollution League. The new body elected as president Gifford Pinchot, Republican nominee for Governor of Pennsylvania, and adopted a resolution calling upon Congress to pass the bill of Congressman T. Frank Appleby of New Jersey making it a federal offense, punishable with a fine of $2,500, to dump oil on navigable waters.

Will Support Appleby Bill

At a meeting of representatives from various resorts and cities on the Atlantic coast held in Atlantic City last week this action was taken. Meetings were held on Aug. 10 and 11, at which prominent speakers emphasized the damage done by oil pollution. The feeling was unanimous that steps should be immediately taken to abate the menace. Representative Appleby said that in 1919 the total tonnage of American oil-burning vessels was 5,000,000, but that in 2 years it has increased to 19,000,000. Oil pollution has increased correspondingly, he said.

Considerable discussion centered around the question of whether the resolution should be worded to support Congressman Appleby's measure specifically. It was finally decided to pass a resolution demanding passage of the Appleby measure at the incoming session of Congress. Copies of the resolution will be forwarded to members of Congress.

Government to Consider Means

A meeting of representatives from the departments of the government concerned in the water pollution problem will shortly be held at the Department of State.

These delegates will consider the general issues involved in connection with the calling of an international conference of maritime nations, in pursuance of the joint resolution of Congress, approved July 1, 1922, with a view to the adoption of effective means for the prevention of the pollution of navigable waters by oil-burning and oil-carrying steamers.

The Department of State will be represented by Stanley K. Hornbeck; the War Department by Lieutenant-Colonel G. B. Pillsbury, Engineers Corps of the army; the Navy Department by Captain H. E. Lackey; the Interior Department by R. Van A. Mills, Bureau of Mines; the Department of Agriculture by George A. Lawyer, Chief Game Warden; the Department of Commerce by Henry O'Malley, Commissioner of Fisheries, and the Shipping Board by W. E. Griffith.

Tariff Bill Boosts Chemical Items

(Continued from page 371)

ments, in the production of synthetic resins and as accelerators in rubber vulcanizing. Aldol has promising future use in the flotation process of ore concentration, particularly copper ore.

A similar fate was suffered by an amendment to the rate on sodium nitrite, except that in this case the amendment increased the duty while the Senate subsequently reduced it. Senator Jones of Washington secured adoption of an amendment increasing the nitrite rate from 3 to 5 cents per pound, the Senate on motion of Senator Robinson reversing this decision the following day and restoring the duty of 3 cents, which was the rate as the bill came from the House.

Camphor Rates

Through an amendment offered by Senator McCormick and indorsed by Senator Smoot, the duty on camphor will be increased to 25 per cent ad valorem whenever it is made to appear to the satisfaction of the President that manufacturers in the United States are producing 2,000,000 lb. of synthetic camphor a year. The rates carried in the bill are 1 cent a lb. on crude camphor and 6 cents per lb. on refined or synthetic camphor. These specific duties are materially lower than an ad valorem duty of 25 per cent would be. The object of the amendment is to encourage the production of synthetic camphor in this country as a club over the Japanese control of the natural camphor market. During the war the Monsanto Chemical Co. of St. Louis spent about $500,000 in a plant for the manufacture of synthetic camphor, according to Senator Smoot, but this is threatened now by the Japanese competition. Whenever the total output of synthetic camphor in the United States reaches 2,000,000 lb. a year, the higher duty will go into effect to protect the industry.

Arsenic on Free List

While the bill was under consideration in the Senate, Southern Senators were successful in having arsenious acid or white arsenic stricken from the dutiable list and placed on the free list. This product is being used extensively in fighting the boll weevil and other pests of agriculture. The House imposed a rate of 8 cents per pound, the Senate Finance Committee reducing this to 2 cents and this final action makes it duty free.

Magnesium Compounds

Rates on several magnesium products were reduced by the committee. As adopted by the Senate they are: carbonate, precipiated, 1½ cents per pound; chloride, anhydrous, 1 cent per pound; chloride, not specially provided for, one-half cent per pound; sulphate or epsom salts, one-half cent per pound; oxide or calcined magnesia, medicinal, 3½ cents per pound; oxide or calcined magnesia not suitable for medicinal use, 3½ cents per pound, this last being an increase over the original rate.

Barytes

Barytes rates were reduced by the Finance Committee to the figures of the House Ways and Means Committee, which are $4 per ton on the crude ore; $7.50 per ton if ground, and 1 cent per pound on precipiated barium sulphate or blanc fixe.

Chalk

The Finance Committee increased from 20 to 30 per cent the duty on chalk or whiting or paris white, if dry, ground, bolted or precipitated. The original recommendation of the committee was for a 35 per cent duty, but this was reduced to 20 per cent when the paragraph was adopted in May, being raised to 30 per cent in the last week of Senate consideration of the bill.

Vegetable Extracts

On recommendation of the Finance Committee, the duty on vegetable extracts for dyeing and tanning—chestnut, cutch, chlorophyll, divi-divi, fustic, hemlock, logwood, mangrove, myrobalan, oak, Persian berry, quebracho, sumac, saffron, safflower, saffron cake, valonia, wattle and others not specially provided for—was reduced from 25 to 15 per cent.

Potassium Compounds

The Finance Committee increased from 1 cent to 2 cents per pound the rate on potassium chlorate and perchlorate. In the potassium paragraph of the bill the committee also struck out the proviso which imposed 15 per cent duty ad valorem duty for 5 years, in addition to the specific rates, the effect being to reduce all rates on potassium products.

Metals Schedule

As passed by the Senate, the Fordney-McCumber tariff bill provides rates in the metals schedule generally lower than those fixed in the measure as it was adopted by the House. This difference was true as the bill was reported by the Senate Finance Committee, and during the weeks of consideration the changes in metals from the committee's original figures have been downward with only a few exceptions.

In the last week of Senate consideration of the bill the Finance Committee reduced the rate on high-speed steel 7 per cent by cutting the duty on steel valued at more than 16 cents per pound to 20 per cent ad valorem, from the original figure of 25 per cent, and decreasing from 10 to 8 per cent the additional duty paid on steel containing more than six-tenths of 1 per cent of metallic alloy.

Metallic Magnesium

Rates on metallic magnesium were reduced in the final days of Senate debate on the bill on motion of Senator Phipps of Colorado, which was not resisted by the Finance Committee. As rewritten, the rate on magnesium in the crude, ingots, alloys or scrap stands in the bill at 10 cents per pound instead of 50 and 40 cents, as provided in the different classifications as originally drawn; the rate on the metal in coils, plates, sheets and other unfinished forms is 20 cents per pound instead of 40 cents, while the rate on ribbons, tubing, powder and other finished articles remains at 40 cents per pound upon the metallic magnesium content and 20 per cent ad valorem.

Aluminum

Repeated efforts were made at various stages of the bill in the Senate to reduce the duty on aluminum from the figures of 5 cents per pound on the crude and 9 cents per pound on the prepared, which were fixed by the House and unchanged by the Finance Committee, but all of these were unsuccessful. Vigorous attacks upon the Aluminum Company of America were made by the Democratic side and Senator Reed of Missouri insinuated that the influence of Secretary of the Treasury Mellon, listed as a director of this corporation, had been felt in fixing these rates. The latter charge brought a heated rejoinder from Senator McCumber, who denied that any person connected with the Treasury Department had had any connection with determining these rates and pointed out that in the first nine months of 1921 imports of unmanufactured aluminum were more than 24,000,000 lb., while exports were barely more than 1,000,000 lb.

Nickel

The Senate committee reduced from 5 to 3 cents per pound the rate on nickel. No change was made in the House rate of 1½ cents per pound on lead-bearing ore. The House rates on zinc ore, which provide a sliding scale according to the zinc content, also were unchanged, but rates on manufactures of zinc were increased slightly. The basic copper rate of 2½ cents per pound in rolls, rods or sheets was not changed.

Pig Iron

The duty on pig iron, kentledge and spiegeleisen was reduced from $1.25 per ton to 75 cents per ton during the last week of Senate consideration of the bill and scrap iron and scrap steel was reduced from $1 to 75 cents per ton.

The rates on all alloys were reduced below the figures fixed by the House Ways and Means Committee, and in its final summing up of the bill the Senate made no changes from the figures which were fixed upon these alloys in May and June.

Most of the reductions made in the metals schedule came in the manufactured articles. In the last week of consideration, the Finance Committee increased by 5 per cent the duties on woven-wire cloth of any metal, but while the figures are five points above those fixed in the House bill, the rates actually are lower as the measure stands now because of the difference in the valuation basis used by the two houses of Congress.

Treasury Department Ruling Will Stop Import of Canadian Iron Oxide

Acting under the authority of the anti-dumping clause of the emergency tariff law of May 27, 1921, which forbids the dumping of imported merchandise into the United States at prices less than the product is sold for in the country of origin, the Treasury Department has issued an order forbidding the dumping of oxide of iron. In an order published by the Treasury Department, Assistant Secretary Clifford announces that after investigation it has been found that the oxide of iron manufacturing industry in the United States is being, or is likely to be, injured by reason of the importation into the United States of oxide of iron from the Province of Quebec, and that such merchandise is sold, or is likely to be sold in the United States at less than its fair value.

The effect of this announcement is to forbid the importation of oxide of iron from the Province of Quebec, unless American purchasers arrange to pay the price which is charged for the product in Canada. Section 201 of the emergency tariff law provides that if the Secretary of the Treasury finds that articles are sold in this country cheaper than in the country of origin, the importation of the merchandise is prohibited.

Tariff Bill Prohibits Import of U. S. Trademarked Goods

In the closing days of the Senate debate on the tariff bill, the Finance Committee introduced an amendment which was adopted and incorporated in the administrative sections of the measure, making it unlawful to import into the United States any merchandise of foreign manufacture which bears a trademark registered in the Patent Office by a person residing in this country.

This provision is of especial importance to the chemical industry as its application is particularly directed to trademarks on products of patents seized by the Alien Property Custodian during the war and sold to American corporations through the Federal Trade Commission or the Chemical Foundation.

As the tariff bill was reported to the Senate by the Finance Committee, practically the same provision was contained in the paragraph on coal-tar chemicals and dyes. It was stricken out of this paragraph several days before the item was taken up in debate because of objections entered by Senator Moses of New Hampshire. Nothing more was heard of the provision until the last day fixed for consideration of Finance Committee amendments, when it was re-introduced by the committee as a section of the administrative title of the bill. Senator Moses opposed it on a point of order, debate being cut off by the time the section was reached, but he was overruled and the section was adopted.

Du Pont Dye Royalties Amounted to $72,000

Answer to Foundation Suits Announces Payments Made to Treasury During License Period

Answer has been filed by E. I. du Pont de Nemours & Co. to the two suits brought against it and the Treasurer of the United States by the Chemical Foundation for an accounting of royalties paid for the use of German dye patents. The suits involve the money paid for the use of these patents from April 10, 1919, when they were purchased by the Foundation, to Sept. 1, 1920, on which date the government license, under which the operations had been conducted by the du Pont company, was terminated.

The action is based on the Chemical Foundation's contention that all moneys paid under license for the use of the German patents from the day they were purchased should go to the Foundation and not to the United States Treasury.

The du Pont company is party to the suit only because it has already paid the money into the United States Treasury, and the action seeks mainly to discover the amount so paid. In each case the answer recites that the company obtained its license from the Federal Trade Commission, and operated under this license until the date of its termination in September, 1920. It sets forth in each case the amount of money, $61,884.98 and $10,103.88, which was paid to the Alien Property Custodian from April 1, 1919, to September, 1920. The answer also says the amount paid was a fair and reasonable royalty for all use made of the inventions.

Employment Service Offered by Four Engineering Societies

Attention is called to an employment service for engineers of every variety of training and experience which is conducted by the four national engineering societies of the United States. This service brings in touch with the various business men the service of 50,000 trained technical men who are members of these societies and one of the objects of it is to show to the various commercial houses the aid which engineers are rendering to others in the same lines and to help these firms and corporations secure similar assistance. Men of engineering training are prominent in all branches of commercial endeavor and their creative ability is recognized as being of great help in the building up of the nation's wealth.

This service is in a position to supply chemical engineers, civil engineers, mechanical engineers, electrical engineers, sales engineers, production managers, superintendents and other trained executives. It is under the direction of W. V. Brown and is located in the United Engineering Building, 29 West 39th St., New York City. Service is free to both employer and to employee.

Refractory Companies Merge

The General Refractories Co., Pittsburgh, Pa., has arranged for a bond issue of $4,000,000, the proceeds to be used in part for perfecting a merger of different refractory interests. The company will take over the General Refractories Co. of West Virginia, as well as the Standard Refractories Co., Clayburg, Pa., the latter acquisition involving $1,500,000. The Claysburg works will be operated in conjunction with the company's plant at Sproul, Pa., in this same section. The company will operate, in all, twelve plants in Pennsylvania, Kentucky and Illinois, with annual output of 247,000,000 bricks and shapes. William C. Sproul is president of the company.

Personal

J. Thompson Brown has been appointed general manager of the explosives department of E. I. du Pont de Nemours & Co., Wilmington, Del., succeeding the late Charles A. Patterson.

R. H. B. Elkins, formerly manager of the New York office of the Duriron Co., Inc., of Dayton, Ohio, has been promoted to the newly created position of chemical engineer for the same firm. Mr. Elkins will make his headquarters at the New York office and will devote his entire attention to the solution of problems for the company's customers.

Prof. Grinnell Jones, of the chemistry department of Harvard University, has been called to Washington, where his services are to be required during the months of August and September by the United States Tariff Commission.

Dr. Victor K. LaMer has been appointed Cutting Traveling Fellow by Columbia University and will sail on Sept. 13 for a year's study and travel in England and on the Continent. He will investigate especially the subjects of food and physical chemistry.

George A. Prochazka, of the Central Dyestuff & Color Co., is in Europe with his family on a vacation trip.

Howard Rhode, of the Lehigh Portland Cement Co., Allentown, Pa., gave an interesting address on the "Manufacture and Marketing of Cement," before the members of the Square Club, on Aug. 8.

Obituary

William G. Price, head of William G. Price & Sons, Chester, Pa., leather manufacturers, died at his home, in Philadelphia, Aug. 7, aged 58 years. He was a member of the Manufacturers' Club and the Philadelphia Country Club, and widely known in the leather industry. He is survived by his wife, two sons and a daughter.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Dyes and Other Synthetic Organic Chemicals

A Brief Summary of Some of the Principal Features in the United States Tariff Commission's Recent Census of Production, Imports and Exports During 1921

AS WAS indicated in its preliminary report[1], the United States Tariff Commission's "Census of Dyes and Other Synthetic Organic Chemicals, 1921," shows an appalling decrease in production. Our output of finished dyes, 39,008,690 lb., was only 46 per cent of the 1920 production. Intermediates fell off 73 per cent in quantity. On the other hand, the total importations of coal-tar dyes during 1921 was in considerable excess of the 1920 receipts. Reducing the vat dyes to a single-strength basis, the total quantity of dyes imported in 1921 was 4,252,911 lb. and the value was $5,156,779.

Exports of domestic dyes for 1921 showed a decrease of 79 per cent as compared with the previous year. The combined value of exports of "aniline dyes" and "all other dyes" for 1921 was $6,270,155, while in 1920 it was $29,823,591 and in 1919, $15,728,499. Very significantly the commission states "this great reduction in our export trade may be attributed in part to the general business depression, but the chief cause was the appearance in the principal foreign markets, such as China, India, and Japan, of German dyes, with which the domestic producers have been unable to compete."

The Tariff Commission's census this year includes, for the first time, production statistics for all synthetic organic chemicals, whether derived from coal-tar, non-coal-tar or natural sources. Included among these are the acids, alcohols, esters, ketones, aldehydes, alkaloidal derivatives, carbocyclic compounds, etc., such as are used as perfume and flavoring ingredients, solvents, medicinals and in numerous industrial processes. The output of these materials in 1921 was 21,545,186 lb. and the sales amounted to 16,761,096 lb., valued at $13,746,235. Included in the production figure are 1,129 lb. of research chemicals, the sales of which totaled 428 lb., valued at over $18 per pound.

[1]See *Chem. & Met. Eng.*, vol. 27, No. 1, p. 31, July 5, 1922.

Dyes and Finished Products

The Tariff Commission accounts for the greatly reduced output of dyes in 1921 by (1) the loss of most of our export trade, (2) the large stocks carried over from the previous year and (3) the general business depression. In addition, reference might have been made to (*a*) the uncertainty regarding the tariff situation and (*b*) the continued inactivity of the principal textile mills resulting from the long-drawn-out labor difficulties.

The three dyes — sulphur black, indigo and agalma black 10B—accounted for 40.8 per cent of the total production of dyes in 1921. Sulphur black led with 7,832,696 lb. (20 per cent of total output); indigo was second with 6,673,968 lb. (17 per cent) and agalma black 10B followed with 1,426,194 lb. (3.7 per cent). The 1921 production when classified according to method of application on the fiber shows decreases for practically every class. Production and imports are compared graphically in Fig. 1. It will be noted that only in the case of vat dyes other

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	150.92
Last week	150.87
August, 1921	158
August, 1920	264
April, 1918 (high)	286
April, 1921 (low)	140

Prices for the twenty-five commodities included in this index were practically without change during the past week. Aniline oil was advanced from 14c. to 15c. per lb., but this had only a very minor effect on the index number.

FIG. 1.—PRODUCTION AND IMPORTS OF DYES COMPARED BY CLASSES.
IMPORTS 1914 FISCAL YEAR. PRODUCTION 1917—1921. CALENDAR YEARS
IMPORTS 1920 AND 1921 CALENDAR YEARS.

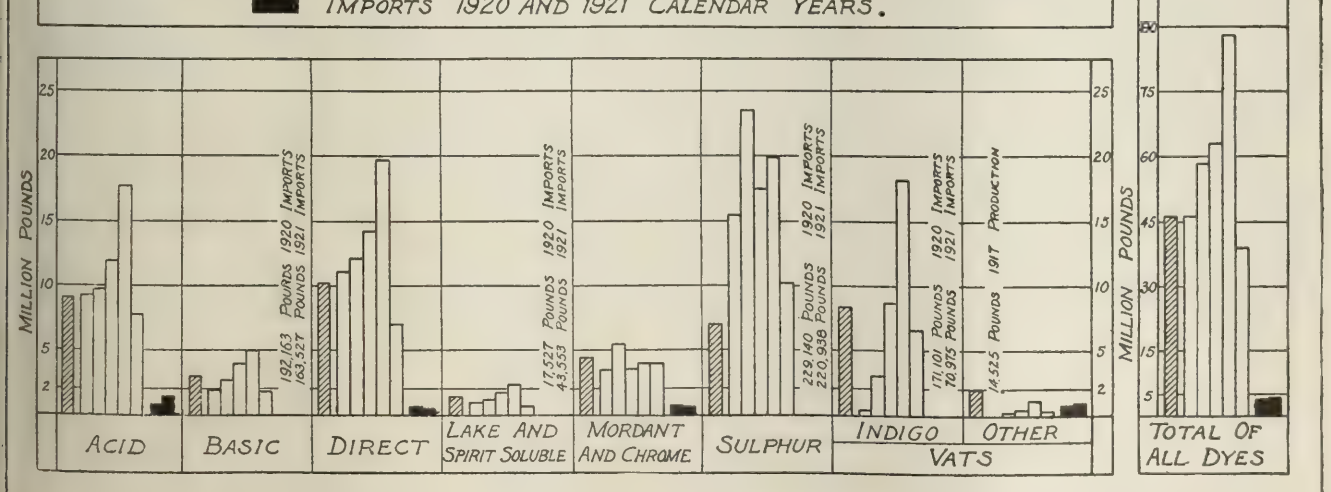
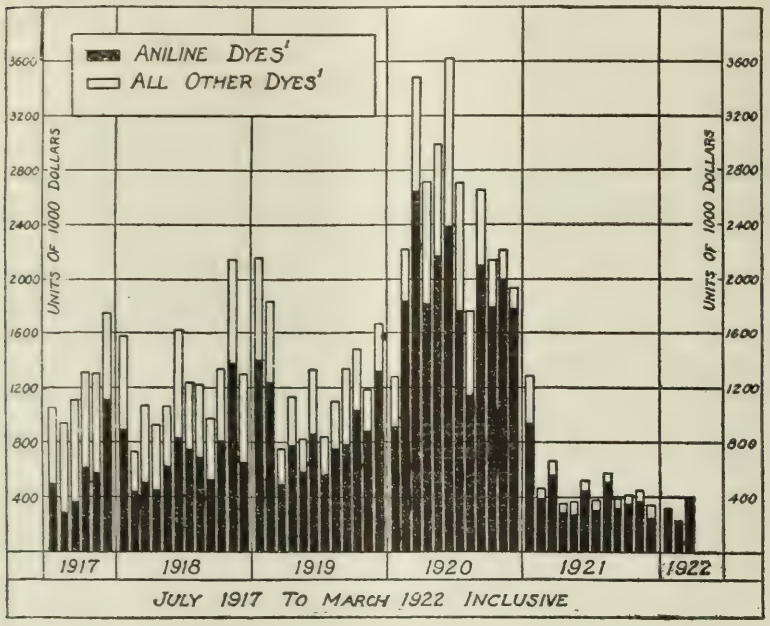


FIG. 2.—VALUE OF DOMESTIC DYES EXPORTED BY MONTHS.



than indigo is the domestic production considerably less than the 1914 imports. In commenting on this situation the report adds:

> The progress of the year included the manufacture for the first time in this country of a considerable number of colors of greater complexity and more specialized application. The development of these products is a technical achievement, highly creditable to the industry. Many of these new products were among the more important colors not heretofore manufactured in the United States and the domestic production of these products is an important step toward a self-contained industry. This progress has continued in the spring of 1922 and production of new dyes has been reported in the first 6 months of the latter year. The domestic dye industry is still somewhat deficient, however, in the manufacture of vat dyes, alizarins and certain special types.

CRUDES AND INTERMEDIATES

In the brief space at our disposal for this presentation it is possible to comment on only a few of the many interesting details included in the commission's compilations. A significant feature in connection with the production of coal-tar crudes is that 78 per cent of the output of coke was from byproduct ovens in 1921, as compared with 60 per cent in 1920. This increase assures the dye industry of more than adequate supplies of its basis raw materials.

Intermediates were produced in 1921 by 108 different firms which reported an output of 70,899,912 lb. Of this quantity 33,637,326 lb. was sold for $8,483,463. Table I includes the more important intermediates used in making the dyes which represent the bulk of our consumption. The percentages in the last column show the decrease in the 1921 output from that of 1920.

TABLE I—PRODUCTION OF PR NC.PAL INTERMEDIATES

	Production in lb.	Per Cent of Decrease
Aniline oil	5,639,234	86
Benzidine	328,577	85
Gamma acid	218,717	48
H acid	1,639,323	68
Alpha-naphthylamine	429,055	92
Beta naphthol, tech	2,959,049	75
Para-nitroaniline	832,438	61
Anthraquinone	125,358	77

EXPORT TRADE IN DYES

Unfortunately the Commerce Department's classification of exports of domestic dyes does not give the detail that would make possible any accurate comparison with either production or imports. Their classification shows, by value only, (1) aniline dyes, (2) logwood extracts and (3) all other dyes and dyestuffs. For the first time quantity as well as value was published in 1921. The combined value of exports of aniline dyes and all other dyes for 1919 was $15,728,499 as compared with $29,823,591 for 1920. In 1921 this figure showed a sharp decline to $6,270,155. The greatest export of aniline dyes for any month of 1921 was in January, when $943,595 worth was shipped; the smallest monthly total was in December, amounting to $254,878.

OTHER USEFUL DATA

Among other valuable features of this report, which was prepared with the assistance of Warren N. Watson, Dexter North and Carl R. DeLong, are the following: Detailed tabulation of domestic production of individual crudes, intermediate and finished coal-tar products (dyes, color lakes, photographic chemicals, medicinals, perfumes and flavors, synthetic phenolic resins, and synthetic tanning materials); a census of dyes imported during 1921 with names of foreign manufacturers and countries of origin; a census of synthetic organic chemicals not of coal-tar origin (perfume chemicals, ethers, esters, medicinals, butyl alcohol and derivatives, and acetylene, ethylene and propylene derivatives.)

Two important and useful compilations are the names and addresses of 175 manufacturers of coal-tar products and 62 producers of synthetic organic chemicals.

The New York Market

NEW YORK, Aug. 21, 1922.

The acute fuel shortage and railroad difficulties were the subjects of most concern in the chemical market during the past week. There has already been a marked decrease noted in the manufacture of several important basic commodities. Producers of caustic soda and soda ash have been forced to buy coal at the present high prices and their costs of production have naturally advanced. The present situation as far as fuel is concerned is generally considered quite unfortunate, coming at the approach of the fall season, when manufacturers were preparing to open extensive campaigns for an increased volume of business.

GENERAL AND SPECIAL CHEMICALS

Barium Carbonate—Spot material held around $62@$63 per ton, with shipment figures at $61. Trading was mostly for small lot requirements.

Bicarbonate of Soda—Producers are holding the market quite steady at 1⅞c. per lb., in barrels, f.o.b. works. The demand is fair.

Bichromate of Potash—Several moderate-sized sales were recorded at 10½c. per lb. Factors were not desirous of breaking away from these figures. Increased producing costs have been the underlying reason for the advance and strength in this commodity.

Bichromate of Soda—Prominent factors maintained prices at 7⅜c. per lb. for round lots and 7½c. for fair-sized quantities. Some resale lots were recorded around 7¼c. per lb. The demand is quite active and has prevented any accumulation of spot stocks.

Caustic Soda—The market is in an exceedingly strong position, due to the pronounced coal shortage. Export demand at the new figures has been very difficult to meet, with only a few sales of standard brands reported sold at $3.65@$3.70 per 100 lb. Contract prices were advanced in some directions, while in others 2½c. per lb. basis 60 per cent, was being quoted for regular shipments.

Copper Sulphate—Most of the agricultural demand has been satisfied and the market is returning to a more normal situation. Spot supplies are scarce at 6½c. per lb. Producers quote 99 per cent large crystals at 6c. per lb., for prompt shipment.

Nitrite of Soda—Leading factors continue to quote 9c. per lb. f.o.b. works, but resale goods have been sold down to 8c. per lb.

Oxalic Acid—The advance in spot quotations has been firmly maintained. Sales at the works have been made as high as 16c. per lb., with spot goods generally heard around 16½@16¾c. per lb. The demand is quite lively for moderate sized quantities.

Prussiate of Soda—The market has not shown any signs of activity of late and trading was mostly for small quantities. The range is around 20½@21c. per lb.

The St. Louis Market

ST. LOUIS, MO., Aug. 17, 1922.

Conditions in the chemical market in this locality are very good, both as to general activity and favorable trend of prices. The movement during the past 2 weeks, particularly of heavy chemicals, has been quite extensive, and while a part of this increase may be attributed to the transportation situation, we believe that a greater part of it is due to the fundamental soundness of industrial conditions throughout the country, as the broadening has not been sudden, but steady from month to month since the beginning of this year.

ALKALIS

The market on alkalis continues in the same trend save for a few large orders placed in anticipation of a complete railroad tie-up. *Caustic soda*, solid, in 5- and 10-drum lots is being quoted at $3.90 and the flake at $4.25. This price has been shaded in several instances, but holds good with all reliable dealers. *Soda ash* is moving in normal volume and is being quoted at $2.20@$2.35 in 1- to 5-bag lots; on carload business as low as $1.85 per 100 lb. for 58 per cent light is being done. *Bicarbonate of soda* can be had at $2.35 in 5-bbl. lots, having advanced somewhat recently. Carload business is being done at around $1.85 per 100 lb., f.o.b. buyer's point. *Sal soda* is just now the weak member of the alkali group. Strange as it may seem, this item is affected by the miners' strike, and the wholesale grocers of St. Louis do a large volume of business throughout the mining district.

GENERAL AND SPECIAL CHEMICALS

Citric acid is very quiet, and this being the last of the season not much is to be expected in the way of heavy purchases, as consumers will buy only enough to tide them over. Stocks are plentiful and prices remain the same. Makers of *oxalic acid* are sold up, and it is very difficult to find spot goods. Quotations for immediate delivery are around 16¾c.@17c. per lb., f.o.b. producers' works, but for future delivery it is understood that this price could be shaded somewhat. Supplies of *white arsenic* are still very scarce and the market continues to be very strong, prices ranging from 7½c.@8c., f.o.b. New York. Stocks of *blue vitriol* in this market are nil, but as the demand for insecticides is practically at an end, there should be freer movement of this article in the next few weeks. *Carbon bisulphide, technical*, remains in heavy demand, but it is not expected that this will continue for any length of time, as the season for this product is about to come to a close. *Carbon tetrachloride* is moving in a routine way. *Copperas* is still very scarce, and when buying it is not a question of price but a matter of stocks and delivery, as producers have not been able to catch up with their orders, due to the slowing up of operations of the steel mills. Prices remain unchanged. *Glycerine* has again advanced and is now being held at 16½c. The market is very firm and several large contract orders were placed at this figure recently. Another rise is not expected for the near future, but it is the consensus of the manufacturers that this price will hold for some time. *Lead acetate* is still being offered at the old schedule, however, it is rumored that an advance will take place shortly owing to the increased cost of acetic acid. *Salicylates* during the past few weeks have been moving more freely, and since our last report there has been an advance on all salicylates with the exception of *salol*, which remains unchanged. *Sulphur* is moving along at its normal rate with no change in price and no unusual business being reported. Producers of *zinc sulphate* have made a further advance in their prices, and are now quoting 3c. per lb., f.o.b. St. Louis in carlots. However, sulphate is not advancing in proportion to the increase in *spelter*, which is now being quoted at $6.20 per 100 lb., St. Louis.

VEGETABLE OILS AND NAVAL STORES

Turpentine has eased off somewhat and is being quoted today at $1.11 per gal. in 5-bbl. lots and $1.17 in single barrels. *Linseed oil* is quoted spot today at 92c. basis raw oil in 5-bbl. lots and 97c. for single barrels. This is about as previously reported. *Castor oil* has had three advances since our last report, jumping from 13¼c. to 13½@13¾c. and finally to 14c. in 400-lb. drums. This seems to be about the peak and a further rise is scarcely expected.

The Iron and Steel Market

PITTSBURGH, Aug. 18, 1922.

Steel production continues to decrease, on account of fuel conditions, and the rate of ingot production, as nearly as can be estimated, is about midway between 25,000,000 and 30,000,000 tons a year, against the rate of about 37,000,000 tons attained late in June.

The iron and steel industry derives no particular comfort from the "settlement" of the coal strike at Cleveland early in the week. The settlement itself was said to involve only about 15 per cent of the union coal capacity, and this means a smaller percentage still of the entire coal strike, for there were strikes in non-union mines, particularly in the Connellsville region, and these strikes have not been affected. Predictions are made that the Connellsville strikes will crumble within a fortnight, but these are merely predictions. The prevalent view is that among the mines formerly union the Pittsburgh district at any rate will not sign the United Mine Workers' scale but will hold out for a non-union or open shop operation, however much time may be required to attain that position.

For the nearby future at least the iron and steel industry does not expect to receive increased coal shipments and as present operations are maintained partly by stocks, now rather small, the outlook is for decreasing production of pig iron and steel.

The effect of diminishing supplies of coal is plainly observed in the production of steel, but is not apparent in the consumption of steel. It may be that consumption of steel is greatly decreased, but the evidence is not seen. Most consumers are urging mills to make heavier deliveries, and some are in the market to purchase early deliveries, which are commanding greater and greater premiums. It does not follow from the observable conditions that there are no stocks of steel in buyers' hands or that there are not large stocks in some cases, it being notorious in the steel industry that buyers endeavor to conceal their possession of steel as long as steel appears to be scarce. After every period of activity there is a spell during which consumers liquidate stocks which prove to be larger than had been assumed.

Some of the Steel Corporation subsidiaries as well as some of the independents are rationing their shipments, endeavoring to furnish steel to the more important consuming lines, while at the same time there is conservation, by denying steel to customers whose business is not of urgent character or who are unable to use the steel immediately.

ADVANCING TENDENCY IN STEEL PRICES

Steel prices show a general advancing tendency. There is not, as formerly, merely an advance in the prompt market, by the increase in delivery premiums, for basis prices, for indefinite delivery, are also advancing. An advance in the minimum on bars, shapes and plates from 1.70c. to 1.80c. was noted in last week's report. This week the American Sheet & Tin Plate Co. (Steel Corporation) has advanced its prices $2 a ton on blue annealed sheets to 2.50c. and $4 a ton on black and galvanized sheets to 3.35c. and 4.35c. respectively. The former prices had become nominal, as the company was oversold through the third quarter and had not opened books for fourth quarter. Sales are being made now chiefly to old customers. Independent pipe mills, with possibly one or two exceptions, have advanced prices on merchant pipe three points on black and two points on galvanized, a point being equivalent to about $1.90 per net ton. Some of the independent wire mills have advanced wire $2 a ton and nails 20c. a keg.

Prices for prompt delivery are not quotable, as there are various circumstances, according to the details of the individual order. An order for a tonnage of plates running into four figures has gone at 2.25c. delivery within 3 weeks.

The spot market in pig iron, the only pig iron market there is, continues to show an advancing tendency, sales being in small lots, out of stock, to urgent buyers. Foundry iron is up $2 a ton, to $30 valley, basic and bessemer being about $26 and $27 respectively, valley furnaces.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0 13½ – $0 13¾	.14 – .14¼
Acid, acetic, 28 per cent	100 lbs.	2 60 – 2 65	2.70 – 3.25
Acetic, 56 per cent	100 lbs.	5 25 – 5 35	5.40 – 5.75
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		12.15 – 12 25	12.30 – 13.00
Boric, crystals	lb.	.11 – .11½	.11¾ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	..... –	.45 – .45½
Hydrochloric	100 lb.	1.10 – 1.20	1 25 – 1 70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)	....	..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06¼	.06¾ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.16½ – .16¾	.17 – .17½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9 50 – 10 00	..... – .....
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	..... – .....
Sulphuric, 66 deg., tank cars	ton	14 50 – 15 00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21 00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.28½ – .29
Tartaric acid, imported, powdered	lb.	..... –	.29 – .30
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1 10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)	..	..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.31 – .33
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.31 – .33
Alum, ammonia, lump	lb.	.03¼ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03¼ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02¾ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08¼ – .08½	.08¾ – .09
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	..... –	2.00 – 2 25
Arsenic, white, powdered	lb.	.08¼ – .08½	.08¾ – .09
Arsenic, red, powdered	lb.	.12 – .12¼	.12½ – .13
Barium carbonate	ton	62.00 – 64 00	65.00 – 68 00
Barium chloride	ton	87.00 – 90.00	91.00 –100 00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2 50
Blue vitriol (see copper sulphate)	.....	..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)	.....	..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2 35 – 2 40	2.45 – 2.50
Calcium carbide	lb.	.04½ – 04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27 00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1 40 – 1 50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.82 – 84
Carbon bisulphide	lb.	.06 – .06½	.06¼ – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10¾ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)	.....	..... –	..... – .....
Caustic soda (see sodium hydroxide)	.....	..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04¼ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6.60	6 65 – 7.00
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)	.....	..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.08 – .08¼	.08½ – .09
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00	..... – .....
Fullers earth—imported powdered—net	ton	30 00 – 32 00	..... – .....
Fusel oil, ref.	gal.	..... –	2.25 – 2 65
Fusel oil, crude	gal.	..... –	1 45 – 1.50
Glauber's salt (see sodium sulphate)	...	..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.16½ – .16¾
Iodine, resublimed	lb.	..... –	4 20 – 4 25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.10½ – 11½
Lead arsenate, powd.	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08 – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07¾
Magnesium sulphate, U. S. P.	100 lb.	2 00 – 2 25	2 30 – 2 50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1 80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.12 – .12½
Phogene (see carbonyl chloride)	.....	..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.10½ – .10¾	.11 – .11¼
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	..... – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.13 – .13½	.14 – .15
Potassium prussiate, red	lb.	..... –	.90 – .95
Potassium prussiate, yellow	lb.	.32½ – .32¾	.33 – .33½
Rochelle salts (see sodium potas. tartrate)	....	..... –	..... – .....
Salammoniac, white, granular	lb.	.06¼ – .06½	.06¾ – .07
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	18.00 –21.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06½ – .06¾	.07 – .07¼
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13 00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09½ – .10	.10¼ – .10¾
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.70 – 3.75	3.80 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .03	.03½ – .03¾
Sodium nitrite	lb.	.08 – .08¼	.08½ – .09
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03¾ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.20½ – .21	.21¼ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1 25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04¼	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	..... – .....
Talc—domestic powdered	ton	18.00 –25.00	..... – .....
Tin bichloride	lb.	.09 – .09¼	.09¼ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.5¼ – .06	.06¼ – .06½
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.30 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb.	.80 — .85
Benzoic acid, U.S.P.	lb.	.65 — .67
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.22 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.33 — .35
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.80 — .85
Meta-phenylenediamine	lb.	.85 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07¼ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15 —	$0.17
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.10 —	2.15
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.75 —	.77
Ortho-nitro-toluene	lb.	.10 —	.13
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.25 —	1.30
Para-amidophenol, HCl	lb.	1.30 —	1.35
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.16 —	.18
Pyridine	gal.	1.75 —	2 75
Resorcinol, technical	lb.	1.30 —	1.35
Resorcinol, pure	lb.	1.75 —	1.80
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.24 —	.26
Salicylic acid, U. S. P	lb.	.28 —	.29
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.14 —	.18
Sulphanilic acid, crude	lb.	24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.20 —	$0.21
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.38 —	.42
Candellila, wax	lb.	.38 —	.40
Carnauba, No. 1	lb.	.40 —	.42
Carnauba No. 2, North Country	lb.	.24 —	.25
Carnauba, No. 3, North Country	lb.	.17 —	.17¼
Japan	lb.	.16 —	.16½
Montan, crude	lb.	.03¾—	.04
Paraffine waxes, crude match wax (white) 105-110 m.p	lb.	.04¼—	....
Paraffine waxes, crude, scale 124-126 m.p	lb.	.02¾—	....
Paraffine waxes, refined, 118-120 m.p	lb.	.03¼—	.03¼
Paraffine waxes, refined, 125 m.p	lb.	.03¾ —	.03¾
Paraffine waxes, refined, 128-130 m.p	lb.	.04 —	.04¼
Paraffine waxes, refined, 133-135 m.p	lb.	.04¼—	.04¾
Paraffine waxes, refined, 135-137 m.p	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09¼
Stearic acid, double pressed	lb.	.09¼—	.09¾
Stearic acid, triple pressed	lb.	.10¼—	.10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.35 —	$6.40
Rosin E-I	280 lb.	6.45 —	6.85
Rosin K-N	280 lb.	6.90 —	8.10
Rosin W. G.-W. W	280 lb.	7.85 —	8.40
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.25 —	1.26
Wood turpentine, steam dist	gal.	.85 —	....
Wood turpentine, dest. dist	gal.	.70 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.36 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.46 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
Blood, dried, f.o.b., N. Y	unit	4.75 —	....
Bone, 3 and 50, ground, raw	ton	37.00 —	39.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.50 —	2.55
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0.19 —	.20
Upriver coarse	lb.	.13½—	.13½
Upriver caucho ball	lb.	.13½—	.13½
Plantation—First latex crepe	lb.	.14 —	.14¼
Ribbed smoked sheets	lb.	.14 —	.14¼
Brown crepe, thin, clean	lb.	.13½—	....
Amber crepe No. 1	lb.	.14 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12¼ —	.12½
Cocoanut oil, Ceylon grade, in bbls	lb.	.08½ —	.08¾
Cocoanut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
Corn oil, crude, in bbls	lb.	.10½ —	.10¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.08 —	.08¼
Cottonseed oil, summer yellow	lb.	.10¾ —	.11
Cottonseed oil, winter yellow	lb.	.11½ —	.12
Linseed oil, raw, car lots (domestic)	gal.	.88 —	.89
Linseed oil, raw, tank cars (domestic)	gal.	.84 —	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.91
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07¼
Palm, Niger	lb.	.06¼ —	.06¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09¼ —	.09½
Peanut oil, refined, in bbls	lb.	.12 —	.12¼
Rapeseed oil, refined in bbls	gal.	.82 —	.83
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y	lb.	.11¼ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¾ —	....

FISH

Light pressed menhaden	gal.	$0.53 —	....
Yellow bleached menhaden	gal.	.54 —	.55
White bleached menhaden	gal.	.56 —	.57
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All prices remain quotably unchanged.

Ferro-Alloys

Quotations same as previous report.

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. works	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	19.00 —	21.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	18 00 —	21.00
Coke, foundry, f.o.b. ovens	net ton	14.50 —	.....
Coke, furnace, f.o.b. ovens	net ton	14.00 —	.....
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19 00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½—	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.29 —	.....
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y	lb.	.45 —	.50
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½—	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	3.25 —	3.50
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½—	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent	19.10
Antimony, wholesale lots, Chinese and Japanese	5.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.75
Lead, New York, spot	5.75–5.80
Lead, E. St. Louis, spot	5.525
Zinc, spot, New York	6.55
Zinc, spot, E. St. Louis	6.15

OTHER METALS

Silver (commercial)	oz.	$0.69¼
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.15@1.25
Platinum	oz.	93.00
Iridium	oz.	180.00@185.00
Palladium	oz.	55.00
Mercury	75 lb.	57.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

GLASS—The Hart Glass Co., Dunkirk, Ind., has resumed operations at its plant, following a short curtailment due primarily to fuel shortage. It is planned to operate at full capacity with regular working force.

Owing to inability to obtain raw materials on account of the railroad strike, the B. R. C. Bottle Works, Cedar Grove, near Shreveport, La., has closed down until the situation shows improvement.

The Upland Flint Glass Co., Upland, near Hartford City, Ind., is developing maximum output at its plant and expects to run on a capacity basis at an early date. New shops are being added and additions will be made in the working force.

LEATHER—The C. P. Osborne Co., Peabody, Mass., is running practically at full capacity at its local tanning plant, with a daily schedule of production calling for about 150 doz. sheepskins, 250 splits and 300 sides of case leather. A regular working force is being employed. The plant is said to have orders on hand to insure this basis of operation for at least 3 months to come.

Glazed kid plants at Wilmington, Del., are gradually increasing production and on the general average are now working close to three-quarters of normal capacity. One local plant is running at maximum output, with full working force.

RUBBER—The Firestone Tire & Rubber Co., Akron, O., is arranging for the early operation of its new plant at Hamilton, Ont., now nearing completion, and will run on a basis of about 1,500 tires per day for a number of weeks. This output will be increased closely following thereafter.

The B. F. Goodrich Co., Akron, O., is pushing production at its local plant, and expects to exceed the current daily output of 20,000 tires, recently established, at an early date.

The Kelly-Springfield Tire Co., Akron, and Wooster, O., is maintaining operations at its local mills on a capacity basis with full working force. It is expected to continue on this schedule for an indefinite period.

Following a reduction in the price of tires the Miller Tire & Rubber Co., Akron, O., is said to have received a quantity of heavy orders necessitating an increase in the current production of 7,500 tires per day, recently established. The advance will be made at an early date, with increased working force.

IRON AND STEEL—The Brier Hill Steel Co., Youngstown, O., has resumed operations at its plate mill, known as Mill No. 132, giving employment to about 150 men, following a curtailment for the last 60 days.

The American Sheet & Tin Plate Co., Elwood, Ind., has resumed operations at all of its local hot mills, forced to shut down recently on account of fuel shortage. It is expected to maintain continuous operations for an indefinite period.

The Gulf States Steel Co., Gadsden, Ala., is running full at its local finishing mills. Four open-hearth furnaces are now in service at the plant.

Owing to fuel shortage, the Phœnix Iron Co., Phœnixville, Pa., has been compelled to shut down its local furnaces, affecting about 150 employees. It is expected to resume as soon as possible.

The Inland Steel Co., Chicago Heights, Ind., has curtailed operations at its hard steel bar mill owing to a strike of employees, who have asked a wage advance of 20 per cent. A portion of the plant of the Calumet Steel Co., in the same district, has also been closed on the same account. About 900 men are out at the present time.

The Wheeling Steel & Iron Co., Benwood, W. Va., has closed down its local mills, following operations for a number of weeks on an 80 per cent capacity basis. It is said that the curtailment is due to the railroad and coal strikes. About 250 men are affected.

As a result of the railroad and coal strikes, the United States Steel Corp. has reduced operations at its mills in the Chicago, Ill., district from 84 to 78 per cent of capacity. The corporation is concentrating on blast furnace operations at its plants in the Youngstown, O., district in order to furnish material to the rolling mills of the American Sheet & Tin Plate Co. Its subsidiary, the Carnegie Steel Co., is maintaining production at ten blast furnaces in the Youngstown section.

The Glasgow Iron Co., Pottstown, Pa., has resumed operations at all departments at its local mills on a capacity basis, giving employment to a regular working quota. Continuous operation is assured for a long period due to large reserve coal supply.

The Janson Iron & Steel Co., Columbia, Pa., has closed down its local mills owing to fuel shortage. The Columbia Rolling Mill of the Reading Iron Co., at this place, is continuing production and has sufficient fuel to run for a few weeks.

The Weatherly Iron & Steel Co., Weatherly, Pa., is operating on a full-capacity basis, and has more orders on hand than for several years past. The plant is shipping on an average of 10 carloads of finished products per week.

The Colorado Fuel & Iron Co., Pueblo, Colo., is curtailing operations at its mills, and about 1,500 men have been released recently. The plant is now giving employment to more than 4,500 operatives.

The Republic Iron & Steel Co., Youngstown, O., is arranging for the use of fuel oil in its open-hearth department, instead of coal, and will fire a number of units at an early date.

The Carnegie Steel Co. has banked all departments at its Farrell Works, Sharon, Pa., with the exception of one blast furnace, affecting about 1,200 men.

MISCELLANEOUS—The Kinzer Brick Co., Ephrata, Pa., has adopted a capacity basis of production at its local plant, giving employment to a full working force.

The Norton Co., Worcester, Mass., manufacturer of abrasive products, is resuming operations at its branch plants at Niagara Falls, N. Y., and Chippawa, Ont., following an extended shut down. Each plant will give employment to about 200 men for initial operations.

Foundries at Sandusky, O., are now running at close to normal production, giving employment to regular working forces.

Owing to fuel shortage, the American Zinc Products Co., Greencastle, Ind., has closed a number of departments at its local mills.

Construction and Operation

Alabama

KEYSTONE—The Keystone Lime Works, Inc., recently organized, has obtained a local plant building and will soon begin the installation of hydrating and operating machinery for a daily capacity of about 1,000 bbl. of lime. The equipment for the most part will be electrically operated. W. A. Hammond, Saginaw, Ala., and George L. Scott, Longview, Ala., head the company.

GADSDEN—The Tri-City Gas Co. will begin at once the installation of a new gas producer and auxiliary machinery at its local plant.

California

TURLOCK — The Hunt-Jewett-Bontz Co., South 1st St., has completed plans and will soon break ground for the construction of a new local plant for the manufacture of industrial alcohol and kindred products. It will consist of a main 4-story factory, with 1-story structure adjoining, estimated to cost about $175,000. The machinery installation will cost in excess of $225,000 in addition to the amount noted.

SAN FRANCISCO—The Illinois Glass Co., San Francisco, manufacturer of hollow ware, bottles, etc., has leased a 2-story building, 124x200 ft., on Mariposa St., near Alabama St., for which plans are now being prepared. It is estimated to cost $125,000. It is planned to have the structure ready for occupancy at an early date.

Connecticut

DANBURY — The Metropolitan Concrete Block Co. has plans under way for the establishment of a new plant for the manufacture of brick, to be operated in conjunction with a recently established works for the production of concrete blocks. A number of kilns will be constructed and machinery installed for a large output. Charles Woods is in charge.

HARTFORD—The Skat Co., Francis Ave., manufacturer of soaps, soap powders, etc., has awarded a contract to Wise & Upson, Inc., for the construction of its proposed 1-story plant addition, 46x61 ft. Work will be commenced at once. F. C. Walz, Hartford, is architect.

WALLINGFORD—The Wallingford Steel Co., recently organized with a capital of $200,000, is arranging for the early occupancy of its new local plant, now in course of completion. Initial production will be devoted to cold-rolled steel products. The new works is said to represent an investment of approximately $75,000, and will be extended at a later date.

MANCHESTER—The Oxford Soap Co., Hilliard St., has awarded a contract to the H. P. Cummings Construction Co., Ware, Mass., for the construction of a new 2- and 3-story plant addition, 70x150 ft., to be used for general manufacture.

MILFORD—The Hoyt Silver Co., New York, N. Y., recently organized by William T. Hoyt, 9 Maiden Lane, and now operating a small plant at 338 Pearl St., is planning for the early establishment of a new plant at Milford for the manufacture of a special stainless metal. The initial works will give employment to close to 300 persons.

Florida

LAKE WORTH—F. E. Bryant, Lake Worth, is organizing a company to construct and operate a sugar-refining plant. A tract of 11,000 acres of land has been acquired in Palm Beach County, to be used for the plant's site, and for sugar cane plantations. It is planned to commence operations at an early date.

Indiana

INDIANAPOLIS — The Board of Sanitary Commissioners, City Hall, E. B. Swift, president, has plans under way and will call for bids at an early date for the construction of a new purification plant at the city water works, 1-story, 100x140 ft., estimated to cost $530,000, including equipment. Charles H. Hurd, 1405 Merchants Bank Bldg., is engineer.

INDIANAPOLIS—The Beveridge Paper Co., Pearl St., has filed plans for the construction of a new plant addition, adjoining its present works, estimated to cost close to $50,000. H. L. Beveridge is president.

HAMMOND—The Metals Refining Co., 627 Hohman St., has awarded a contract to Rowley Bros. Co., 332 South LaSalle St., Chicago, Ill., for the construction of a new 1-story and basement building on Summer St., 38x50 ft., estimated to cost about $35,000.

INDIANAPOLIS—The Chapman-Price Steel Co., Shelby St., will hold in temporary abeyance the construction of its proposed new local steel mill, comprising a number of buildings, estimated to cost about $500,000, with equipment. It is expected to commence erection some time during the coming year. Niles Chapman is president.

KOKOMO—The Mileage Oil Refining Co., comprising a recently consolidation of the Service Oil & Refining Co., the Hoosier Oil Co. and the Iroquois Oil Co., is planning for the early operation of its oil refinery at Fairmount, Ind., and will develop a capacity of 1,200 bbl. per day. The company has arranged for an increase in capital from $100,000 to $800,000, and will use a portion of the proceeds, it is said, for extensions and improvements in the plant, including the construction of a number of service buildings. J. C. F. Martin is president; and S. W. Winder, Marion, Ind., is secretary and treasurer.

Illinois

CHICAGO — The International Harvester Co., 606 South Michigan Ave., will commence the immediate construction of a 1-story, open-hearth furnace building at its Wisconsin steel works, Torence Ave. near 110th St., to be 143x500 ft., estimated to cost $360,000. The general contract has been let to the Bates & Rogers Construction Co., 37 West Van Buren St.

Louisiana

SHREVEPORT—The Southern Soap Co., Box 602, recently organized with a capital of $100,000, has plans under way for the con-

struction of a local plant for the manufacture of soaps, soap powders and kindred specialties. Work will be commenced at an early date. A list of equipment to be installed will be arranged at once, and bids called early in September. W. A. Vickers is president and general manager.

WINNFIELD—A. C. Campbell, Winnfield, is organizing a company to construct and operate a local plant for the manufacture of concrete blocks, tile and kindred productions. It is proposed to commence work at an early date.

Maine

BRIDGTON—Fire, Aug. 6 damaged a portion of the plant of the Sims Leather Co., with loss estimated at close to $13,000.

Maryland

BALTIMORE — The Bethlehem Steel Corp., Bethlehem, Pa., will commence the immediate construction of an addition to its local plant in the Sparrows Point district, estimated to cost in excess of $3,000,000, with equipment. The work will comprise a number of new open-hearth units with subsidiary departments, to provide for an increase of close to 5000,000 tons of steel ingots per annum. Eugene G. Grace is president.

Michigan

MONROE—The Republic Glass Co., Kentucky Ave., will commence the immediate construction of a new 1-story plant, 200x400 ft., for the manufacture of general glass products, estimated to cost about $50,000, exclusive of equipment. Emanuel Llera is president.

Minnesota

ST. PAUL—The Flaxlinum Insulating Co., Hampden and Wabash Aves., manufacturer of insulating products, plans for the rebuilding of the portion of its works recently destroyed by fire.

Missouri

ELDORADO SPRINGS—The Eldorado Development Co., recently organized with a capital of $300,000, has acquired a tract of about 320 acres of land, and plans for the establishment of a new zinc plant. It is proposed to provide a capacity of approximately 300 tons per day. A list of equipment for installation is being arranged, and it is expected to call for bids during September. A. B. Stricklett is president and general manager.

North Carolina

PINE HALL—The Pine Hall Brick Co., recently organized, has acquired the plant and property of the Dan River Brick Co., comprising about 125 acres of land, and will inaugurate operations at an early date. Plans are said to be under way for extensions and improvements. C. L. Lester is general manager.

CHARLOTTE—The City Council is taking bids until Aug. 29 for the construction of a new filtration plant at the municipal water works, estimated to cost about $300,000. William Platt, Durham, N. C., is consulting engineer. Edgar Reade is city clerk.

COLON—The L. C. Isenhour Co. has preliminary plans under consideration for the construction of a local plant for the manufacture of brick, tile and kindred burned clay products.

RALEIGH—The City Council has plans in preparation for the construction of a new filter plant at the city waterworks, to include an electrically operated pumping station, estimated to cost about $150,000. Bids will be asked in September. J. B. Bray, chairman of the Board of Public Works, is in charge. William C. Olsen, Kinston, N. C., is consulting engineer.

New Jersey

LINDEN—The Superior Novelty Mfg. Co., 124 East Jersey St., Elizabeth, N. J., manufacturer of celluloid and fiber products, has awarded a contract to H. Wilhelms & Sons, Inc., Elizabeth, for the construction of a new 1-story plant, 50x200 ft., on Edgar Road, Linden, to cost approximately $50,000. William Finne, 712 1st Ave., Elizabeth, is architect.

New York

LONG ISLAND CITY—The National Liquid Bleach Co., 18 Purvis St., has acquired an entire block front of property on Foster Ave. between Honeywell and Buckley Sts., as a site for a new plant. Plans will be prepared at once and construction commenced at an early date.

NEW YORK—The Tidal Refining Co., 11 Broadway, a subsidiary of the Tidewater Oil Co., with headquarters at the same address, has appropriated a fund of $1,000,000 for extensions and improvements in its oil refineries and gasoline extraction plants in Oklahoma and Kansas. The company is now operating 2 oil refineries and 22 gasoline plants. Considerable new equipment will be installed.

NEW YORK—Fire, Aug. 8, destroyed a portion of the plant of W. H. Dong & Co., 244 Canal St., manufacturers of coloring products for foodstuffs, etc., with loss approximating $12,000. It is proposed to replace the damage at an early date.

Ohio

TOLEDO—The Toledo-Libbey-Owens Sheet Glass Co., a subsidiary of the Libbey-Owens Sheet Glass Co., Nicholas Bldg., has completed plans and will break ground at once for the construction of a new local plant for the manufacture of sheet glass products. The initial works will comprise a number of buildings, with tanks, electric power plant, etc., and are estimated to cost close to $3,000,000, including equipment. The company is capitalized at $6,000,000, and has arranged for the sale of a preferred stock issue of $3,000,000 to finance the construction.

MIDDLETOWN—The Gardner-Harvey Paper Co. will soon take bids for the construction of a new 1-story and basement plant addition, 200x400 ft., estimated to cost approximately $130,000. E. T. Gardner is president.

Oklahoma

ARDMORE—The Amerada Petroleum Corp. has acquired property in the Amerada Pool district as a site for the construction of a new absorption gasoline plant, to have a capacity of 4,500,000 cu.ft. Plans will be prepared at an early date.

Pennsylvania

GREENVILLE—The Greenville Steel & Iron Co., care of the Greenville Chamber of Commerce, has plans in progress for the construction of a new plant on local site for the manufacture of steel products. It will comprise a number of buildings including four 60-ton open-hearth furnaces, and one 10-ton open-hearth furnace, the latter to be used in connection with experimental work; blast furnace; four rolling mills; cold drawing mill, etc. A 15,000-hp. power plant will also be built. A feature will be made of the manufacture of electric steel castings. The plant will have an initial output of close to 300,000 tons a year, and is estimated to cost approximately $2,000,000. General offices will be located at Greenville. Colonel H. P. Bope, formerly connected with the Carnegie Steel Co., Pittsburgh, heads the company, which was recently organized. H. E. McConnell will be managing director.

PHILADELPHIA—The Henry Bower Chemical Mfg. Co., 29th St. and Grays Ferry Road, specializing in the production of ammonia and kindred products, has filed plans for the construction of an addition to its plant to cost about $25,000. Alterations will be made, also, in one of the existing buildings at the works.

NEW CUMBERLAND—Albert Hanker, operating a local box-manufacturing plant, is perfecting plans for the construction of a new plant in the vicinity of Second and Reno Sts., to be equipped for the manufacture of glazed paper products.

TEMPLE—The Stalium Metals Co., recently organized to manufacture special metals, will commence construction at once of a new local plant to comprise a number of buildings, estimated to cost about $200,000 S. S. Staley heads the company.

Texas

YOAKUM—The Texas Hide & Leather Co. has plans under way for the construction of an addition to its plant to cost about $17,000. Improvements will be made also in the existing works.

RANGER—The Texas-Pacific Coal & Oil Co. has acquired property near Caddo, Tex., as a site for a new gasoline absorption plant, estimated to cost about $100,000, including equipment. Work will be commenced at an early date.

DALLAS—The Allied Chemical Co. is completing plans and will soon break ground for the construction of a 2-story plant at Alma St. and Santa Fe Ave., 40x125 ft., to include a power plant, office and other miscellaneous structures. Initial production will be devoted to boiler compounds and other chemical products. The new plant will cost close to $50,000. W. R. Sparkman is president; and H. H. Howard, vice-president and general manager.

Virginia

HOPEWELL — The Hummel-Ross Fibre Corp. has preliminary plans under consideration for the construction of a number of new plant buildings at its local mill, to be equipped for general production and finishing operations. It is said that the plant will cost in excess of $175,000, including equipment.

Washington

SEATTLE—The J. W. Fales Paper Co. has plans under way for the construction of a new 3-story building at its plant, to cost about $35,000.

West Virginia

HUNTINGTON—The Superior Glass Products Co., Adams Ave. and 19th St., has tentative plans under consideration for the rebuilding of the portion of its plant destroyed by fire, Aug. 2, with loss approximating $150,000, including equipment.

HUNTINGTON—The Eureka Rubber Preserving Co., recently organized with a capital of $400,000, has plans in progress for the construction of a new plant on local site for the manufacture of rubber preservatives, primarily for automobile tire service. The works will include a large experimental laboratory. L. C. Basham is general manager.

New Companies

THE ARTHUR A. LEHMAN CO., New York, N. Y., care of J. Q. Perry, 84 William St., representative, has been incorporated with a capital of $12,000, to manufacture chemicals and chemical byproducts. The incorporators are J. C. Treadwell, A. A. Lehman, and W. T. Easley.

THE SYNTHETIC LEATHER CORP. OF AMERICA, Scotch Plains, N. J., has been incorporated with a capital of $1,000,000 to manufacture paints and affiliated products. The incorporators are R. O. Lipton, Rufus Delafield, and Frederick J. Balmer, Scotch Plains.

THE BALTIMORE WATER PAINT CO., 942 Madison Ave., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture paints and affiliated products. The incorporators are Herbert C. Metcalfe, I. Brenner, and Albert H. Samuel.

THE FELSTONE CO., Asheville, N. C., has been incorporated with a capital of $100,000, to manufacture pottery and other burned clay products. The incorporators are G. C. Reiniger, C. Marshall Gravatt, and Blair Taylor, all of Asheville.

THE CLAIR CHEMICAL CORP., New York, N. Y., care of J. I. Wiener, 1482 Broadway, New York, representative, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are W. A. Miller, R. L. Noah, and L. Rothschild.

THE STATE REFINING CO. INC., Dallas, Tex., has been incorporated with a capital of $400,000, to manufacture refined petroleum products. The incorporators are Shearon Bonner, S. F. Semo, and F. B. Horton, all of Dallas.

THE ROY RUBBER CO., 221 East Hanover St., Trenton, N. J., has been incorporated with a capital of $100,000, to manufacture rubber products. Edward L. Royal, address noted, is the principal incorporator, and represents the company.

THE EBERLING BRICK & TILE CO., Detroit, Mich., has been chartered under state laws, to manufacture brick, tile and other burned clay products. The incorporators are William Lucking, James W. Thomas and Howell Van Auken, 1502 Ford Bldg., Detroit.

THE DE COTTIS CHEMICAL & COLOR CO., Pittsburgh, Pa., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts, colors, etc. C. Schoemer, 408 Union Arcade, Pittsburgh, is treasurer.

THE LUSTERINE POLISH CO., 2212 West Harrison St., Chicago, Ill., has been chartered under state laws, to manufacture polishes, cleaners, etc. The incorporators are William D. Sheppard and John Schouten.

THE WATSON CHEMICAL CO., Lebanon, Mo., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are C. O. McCain, C. G. and E. I. Watson, all of Lebanon.

THE BOONTON MOULDING CO., Boonton, N. J., has been incorporated with a capital of $50,000, to manufacture composition products, moulded materials, etc. The in-

corporators are Frank H. Pierce and George Scribner, Myrtle Ave., Boonton.

THE WYOMING & MONTANA OIL CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $1,000,000, to manufacture petroleum products.

THE RED DIAMOND CHEMICAL CO., Philadelphia, Pa., care of Biddle, Paul, Dawson & Yocum, 505 Chestnut St., Philadelphia, representatives, is being organized by Calvin M. Smyth and Woodward K. Greene, to manufacture chemicals, chemical compounds, oils, etc. Application for a state charter will be made on Sept. 5.

THE MARSHALL METAL CORP., 2608 South Wells St., Chicago, Ill., has been incorporated with a capital of $100,000, to operate a metal fabricating works for the production of aluminum, steel, brass and other metal products. The incorporators are Frank E. Chamberlain, John J. Stream, and John R. Marshall.

THE HAMILTON LEATHER PRODUCTS CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $250,000, to manufacture leather products.

THE PEERLESS LIQUID CEMENT CO., New York, N. Y., care of Stern & Stern, 49 Chambers St., representative, has been incorporated with a capital of $5,000, to manufacture liquid cements and affiliated products. The incorporators are J. Keeler, and S. Lange.

THE TOLEDO ALUMINUM & BRONZE CASTINGS CO., Toledo, O., has been incorporated with a capital of $10,000, to manufacture aluminum, bronze, brass and other metal castings. The incorporators are Otto K. Rudon and Charles M. Kistner, both of Toledo.

THE WHARTON COUNTY OIL MILLS, INC., El Campo, Tex., has been chartered under state laws to operate a local mill for the manufacture of cottonseed oil products. The incorporators are H. E. Wilson, A. L. Lawson, and Hans Goldmann, all of El Campo.

THE BURWALL CHEMICAL CORP., New York, N. Y., care of Tison & Melick, 15 William St., representatives, has been incorporated with a capital of $500,000, to manufacture chemicals and chemical by-products. The incorporators are M. Wittlan, E. J. Russo, and E. C. Beekmann.

HERRMANN, MORRIS & CO., 878 Mt. Prospect Ave., Newark, N. J., has filed notice of organization to manufacture dry colors, chemical specialties, etc. Edwin Blum, 44 West 70th St., New York, N. Y., heads the company.

THE INLAND GLASS CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws, with a capital of $1,500,000, to manufacture glass products.

THE FALOR RUBBER CO., 910 South Michigan Ave., Chicago, Ill., has been incorporated with a capital of $50,000, to manufacture rubber products. Shelby A. Falor is president; and C. F. Schnee, secretary.

THE CARNAHAN PRODUCING & REFINING CO., San Antonio, Tex., has been incorporated with a capital of $25,000, to manufacture petroleum products. The incorporators are Henry C. King, Jr., Clinton Chenault, and J. E. Carnaham, all of San Antonio.

THE RELIABLE GAS & OILS, INC., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture and deal in lubricating oils, etc. The incorporators are Hugh F. Gilligan, Harry B. O'Connell, and William F. Haas, 1212 Broad St., Newark.

THE ATLANTA GLASS MFG. CO., Atlanta, Ga., has been incorporated with a capital of $500,000, to manufacture glass products. The company has plans under way for the erection of a local plant. F. J. Cooledge, Jr., Atlanta, is president.

THE AMERICAN OPALOGRAPH CORP., Long Island City, N. Y., care of Weller & Rogers, Jamaica, L. I., representatives, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical by-products. The incorporators are F. J. Klein, C. H. Senior and H. D. Snyder.

THE GRADY BRASS CO., Wilmington, Del., care of the Corporation Service Co., Equitable Bldg., representative, has been incorporated with a capital of $10,000, to manufacture brass and bronze products.

THE UNITED HIDE CO. OF NEW JERSEY, Newark, N. J., care of Harold Simandl, 418 Kinney Bldg., representative, has been incorporated with a capital of $100,000, to operate a local tannery. The incorporators are M. R. Gibney, Leo D. Schwartz and Mark Herbst.

THE RADIO-TONE CHEMICAL CO., New York, N. Y., care of Leon Bleecker, 249 West 34th St., representative, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical by-products. The incorporators are E. G. Coundjeris and E. G. Manias.

THE ALLYNDALE LIME CO., Southington, Conn., has filed notice of change of name to the CAINE LIME CO.

Manufacturers' Catalogs

BAKER & CO., INC., Newark, N. J., has issued its fourteenth edition of "Data Concerning Platinum," which contains new tables, illustrations and matter descriptive of various appliances made of platinum.

THE EAST JERSEY PIPE CO., Paterson, N. J., in a new pamphlet, Bull. X203, illustrates and describes Type B Hercules electric hydro-extractors.

THE BARRETT CO., New York, has issued a booklet on Barrett Flotation Oils and Reagents.

THE LINK-BELT CO., Chicago, is issuing literature on the Link-Belt crawler crane, which is the newest machine from this company's Chicago shops.

THE CONNERSVILLE BLOWER CO., Connersville, Ind., in order to more completely describe its line of small blowers, has just issued Bulletin 21, on Victor Positive Pressure Blowers.

THE SCHUTTE & KOERTING CO., Philadelphia, Pa., has issued a very attractive catalog entitled "Koerting Fuel Oil Burning Systems." It consists of three bulletins which describe mechanical fuel oil-burning systems and fuel oil burners in which the oil is atomized by low- or high-pressure air and steam. It discusses thoroughly the installation, operation and maintenance of oil-burning equipment, its characteristics, requirements and functions, the relative merits of mechanical and spray oil burners, the design, purpose and operation of air control registers, oil-pumping outfits, duplex oil strainers and fuel oil heaters, the general requirements of steam boiler furnaces for burning oil, operation, inspection of the system, lighting the fires, air for combustion, indication of satisfactory operation, number and arrangement of burners, effects of carbon deposits and soot, etc. The catalog is profusely illustrated in color.

THE ELECTRIC FURNACE CONSTRUCTION CO., Philadelphia, Pa., has published two new catalogs. "Electric Furnaces for Melting, Refining and Superheating of Iron and Steel" describes various types of electric furnaces and particularly a new feature of the "Greaves-Etchells" steel melting furnace applied to four or more electrode furnaces. This system permits of all the electrical power being put either entirely through top electrodes or, by change of position of the switch, through top electrodes and through the whole of the furnace hearth, each connection being so arranged as to give a balanced load and a high power factor. This gives a very flexible electric melting unit, having all the advantages of top electrode furnace for melting down, and top and bottom heat for the refining and addition of alloys and finishing off. This bottom heat has been found extremely beneficial during these latter operations, giving as it does slow circulation of the molten bath from the bottom, uniform temperature throughout, and a homogeneous finished product. The other catalog describes the "Electro" steam boiler, developed by F. T. Kaelin, chief engineer of the Shawinigan Water & Power Co. These electric steam boilers take high tension current direct and use the water itself as a resistance. These boilers have a thermal efficiency of over 98 per cent and a unity power factor, and should be of interest to all hydro-power companies or consumers of power who pay on peak or connected load basis.

THE BROWN INSTRUMENT CO., Philadelphia, Pa., announces the publication of a new resistance thermometer catalog which explains the theory of resistance thermometry, the various type of instruments which are made and the merits of each type. Copies will be send to any executive on request.

THE CORNING GLASS WORKS, Corning, N. Y., has issued a pamphlet on Pyrex Industrial Glassware, which is a preliminary announcement of a new stage in the evolution of Pyrex glass, in the application of Pyrex to chemical plant uses. In the pamphlet is a brief description of three typical shapes, with dimensions, prices, etc., and the following are articles either in production or in the final experimentage stage: Socket pipes and bends, "S" bends for cooling and condensation work, pipe lines made of large bore tubes, tubes for catalytic re actions, retorts for distillations, etc., evapo rating dishes, flat pans for driers, etc., re ceivers for hot liquids, flat sheet glass an sight glasses and sight pipe sections. Som of the outstanding features of this glass ware are also given.

THE OLIVER-SHERWOOD CO., San Fran cisco, Calif., announces a new bulletin o "Olivite" centrifugal pumps, which ar especially designed for rigorous service i chemical industries. The pump is not hard rubber pump, but it is of acid-proo character due to a new composition whic has a rubber basis, and is adapted to han dling and pumping of dilute solutions o hydrochloric, nitric, sulphuric and phos phoric acids.

THE DELAVAL STEAM TURBINE CO., Tren ton, N. J., in a 28-page catalog illustrate and describes a line of velocity stage tur bine especially designed for high-pressur and high-temperature steam. The cast ste steam chest is located in the casing cove in order to avoid the conduction of heat t the bearings. In addition to the speed gov ernor and governor valve, there is an in dependent valve controlled by an automati over-speed trip. The turbines are built i sizes up to 1,200 hp., and are designed t be directly coupled to high-speed centrifu gal pumps and blowers, small a.c. and d.c generators, and by means of double helica speed reducing gears, to large pumps an blowers, medium size generators, belt pul leys, rope sheaves and slow and moderat speed machinery.

THE WESTINGHOUSE ELECTRIC & MFG. Co East Pittsburgh, Pa., in Circular 1579-B, o "Micarta Gears and Pinions," describes th development of this material, which is non metallic, for gear and pinion applicatio that can be advantageously substituted fo untreated steel, cast iron, bronze and al other materials used for gearing. It is laminated product of specially treate woven fabric and can be machined in th ordinary manner. This material was de veloped to meet the demand for silent gea drives. The company also states that it i not attacked by rodents and vermin; is no affected by water or oil, or by most aci and alkali solutions; can be kept in storag indefinitely without deterioration and is ap plicable to a great many special construc tions. The catalog contains general in formation and technical data for cuttin micarta gears and pinions.

Coming Meetings and Events

ALPHA CHI SIGMA dinner, during th Chemical Exposition, will be held Thursday Sept. 14, at 6:30 p.m. at Keen's Chop House 107 West 44th St., New York City. Mem bers are requested to register at *Chem. & Met.'s* booth at the Exposition.

AMERICAN CHEMICAL SOCIETY will hol its fall meeting in Pittsburgh, Pa., Sept. to 9.

AMERICAN ELECTROCHEMICAL SOCIETY wil hold its fall meeting in Montreal, Sept. 21 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold it annual convention and exhibition at Atlan tic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AN METALLURGICAL ENGINEERS will hold it 126th meeting at San Francisco, Calif., Sept 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATIN will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ASSOCIATION OF IRON AND STEEL ELECTRI CAL ENGINEERS will hold its sixteenth annual convention Sept. 11 to 15 at Cleve land Public Hall, Cleveland, Ohio.

NATIONAL EXPOSITION OF CHEMICAL IN DUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AN MECHANICAL ENGINEERING will be held a the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NATIONAL SAFETY COUNCIL will hold it Eleventh Annual Safety Congress in De troit, Aug. 28 to Sept. 1.

NEW JERSEY CHEMICAL SOCIETY has dis continued meetings for the summer, bu will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS wil hold a 3-day national convention in New York, beginning Oct. 18. The general topi of the convention is "Economics of Indus try."

CHEMICAL & METALLURGICAL ENGINEERING

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The Theme of This Issue— Increased Production Efficiency

PSYCHOLOGISTS tell us that sustained emotion is harmful and beyond a certain point impossible. That is why a man viewing Niagara for the first time is awed, whereas the bellboys at Hotel Clifton hardly ever glance at the spectacle. We, you, in our relation to the chemical industry are much like the Clifton bellboys with respect to Niagara. Our contact is so close, so continuous, that we are likely to look upon it only in the most casual manner. For this reason it is worth while occasionally to detach ourselves and view the whole spectacle or a part of it with the enthusiasm of a novice. The thrill may not and will not be sustained, but it will have the inestimable value of orienting us anew and lifting us out of the rut of routine.

Such is the purpose of this issue of *Chemical & Metallurgical Engineering*. Speaking in all modesty for ourselves, but with full credit to the excellent authors who have contributed the contents, we think the issue serves the purpose of taking the reader away from the routine of his task and directing his attention in a most inspiring manner to a special topic of undoubted importance.

Why seek to increase the efficiency of our production processes?

Production and distribution, their interrelations and their influence on human affairs, constitute in large measure the problems which our civilization is now facing. Between these two factors there can be no choice as to which is more important. If the world as we know it is to continue to develop along its present paths, then ultimately both of these problems must receive as nearly perfect a solution as is within the compass of human ability. The question of importance between these two factors is one of immediacy.

As the population increases and the free natural resources of the world diminish, the pioneer type of independent existence becomes possible to an ever-decreasing number. More and more we depend on cheap and rapid production of goods—quickly and efficiently distributed—for the maintenance of our well being and happiness.

The problem of distribution must be solved. If it is not, our ability to obtain the necessities and luxuries by which our standard of living and our very civilization are maintained will lessen. If it lessens to any great extent, the whole structure of our life as we know it will tumble about our ears, as it recently did in Russia. Only through efficient, scientifically administered distribution can the spread between the producer and the consumer be kept down. The development of this administrative control is largely a matter of government, and for this reason must unfortunately wait on politics. In the long run, however, the public at large has government under its control and can, when educated to the point of realizing the necessity of good distribution methods, demand and get them.

Efficient distribution, although it may seem extraneous to our main editorial theme, is nevertheless so closely tied up to the problems of production that we have felt justified in giving it some consideration at this time. With this end in view we have included a series of short, poignant messages from leading sales executives outlining their views as to how efficient production can be supported by better directed and more intelligent distribution.

Efficient production is fully as important to our way of life as is good distribution. The advent of the machine made possible a vast extension in quantity and kind of the goods by which mankind lives. Machinery on the farm increased the available food supply, and machinery in the town increased the supply of those goods which the farmers needed and for which they were willing to exchange food. The age-long checks were removed, the doctrine of MALTHUS for the time ceased to operate and the population of the world increased by bounds. Such a situation cannot continue indefinitely. There must come a time when the most strenuous efforts of all workers will not serve to keep up the standard of living requisite to well being, even with the improvements in method and equipment which will without doubt then be available. The limit of exploitation of the earth's resources will eventually be reached and the law of MALTHUS must then operate.

The earth's resources are still ample to keep all in comfort. The scientific knowledge for their development is available. Man's ineptitude alone is responsible for the problems of adequate production which the world now faces and upon the solution of which so largely depend the welfare and contentment of the race and the dissipation of the ugly unrest so prevalent today.

Production need not delay, as distribution must, the solution of its problems. The power to reach these solutions lies today in the hands of the technologists, engineers, executives and owners who control our industries. Every consideration of successful business, the highly competitive market which must be met, the demands of labor and the demands of capital, all these strongly urge them to exercise this power. If those at present in control do not increase the efficiency of production, then their places must be taken by those that will. For the means of effecting this increase in production efficiency are at hand and the lower prices that will result are the first step that must be taken in restoring the balance of our war-tried world.

With these facts in view, we have gathered in this issue the thought of some of the country's industrial leaders on the present industrial situation and their recommendations as to the paths to be followed to reach an improved condition. The articles in which their thoughts are embodied form a message which cannot fail to be of inspiration and benefit to all connected with productive industry—a message of INCREASED PRODUCTION EFFICIENCY.

The Human Factor in Efficient Production

HUMAN EFFORT lies at the very foundation of production, and yet of the entire structure it is the least tangible part. Even in our industries where science and engineering have evaluated machine and process with all the precision of mathematical certainty, there still remains the human element, the unknown quantity, the x in every equation. That intangible something which eventually finds its way into the profits and losses of industry touches on every phase of production, distribution and management. It offers a myriad of problems, many as old as industry itself. But it is in the intricacy of modern business that we find most evidence of its workings, and it is there that we should study it. The age-old problems of employer and employee have so broadened that the manager of today is concerning himself with many questions which a few years ago were regarded as foreign to industry's obligations. Such factors as the health and happiness of the workers, their welfare and safety, physical and mental comfort, housing and sanitation, selection and training—all these are now recognized as just as much the problem of management as those of supervision, wages and hours of work.

But underlying all of this is the fundamental conception of labor—not as a commodity subject to impersonal barter and trade, but as a vital, living force sharing with capital in the ups and downs of industry. When the Secretary of Labor tells us, as he does in this issue, that the American workman is coming to realize his tremendous responsibility to himself, his craft, his industry and his country, Mr. DAVIS is speaking for an enlightened citizenry. And certainly labor must look far to find a more creditable spokesman. Coming to this country as a youngster in a large family of Welsh immigrants, JAMES J. DAVIS began a most unusual career, and yet one that is typically American. He was only 11 when he entered the steel mill to learn his trade as a puddler, and there for 14 years he worked at severest manual labor. Naturally, with such a grounding, the Secretary of Labor looks at industry through the eyes of labor, but not with the bias of the partisan nor the prejudice of the professional organizer. His message on "Labor's Responsibility for Industrial Efficiency," which was written specially for this annual number of *Chemical & Metallurgical Engineering*, sounds the opening note in our editorial appeal for INCREASED PRODUCTION EFFICIENCY. It has been given this position of honor because we regard it as a classic on which labor may well rest its case.

"Wages" is one of the shortest and simplest words of our language, but it is of tremendous connotation. Concretely, it expresses all of the contractual relations existing between employer and employee. HARRINGTON EMERSON, in his contribution on this subject, gets at the very fundamentals on which wage payments are based. In tracing these relations from Biblical to modern times, he derives four great fundamental principles which he holds essential to the ideal wage system.

Labor turnover—what employer is there who hasn't reason to give it thought? PHILIP BRASHER is inclined to believe that excessive labor turnover is resulting in greater loss to the average manufacturer than is the strike or the lockout. But in either case the cause is the same—the lack of harmonious relations between the employer and the employed. Our contributor offers a solution to this problem in just one word—contact.

Health and happiness of the worker are paramount considerations of the thoughtful employer. JOHN S. SHAW'S experience in one of our largest industries leads him to the conviction that the promotion of these factors favorably affects production and costs. To his way of thinking, the manager can profitably spend as much time and money advancing the comfort and contentment of his workers as in the solution of the physical and technical problems of production. Mr. RESNICK, of the Safety Institute of America, would add safety to this category. Although the industrial safety movement had its inception in a purely humanitarian appeal, it has demonstrated over and over again that to safeguard life and limb is to sidestep a costly drain on morale, production and profit. The progressive manufacturer will find in this article many thoughtful suggestions for removing the hazards of production.

A keener sense of one's place in industry and a better understanding of production principles will make any employee more valuable to his employer. But B. M. NUSSBAUM, in his article on industrial training, would concentrate on the foreman, who he believes holds the most strategic position in the plant organization. By teaching these key men to pull together, it is possible to build up a loyalty that will solve many of the problems of management, that will lower costs, eliminate waste and increase production.

Doubtless there are many other problems of production that turn on the human element. But their solution is not radically different from those which we have already advanced. The whole matter can be summed up in no better way than in a single sentence from Secretary DAVIS' message: "The highest efficiency will be reached by that industry in which the employer knows intimately the problems and needs and aspirations of the worker, and in which the worker has a sympathetic understanding of the difficulties and discouragements and purposes of the employer."

Some Economic Angles To Production Efficiency

IN A recent issue of the *American* magazine there appeared an interview by a versatile and pleasing writer, BRUCE BARTON, with a real leader of industrial progress, HENRY DENNISON, president of the Dennison Manufacturing Co. The interview made a profound impression, partly because it stood out in contrast with the more ephemeral material with which it was flanked, but mainly because it set forth in a convincing manner the invaluable asset which the business man can make of statistical economics. As a result of his study of the business cycle and similar economic subjects, Mr. DENNISON showed how he had stabilized his business with respect to booms and depressions. His company ceased buying raw materials in the winter of 1920, even though orders were piling up and the business boom was at its height. A year later when hundreds of companies were taking a staggering and sometimes fatal inventory loss the Dennison Manufacturing Co. had a clean bill of health.

The incident holds its logical lesson for industry in general, and the chemical and related industries in particular. Consequently the suggestions in this issue by ERNEST T. TRIGG, relative to the possibility of eliminating the very high and very low spots in the business cycle, find an appropriate place in a symposium on increased production efficiency. Can the wavering curve of business be made to approach more nearly a horizontal line? If so, employment would be steadier and

e of the most serious evils of our economic system ould be mitigated. Mr. TRIGG'S suggestion to under- ke construction work, both municipal and private, ring periods of depression is essentially logical. At ch times material and labor costs will be low and the pply plentiful.

The connection between increased production effi- ency and the business cycle is immediate and funda- ental. Nothing is so upsetting to production efficiency irregular production. In a plant working at 100 per nt capacity, the fixed charges—those that do not vary ith rate of production, such as rent, taxes, insurance, preciation, etc.—are a relatively small percentage of e total cost. As production diminishes the ratio of tal cost to fixed charges decreases, and finally a point reached where the total cost exceeds revenue from es. This subject is admirably developed by Professor AUTENSTRAUCH in his article on the budget. The aphical determination of the point is amazingly simple one has accurate costs. And thus we arrive at the ux of the application of economic principles to busi- ss—costs, accurate costs—costs which are not biased any limited point of view, such as sales or produc- on. The development of this theme in its relation to oduction efficiency is covered in this issue by GEORGE COMER, who pleads for a rational interpretation of st data. We look upon his article as excellent am- unition in the campaign which we have consistently aged to impress chemists with the importance and cessity of accurate cost data.

In conclusion, it is well to remember that although oduction efficiency is obviously dependent upon the lution of many technical problems, and although hap- ly the welfare of the worker and other human ele- ents have become recognized factors in efficient oduction, the keystone of success certainly lies in the onomic soundness of a business.

ncreased Production Efficiency From an Engineering Standpoint

PRODUCTION EFFICIENCY can be increased by bringing into play on the elements of production ree kinds of knowledge: engineering science, economic ience, and human relations. The influence of these ree cannot be considered separately, for they overlap many points. However, no one man, be he ever so le, can be thoroughly expert in the application to dustry of more than a small part of any of these anches of knowledge. The knowledge of many, taken gether, must be sought to give us the complete picture.

The engineering phases of increasing production effi- ncy, those phases concerned with the technology of dustry, form an important part of this picture. They al primarily with the proper utilization of buildings d equipment, utilization in such a way as to obtain aximum production for least cost. The important ings to be considered are the design of the plant, e routing and handling of the materials through the ant, the choice and use of the process equipment and e proper application of power to the various opera- ons.

Other factors must be considered which are only in rt of an engineering nature, being fully as much ncerned with economics or human relations. Often ese factors are extremely important from an engineer- g point of view and have a strong influence on the imary engineering problems of production. Among ese perhaps the most important are the lighting, heat- ing and ventilation of the plant; the safety of operating conditions; the standardization of product and operation; and the research work necessary to keep all the foregoing at the best possible level.

In the contributions to this issue will be found much valuable information and many inspiring suggestions as to the engineering means to be employed in increasing production. These contributions are of two types: papers by specialists on the phases of the subject which are their particular concern and short messages from men responsible in the management of different industries. We believe the first category presents an unusual opportunity for the reader to familiarize himself with the basic engineering principles through which the technique of production can be improved, while the second presents the production problems of individual industries and suggests their solution in a manner that cannot fail to be profitable.

The layout of buildings and equipment, the routing of materials through the plant, and the handling of materials in accordance with this routing comprise the most important production problems with which we are now confronted. These three problems must be considered together, and to reach a rational basis of consideration a beginning must be made with the flow-sheet, as A. E. MARSHALL so clearly points out. After the flow-sheet has been established, the routing of the process can be readily determined. This routing forms the starting point for scientific plant design. FRANK D. CHASE shows in his paper on this subject that the important factors in plant engineering are the location, layout, equipment design, finance, operation and management. The bearing of all these factors on the successful operation of a plant should be determined before the plant is built. The material-handling equipment must be chosen on the basis of the routing and the plant layout must fit the exigencies of this equipment. J. G. HATMAN brings before us the fundamental principles on which a chemical plant handling system must be based if its full possibilities are to be realized.

The proper application of power to industry is one of the most important services which the engineer has to perform today. The present tendency is toward the more general use of electricity, and C. B. GIBSON shows us that electric power is power scientifically applied and hence aids the executive in the study of plant problems and leads to more efficient operation, better quality of product and general plant betterment. Steam is the general source of this electric power and in addition has a wide application in the processes of many industries. HERBERT B. REYNOLDS points out in his paper the importance of conserving fuel in the generation of steam power. He feels that generally the power plant is the stepchild of the management, is not understood and for that reason receives much less attention than it profitably should. Power costs should be determined to permit management to know and control this feature of production, realizing thus its best efficiency. Gas is a primary source of heat in many industries and in others is a recognized rival of steam. CARL J. WRIGHT shows how this source of power and heat could be used to advantage more extensively. Gas gives not only increased thermal efficiency but in many cases gives increased quantity and better quality of product.

Among the factors which are not wholly of an engineering nature but which have an important bearing on good engineering in the plant, CHARLES GALLO well points out the advantages to be obtained from good

plant lighting, among which perhaps the most important is that it permits the operators to see clearly and quickly enough to obtain the best results from the equipment. Another means of obtaining the best results from the equipment is brought out in WILLIS H. CARRIER'S thoughtful paper on the value of conditioned air in industry. Safety engineering is generally considered from the point of view of its effect on the personnel, but LOUIS RESNICK'S article on this subject shows that safety of operation also plays an important part in enabling the equipment to function at its best.

Mass production is attained essentially through standardization of product and operation; and for this reason the present active campaign for standardization in industry has a direct bearing on production engineering, for it is by means of mass production that the full advantage of scientific plant engineering is realized. Standardization in chemical industry can be successfully realized only by means of extensive research. C. G. DERICK'S paper on research brings out this fact among many other points of equal importance.

In studying the shorter articles presented by men from the various industries the reader cannot fail to be impressed with the importance of the message which they contain. It avails little to pick out the features of these articles which are of special interest from an engineering point of view. Every reader will profit from a study of this entire symposium. Emphasis may well be given, however, to the point brought out by O. S. SLEEPER, that the road to improvement in process equipment lies through the complete co-operation of chemical manufacturers and equipment makers, and that the progressive manufacturer cannot afford to have any secrets from the man who builds his equipment.

The Eighth Exposition Of Chemical Industries

THE exposition that will open at Grand Central Palace on Sept. 11 will represent the consummation of a year's thought and effort begun when the last one closed a year ago. The orderly arrangement of exhibits will have been assembled for the visitor almost as if by magic, and the carefully planned programs will be carried out with a degree of smoothness and precision that will scarcely be appreciated by those whom they are intended to benefit. Only those who have been directly connected with the preparation of the vast spectacle will have any adequate comprehension of the work involved.

It is doubtful if any technical exposition has grown to the magnitude and enjoyed the degree of popularity that has been attained by the chemical exposition. Essentially technical in its nature, it has nevertheless been able to offer a popular appeal to intelligent people that has undoubtedly done much to create in the mind of the public a sense of the importance of the chemical industry in our national welfare. That it has been possible to increase and sustain this interest for 8 successive years is a tribute not only to the management of the exposition but to the excellence of the exhibits as conceived by those who have made them year after year. They have had a tremendous educational value as well as undoubted commercial and technical importance. Engineers have attended in order to pick up new ideas; college professors have brought their classes for purposes of instruction; and buyers and sellers have even transacted business on the floors of the exposition. All told, it has been a remarkable and ever-increasing success, to which the show for 1922 will be no exception.

Twenty Years of Militant Journalism

WITH the publication of this issue, *Chem. & Met.* rounds out 20 years of growth and service. It was in September, 1902, that *Electrochemical Industry*, as it was then called, was first offered to a friendly but critical group of scientists and industrial leaders who were inaugurating electrochemistry and electrometallurgy in this country. The magazine was conceived in a new spirit of technical literature and born under the favorable auspices of conservative and successful publishing. In the first issue the editor frankly declared an editorial policy "unhampered by precedent" that would enable him to conduct the magazine "along the most advanced lines of modern technical journalism." And "unhampered by precedent" it has been from that day to this.

How well the standards of the founders have been maintained and how nearly they realized their hopes and ambitions are matters of record in twenty-seven volumes of technical literature. That these volumes have been bound and preserved by an unusually large number of subscribers is testimony to a quality of permanence in their value seldom found in current literature. That the journal has reached its present proportions and acknowledged position of importance in the chemical industry is a tribute to its service to reader and advertiser alike.

It is not our purpose here to chronicle the details of 20 years of editorial effort. But a few matters are worth recording. "Unhampered by precedent" the magazine did not hesitate to render service whenever and wherever opportunity offered. This led to growth and expansion. Dr. ROEBER loved to refer to the paper as an insurgent publication, and in September, 1912, on its tenth anniversary he saluted his readers under the caption "Ten Years of an Insurgent Engineering Journal." And the record disclosed a spirit of service and independence that readily accounts for the journal's success and progress. At that time its name had already been twice changed, as its editorial scope and contents were modified to serve an expanding field. And since then equally important changes have been made, all dictated by the demands of the times. Once more the name was changed. Once more "unhampered by precedent" the monthly magazine became an equally successful semi-monthly and finally assumed unquestioned leadership in its field by weekly publication.

Thus we arrive at our present status as an exponent of technology in industry—the application of the principles of science, mathematics and engineering to industrial processes. Once more "unhampered by precedent" we have conceived an editorial scope that covers the broad range of chemical and related industries in which the fundamental processes of chemical engineering are applied. On this basis we serve the ceramist and the soapmaker, the producer of sugar and the manufacturer of paper and pulp, the refiner of petroleum and the burner of lime and cement, the strictly chemical industries and the related manufacture of coal and wood byproducts, fertilizers, paint and varnish, rubber, leather, food and animal products. And hand in hand with this service to technology has developed a fighting spirit of support for the chemical industry in our national life and welfare. The insurgency of a decade ago has begotten the militancy of today. What the future holds we cannot tell, but whatever it be it will still be met "unhampered by precedent."

Program of the Exposition

Four Technical Societies and One Trade Association to Hold Sessions for Reading and Discussion of Papers—Wide Range of Industrial Processes Illustrated by an Excellent Selection of Motion Pictures

ONE of the novel features of the daily technical programs at the Eighth National Exposition of Chemical Industries will be the first session of the recently organized Technical Photographic and Microscopical Society. This organization is made up of technologists in all industries in which photography, microscopy and photomicrography play an important part.

Other organizations that will hold their regular sessions at Grand Central Palace during Exposition Week are the Technical Association of the Pulp and Paper Industry, the American Ceramic Society and the New York Section of the American Chemical Society.

The Synthetic Organic Chemical Manufacturers Association of the United States will hold a session on Tuesday afternoon and there will also be a general meeting at which chemical engineering problems will be discussed.

The motion picture program this year comprises an unusually good selection of films on industrial subjects that will have a strong educational value.

Among the general addresses none will arouse more interest than that scheduled for Monday evening, when Wayne B. Wheeler, counsel for the Anti-Saloon League, will speak on "The Attitude of the Anti-Saloon League Toward Industrial Alcohol."

The detailed program follows:

Program of Speakers and Meetings

All in the Meeting Auditorium—Fourth Floor.

MONDAY, SEPT. 11.

8 p.m.—Opening address by Charles H. Herty, chairman, Exposition Committee.

Wayne B. Wheeler, counsel Anti-Saloon League, "The Attitude of the Anti-Saloon League Toward Industrial Alcohol."

Miss Lida Hafford, director, general headquarters, General Federation of Women's Clubs, "Woman's Interest in Chemistry in America."

TUESDAY, SEPT. 12.

2 p.m.—Meeting of the Synthetic Organic Chemical Manufacturers Association of the U. S.

8 p.m.—E. H. Hale (Liquid Carbonic Co.), "Manufacture, Properties and Application of Carbon Dioxide."

P. W. Heath (Liquid Carbonic Co.), "Using Carbon Dioxide in Ice Cream."

C. R. DeLong (Chemical Division, U. S. Department of Commerce), "How the Department of Commerce Can Serve the Chemical Industry."

WEDNESDAY, SEPT. 13

Pulp and Paper Day

2 p.m.—Meeting, Technical Association of Pulp and Paper Industry, George E. Williamson, chairman.

W. C. Edge (Paul B. Huyette Co.), "Safety and Efficiency Appliances for the Boiler Plant."

E. J. Trimbey (Trimbey Machine Works), "Trimbey and Tibbitts Proportioning and Metering System for Paper Stock."

George L. Dickey (Industrial Filtration Corp.), "Rotary Filters for Washing of Paper Pulp and for Filtering and Washing Caustic Lime Mud." (Illustrated.)

H. A. Morrison (Oliver Continuous Filter Co.), "Efficiencies and Economies in Washing Black Liquor From Digested Soda and Sulphate Stock."

L. D. Mills (The Merrill Co.), "The Merco Nordstrom Plug Valve."

H. S. Thayer (Atlas Electric Devices Co.), "Testing Colored Materials for Fastness to Light."

A. E. Campbell (The Schaeffer & Budenberg Mfg. Co.), "Instruments for Promoting Efficiency in the Paper Mill."

L. G. Bean (The Bristol Co.), "Application of Recording Instruments in Pulp and Paper Industry."

C. C. Phelps (Uehling Instrument Co.), "The CO_2 Record of Combustion Efficiency."

Harry Carlson (Sandvik Steel, Inc.), "Steel Belts and Their Application to the Solution of Conveying Problems."

H. Austin (Ernest Scott & Co.), "Scott Evaporator as Used in the Pulp Mill for Recovering Soda From Spent Liquors."

L. G. Chase (Yarnall-Waring Co.), "The V-Notch Meter and Its Application to the Paper Mill."

W. D. Mount (Glamorgan Pipe & Foundry Co.), "Continuous Causticizing With Lime Recovery and Re-use."

Jerome D. Stein (Grinnell Co.), "The Grinnell Drier Applied to Wall-Paper and Coated Paper."

L. Mann (National Aniline & Chemical Co.), "The Proper Selection and Application of Dyes for Paper."

THURSDAY, SEPT. 14

2 p.m.—Meeting, Technical Photographic and Microscopical Society. (Meeting will take place in Motion Picture Room.) James McDowell, chairman.

Miss Eloise Gerry and Dr. E. M. Diemer (Forest Products Laboratory, Madison, Wis.), "Photomicrography in Pulp and Paper Research Problems."

Henry Green (New Jersey Zinc Co., Palmerton, Pa.), "The Photomicroscopy of Paint and Rubber Pigments."

Dominic S. Mungillo (Craftsmen's Film Laboratory, New York), "How Motion Pictures Are Finished."

Clarence W. Gibbs (Victor Animatograph Co., New York), "Mechanics of Motion Picture Apparatus."

Alfred B. Hitchins, Ph.D. F.C.S. (director Ansco Research Laboratory, Ansco Co., Binghamton, N. Y.), "The Motion Picture as an Aid to Industry."

Guido E. Daub (A. F. Gallun Sons Co., Milwaukee, Wis.), "Microscopy in Leather Tanning."

Albert H. Grimshaw (Textile School, New Bedford, Mass.), "Use of the Microscope in Textile Work."

Philip O. Gravelle (South Orange), "Protozoa and Rotifers: Studies in Microscopic Animal Life." (Illustrated by motion pictures.)

8 p.m.—M. L. Crossley (Colco Chemical Co.), "The Colors That Please Us."

FRIDAY, SEPT. 15

Ceramic Day

2 p.m.—Meeting, American Ceramic Society.

8 p.m.—Meeting, New York Section American Chemical Society. Martin H. Ittner, chairman.

W. D. Collins (U. S. Geological Survey), "Moderation in Standardization."

N. F. Harriman (U. S. Bureau of Standards), "Standardization From the Consumer's Point of View."

I. G. Jennings (Glass Container Association), "Discussion of the Reasons for the Varieties of Shapes and Sizes."

J. M. Roberts (secretary of the Apparatus Manufacturers' Association of the United States), "What Has Been Accomplished in the Standardization of Scientific Apparatus."

Ross C. Purdy (secretary, American Ceramic Society and chairman of committee on refractories of the American Society of Testing Materials), "Standardization of Fireclays and Refractories."

Emerson C. Poste (Elyria Enameled Products Co.), "Standardization of Enameled Wares for Chemical Purposes."

William A. Durgin (Division of Simplified Practice, Department of Commerce), "Standardization."

Motion Picture Program

All in the Motion Picture Room, Fourth Floor

TUESDAY, SEPT. 12

2 p.m.—"The Story of Sulphur" (2 reels), Courtesy, U. S. Bureau of Mines and Texas Gulf Sulphur Co.

"Dust Explosions" (1 reel), Courtesy, U. S. Bureau of Chemistry.

"Protecting Buildings Against Lightning" (1 reel), Courtesy, Baltimore Copper Works.

"The Story of Asbestos" (4 reels), Courtesy, Johns-Manville Co.

"Nickel and Copper Mining, Smelting and Refining" (3 reels), Courtesy, International Nickel Co. (Speaker.)

"Recovering Values From Fume and Smoke" (1 reel), Courtesy, U. S. Bureau of Mines and Research Corporation.

7:30 p.m.—"The Story of Natural Gas" (4 reels), Courtesy, U. S. Bureau of Mines.

"Extinguishing the Largest Oil Fire in the History of Casper, Wyo." (1 reel), Courtesy, Foamite-Childs Corporation.

"The Romance of Cotton" (1 reel), illustrated with address by David Wesson of Southern Cotton Oil Co.

"The Story of Air Reduction" (4 reels), Courtesy, U. S. Bureau of Mines.

WEDNESDAY, SEPT. 13

2 p.m.—"The Story of Heavy Excavating Machinery" (4 reels), Courtesy, U. S. Bureau of Mines.

"The Story of Abrasives" (4 reels), Courtesy, U. S. Bureau of Mines and the Carborundum Co.

"Prospecting for Gold in Northern Ontario," and "Assaying for Gold in Northern Ontario," (3 reels), Courtesy, Ontario Department of Mines.

7:30 p.m.—"The Manufacture of Newsprint Paper at the Spanish River Pulp & Paper Co. Mills in Ontario" (8 reels), Courtesy, The G. H. Mead Co.

"Barrel Making in America" (2 reels), Courtesy, Lucas E. Moore Stave Co.

"The All-weather Fire Extinguisher That Won't Freeze" and "An Industrial Firefoam Sprinkler System" (1 reel), Courtesy, Foamite-Childs Corporations.

THURSDAY, SEPT. 14

2 p.m.—Room occupied by meeting of T.A.P.P.I.

7:30 p.m.—"Mexican Petroleum" (4 reels), Courtesy, U. S. Bureau of Mines.

"Extinguishing the Largest Oil Fire in the History of Casper, Wyo." (1 reel), "Fire-Extinguishing Tests on Blazing Oil Tanks at Port Arthur, Tex. (1 reel), Courtesy, Foamite-Childs Corporation.

"Protozoa and Rotifers: Studies in Microscopic Animal Life" (1 reel).

"Inspiration: One of the World's Great Copper Mines" (3 reels), Courtesy, U. S. Bureau of Mines.

"How Motion Pictures Are Finished" (1 reel), Courtesy, Craftsman Films, Inc.

FRIDAY, SEPT. 15

2 p.m.—"Prospecting for Gold in Northern Ontario" and "Assaying for Gold in Northern Ontario" (3 reels), Courtesy, Ontario Department of Mines.

"Inspiration: One of the World's Great Copper Mines" (3 reels), Courtesy, U. S. Bureau of Mines.

"Nickel and Copper Mining, Smelting and Refining" (3 reels), Courtesy, International Nickel Co. (Speaker.)

"Protecting Buildings Against Lightning" (1 reel), Courtesy, Baltimore Copper Works.

"An Industrial Firefoam Sprinkler System" (1 reel), Courtesy, Foamite-Childs Corporation.

7:30 p.m.—"The Story of Natural Gas" (4 reels), Courtesy, U. S. Bureau of Mines.

"The Story of Abrasives" (4 reels), Courtesy, U. S. Bureal of Mines and the Carborundum Co.

"Barrel Making in America" (2 reels), Courtesy, Lucas E. Moore Stave Co.

"Dust Explosions" (1 reel), Courtesy, U. S. Bureau of Chemistry.

SATURDAY, SEPT. 16

2 p.m.—"The Story of Air Reduction" (4 reels), Courtesy, U. S. Bureau of Mines.

"The Story of Asbestos" (4 reels), Courtesy, Johns-Manville Co.

"The Story of Sulphur (2 reels), Courtesy, U. S. Bureau of Mines and Texas Gulf Sulphur Co.

"Fire-Extinguishing Tests on Blazing Oil Tanks at Port Arthur, Tex." (1 reel), and "Extinguishing the Largest Oil Fire in the History of Casper, Wyo." (1 reel), Courtesy, Foamite-Childs Corporation.

7:30 p.m.—"Nickel and Copper Mining, Smelting and Refining" (3 reels), Courtesy, International Nickel Co. (Speaker.)

"Protecting Buildings Against Lightning" (1 reel), Courtesy, Baltimore Copper Works.

"The Romance of Cotton" (1 reel), illustrated with address by David Wesson of Southern Cotton Oil Co.

"Recovering Values From Fume and Smoke" (1 reel), Courtesy, U. S. Bureau of Mines and Research Corporation.

"The Manufacture of Newsprint Paper at the Spanish River Pulp & Paper Co. Mills in Ontario" (8 reels), Courtesy, The G. H. Mead Co.

Classified List of Exhibitors

A List for Ready Reference From Which the Busy Reader Can Quickly Ascertain the Names of Those Companies Exhibiting the Special Products in Which He Is Most Interested

IN AN EFFORT to render better service both to the readers of *Chem. & Met.* and the exhibitors at the exposition, a new method of presentation has been adopted this year. Hitherto we have given an alphabetical list of exhibitors with a brief explanatory statement of their exhibits. This has not been wholly satisfactory, because readers were more interested in the material exhibited than in the concerns exhibiting.

Accordingly this year we have classified the exhibitors according to the character of their exhibits and have listed the companies under classifications that will enable the reader to see at a glance who is exhibiting the things in which he is most interested.

No attempt has been made to give the booth number of the various exhibitors, as this will be more conveniently ascertained by reference to the pocket-size program that we shall distribute at the exposition. The principal purpose of the present classification is to enable the reader to determine at leisure those things to which he will prefer to devote the most of his time.

Abrasives:
The Carborundum Co.
Norton Co.

Absorption Equipment:
Silica Gel Corp.

Acid Plants and Equipment:
United Lead Co.

Acid-Resisting Materials:
Bethlehem Foundry & Machine Co.
The Duriron Co., Inc.
Electro-Chemical Supply & Engineering Co.
General Ceramics Co.
General Filtration Co., Inc.
Haynes Stellite Co.
Maurice A. Knight
Luzerne Rubber Co.
Johns-Manville, Inc.
J. L. Mott Iron Works
Nitrose Co.
Westinghouse Elec. & Mfg. Co.

Agitators:
Bethlehem Foundry & Machine Co.
The Dorr Co.
General Ceramics Co.
Hunter Dry Kiln Co.
F. J. Stokes Machine Co.
The Carrier Engineering Co.
W. L. Fleisher & Co., Inc.

Alcohol:
Alcohol Warehouse Corp.
U. S. Industrial Alcohol Co.

Alloys:
American Brass Co.
American Manganese Bronze Co.
Anaconda Copper Mining Co.
Anaconda Rolling Mill Dept.
Aterite Co., Inc.
Baker & Co., Inc.
British-America Nickel Corp., Ltd.
Calorizing Co. of Pittsburgh
The Duriron Co., Inc.
Haynes Stellite Co.
Hoyt Metal Co.
International Nickel Co.
International Smelting Co.
Monel Metal Products Co.
Tuc-Tur Metal Corp.
United Metals Selling Co.
York Metal & Alloys Co.

Asbestos:
Johns-Manville, Inc.
Powhattan Mining Co.

Asphalt:
The Barber Asphalt Co.

Associations:
National Lime Association
Talc & Soapstone Producers Assn.

Autoclaves:
M. W. Kellogg Co.

Automatic Machinery:
Economic Machinery Co.
Edward Ermold Co.
Karl Kiefer Machine Co.
Mohan & Co., Inc.
Standard Sealing Equipment Corp.
Trimbey Machine Works
Wallace & Tiernan Co., Inc.

Bags:
Arkell Safety Bag Co.

Balances:
Christian Becker, Inc.
Palo Co.
Voland & Sons

Bakelite:
The Bakelite Corp.
The General Bakelite Co.

Barrels and Drums:
The Associated Cooperage Industries of America
Chess & Wymond
The Cleveland Cooperage Co.
B. & A. D. Fessenden Co.
Pioneer Cooperage Co.
Pressed Steel Tank Co.
Seymour & Peck Co.

Belting:
R. & J. Dick Co., Inc.

Blowers and Fans:
Abbé Engineering Co.
Beach-Russ Co.
The Duriron Co., Inc.
General Ceramics Co.
Schutte & Koerting Co.
B. F. Sturtevant Co.

Books, Technical:
P. Blakiston's Son & Co.
J. B. Lippincott Co.
D. Van Nostrand Co.
John Wiley & Sons, Inc.
H. W. Wilson Co.

Burners:
Glens Falls Machine Works
Macleod Co.
Surface Combustion Co.
Trimbey Machine Works
Will Corp.

Canada:
Dominion Water Power Branch
Forest Products Labs. of Canada
Ontario Dept. of Mines

Carbon Products:
Barnebey Cheney Engrg. Co.
Carbrox Co., Inc.
Darco Sales Corp.
Industrial Chemical Co.

Centrifugals:
De Laval Separator Co.
Fletcher Works
Sharples Specialty Co., Inc.
Tolhurst Machine Works

Chemical Engineers:
H. F. Jacoby
Petri & Dorr

Chemical Plant Equipment:
Allis-Chalmers Mfg. Co., Inc.
A. J. Becker
Benzine Condensation Co.
Buffalo Foundry & Machine Co.
Builders Iron Foundry
Clipper Belt Lacer Co.
Corning Glass Works
Crane Co.
Crane Packing Co.
J. P. Devine Co.
Electro Bleaching Gas Co.
The Elyria Enameled Products Co.
Filtration Engineers, Inc.
General Ceramics Co.
Glamorgan Pipe & Foundry Co.
Glens Falls Machine Works
Haynes Stellite Co.
International Nickel Co.
Henry E. Jacoby
Janney, Steinmetz & Co.
M. W. Kellogg Co.
Maurice A. Knight
L. O. Koven & Brother
La Bour Co.
Monel Metal Products Co.
J. L. Mott Iron Works
Niagara Alkali Co.
Perry & Webster, Inc.
Pfaudler Co.
Ernest Scott & Co.
Charles E. Sholes
Silica Gel Corp.
Sowers Mfg. Co.
Stuart & Peterson Co.
Trimbey Machine Works
United Lead Co.

Chemicals:
American Aniline Products, Inc.
American Cyanamid Co.
Apex Chemical Co., Inc.
Avery Rock Salt Mining Co.
J. T. Baker Chemical Co.
Chemical Service & Sales Corp.
The Cleveland-Cliffs Iron Co.
Commercial Solvents Corp.
The Davison Chemical Co.
Eimer & Amend
Electro Bleaching Gas Co.
Federal Phosphorus Co.
Heyden Chemical Company of America, Inc.
Innis, Speiden & Co.
International Nickel Co.
International Salt Co. of N. Y.
Isco-Bautz Co.
Isco Chemical Co.
A. Klipstein & Co.
Lindsay Light Co.
Liquid Carbonic Co.
Mallinckrodt Chemical Works
Mathieson Alkali Works, Inc.
Merrimac Chemical Co.
Miner Laboratories
Monel Metal Products Co.
National Aniline & Chemical Co.
National Rosin Oil & Size Co.
Niagara Alkali Co.
Nitrogen Corp.
Pennsylvania Salt Co.
Perth Amboy Chemical Co.
Philadelphia Quartz Co.
Powers-Weightman-Rosengarten Co.
Rhodia Chemical Co.
Roessler & Hasslacher Chemical Co.
Southern Agricultural Chemical Corp.
Southern Cotton Oil Co.
Stein, Hall & Co., Inc.
Takamine Commercial Corp.
Takamine Laboratory, Inc.
Chas. S. Tanner Co.
Tennessee Copper Co.
U. S. Industrial Alcohol Co.
U. S. Industrial Chemical Co.
U. S. Radium Corp.
Wilbur White Chemical Co.
Will Corp.
Zinsser & Co.

Chemical Stoneware:
General Ceramics Co.
Maurice A. Knight

Clarifiers:
Petri & Dorr

Classifiers:
The Dorr Co.

Coal-Tar Products:
The Barrett Co.

Coil Pipe:
Whitlock Coil Pipe Co.

Coke Ovens:
Foundation Oven Corp.
Koppers Co.
Seaboard By-Products Coke Co.

Combustion Apparatus:
Mono. Corp of America
Uehling Instrument Co.

Combustion Engineering:
Surface Combustion Co.

Compressors:
Beach-Russ Co.
Nash Engineering Co.
Yarnall-Waring Co.

Concrete Hardening and Waterproofing:
Anti-Hydro Waterproofing Co.

Condensers:
Benzine Condensation Co.

Consultants:
Curt Bredt

Containers:
American Welding Co.
Arkell Safety Bag Co.
The Associated Cooperage Industries of America
Chess & Wymond
The Cleveland Cooperage Co.
The Container Club
Diamond State Fibre Co.
B. & A. D. Fessenden Co.
Janney, Steinmetz & Co.
Liquid Carbonic Co.
Newark Paraffine & Parchment Paper
Seymour & Peck Co.

Conveying Equipment:
The Dow Co.
Karl Kiefer Machine Co.
Sandvik Steel, Inc.

Crushing and Grinding Equipment:
Builders Iron Foundry
J. H. Day Co.
Hardinge Co.
Sturtevant Mill Co.

Distillation Equipment:
M. W. Kellogg Co.
Koppers Co.
F. J. Stokes Machine Co.

Drying Equipment:
Buffalo Foundry & Machine Co.
J. P. Devine Co.
Filtration Engineers, Inc.
W. L. Fleisher & Co., Inc.
Grinnell Co.
Hunter Dry Kiln Co.
Industrial Waste Products Corp.
Proctor & Schwartz, Inc.
Ruggles-Coles Engineering Co

Drying Equipment:
F. J. Stokes Machine Co.
B. F. Sturtevant Co.
Dust Collectors:
Macleod Co.
W. W. Sly Mfg. Co.
Dyes and Intermediates:
American Aniline Products, Inc.
Bachmeier & Co., Inc.
Marietta Refining Co.
National Aniline & Chemical Co.
Newport Chemical Works, Inc.
G. Siegle Corp of America
Zinsser & Co.
Electrical Instruments:
Leeds & Northrup Co.
Pyrolectric Instrument Co.
Wilson-Maeulen Co.
Electrical Equipment:
Benjamin Electric Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Electrolytic Cells:
Electro-Chemical Supply & Engineering Co.
General Filtration Co., Inc.
Engineers:
Henry E. Jacoby
Lewis-Green-McAdams & Knowland
Perry & Webster, Inc.
Research Corp.
Charles E. Sholes
Evaporators:
The American Chemical Machinery Co.
Buffalo Foundry & Machine Co.
Chemical Equipment Co.
Henry E. Jacoby
Ernest Scott & Co.
Zaremba Co.
Extractors:
J. P. Devine Co.
East Jersey Pipe Co.
Glamorgan Pipe & Foundry Co.
Van Vlaanderen Machine Co.
Fabrics:
Salmon Falls Mfg. Co.
Fertilizers:
American Cyanamid Co.
Anaconda Copper Mining Co.
International Smelting Co.
Southern Agricultural Chemical Corp.
Tennessee Copper Co.
United Metals Selling Co.
Fiber Products:
Diamond State Fibre Co.
J. P. Lewis Co.
Filling Machines:
Karl Kiefer Machine Co.
Mohan & Co., Inc.
Filter Cloths:
National Filter Cloth & Weaving Co.
Filters:
Celite Products Co.
Filtration Engineers, Inc.
General Ceramics Co.
General Filtration Co., Inc.
Glamorgan Pipe & Foundry Co.
Industrial Filtration Corp.
Henry E. Jacoby
Karl Kiefer Machine Co.
Maurice A. Knight
Newark Wire Cloth Co.
N. Y. Continental Jewell Filtration Co.
Norton Co.
Oliver Continuous Filter Co.
Proctor & Schwartz, Inc.
Provost Engineering Corp.
D. R. Sperry & Co.
United Filters Corp.
Vallez Rotary Filters
Fire Extinguishers:
Foamite Childs Corp.
General Fire Extinguisher Co.
Furnaces and Accessories:
Bethlehem Foundry & Machine Co.
General Electric Co.
Hanovia Chemical & Mfg. Co.
Palo Co.
Pyrolectric Instrument Co.
Quigley Furnace Specialties Co.
Surface Combustion Co.
Wedge Mechanical Furnace Works
Young Brothers Co.
Gages:
American Steam Gauge & Valve Mfg. Co.
Bailey Meter Co.
The Brown Instrument Co.
The Foxboro Co., Inc.
Jos. W. Hays Corp.
Paul B. Huyette Co.
Liquid Carbonic Co.
Pneumercator Co.
Reliance Gauge Column Co.
Schaeffer & Budenberg Mfg. Co.
Glass Enameled Apparatus:
The Elyria Enameled Products Co.
J. L. Mott Iron Works
Pfaudler Co.
Gears:
Philadelphia Gear Works
Glassware, Chemical
Corning Glass Works
Eimer & Amend
Whitall Tatum Co.
Government Bureaus:
Dominion Water Power Branch
Forest Products Labs. of Canada
Ontario Dept. of Mines
U. S. Bureau of Chemistry
U. S. Bureau of Mines
Heating Equipment:
Parks-Cramer Co.
Power Specialty Co.
Westinghouse Elec. & Mfg. Co.
Heating Systems
General Electric Co.
Parks-Cramer Co.
Whitlock Coil Pipe Co.
Humidifiers:
The Bahnson Co.
Insulators, Electrical:
The Bakelite Co.
Diamond State Fibre Co.
General Bakelite Co.
Redmanol Chemical Products Co.
Insulators, Heat:
Armstrong Cork & Insulation Co.
Celite Products Co.
Electro Bleaching Gas Co.
Charles Engelhard, Inc.
Johns-Manville, Inc.
Niagara Alkali Co.
Quigley Furnace Specialties Co.
Kettles:
J. L. Mott Iron Works
Sowers Mfg. Co.
Stuart & Peterson Co.
Kilns:
Glamorgan Pipe & Foundry Co.
Labeling Machines:
Economic Machinery Co.
Edward Ermold Co.
Mohan & Co., Inc.
Laboratory Apparatus & Supplies:
Alberene Stone Co.
Christian Becker, Inc.
Central Scientific Co.
Cooper Hewitt Electric Co.
Coors Porcelain Co.
Corning Glass Works
Eimer & Amend
Charles Engelhard, Inc.
General Ceramics Co.
Hanovia Chemical & Mfg. Co.
Kewaunee Mfg. Co.
Maurice A. Knight
Leeds & Northrup Co.
Palo Co.
R. U. V. Co., Inc.
Schwartz Sectional System
Scientific Equipment Co.
Victor X-Ray Corp.
Voland & Sons
Will Corp.
Lacquers:
The Egyptian Lacquer Mfg. Co.
Maas & Waldstein Co.
Zeller Lacquer Mfg. Co.
Lead Burning:
John F. Abernethy
Lead-lined Equipment:
Lead Lined Iron Pipe Co.
United Lead Co.
Lime:
National Lime Assoc.
Magnetic Separators:
Dings Magnetic Separator Co.
Material Handling Equipment:
A. J. Becker
Guarantee Construction Co.
Revolvator Co.
Metals:
American Brass Co.
Anaconda Copper Mining Co.
Anaconda Rolling Mill Dept.
Baker & Co., Inc.
British America Nickel Corp., Ltd.
Calorizing Co. of Pittsburgh
The Duriron Co., Inc.
Gibson & Price Co.
Haynes Stellite Co.
Hoyt Metal Co.
Illinois Zinc Co.
International Nickel Co.
International Smelting Co.
Metals Disintegating Co.
Mineral Point Zinc Co.
Monel Metal Products Co.
N. J. Zinc Co.
Raritan Copper Works
Tuc-Tur Metal Corp.
United Metals Selling Co.
York Metal & Alloys Co.
Meters:
Bailey Meter Co.
Builders Iron Foundry
The Foxboro Co., Inc.
Moto Meter Co., Inc.
Simplex Valve & Meter Co.
Trimbey Machine Works
Yarnall-Waring Co.
Microscopes:
Bausch & Lomb Optical Co.
Mixers:
Abbé Engineering Co.
Joseph Baker Sons & Perkins Co., Inc.
J. H. Day Co.
The Elyria Enameled Products Co.
L. O. Koven & Brother
Pfaudler Co.
Provost Engineering Corp.
Read Machinery Co.
Strite Machine Co.
Optical Instruments:
Bausch & Lomb Optical Co.
Oils:
Boyer, Kienle Co., Inc.
National Rosin Oil & Size Co.
Southern Cotton Oil Co.
Packaging Equipment:
Standard Sealing Equipment Corp.
Packing:
Crane Packing Co.
Huhn Mfg. Co.
Paints & Pigments:
Anaconda Copper Mining Co.
International Smelting Co.
N. J. Zinc Co.
Nitrose Co.
G. Siegle Corp. of America
United Metals Selling Co.
Wailes-Dove-Hermiston Corp.
Perforated Metals:
Beckley Perforating Co.
Chemical Service & Sales Corp.
Perfumes & Flavoring Extracts:
Florasynth Laboratories:
Pipe and Tube:
The Duriron Co., Inc.

M. W. Kellogg Co.
Lead Lined Iron Pipe Co.
United Lead Co.
Wheeler Condenser & Engineering Co.
Whitlock Coil Pipe Co.

Platinum:
Baker & Co., Inc.

Porcelain:
Coors Porcelain Co.

Power Plant Equipment and Supplies:
Armstrong Machine Works
Crane Co.
Crane Packing Co.
Jos. W. Hays Corp.
Paul B. Huyette Co.
Lunkenheimer Co.
Nitrose Co.
S. Obermayer Co.
Quigley Furnace Specialties Co.
Reliance Gauge Column Co.
Roto Co.
Sarco Co., Inc.
C. J. Tagliabue Mfg. Co.
Templeton Mfg. Co.
Wheeler Condenser & Engrg. Co.
Whitlock Coil Pipe Co.

Power Transmission Equipment:
Clipper Belt Lacer Co.
R. & J. Dick Co., Inc.
Morse Chain Co.
Smith & Serrell

Publications:
The American Dyestuff Reporter
The American Perfumer and Essential Oil Review
Canadian Chemistry & Metallurgy
Canadian Fisherman
Canadian Mining Journal
Canadian Textile Journal
Chemical Age
Chemical and Metallurgical Engineering
Chemical Catalog Co., Inc.
Chemical Color & Oil Record
Color Trade Journal
Combustion
Drug & Chemical Markets
Fertilizer Green Book
Industrial Arts Index
Iron and Steel of Canada
Journal of Commerce (Canadian)
Journal of Commerce (N. Y.)
Manufacturers Record
N. Y. Commercial
Oil, Paint & Drug Reporter
Paper Mill & Wood Pulp News
Pulp & Paper
Magazine of Canada
Textiles
Textile World
Thomas Publishing Co.

Pulverized Fuel Equipment:
K-B Pulverizer Co., Inc.

Pulverizers:
Abbé Engineering Co.
Hardinge Co.
K-B Pulverizer Co., Inc.
Provost Engineering Corp.
Raymond Bros. Impact Pulverizer Co.
Sturtevant Mill Co.

Pumps:
Abbé Engineering Co.
American Hard Rubber Co.
American Steam Pump Co.
Beach-Russ Co.
Blackmer Rotary Pump Co.
Buffalo Foundry & Machine Co.
Chemical Equipment Co.
The Chemical Pump & Valve Co.
J. P. Devine Co.
The Dorr Co.
The Duriron Co., Inc.
General Ceramics Co.
Huhn Mfg. Co.
Karl Kiefer Machine Co.
La Bour Co.
Nash Engineering Co.
Nassau Valve & Pump Corp.
Oliver Continuous Filter Co.
Provost Engineering Corp.
Schutte & Koerting Co.
F. J. Stokes Machine Co.
United Lead Co.
Wheeler Condenser & Engrg. Co.

Pyrometers:
The Brown Instrument Co.
Charles Engelhard, Inc.
Leeds & Northrup Co.
Schaeffer & Budenberg Mfg. Co.
Thwing Instrument Co.
Wilson-Maeulen Co.

Recording Instruments:
Bailey Meter Co.
The Bristol Co.
The Brown Instrument Co.
The Foxboro Co., Inc.
Jos. W. Hays Corp.
Paul B. Huyette Co.
Leeds & Northrup Co.
Mono. Corp. of America
Schaeffer & Budenberg Mfg. Co.
C. J. Tagliabue Mfg. Co.
Thwing Instrument Co.
Uehling Instrument Co.
Wilson-Maeulen Co.
Yarnall-Waring Co.

Refractories:
Calorizing Co. of Pittsburgh
The Carborundum Co.
Johns-Manville, Inc.
Norton Co.
Quigley Furnace Specialties Co.

Refrigerating Equipment:
Silica Gel Corp.
Whitlock Coil Pipe Co.

Rubber Products:
American Hard Rubber Co.
Luzerne Rubber Co.

Safety Devices:
Burrell Technical Supply Co.
Irving Iron Works Co.
Mine Safety Appliances Co.
U. S. Bureau of Mines
Willson Goggles, Inc.

Salt:
Avery Rock Salt Mining Co.
International Salt Co. of N. Y.
Myles Salt Co.
Pennsylvania Salt Co.

Scientific Instruments:
Bausch & Lomb Optical Co.
Cooper Hewitt Electric Co.
Eimer & Amend
Leeds & Northrup Co.
Palo Co.
Pyrolectric Instrument Co.
R. U. V. Co., Inc.
C. J. Tagliabue Mfg. Co
Thwing Instrument Co.
Victor X-Ray Corp.
Weinhagan & Hespe
Will Corp.
Wilson-Maeulen Co.

Screens:
J. H. Day Co.
Newark Wire Cloth Co.
Sturtevant Mill Co.
W. S. Tyler Co.

Scrubbers:
The American Chemical Machinery Company
Benzine Condensation Co.

Shipping Room Equipment:
W. H. Alexander
Ideal Stencil Machine Co.

Societies:
American Ceramic Society
American Chemical Society
Chemists' Club

Southern Resources:
Southern Railway System

Spray Systems:
W. L. Fleisher & Co., Inc.
Macleod Co.
Schutte & Koerting Co.
Yarnall-Waring Co.

Steam Appliances:
Armstrong Machine Works
Crane Co.
Crane Packing Co.
Paulsen Spence Co.
C. J. Tagliabue Mfg. Co.
Templeton Mfg. Co.
Wheeler Condenser & Engrg. Co.

Stoneware:
General Ceramics Co.

Sulphur:
The Freeport Sulphur Co.
Texas Gulf Sulphur Co.
Union Sulphur Co.

Talc & Soapstone:
Talc & Soapstone Producers Assoc.

Tanks:
American Hard Rubber Co.
Atlantic Tank & Barrel Corp.
Beckley Perforating Co.
The Elyria Enameled Products Co.
Janney, Steinmetz & Co.
New England Tank & Tower Co.
Pfaudler Co.
Charles E. Sholes

Temperature Apparatus:
Charles Engelhard, Inc.
The Foxboro Co., Inc.
Moto Meter Co., Inc.
Sarco Co., Inc.
C. J. Tagliabue Mfg. Co.

Testing Apparatus:
Atlas Electric Devices Co.

Thermometers:
American Steam Gauge & Valve Manufacturing Co.
The Brown Instrument Co.
Eimer & Amend
Charles Engelhard, Inc.
The Foxboro Co., Inc.
Moto Meter Co., Inc.
Sarco Co., Inc.
Schaeffer & Budenberg Mfg. Co.
C. J. Tagliabue Mfg. Co.
Thwing Instrument Co.
Weinhagen & Hespe
Wilson-Maeulen Co.

Thickeners:
The Dorr Co.

Trucks & Tractors:
Baker R. & L. New York Corp.
Revolvator Co.

Valves:
America Steam Gauge & Valve Mfg. Co.
Aterite Co., Inc.
A. W. Cash Co.
Chemical Equipment Co.
The Chemical Pump & Valve Co.
Crane Co.
The Duriron Co., Inc.
Everlasting Valve Co.
Kelly Valve Co.
Lead Lined Iron Pipe Co.
Liquid Carbonic Co.
Lunkenheimer Co.
Manning, Maxwell & Moore
Merrill Co.
Nassau Valve & Pump Corp.
Schutte & Koerting Co.
Simplex Valve & Meter Co.
Paulsen Spence Co.
United Lead Co.
Wallace & Tiernan Co., Inc.

Waterproofing:
Apex Chemical Co., Inc.

Water Purification:
Cooper Hewitt Electric Co.
Permutit Co.
R. U. V. Co.
Wallace & Tiernan Co., Inc.

Welding:
American Welding Co.

Labor's Responsibility for Industrial Efficiency

By James J. Davis
Secretary of Labor

THE word efficiency has come to be looked upon as somewhat of a fetish in our modern industrial life. To many of us it conjures up bespectacled experts, armed with vast documents and charts, who speak of plats, and peaks, and depressions, and index numbers and curves.

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James J. Davis
Secretary of Labor

But experts are as experts do. Many times we need them sorely. Sometimes, however, I am inclined to throw up my hands and say, "Let us have a little less efficiency and a little more common sense."

For when we embark on the wide sea of mathematical formulas and seek to index the power of every human cog in the industrial machine, there are too many opportunities for us to overlook some vital factor in our calculations. We are likely to think a little too much in terms of figures, and a little too little in terms of manhood. For behind all of the calculated niceties of mathematically charted efficiency lies the human factor, and no mathematician since Euclid has yet been able to reduce humankind to exact arithmetic. After you have reduced every industrial operation to formulas, you have behind them always the algebraic unknown quantity, *x*, humankind.

Ultimately, efficiency in industry today rests with labor. The American workman bears upon his shoulders a heavy responsibility to himself, his craft, his industry and his country. For upon him depends, in large measure, the quantity and quality of the nation's production of marketable goods, the index and basis of

prosperity for the individual, the community, the industry and the country. In the work that lies before the hands of the workman is day by day the fate of himself, his employer and the great consuming public that waits on his products. If he falters, no matter what the cause, the result is felt by all dependent on his labor.

More and more, labor in America is coming to realize the tremendous responsibility which rests upon it and the certainty with which it faces disaster unless it accepts and discharges that responsibility. Just as the modern employer has come to realize that he must pay his labor a wage that is more than merely enough to provide him with food, clothing and shelter, the workman is facing his duty to himself and society. The employer who is abreast of the times knows that his workers, and the workers of every other employer, must receive not only a living wage but a saving and buying wage. He knows that the 40,000,000 gainfully employed in America provide out of their wage surplus the vast buying power of America upon which all industry is dependent and without which there can be no prosperity in the land. The workman is learning that to earn a saving wage he must deliver an honest day's work in order that the industry which supports him and his may endure and prosper.

THERE can be no excuse for the worker who shirks on the job, who fails to give to his employer the honest best that is in him. The laboring man who accepts his wage and deliberately slows down his efforts is no better than the bandit who with revolver and jimmy enters the employer's office at midnight and loots the safe. He is taking what does not belong to him. He is doing injustice to himself, his employer and his fellow workers. He is jeopardizing the prosperity of every individual who is touched by his work. I am inclined to think there are few of this type of worker in American industry. I am convinced there are not many who have the point of view of the workman who was approached by an exasperated foreman with the reprimand:

"Here, John, what's the matter? Don't you see that the man beside you is doing three times as much work as you are?"

"I know," was the reply, "I've spoken to him about it half a dozen times, but he doesn't pay any attention to me."

THE greatest need in America is industrial peace. Without it we cannot have our highest production, and without our highest production we cannot bring the nation to its highest prosperity. Industrial warfare, with its constant interruption of production, is the greatest enemy to efficiency in production. To end industrial warfare we need understanding and co-operation between the men who manage industry and the men whose labor makes industry possible. The highest efficiency is reached by that industry in which the employer knows intimately the problems and needs and aspirations of the workers and in which the worker has a sympathetic understanding of the difficulties and discouragements and purposes of the employer. Many of our present-day industrial difficulties were unknown in the days when industry, organized on a much smaller scale, permitted closer personal relations between the men who managed industry and the men who worked in it. The successful surmounting of these difficulties lies in developing some system whereby that close personal relationship may be restored or some adequate substitute found for it.

WE HEAR much talk of man's inhumanity to man in industry, but every man in his personal relationship is essentially human. Inhumanity, in the majority of cases, arises from ignorance.

Efficiency in industry, then, turns largely on the human factor. The human relationships in industry call for a more intimate knowledge among employers of their workers and their problems and for a wider appreciation among workers of the difficulties and aims of their employers. With a closer relationship between employer and employee, a wider knowledge of the problems confronting each, we may look toward the inauguration of a real Golden Rule in industry, that will bring efficiency to its highest point.

Washington, D. C.

Increased Production Efficiency Means Good Material Handling

The Material-Handling Problem in the Chemical Plant—Analysis of This Problem and Some Suggestions Toward Its Solution—Advantages Derived From Good Material-Handling Methods

By J. G. Hatman
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Production Engineer, Frankford (Pa.) Plant, The Barrett Co.

THE majority of chemical plants in the United States are additions to existing industries. During and just prior to the war our national chemical industry knew an enormous expansion. In the rush of this building program conditions were more or less chaotic. Production at any cost was the absolute need of the times; and there was no opportunity, and little inclination, to consider the means by which this production could be attained in an efficient and economical manner.

Other plants besides these war plants existed, but they had been built in days of little competition and there had been no incentive for their owners to adopt the most efficient means and machinery of production. For this reason we find practically all chemical plants today in serious need of effecting reductions in their production costs, for on these reductions depends their ability to meet the keen competition of crowded market and low demand—depends, in fact, their continued existence.

Means by Which Costs May Be Reduced

The three essential elements of a manufacturing concern are buildings, equipment and personnel. When we have the best possible in each of these three divisions —properly co-ordinated by a sane and efficient management—we have the ideal in organization and, *per se*, the lowest possible production costs.

Perhaps perfection in any one of these three elements, or in the management that controls them, is unobtainable; but the approach to perfection is open to all, and it remains only to study these various elements and determine in what way the approach shall be made. Elsewhere in this issue the subjects of buildings, personnel and management are treated. Here the attempt will be made to point out what seems to the writer the most important way in which equipment can be treated with a view to lowering costs and increasing efficiency.

The Equipment Problem in the Chemical Plant

Modern manufacturing equipment consists of two main divisions: equipment which performs the various operations in the manufacture, and equipment which serves to bring the material to and take it away from machines of this first division. These two classes may be called—in their simplest terms—process equipment and material-handling equipment.

The equipment problem is, therefore, twofold. It is necessary to have the best possible process equipment, adapted to the particular circumstances of the given plant, that may be procured. It is necessary to have such material-handling equipment as will enable all the other elements involved—the buildings, the process equipment, the personnel and the management—to realize each its best performance.

The Status of Process Equipment

Process equipment is a matter of development. At any given time the manufacturer has available for his use equipment which represents the best results of research and invention in his particular line. In some instances it may, in the light of information in the manufacturer's hands, be possible to make improvements in this equipment which will render it more efficient and thus lower production costs. Also, the function of management, in housing, arranging and controlling the operation of the equipment, can do much to render it efficient.

The great means, however, for improving the efficiency of industry through the process equipment lies in the development of improvements through research and invention. This is a matter of time. Constantly new items appear. The alert manufacturer, who keeps his eye on the market and adopts the best of this equipment suited to his needs and applies it in the most efficient manner, is doing the best that can be done toward realizing on the process equipment itself.

The Status of Material-Handling Equipment

The material-handling equipment, however, presents an entirely different range of possibilities to the management which seeks to reduce costs. Here we have an almost infinite variety of appliances—well designed and thoroughly tested. While improvements will no doubt occur from time to time, there is no point in waiting. The equipment available is good enough, efficient enough, for present needs; and the problem of the management is to select the proper equipment and then proceed to realize the maximum of benefit from its use.

Handling Problem in Chemical Industry

Handling, in chemical industry as in any other field, divides readily into three divisions. These are: Inbound—crudes and intermediates; interdepartmental—between processes; and outbound—finished products. The problem of the design or choice of the handling equipment is likewise concerned with three major requirements as follows:

1. To have the bulk raw materials available at the time, in the place and in the quantity desired.
2. So to move the materials from department to department, from process to process, that each piece of process equipment is kept working at its most efficient rate.
3. To remove the finished products from the productive departments in such a way that production is not blocked. To take them into and out of storage in the most economical manner. And to provide for expeditious and efficient shipping.

The Raw Material Problem

In general, all crudes should be received at one point unless the particular crude is used in only one department. In this case it may be more conveniently unloaded at that place.

The raw materials, be they crudes or intermediates, will generally be received in one of the following ways:

1. Liquids in tank cars or tank ships.

2. Bulk dry materials in cars or ships.
3. Bags in cars, motor trucks or ships.
4. Barrels in cars, motor trucks or ships.
5. Drums of solids or liquids in cars or ships.

Raw Materials in Liquid Form

The bulk raw materials received in liquid form in tank cars or tank ships may be efficiently handled in two ways—i.e., they may be pumped or they may be blown by compressed air.

In case the handling is done by pump, care must be taken that the pumps and pipe-lines are large enough to assure the desired end of unloading maximum gallonage in the minimum time.

In many branches of chemical industry the use of compressed air for blowing liquid material from tank cars or tank ships should be employed with caution, if at all, as there is some danger involved in this method with certain materials. In case this method is the suitable one to use, care should be taken to have a sufficient supply of compressed air, of a proper pressure, available when needed.

In either of the above cases, the pipe-lines used are worthy of careful study. These pipe-lines should follow the straightest course which can be obtained. They should have no traps or sharp bends. Fittings should be used as sparingly as possible. In the case of liquids which crystallize or become viscous at ordinary winter temperatures, the pipe-line should be protected from the weather and suitably heated. In any case, means should be provided for steaming out and blowing out the lines.

Bulk Dry Materials

Bulk dry materials may be received in gondolas or boxcars; in cargo ships; or, in rare cases, in motor trucks. In any case, these materials will be stored in some type of bin or in a storage pile.

Unloading will be best taken care of by dumping into a track pit from the gondolas. Trucks and boxcars should be unloaded into a pit also. For the boxcars, there are several types of efficient unloaders to be obtained, including the mechanical shovel and the portable belt unloader. This class of material is generally unloaded from a ship's hold by some type of crane, depending on such conditions as the size of the ship and the disposal of the material.

Handling this class of materials from the unloading point to storage and to process may be done by various types of handling equipment such as cranes, belt and bucket conveyors, storage battery trucks, industrial railways. The choice depends, among other things, on the amount and nature of the material to be handled and the physical conditions in the plant. Each case of this type calls for a careful study and the exercise of sound judgment in making a choice. It should always be borne in mind that the main consideration is properly to feed the process equipment—to have the right amount of material at the desired place when it is wanted.

Handling Bags, Barrels and Drums

Bags, barrels and drums should be unloaded on one central platform. This platform should be at car-floor height and can be so arranged as to serve trucks in cases where the material is so received. Where ships are used to bring this type of material to the plant, special arrangements must be made to accommodate the unloading. A scale should be placed near the unloading point so that materials can be weighed without rehandling.

This class of material can best be stored in a central storehouse. The quantities are taken from stores only as desired—a reserve can be maintained—and the feeding of the process equipment in the cheapest and most efficient manner can be more readily arranged.

Handling of materials in these containers from the car, truck or ship to the storehouse and from the storehouse to the manufacturing departments is generally best accomplished in chemical plants by some form of mobile transportation. Monorails and various types of conveyors are efficient in special cases; but small motor trucks or tractors drawing several trailers generally accomplish best the results desired.

Arrangements should be made for the economical removal of the material from the bags, barrels and drums and its movement to the start of the process in which it is used. This emptying should be done as near the place of usage as possible. Drums of liquid can be emptied conveniently by rolling them onto a track under which is a pan to be emptied by hand or a catchbasin which may be pumped out. Several drums can be emptied at once in this manner. Barrels and bags can be dumped over a grating and a drag conveyor used to get the solid material to the apparatus where it is to be used.

The Interdepartmental Problem

Material handling between departments and processes of a chemical plant depends primarily on two things: the nature of the material to be handled and the type of process equipment between which the handling is to be done. As a secondary but sometimes strongly influencing consideration there is the consideration of position, the relative elevations of the two points, the distance between them and the intervening topography.

Governing conditions will vary greatly in this phase of handling. For this reason it is possible to give only general recommendations. For handling liquids the general run of operations will be best served by gravity flow in pipe-lines where the elevation lowers and by pumping where the elevation increases. Because processes or departments of chemical plants are most often housed in separate buildings, the only general recommendation that can be made is that the solid materials should be placed in some type of container and transported by truck or tractor and trailers. There are many special cases where other types of handling equipment are the most economical; but the tractor or truck method is of almost universal application here.

The Pacemaker of Production

Most careful attention should be given to the selection and operation of the interprocess handling equipment. As stated above, this equipment must so move the material that each item of process equipment is kept working at its most efficient rate. For this reason we can call this part of the handling equipment the pacemaker of production. The output of the productive departments depends entirely upon the way in which the materials are moved through them. The workers must keep the pace of the machinery.

As a method of procedure in solving a problem in interprocess handling, there should first be determined the most rapid rate at which the process equipment can turn out the desired quality of product. The han-

dling equipment should then be chosen, designed and operated to feed the process equipment at exactly this rate. Given such conditions, it becomes the duty of management to provide the personnel to realize the best results. This problem is much simpler than the problem of obtaining efficient production where no handling system, or a poor one, exists.

The Finished Product Problem

The finished products can be classified in two different ways. First, as liquids and solids. Second, as materials to be shipped in bulk and materials to be shipped in small quantities.

The elements of the problem involved in handling these products comprise getting the material from the end of the process to the place where it is put in the container; placing it in the container; taking the container to the finished-goods storehouse; and moving the finished goods from this storehouse to the car, truck or ship in which they are to leave the plant.

Bulk Liquid Products

Bulk liquids will generally be shipped in tank cars or tank ships. The most efficient system is to move these by gravity through pipe-lines. This method is the cheapest and prevents any possibility of contamination. Where gravity cannot be used, resort should be had to pumps. The same general considerations on pipe-lines that obtain with liquid raw materials apply to liquid finished products.

It is very seldom compatible with the best efficiency to have the daily production correspond exactly with the daily shipments. For this reason tank storage should be provided for the liquid finished products. The size and location of these tanks should be carefully determined with the plant requirements and conditions fully in view.

Bulk Solid Products

Almost invariably, bulk solids should be shipped in some kind of container and not loose. The loss from waste, spoilage and contamination in loose shipments makes the container a saving rather than an expense. But this container should be the cheapest one which will give efficient service.

These bulk solids are usually in crushed or powdered form. If they are not, the case is too unusual to be considered in the scope of this paper. Some of these products are chemically active and require highly specialized containers. The general run of material of this type can, however, be handled in bags, barrels or drums. Of these three containers the bag is the best and most economical for the following reasons:

1. The cost of the bag is lowest.
2. A larger net quantity of product can be shipped per car.
3. Less space is required to store the empty containers.
4. Automatic bagging equipment is available.
5. Less labor is required for closing.
6. Bags are handled more simply than other containers.

Handling for Bulk Solid Products

If we consider only the general case of bulk solid products in crushed or powdered form to be packed in bags, an extremely simple and efficient handling routine can be established. The material can be moved from the last manufacturing process to the bag-filling equipment by a belt conveyor and automatically fed to the filling machine. The filled and closed bags from this machine should be deposited on skids and these skids taken to the storage space by lift truck.

During storage the bags should remain on the skids. In this way any rehandling is saved—for when the material is to be shipped the skidful of bags can be taken on the lift truck again and moved to the shipping point without touching the bags. One man can handle as many bags per day in this way as six could handle were a system to be used where rehandling were necessary.

In loading truck, car or ship the lift truck can run directly to the point at which it is desired to place the bags. In loading the hold of a ship, the bags have to be stacked too high for the work to be economically done by hand. About one-half the loading crew can be dispensed with if a motor-driven stacking machine is used and a very definite saving is thus effected.

Materials Shipped in Small Quantity Units

A large part of the product of chemical industry must be shipped to the consumer in small unit quantities. Although the total shipped by a plant to any given primary consumer may be large, such large quantity will consist of many small packages. The elements of the handling problem are here the same as in the case of bagged materials.

These materials will occur in various forms—liquid and solid. The difficulty of the problem lies in the fact that one plant may produce a large variety of such substances. As a result, various means of filling the containers must be employed and after filling will come the problem of handling to storage and shipping a collection of packages which often will fit no one system of conveying.

Handling for Miscellaneous Containers

It is in the solution of this difficulty that we find room for the greatest improvements. The finished materials, after leaving the manufacturing processes, can be moved to the filling department, if liquid by gravity or pump, and if solid on a belt conveyor. After the containers are filled they may be taken to storage and shipment in a variety of ways. There is conveying equipment available to solve any problem of this nature and the point is to select that equipment which will move the material most efficiently and with the fewest number of men. It is also important to keep the flow of finished product away from the manufacturing departments as steady as possible, so that there will be no tendency for the material to accumulate and clog production.

A successful solution of this problem from the experience of one of the largest plants in the country shows what can be done along these lines. The nature of their products made necessary a large variety of containers of different weights and sizes. Finding the hand method of movement too costly, they had a thorough study made of the possibilities of their case. As a result, they adopted a special type of skid having a boxlike receptacle mounted on it, the walls of which could be varied in height. They then standardized on containers—still various in size and shape—which would fit into these receptacles.

A multiplicity of these skids were built. Lift trucks handled the skids at the plant and into cars and ships.

Goods were shipped to their branches in the receptacle-skids and at those points lift trucks again did the moving. The saving effected was nine-tenths of the sum previously spent on handling.

Importance of Containers

The possibility of finding any means of successfully handling these small and varied products largely lies in the simplification and standardization of containers. There is no reasonable excuse from a manufacturing or business standpoint for the great variety of those now in use. The successful manufacturer will concentrate all his effort on supplying products packed in a few standard sizes and shapes. This will cut down the costs for storage of empty and filled containers. It will greatly reduce the time and labor necessary for filling. And it will render possible the adoption of an efficient handling system—one that will effect further savings in time and labor—one that will aid in attaining an efficient functioning of the plant as a whole.

How Good Material Handling Aids Production Efficiency

The elements of the handling problem in chemical industry and methods to be used in seeking its solution have been brought out in as much detail as is possible in a short article. Now let us consider how the solution of this problem will affect production.

It was stated above that production could be improved by bringing buildings, equipment, personnel and management to a higher level. The rôle of the handling equipment is that of the efficient servant—a servant which functions to permit its four masters to realize their best possibilities and without which they are unable to operate in harmony. Let us note some of the ways in which this servant can help its masters toward higher efficiency.

Relation of the Handling System to the Buildings

The effect of a well-designed, efficient material-handling system on the utility of the buildings is threefold:

1. It allows for a fuller utilization of the manufacturing space by doing away with the necessity for storage spaces between processes and permitting the process equipment to be placed in the most economical manner.

2. It lessens the amount of space which must be devoted to storage of raw materials, because it feeds the process more efficiently.

3. It lessens the amount of space which must be devoted to storage of finished products, because it enables the management to count on a continuous production of definite dimensions and to plan distribution accordingly.

Relation of the Handling System to the Process Equipment

The well-designed, efficient material-handling system aids the process equipment to function in the following ways, among others:

1. It feeds the material to the machine continuously at the exact rate at which the machine operates most efficiently.

2. It removes the material from the machine continuously at the exact rate at which the product is finished.

3. It prevents the accumulation of finished or unfinished goods about the machine, which reduces the space overhead chargeable to it and allows complete freedom of operation.

4. It greatly reduces the amount of labor expended on the process—both direct labor and indirect labor; allows the process equipment to function in as nearly an automatic manner as possible and thus permits the process equipment to produce its maximum at the lowest possible cost.

Relation of the Handling System to the Personnel

Some of the effects of a well-designed, efficient material-handling system on the personnel of the manufacturing plant are:

1. It reduces the personnel to the lowest possible number.

2. It permits the employment of only the skilled or semi-skilled class of workers.

3. It enables the employee—provided the other elements of building, process equipment and management are efficient—to work at his best and hence command a high rate of pay.

4. It takes the burden of physical labor from the laborer and makes him a brain worker.

5. Through the four gains stated above, it helps to achieve the maximum of production per dollar of payroll and hence increases the production efficiency.

Relation of the Handling System to the Management

Good material handling is the mechanical substitute for management:

1. By relieving management of a vast burden of detail, it permits management to function in a broader way, to maintain a better control of the elements of production and more successfully to anticipate fluctuations in productive demand.

2. We have called mechanical handling the pacemaker of production. It gives the management much more dependable production figures than could be had with manual methods. It holds the worker—easily and without overstrain—to a definite and high productive pace—and this with little effort along the lines of supervision.

3. Clerical, administration, insurance and other overhead costs are greatly reduced. This follows naturally on the lessening of the labor force and the greater ease of obtaining cost figures and other data which management needs.

Relation of Material Handling to Productive Efficiency of Manufacture

Material handling knits manufacture into one whole and permits management to treat it more and more as a unit, as a machine, to which material is fed and from which finished goods are received. This trend, carried to its ideal end of perfectly effective manufacturing elements—buildings, process equipment and personnel—co-ordinated in effort by a perfectly adapted automatic handling system, would result in the practical elimination of all management and the realization of the minimum production costs. This is the goal—one which can never be reached, but toward which the mechanical handling system is rapidly carrying those who are far-sighted enough to take advantage of its possibilities.

Frankford, Pa.

Wages

The Fundamental Relations Between Employer and Employee Upon Which Wage Payments Are Based—Essentials of a Good Wage System —How Wages Should Be Measured—How These Theories Work Out in Practice Illustrated by the Results Obtained in the Ford Industries

By Harrington Emerson
President, The Emerson Engineers

I WAS brought up on the Bible, my father being a clergyman, and I still turn to it for instruction. What I like about the Bible is that it gives us principles rather than expedients.

As I read the texts, these principles seem to be, that the relation of employer and employee is very exalted, comparable to the Kingdom of Heaven; that wages rest on free contract and agreement; that standard wages are by the day and payable daily; that the factory is the employer's own and he has the sole right to judge of his needs; that he can freely select those who are better than others and that he can pay these better men a higher wage, but not pay a lesser wage than the standard to any employee, however incompetent, and that wages shall not be oppressively low.

Fundamental Relations

"For the Kingdom of Heaven is like unto a householder which went out early in the morning to hire laborers into *his* vineyard, and when he had agreed with the laborers for so much a day [not by the hour or piece] he sent them into *his* vineyard." And he hired other laborers later and said unto them: "Go also into the vineyard and whatsoever is right, that shall ye receive."

And at the day's end he paid none less than he had agreed and that they had voluntarily accepted; and he paid some more than they expected, and some expected more than they had agreed for and they murmured; but the householder answered one of them and said, "Friend, I do thee no wrong. Didst thou not agree with me? Take what is thine and go thy way. Is it not lawful for me to do what I will with my own? The last shall be first and the first last, for many are called but few are chosen."

The Bible is very severe against delays or holding back of wages or arbitrary reductions.

"The wages of him that is hired shall not abide with thee all night until the morning."

"Behold the hire of the laborers who have reaped down your fields, which is of you kept back by fraud, crieth."

"I shall be a swift witness against those that oppress the hireling in his wages."

"Your father hath deceived me and changed my wages ten times."

And this for the wage earner: "Do violence to no man, neither accuse any falsely, and be content with your wages."

I knew a modern enterprise with three thousand employees that paid them all off daily.

Evolution of Employer-Employee Relations

A further fundamental fact about the relations of employer and employee is that the evolution is from status to contract. There was a time when workers were slaves, working like horses, without wages; but for food, shelter and clothes. Then came serfs, part of whose time was their own, but they could not leave the land; then came the "corvée," forced labor without compensation. The worker had to do the master's work first. We are slowly, oh, so slowly, progressing into full contract; but many harmful restrictions still linger on. Man is an animal, very slow to observe and adopt improvements. Five hundred thousand years ago he observed insects and birds flying all about him, but until this generation it never entered his head to try even to glide. So also in the matter of wages, we have not nearly reached full contract.

Because conditions have improved in the last hundred years and because labor unions have agitated for better conditions, for the abolition of abuses, it is, without reliable foundation, claimed by some that trade unions deserve the credit for the changes; and that without trade unions there would have been no progress. This is an untenable conclusion.

Development of Contract Relations

In earlier centuries the Church inveighed against the practice of keeping Christians in bondage and practiced manumission.

The anti-slavery agitation of the last century was due to the advancing spirit of humanity preached by the reformers of the eighteenth century in France, which worked out into the French Revolution, with its slogan of "Liberty, Equality, Fraternity."

In England a form of slavery existed down to the end of the eighteenth century. Colliers and salters, on entering into a coal work or salt mine, were bound by the law, independent of bargain or agreement, to perpetual service; and in case of sale of the ground, their services passed with the title. The sons of the collier and of the salter could follow no occupation but that of their father and were not at liberty to seek employment elsewhere than in the mines to which their fathers belonged.

It was decided in 1772 that no slaves could be imported into England. In 1787 a society was formed in London to suppress the slave trade. Wilberforce and Pitt agitated in Parliament. Slave trading was made illegal after Jan. 1, 1808, and in 1811 it was made a felony; in 1824 it was made piracy. The French freed their negroes in 1848, the Dutch in 1863. In the United States slavery was curtailed, not through the efforts of the slaves or of labor unions, but through the opinions of enlightened individuals as Franklin, Washington, Hamilton, Jefferson. The Pennsylvania Abolition Society was formed in 1775. William Lloyd Garrison, Wendell Phillips, Arthur Tappan were active in 1831. The Free Soil party was formed in 1848. Slavery was ultimately abolished in the United States, Jan. 1, 1863.

The modern theory of work is that the better the worker the lower the labor cost. The modern theory is

hat the worker is a supervisor, but tools and machines o the heavy work. These theories have been enunciated and put into effect by enlightened and progressive mployers in advance of and beyond any claims of trade nions. The Cadburys in England, also Lord Leverulme; in the United States, above all others, Henry ord and the American Rolling Mill Co. have led the ay.

Essentials of a Wage System

It is easy to enumerate the essentials of a good wage ystem.

(1) Free agreement between employer and employee s to the basic daily wage for the locality and occupaion.

(2) Definite understanding as to the amount of outut, whether through direct work or supervision, or oth, that is to be given as an equivalent of the wages. This is often wholly ignored by both parties to the ontract. It is exceedingly rare to find any agreed to quivalents, much less fair equivalents.)

(3) An understanding that any deviation by the mployee in the way of delivering more than the conract wage equivalent shall be fully recognized and paid or by the employer.

These essentials are embodied in the wage agreenents with trainmen.

The wage is so much per day of 8 hours. An agreedo number of miles is a day's work. More miles within hours, or more than 8 hours, receive extra comensation.

An Additional Principle

A fourth principle is looming up—namely, that the horter the day the higher should be the pay per hour; he longer the day the lower the pay per hour. This rinciple is based on the fact that a supervisory or anual or mental worker can deliver more per unit of ime for a few hours than during many hours. A printer can run 100 yards at the rate of 20 miles an our, but for 2 hours the rate of speed drops to 10 iles an hour. A man can fight but a few prizefights n his lifetime; he can do less strenuous work conuously for 60 years.

The time is coming when the shift will be 4 hours r 6 hours and the man who takes six shifts a week, ne a day, will receive more per hour or for the shift han the man who takes more than one shift a day.

Principles are eternal, expedients are excellent within he limits of principles. Even if I advocate expedients, go back into antiquity for principles.

What Wealth Is

An error we must banish from our minds is that ork creates wealth. Work creates production, but if nsumption equals production, there is no wealth. Vealth is the difference between production and conumption and is an individual matter. Many of us roduce, but we are not wealth creators if we consume ore than we produce. The man who produces, or arns, $1 a day and consumes $0.90 is not only a producer, he is also a wealth creator.

The man who earns or produces $50 a day and spends, r destroys, $60 is a wealth destroyer. He is like a eed in a cornfield. He utilizes his power and the ifts of nature to no purpose.

Those who are producers but also spenders often nagine that they have created existing wealth. Only so far as they saved did they create any wealth. Two men work on a house. Their labor produces it. Each receives $4 a day. One spends it all. He smokes, he chews gum, he goes to the movies, he rides on the merry-go-round, he is a devil of a fellow (it is assumed that he does not drink). The other saves a dollar a day and at the end of 10 years owns the house both built. A revolution comes. The spendthrift soviet, the communist, points to the house and says, "Behold what my labor created! Down with the bourgeoisie!" Yes, his labor created it, he was paid for his labor and he spent the proceeds as he chose.

It is a fundamental error to imagine that because I am poor someone else has grabbed off my share. If I do not breathe deeply, it is my own fault, for the oxygen is there. If I stick in a tenement cellar, the fault is mine, no one else's. I remember two cases which taught me much.

Examples of the Above Principle

Many years ago there was an immigrant garment sewer, with a large family. He lived in a New York cellar. When the spring came, he bought a tent and some cots and moved out onto the Long Island shore with his and his wife's sewing machines. Milk and vegetables were to be had from the neighboring farms, some chickens were obtained, the children weeded gardens and did other chores, they fished in the sea, they reveled in the salt water and sunlight; while he and his wife stitched. The finished garments went into the city by express, the unfinished ones came out the same way. At the end of the season his boys and girls were brown and lusty and strong, self-reliant, fed up on vitamines. Few millionaires could, or would, have done as much for their children!

The other story is of the survey of the conditions of a New England factory village, by a physician. He ascertained twelve causes for poverty, disease, misery.

The mill was responsible for a measure of bad health, because there was dust in the air, a preventable evil which it should have been compelled to remedy.

The eleven other causes were:

Bad food,	Narcotics.
Badly cooked,	Bad clothing.
Badly eaten.	Irregular habits.
Bad, unventilated living and sleeping quarters.	Personal uncleanliness.
	Sicknesses.
Drink.	Contagious infections.

This mill and its workers were wealth producers, but not wealth creators. Character had not kept pace with individual production. It is not the system that is at fault, it is the individual.

Further Examples of Wealth Production

Only a few days ago I heard of a young man who worked his way through college, who is only 35 now, who works from 8 a.m. until midnight, who has earned and saved a million dollars.

I have also watched with interest a small isolated group of foreigners in our great New York. A Jewish landlord who speaks a mangled German and an amusing English owns two houses, which he has rebuilt into room and apartment houses and rents furnished. He has obtained two Austrian families, each with male relatives. The hard working, thrifty Austrian women act as caretakers, giving maid service, the men work at their trades, and at night and on holidays and Sundays they work overtime remodeling houses. All send astonishingly generous contributions to dependent rela-

tives in stricken Austria, the young men budget their incomes and save; one of them has over a thousand dollars saved up. They are not "reds" or destroyers, they are upbuilders, wealth creators and they think the United States is a land of glorious opportunity.

Fundamentals of Wage Rate Establishment

Avoiding those two fundamental delusions of the twentieth century, that there is not enough to go around and that the unsuccessful have been deprived of opportunity, we can enumerate the few fundamentals.

The Measure of Wage

The current wage is to be measured by a time unit, as the day, the week, the month, the year. The wage earner has daily expenses for eating and sleeping, like the rates at a hotel, he has monthly expenses for bills and for rent, he has yearly expenses for clothing, for insurance, for education, for holidays, etc. As a matter of expediency in accounting, it is desirable to figure wages on an hourly basis, but the amount earned by the day or the week or the month or the year should not be lost sight of. Expenses are not by the hour, which is merely a convenient accounting unit of time.

Wage Rates Competitive

The wage rate should be the current one for similar work and skill, at the time and place. This rate is a competitive one and cannot be based on any sentimentality as living wage. We might as well understand that there are certain matters beyond human power to regulate. The sun shines and we have floods or droughts, hail falls, varying the return from the soil. We starve or we have plenty, the sun pays no attention to our living needs. We could take lessons from the frogs, biologically older than we are. When food is plenty the tadpoles to a larger extent turn into females. The race is broadened. When food is scarce, the larger number of tadpoles become male frogs, the quality of the race is improved.

The current wage, whether by the hour, day, week, month or year, should be arrived at by mutual agreement and bargaining and the agreement should be adhered to by both parties.

As an employer, I would always make the basic wage higher than the current rate in the district, not from any spirit of philanthropy but because of another great principle.

Quality, up to a certain point, increases faster than cost. This is true both as to industrial materials and as to industrial service.

High-speed steel in machine shops is worth easily a thousand times as much as carbon tool steel, but it costs only four times as much. A good leather belt costs perhaps twice as much as a poor leather belt, but will last ten to a hundred times as long and will lose 5 per cent less power, and interrupt work less often, by breaking. In Mexico I found a case where failure to obtain a good main drive belt had shut down a whole section of a machine shop for a year.

Poor medicines of insufficient strength kill thousands.

It is not the fanned almonds or peanuts I want, at their reduced prices, nor the cull fruit, nor the shoddy cloth, nor vinegar shoes and paper stockings. When I was a boy my socks were knit by hand out of handspun and hand-woven flax, sun bleached, snow water rotted. These socks wore like iron without a hole for years and years, but they cost less than I now pay for flimsy stuff.

Similarly with service work. It is not the lowest priced servant or clerk or worker of any kind who is valuable.

As an employer, I want to pay the highest, not the lowest, wages in the district. I want to pay more than the worker has individually earned.

Relation Between Wage and Service

For all wages paid there should be a definitely predetermined relation between payment and service.

It is astonishing that this fundamental requirement is still so universally ignored. In spite of decades, almost centuries, of experience, we have not yet got away from status. The horse is ours, feed him we must, as little and as cheaply as will keep him alive and in strength, and then get all the work possible out of him! This is status. Contract is something quite different. There is a definite payment per hour or per day for a definite service per hour or per day.

A good example of equivalent for wages is furnished by Henry Ford's moving assembly track. It moves at a definite rate, in an 8-hour day so many cars are assembled, the worker has skill commanding $6 per day. He must be skilled enough to acomplish what he has to do on each car, on each side of the car, in so many minutes. Henry Ford, better than any other great industrial, knows exactly what his manufacturing costs are per hour and per piece. The man cannot work faster or slower.

The fireman on an express train locomotive takes so many hours to a run and shovels on the average so many tons of coal. If the coal furnished becomes of much poorer average quality, if more cars are permanently added to the train he is entitled to a readjustment.

The living wage is sentimental absurdity. The state may prohibit me from working more than 8 hours a day and prohibit my earning less than 50 cents an hour when I work, but it cannot guarantee me 8 hours. Ten, 20, 30, 40, 50 up to 90 per cent or even more of us may be idle. Those who work receive the living wage, those who are idle starve! What they do in reality is to live off of those who are working or who did work.

The Basic Wage

This brings us to the fourth great fundamental. There is a basic wage for the trade in the district at the time. More workers will get it in flush times; good workers will get it in slack times.

Every worker is entitled to additional emoluments or to rebates for any deviation from the current standards.

The best illustration of the whole principle is found in walking. We have three elements, the walker, the weather, the condition of the road.

It is on the combination of these three that the normal performance will depend.

Normal Performance

What is normal performance? What is normal performance for heart beats, or for breathing? It is not the sudden and brief palpitation of extreme excitement, not the rapid breathing of extreme exertion. Yet also it is not the 2 minutes during which one can hold one's breath nor the rare occasion when the heart slows down or even stops. Normal performance includes both extremes. It is the total minutes of life divided into the total heart beats or the total breathings. A normal performance is therefore set up for a year at least, or

for longer, and this is wholly incompatible with any 8- or 10- or 12- or 6- or 4-hour day. We may attempt the 8-hour day, but if we adopt it as the maximum, we shall have many days of less hours and in the year average only 6 or 5 hours.

Eight hours, 6 hours, 4 hours is an industrial dream. A man should work as long as he likes to and is not overfatigued. Europe is repudiating the 8-hour day. France knows and Germany knows that working 8 hours a day Germany cannot pay the reparations and that working 10 hours she could.

This is what Keil, Minister of Labor in Württemberg, states: "If Germany is to recover from her war losses, pay her reparations and free her territory she must work 2 or 3 hours a day longer." Professor Lindemann of Cologne states:

"Germany must either lengthen her hours of work to pre-war length or she must suffer chronic hunger and suffer a rapid deterioration in national welfare and health."

Co-operation a Necessity

Chess is a very fine game. Two opponents, equally matched, sit opposite each other and each tries to do the other, to weaken him, to put him in a hole from which he cannot escape. The relations of employer and of employee have for centuries been of the chessboard type. This is unfortunate. Both cannot win. It is seldom that a game is drawn; there is generally a loser. This is not the relation between different parts of the body. The two hands, the two eyes work together. In playing a violin which hand is more important? Every part of the human body works in harmony with the other part. Employee and employer are in the same boat and neither should rock, each should pull equally, on his own oar.

How These Theories Work Out in Practice

In all the centuries there came one man who instinctively got the right idea and he has probably had less labor troubles per thousand employees than any other employer on so large a scale who ever lived. I can at least imagine his theories, which are so sane that at the start they seemed crazy.

Suppose, then, we set forth these theories in the form of a Socratic dialogue, by which method they will be made most clear to the understanding.

"Here is a new form of transportation, a self-propelling vehicle. There are 100,000,000 persons in the United States. At least 15,000,000 of them would like to have a buzz-buggy."

"Why, Mr. Ford, the farmers begrudge paying $75 for a horse buggy; the farmers did not even buy bicycles."

"It makes no difference; 15,000,000 would like to own a buzz-buggy."

"But there are no roads. That is the reason there were few bicycles far from city streets and park drives."

"It makes no difference, roads will come."

"But there is very little gasoline, not enough for 1,000,000 automobiles."

"That also makes no difference. Gasoline will come."

"But these buzz-buggies, good ones, cost $8,000 each and it takes quite a good farm to be worth $8,000."

"I expect to bring buzz-buggies down to the price of a team of horses."

"How are you going to do it?"

"There are only three elements of cost: equipment or investment costs, personal compensation costs, and cost of materials. In an automobile, whether it costs $8,000 or $300, the three elements are there and in substantially the same proportions."

"What is it going to cost to supply an automobile?"

"It will cost me exactly what 5,000,000 persons are willing to pay. If, when automobiles are selling for $2,000 a man wants to pay me $1,000, I shall furnish it, and if, when others are selling for $1,000, I find the crowd is willing to pay $800, I will built it at that price, and, if the crowd is willing to pay $600, $500, $350, I shall furnish it, still observing the proportions of perpetuation of investment costs, personal compensation costs and material costs."

"Do you mean to say that you can reduce the investment charge to one-third?"

"Yes, by working my equipment continuously. If the same machine makes each 24 hours three times as many gasoline tanks, the investment charge drops to one-third."

"But how about wages? A man cannot work 24 hours a day, like a machine, and turn out three times as much."

Man as the Machine Supervisor

"No, but the modern idea is that man is a supervisor of equipment, a handler of materials, not a muscular drudge like a mule. There is no limit to the amount of equipment a man can supervise, nor to the amount of material the supervised equipment will handle. Therefore, to reduce the man cost to any extent desired, all that is necessary is to obtain more intelligent men than the average and I obtain such men by paying them more."

"But what about materials? A car's weight has not dropped to one-third."

"The actual first cost of steel and of rubber and of wood is very small, the scrap value of a car is at most 2 to 3 cents a pound. All the rest is equipment and personal compensation cost, and by enormous production these can be brought down.

"What is the method?"

"It is very simple. We find that we can sell cars by the million if they cost only $300 each. Let us assume that the three costs are, for perpetuation, $75; for personal compensation, $75; for materials, $150. Can a $6 a day man do all the work on a car in 12 days? He must! We can give him the machines to do it!"

What Will Follow the General Adoption of These Theories

The possibilities in this line are beyond belief. I have seen a material and man cost of $6 reduced to 6 cents, a labor cost of $25 reduced to 5 cents. I have seen a wise investment of $100 in equipment reduce man cost more than $100,000.

The wage question is, therefore, not whether the employer can do the employee, nor the employee do the employer, nor yet whether both can extort high prices for small quantities from the purchaser; but whether a fair ratio can be established between perpetuation costs of equipment, personal compensation costs and machine costs.

If the relation is established and if all three combine, the result is vast quantity at low price to the public, opportunity to invest largely at low rates, high compensation to skilled men for short hours.

New York City.

Measuring Administrative Efficiency

The Problem of Administration Today — Fundamental Questions of Administration—The Questions Can Be Daily Answered by the Intelligent Use of the Proper Control Charts—The Time Concept of Administration Is the True Basis of Control

By Walter N. Polakov
Of Walter N. Polakov & Co., Inc., Engineering Counselors

THE post-war industrial situation has shifted the administrative center of gravity from making workmen personally efficient to making administrative organization flexible enough to meet the rapidly changing situation.

We have developed a high state of technique, especially in chemical and metallurgical industry, because of a broad application of engineering research. Theoretically and practically competent chemists and engineers are available; workmen, seeking steady employment rather than high wages, readily develop necessary skill under competent training; but administrative leadership meets with new difficulties.

Problem Before Industrial Administrator

To analyze a situation, first of all intelligent questions must be asked; then these should be answered. Men of average intelligence seldom know how to formulate a question; men of higher intelligence can ask clear and definite questions; but only trained men in each profession can both put a question and give an answer to it.

The problem before an industrial administrator of today is not only that of formulating pertinent questions in order to bring forth the nature of the rapid changes in industry; not only to answer these questions, thus pointing out the relation between cause and effect; but, essentially, to act according to the facts disclosed and thus get things done.

Place of the Industrial Consultant

It might be well to leave the analysis of the situation and the interrelation of changing causes and effects to the care of trained and experienced industrial diagnosticians, who, by virtue of their profession, have a horizon broader than any one plant or any one industry; who, thanks to years of experience in various fields of industry, have acquired the technique of putting questions and evolving answers; who, for this purpose, have devised a method of informing the administrators with the least loss of time and energy and with the utmost accuracy and precision what to do and when to do it, leaving the question of how to do it to the technical staff of the organization.

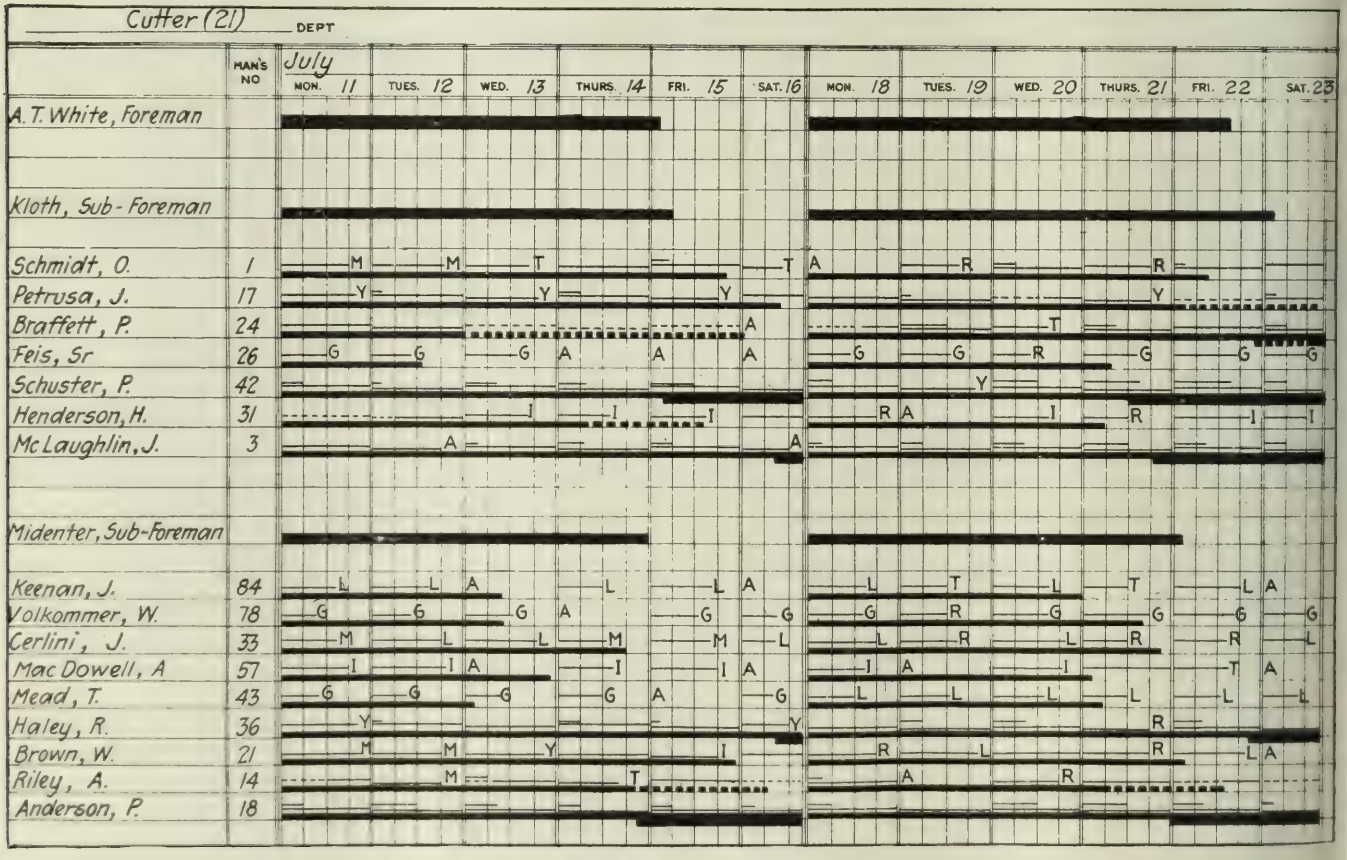


FIG. 1—MAN RECORD CHART.

Each daily space represents the amount of work to be done in a day. If less was made, the thin line is drawn proportionately shorter; if more, the lines are doubled up at the end. Broken lines indicate time taken for jobs about which it was not known how long they should take. Heavy lines are the summaries of the work done per week. Thus one of the subforemen got out more than 4 days' work in a week while another just 4. The next week the first subforeman got out more than 5 days' work in a week while the second was still a day behind. Letters after short bars denoting less work done in time allotted indicate cause of delay thus: *A*—absence of operator; *G*—green operator; *T*—tool trouble; *I*—instructions missing; *M*—material causing trouble, etc. When the trouble is so known, it enables those responsible to find a means of eliminating it.

WORKING PERIOD ~ WEEKS One DAY PERIOD ENDING ____ 19 Sample from a Textile mill

TONS	DEPARTMENT OR MACH CLASS	% OF CAPACITY USED ON ____ TURN (10 20 30 40 50 60 70 80 90)	DETAILS OF EXPENSE OF IDLENESS DUE TO: LACK OF ORDERS	LACK OF HELP	LACK OF MATERIAL	REPAIRS	POOR PLANNING	EXPENSE OF IDLENESS: TOTAL	UNAVOIDABLE %	UNAVOIDABLE AMOUNT	INCREASE IN EXPENSE OF PRODUCT %	AVOIDABLE	REMARKS
	Spinning		$18.70					$18.70					
	Winding			103.74		15.00		118.74					
	Doubling		10.61					10.61					
	Twisting		17.93					17.93					
	Quilling		10.67	10.00				20.67					
	Warping				390.75			390.75					Lack of Wound Yarn
	Weaving		75.00		840.25			915.25					Lack of Warps
	Finishing				210.72			210.72					Lack of Woven Goods
	Inspecting			10.70	39.00			49.70					"
	Shipping		66.00		150.17			216.17					" "
	Total		198.93	124.44	1630.89	15.00		1969.26					

FIG. 2—MACHINE RECORD CHART

The idleness of productive capacity indicated by this Gantt chart is also interpreted in terms of expense involved. Mill that had on hand enough work to keep 80 per cent capacity busy (spinning) produced only 55 per cent of total output, having large portion of the equipment idle for various classified reasons. Note how delay in hiring winders reflected in heavy losses in warping, shortage of warps caused idleness in weave shed, etc., down the line. Such knowledge readily directs the efforts of executives toward the trouble at its origin and enables them, through knowledge of the cause, to find the remedy.

Fundamental Questions for Administrators

The fundamental questions that must be asked and answered in any industry, in any establishment, are:

1. Is the most needed work done first and will it be completed in time? If not, why not?
2. Is the plant equipment utilized to the fullest extent? If not, why not?
3. Is the available knowledge and skill applied in the fullest measure? If not, why not?

There might be an endless number of other questions asked; but the answers to all must be deferred until the replies to these three cardinal questions are daily received and use is made of these answers.

Figs. 1, 2 and 3 suggest the graphic method of getting the necessary facts for answering the three questions just mentioned.

A more specific instance taken from files of one of our clients shows by chart how the record of fuel utilization in a power plant reflects not only a better utilization of available knowledge and skill, but simultaneously provides management with an accurate means of measuring the quality of work and provides men with stimulating scores of their game against bogey—a standard of perfection toward which they are making marked progress.

Proper Measurement the Basis of Administrative Control

The practical task of controlling production must of necessity begin with measurement; and, to be correct, measurements must be made in the proper dimension. It would be a grave blunder to apply a unit of one dimension to an entirely different dimension, or to use a measurement which contains a variable element. We cannot use for measuring human work the units of mechanical power such as foot-pounds or horsepower, which would embrace only the muscular work of men, even though these expressions contain the time rate, for it would be a confusion of a part with the whole. This time rate of man's work is the only measure of production which is of the same dimensionality as the energy causing it and it is as constant as the solar system itself.

Since time may be spent for different purposes and the amounts of work that can be done in a unit of time may differ of necessity, the scales may be as varied as are human activities themselves; but we cannot conceive human activity without or beyond time.

Charts Which Answer the Questions of the Administrator

Time, in its relation to our existence, is divided into present, past and future. Hence we have three fundamental managerial problems visualized in three forms of charts: applied to the present or to current work, the Man Record Charts; referring to work done in the past, the Machine Record Charts; and projected to future work, Progress Charts, with their schedules laid out on the time scale of future requirements.

The Man Record Chart

During the time devoted to productive work there is a variable amount of work done, and this is what is shown on the man record chart, but this work is performed and directed by men. "To feel the lure of perfection," says Prof. C. J. Keyser, "in one or more types of excellence, however lowly, is to be human; not to feel it is to be subhuman." And a chart of this kind involves that ideal of service. It shows what is expected to be accomplished within the work time for any occupation, however lowly.

In such a chart this ever-striving impulse of self-expression in service which throbs in every human being is given adequate expression and stimulus. It is accomplished by predetermining the ideal, however modest, which is accepted by a man as within his power of attainment. Then, and only then, can the lines of attainment be drawn from day to day to denote falling short of the aim, or equaling, or surpassing it, as the obstacles of inertia, ignorance or lack of co-ordination are overcome by the strongest of all human propensities

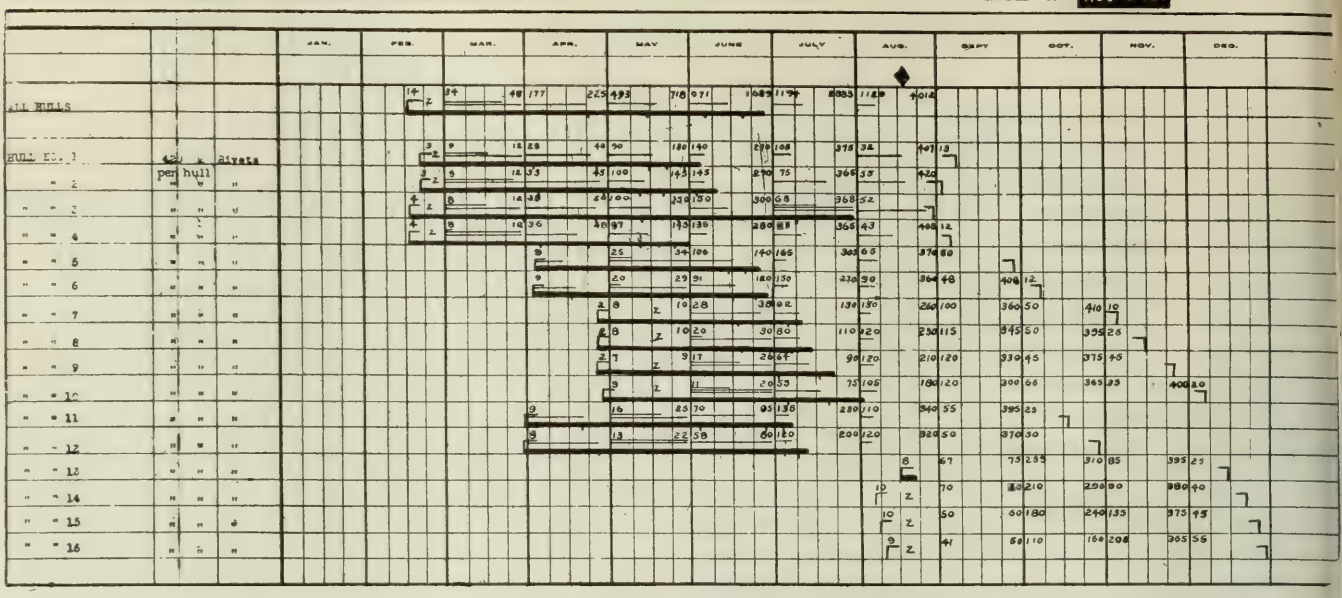


FIG. 3—PROGRESS CHART

Each hull of the sixteen boats under construction was scheduled for completion at the time marked by a half bracket]. In the middle of August (when this chart was entered) the work was about 7 weeks behind the promise. Amount of work done on each hull during each month is shown by thin lines and cummulative total by heavy lines. Numbers on the left of each monthly space show the number of rivets that are scheduled for that month, and on the right the number to be completed by the end of the period. For instance, the record of the hull No. 3 indicates that in May only 50,000 rivets were driven instead of required 100,000, while in July two and a half times more was done than scheduled in order to catch up, or 170,000 rivets instead of 68,000. Same principle and method are equally applicable to any factory, department, contract or activity.

—the desire to excel oneself. This type of chart can truthfully be called a tool for humanizing industry, for it not only reveals to a man his own dignity and capacity as a creator, but subtly, though persistently, calls for co-operation between brain and brawn in accomplishing the work. It tells what each and all are doing at present.

The Machine Record Chart

The machine record chart reveals to one who reads between the lines much more than merely the time a certain machine was idle. Its scale is also time; but the time during which a machine remains unproductive has a graver significance than a reminder that "time is money." It means that someone, who should have operated it or supervised its operation, did no work; and the time of inventing, developing and building this machine, which is greater in its productive significance than the time of the operator, is irretrievably lost.

The Material Utilization Chart

The material utilization chart—like the charts already shown — indicating the waste of material or energy, also has a deeper meaning. It shows the extent to which the work of other men in recovering, preparing and delivering this material or energy has been destroyed. It means that the work of hosts of other men has been rendered useless and their productive time forever lost. This type of chart gives us the measure of our utilization of work that has been done before. It proves whether we are worthy of our inheritance from the past.

The Progress Chart

The progress chart integrates all elements of work; it sums up the progress made, its acceleration, its retardation, its time rate. Like other charts, it brings together the ideal and the fact. Its ideal projects into the future and sets before us the task which we are called to perform—no matter how small or how great it may be—whether filling an order in a shop, feeding a nation, or advancing the life and happiness of mankind. It calls for a plan and vision of the future. It is based on knowledge of the past and it reveals our position at present.

This Time Concept Is the Basis of Efficient Administration

The time concept in the control of industry, direction of production and measurement of human work thus stands revealed as the wished for solution, free from errors of confused types and dimensions. It refers all facts to the irreducible and final element of human life—time. Because it is true to the human dimension, it is both human and humane; hence it obliterates conflicts between men and management, promotes the fullest exercise of man's creative forces and places work in its proper relation to life.

Such and similar work of engineering administration and industrial counselor prompted our great American mathematician—Prof. C. J. Keyser—to define engineering as: "The science and art of directing the time-binding energies of mankind—the civilizing energies of the world—to the advancement of the welfare of man."

This definition itself is but an apt formulation of the admirable time-binding work done by some of our leaders and an excellent example of the far-reaching implications of Korzybski's concept of man as the time-binding class of life. It is indeed, highly significant that Calvin Rice, secretary of the American Society of Mechanical Engineers, in a recent message called the attention of the engineering profession to this function and responsibility.

To measure the time-binding quality of industrial administration is today beyond any doubt a task before which any other transient problem shrinks into insignificance.

New York City.

Steam for Power and Process in the Chemical and Allied Industries

General Considerations in the Use of Steam—Control System Should Be Simple and Thorough—Establishing This Control System Through the Work of a Test Engineer—Functions of the Test Engineer in Boiler Room, Engine Room, Distribution System and Process Work

By Herbert B. Reynolds
Mechanical Engineer

With the increasing cost of coal and other fuel, more and more attention is being given to its economic use. Even in the large power stations, where there has always been more or less stress put on the efficient use of coal, the managements are constantly on the lookout for means of reducing the consumption of coal. However, it is in the smaller industrial plants that the greatest opportunity lies for conserving fuel.

It has been the author's experience that even in some of the best-managed establishments, where the most modern methods are applied in the manufacturing end, wastes have been permitted to go on in the boiler and engine rooms without receiving notice. As long as the voltage is on the line and the steam and compressed air pressures do not fall too low, there is no complaint. However, in the meantime it may be costing twice what it should cost to maintain the service.

The Reasons for Inefficient Methods

This general inefficiency in the industrial plants is often due to the fact that those responsible for the management of the factory are specialists in the manufacture of their particular product and have no interest in the power end, which is in most cases quite foreign in nature to the manufacturing end.

I have known cases where a piece of equipment has been purchased for the manufacturing end of an establishment, the use of which may give a moderate return on the investment; while, on the other hand, the veto has been put on the purchase of some inexpensive equipment for the power house which should pay for itself many times within a year. The reason for this, as above mentioned, is that the management knows nothing about the power end; and, furthermore, it does not want to know anything. Often the only thing known about the power plant is that it is a necessary evil, and can cause a lot of trouble if it has to shut down for any reason or other.

Power Costs Should Be Determined

All modern manufacturing plants maintain a very extensive and detailed cost system, from the records of which the cost on each particular manufacturing operation or process can be obtained with the highest degree of accuracy. If the cost of any particular operation or process takes a sudden jump, a lot of explaining has to be done. In addition to this, a corps of experts is employed to make time studies, motion studies, etc., in an endeavor to reduce costs. However, a great many of those well-managed plants do not know how much a pound of steam or a kilowatt-hour of energy costs them, although these costs may form no small part of the total manufacturing costs. The power station costs in these cases are generally thrown in with the overhead, where it is difficult to detect any variations due to inefficiency in the use of fuel.

Fundamental Costs in Steam Production

Where records are lacking, the means for determining these records are generally lacking. Most plants know how much coal they use during a period, say a month; but a great many have no means for determining the output of their power department. Without knowing the output of both electric and steam power, no check can be kept on the operation of the plant. In order to obtain the output no very elaborate equipment is required in most cases. It is difficult to make any general recommendations as to what records should be obtained, as the class of service in various plants varies so much.

There are, however, two items which should be obtained in every plant. They are the amount of coal burned and the amount of water evaporated into steam. By knowing these two items, the efficiency of the boiler room operation can be determined. It may be well to state right here that this item is one of the most important for the management to watch, as there is no other place in the plant where more loss can occur due to indifferent labor. The determination of the engine room efficiency is a more difficult matter, especially in those plants which render various kinds of service such as electric power, compressed air, high- and low-pressure steam, refrigeration, etc. However, an endeavor should be made to obtain such records by means of which a check of the engine room performance can be had.

Reports on Steam Generation

As to just what records the management should have submitted daily, weekly or monthly, this is also difficult to outline so that it would be applicable to all plants. However, this report should be very brief and contain only those items which are of direct interest to the management, such as total coal consumed, water evaporated per pound of coal (boiler efficiency), total kilowatt-hours of electric power generated, etc. It is often desirable to submit this report in graphic form so that any change in the performance of the plant will stand out and be easily detected.

Control by Means of a Test Engineer

In order to inaugurate a system as outlined above, a young technical graduate should be employed. This position should be filled with great care. A man who has had several years' experience in the efficiency department of some large central station should be obtained.

He should possess tact and initiative; and should have a pleasing personality which will enable him to gain the confidence and good will of the operating men in the boiler room and engine room. The title of this man should also be selected with care. Titles such as efficiency engineer, betterment engineer, etc., should be avoided, as titles of this nature are apt to prejudice the operating men against him. The title of test engineer will be satisfactory in most cases. The test engineer should report to the man who has general charge of the power department.

It should be impressed upon the test engineer that everything he does should have either a direct or an indirect bearing on the improvement of economy. Otherwise there may be a tendency for him to make the place look like a Christmas tree by installing all kinds of instruments, and to fill the files with high-brow technical reports containing the results of elaborate tests. On the other hand, it will be necessary for him to run certain tests and collect data which will be of no interest to the management and which may appear to be useless.

Isolated Plant or Central Station

There is one question which manufacturers who use more or less electric power generally ask themselves, and that is whether or not they could save money by purchasing their power from the nearest central station. This question cannot be answered until each case has received very careful engineering study. In general, if the power consumption is large compared with the demand for low-pressure steam for heating or process work, then it may pay to purchase power. However, in most chemical industries, with the exception of those employing electrolytic processes, the demand for power is small compared with the steam load. In these cases it is doubtful if any saving can be accomplished by purchasing power, especially if the private plant is fairly well managed. However, as stated above, this question can be answered only after a very careful study of each plant. There are, no doubt, a few places where a combination of central station and private plant service would be the cheaper.

Boiler Room

The boiler room in most private plants is generally the last place to receive any attention in so far as the adoption of modern and efficient methods is concerned. A low type of indifferent labor is also generally found in most industrial boiler rooms. This is most unfortunate, because it is in the boiler room where the greatest loss can occur due to lax methods. The impression seems to be that the only qualification needed for a fireman is the ability to shovel coal. Actually, a boiler should be under the direct supervision of a highly trained man, as the real work of a fireman is to watch and regulate a more or less complicated chemical reaction—that is, the combustion of coal. The chemical engineer would not think of leaving one of his departments, where an important chemical process was being carried on, in charge of unskilled laborers. However, this is exactly what is done in the average industrial boiler room. The result is that loss occurs due to the improper mixing of the two raw materials—that is, air and coal.

Control Instruments

One of the first things that should be done is to provide instruments which will tell the fireman whether or not he is obtaining the right mixture of air and coa There are several types of these instruments availabl some of which are better suited than others for th work. It may be well to mention here that all instru ments should be selected with great care. After ir struments have been installed, they should receive regu lar attention from some one man who should be hel responsible for their operation. Nothing will caus the operating man to distrust scientific methods mor than a lot of instruments in a plant which are out o order half the time. After the installation of thes instruments the men should be furnished with shor non-technical instructions as to how to use them.

Next to the proper handling of the fires comes th proper maintenance of the boiler room equipment, suc as the condition of the furnace brickwork, boiler heat ing surface, both internal and external, baffles, etc There are all matters which the test engineer shoul follow up.

The Question of Coal

Coal is the greatest item of expense in the operatio of any power plant. For this reason, it should be pur chased with the greatest care. The first question tha should be asked in regard to the coal is whether o not the right kind of coal is being used. The price ma be right, but the coal may not be the most economical The selection of coal requires a great amount of carefu study, as there are a great many factors to be con sidered, the most important of which are the type o stoker, furnace, the analysis and the price of the coal None of these items can be considered independent o the others. It is impossible to give any detailed in structions in an article of this kind as to the selectio of coal. However, an attempt will be made to point ou in a general way those factors which should be con sidered. The type of the stoker equipment will decid as to what general class of coal should be used.

After this has been decided upon, the analysis o several coals of this class should be studied. One o the most important characteristics of the coal which should be considered is the heating value. However the mistake should not be made in thinking that this is the only characteristic worth considering. The per centage of ash has a most important bearing on the value of coal. A paper presented before the June, 1922 meeting of the American Society for Testing Materials entitled "A Rational Basis for Coal Purchase Specifications," by E. B. Ricketts, treats the subject of the selection of coal in a very thorough manner. A rough rule which may be used is that each 1 per cent reduction in the heating content of a coal reduces the value of that coal from 1 to 2 per cent, and an increase of each 1 per cent in the ash content reduces the value from 2 to 3 per cent. This rule covers increase in coal- and ash-handling costs.

Influence of Coal on Power Plant Capacity

The quality of coal has a very important bearing on the capacity of a plant. There are probably instances where additional boilers have been added when this could have been avoided by changing to a different coal. Even if the new coal costs more, it may be cheaper to use it than to add boilers. It is quite often possible to double the capacity of an existing boiler plant by simply changing the stoker equipment. In view of this, those plants which are pressed for boiler capacity should look carefully into the possibility of changing either the coal which is being used or the stoker equip-

nent, or both, before buying additional boilers and adding to the boiler house.

After making a preliminary selection of coal, it should be tried out in the plant before the contract is signed, as the analysis will not always give an indication as to how satisfactory a coal will burn under actual operating conditions. It may also be well for the test engineer to run a set of boiler tests in order to determine the efficiency, maximum capacity obtainable, etc. After a coal has been definitely decided on, a set of specifications should be drawn up and incorporated in the contract. These specifications should provide for a bonus and penalty if the coal in any particular shipment is better or poorer than that called for by the specifications.

Limitation of space does not permit giving any detailed directions for drawing up a coal contract. This should be one of the duties of the test engineer. When coal is bought by specification, it is necessary that samples be taken from each shipment and analyzed. This should be a very easy matter in a chemical industry where laboratory facilities are available. Although not the largest source of loss, the amount of unburned coal which is rejected from the furnaces should be checked up by taking periodic samples of the ashes and analyzing them.

Treatment of Feed Water

Another matter which deserves investigation in most small plants is the treatment of the boiler feed water. This is a subject which should be of interest to the chemical engineer; and at the same time there may be possibilities of saving if given proper attention.

Considerations of Load

The test engineer should look into the question of the number of boilers which are being used in cases where the plant contains a number of units. The general tendency is to use all the boilers in the plant, although it may be possible to carry the load on a fewer number, resulting in a saving of coal. This, however, depends upon the character of the load. If the high loads are of short duration and it is necessary to carry banked boilers a large part of the time, then the chances are that no more boilers should be fired than are absolutely necessary to carry the maximum load. On the other hand, if the load is very steady throughout the 24 hours, it may pay to use all the boilers in the plant. As mentioned above, this is a matter for the test engineer to study.

Too much attention cannot be given the general appearance of the boiler room. The windows should be kept clean, the walls whitewashed or painted and the lighting properly arranged and kept in good order. If the boiler room is kept in good order and clean, it will be easier to obtain and keep the right kind of firemen.

Engine Room

Although there may be some opportunity for improvement in the engine room, there is less chance for any great loss due to poor operation than in the boiler room. If engines are used, the setting of the valves should be checked up from time to time by the test engineer. In the case of turbines, a careful watch should be maintained over the conditions of the blades, clearances, etc. The surface of condensers should be kept clean and means should be provided for measuring the amount of air leaking into them. The air which can leak through a small pin hole may cause a loss of hundreds of dollars in a year.

Exhaust Steam for Process Work

At one time a great loss occurred in many industrial plants by using high-pressure steam for various manufacturing processes and heating where low-pressure steam taken from the exhaust of engines or turbines could have been used. The exhaust steam from an engine or turbine contains almost as much heat as live steam and thus is almost as useful.

With the development of the bleeder turbine great improvements have been made in this direction. In cases where all the exhaust steam cannot be used in manufacturing processes, the bleeder turbine offers a means of operating the turbine partially condensing, resulting in low steam consumption, and at the same time steam at any desired pressure can be drawn from it for use in manufacturing processes, after it has generated a certain amount of power. If all or nearly all the exhaust steam can be used in processes or for heating, the fuel costs for power is almost nothing, as the turbine simply acts as a reducing value and at the same time generates power. If there is a surplus of exhaust steam, which is either being condensed or discharged to the atmosphere, each process using high-pressure or live steam should be carefully studied in an endeavor to substitute the use of low-pressure steam.

Distribution System

The most characteristic feature about a great many distribution systems is the lack of system. This is generally caused by the gradual growth of the industry. It is very difficult to reconstruct a distribution system without a great deal of expense. Nevertheless, in many cases it is possible to make improvements at a very small cost.

The covering of steam pipes should receive very careful attention, not only in order to conserve fuel but to keep the temperature of the working rooms down to a minimum during hot weather. All steam lines should be carefully drained of condensate. One of the greatest hidden losses in a distribution system is caused by leaky traps. If the system is a large one, it will pay to employ a trap inspector whose duty would be to make periodic inspection of all traps. If conditions permit, the discharge of all traps and any other condensation should be returned to the boiler room and used for feed water. There are several advantages in doing this: First, the water is recovered; second, the heat in the water is conserved; and third, condensation is almost free from any scale-forming elements, making excellent feed water.

Present Status of the Use of Steam

During the last few years great strides have been made in the conservation of heat in various chemical processes. An example of this is the development of multi-stage evaporators in which steam is used to evaporate a liquid, the vapor of which is passed on to a second evaporator, where it is condensed, and at the same time the heat is used in evaporating another liquid. In this manner the heat in the steam is used over and over again in carrying on several distilling operations.

Where an industry consists of several departments, means should be provided for measuring the amount of power and steam consumed by each department. If this is done, excess consumption can be traced.

New York City.

Good Lighting
A Servant That Will Increase Production

Artificial Illumination a Necessity — The Advantages to Be Derived From Good Artificial Illumination — Relative Cost of Good Lighting Referred to the Cost of Labor—The Importance of Proper Distribution

By Charles Gallo
Illumination Bureau, Westinghouse Lamp Co.

IN THE industries, artificial illumination is an investment in superior management. Primitive man with his "pine knot" torch and modern man with his "billion candlepower" searchlight both found and find artificial light a necessity. Notwithstanding the progress which man has made in the field of artificial lighting—a progress whose alpha and omega might be represented by the pine knot with its smoke and yellow flickering light and the modern minute and highly efficient tungsten lamp used on the surgeon's or the dentist's probe—the real need for effective artificial illumination is not always clearly realized.

The surgeon and the dentist recognize and appreciate the value of modern illuminants. The industrial executive, to whom effective and adequate illumination on a broader scale may render as great a service, is frequently too busy with other and perhaps more pressing problems to consider the subject of artificial light. Yet this subject handsomely repays consideration.

Advantages Derived From Good Illumination

Briefly summarized, the advantages derived from good illumination are:

1. Increased production.
2. Reduced accidents.
3. Greater accuracy in workmanship resulting in improved quality of the products manufactured.
4. Less eye strain, thus increasing the efficiency and health of the workers.
5. Working conditions more pleasant, with greater contentment of employees and a reduction in the labor turnover.
6. More order and neatness in the plant and pride in its appointments.
7. Supervision made easier.

These advantages are very real and they are obtainable at very moderate cost. The details of working out a satisfactory lighting installation may be delegated to an illuminating engineer, and the manufacturers of lamps are always ready to supply advice without charge to their customers. The executive or manager owes it to himself, however, to see to it that this phase of his supervision is not neglected.

Increased Output Through Good Illumination

Adequate and effective illumination has increased the output of various manufacturers from 5 to 20 per cent. In some cases even higher increases have been observed. These increases are due to the fact that with good light the workmen can *see faster*. The truth of this statement may be easily demonstrated in your own shop. Go near some machine with a fairly large flywheel or gear. The apparent speed at which that wheel revolves will depend on the amount of light that falls on it. Obtain a lamp and a reflector (about 200-watt size) direct a strong light suddenly on the moving wheel, and you will see it *slow down*. Does the speed of the wheel actually change? No! You can *see* the spokes *more quickly* and the wheel *seems* to go slower.

EXAMPLE OF GOOD GENERAL LIGHTING

The same things happen in any operation which requires manual attention. It takes time for a workman to see and to pick up a given tool. Increase the light on that tool and the operation is speeded up unconsciously and automatically. The man moves faster because he sees faster. The truth of this has been demonstrated time and again in machine shops, foundries, textile mills and other industries.

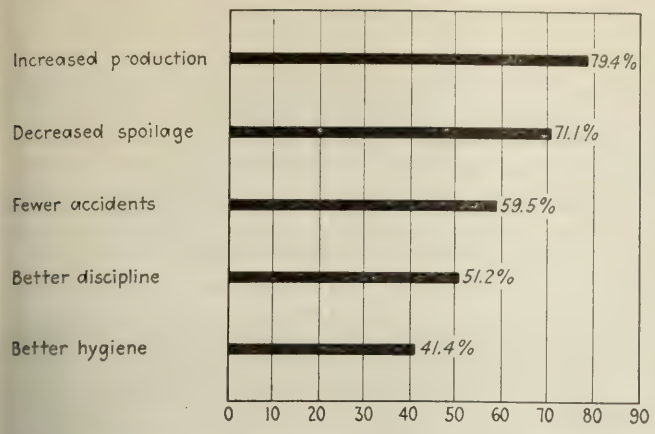
Cost of Lighting Referred to Cost of Labor

Many industrial executives have realized the advantages which good lighting carries with it. They are cashing in on their realization because they have installed modern and effective lighting systems and they will never go back to the old. A few are named:

Phelps-Dodge Corporation, Nocozari, Sonora, Mexico.
Chapman Valve Co., Indian Orchard, Mass.
Millers Falls Paper Co., Millers Falls, Mass.
American Steel & Wire Co., Worcester, Mass.
Alabama Pipe & Foundry Co., Anniston, Ala.
Columbus Forge & Iron Co., Columbus, Ohio.
Conner Steel Co., Birmingham, Ala.

The cost of good illumination will of necessity be variable. Two and one-half per cent of the wages is, however, a trustworthy average figure. Wages represent about 20 per cent of the value of the finished product. It follows that the cost of good lighting is in the neighborhood of one-half of 1 per cent of the value of the product.

We have previously noted that production is frequently increased from 5 to 20 per cent, due to good lighting. Were production increased only 7 per cent,



BETTERMENTS EFFECTED BY GOOD LIGHTING

the money invested in good lighting would be earning interest at the rate of 1,300 per cent. Isn't good lighting an efficient servant?

Accidents and Waste Eliminated by Good Lighting

The report on "Eliminating Waste in Industry" issued by the American Engineering Council's committee attributed industrial waste to a number of factors, among which are:

1. Low production—caused by faulty management, faulty equipment and plants.
2. Lost production—caused by ill health, physical defects and industrial accidents.

The same report stated that the responsibility for over 50 per cent of the waste in industry lay with the managers of the various industries.

Above we have hinted at the fact that managers may decrease some of the waste due to *low* production by improving lighting conditions. Waste due to *lost* production caused by accidents and ill health may also be reduced by good lighting.

Fig. 1 shows how darkness or inadequate lighting and accidents go hand in hand. Accidents are not all due to poor lighting conditions. Statistics show, however, that accidents may be reduced about 20 per cent by improving lighting conditions. Records for the year 1919 show that 23,000 fatal or crippling accidents caused a loss in time equivalent to $853,000,000. If good lighting reduced accidents by only one-eighth this would represent a saving of over $100,000,000. Is that worth while?

In this article we have thus far mentioned good lighting and adequate lighting. It will probably be well to define these terms, to try to explain what is good and adequate lighting.

What Is Good Lighting?

Daylight and plenty of it, shaded and softened, is both good and adequate. How good and how adequate is perhaps best realized by the illuminating engineer, who must try to produce equivalent results, by using that wonderful, if small, substitute for the sun, the modern incandescent lamp. The human eye can, when not imposed upon by glare, adapt itself to operate over a stupendous range of illumination values, and the illuminating engineer can therefore obtain good results with the means already at his command.

Adequate lighting is that which will supply an illumination of such a value as to enable a given operation to be performed most rapidly. Illumination from the quantity standpoint is measured in foot-candles. Ten years ago 3 foot-candles was considered good illumination for weaving operations in a cotton mill or for grinding or mixing in a chemical plant, because any more light was prohibitively expensive. Today 10 foot-candles is considered good lighting for the same purposes, and costs less. It may be that 10 years hence still higher values will be considered desirable. As competition increases and with it the necessity of more and better production, good illumination is found more and more profitable. The modern factory lighting codes such as that issued by the Illuminating Engineering Society give the values of illumination which are now considered adequate for the various industrial processes.

Distribution of Lighting Important

Good lighting combines an adequate illumination with a proper distribution of the light. If you are reading a book or a paper some sunny afternoon, you will probably turn your back to the sun, in order to avoid the annoying glare. If the paper is white, you will move it into the shade. By so doing you improve, in so far as you are concerned, the distribution of sunlight on your reading matter. For this reason bare lamps cannot supply good lighting. They must be equipped with proper reflectors in order to shield the eyes from the annoying and blinding brightness of the lamp filaments and also to direct the light where it is needed—where the work is performed.

Artificial lighting is paid for on the basis of kilowatt-hours. You pay for the same amount of current whether you use it as heat or as light. Since you are purchasing light, the moral would be, get as much of it as possible for a given expenditure. To do that, use efficient lamps. The light-producing efficiency of the modern lamp increases with the size or the wattage of the lamp. Other things being equal it is more profitable to use large lamps and fewer of them, than a multitude of small lamps.

Lighting Trend Toward General Illumination

The trend of good lighting in today's industries is toward general illumination, using large shielded lamps wherever possible. The limiting factor is generally the height at which the lighting equipment can be mounted. For given types of reflectors the ratio of spacing to mounting height is constant and must not be exceeded when good lighting is required throughout a given area.

General illumination is the lighting system "par excellence" for chemical plants. In these plants maintenance of equipment is at times a veritable bugbear. General overhead illumination, by reducing the number

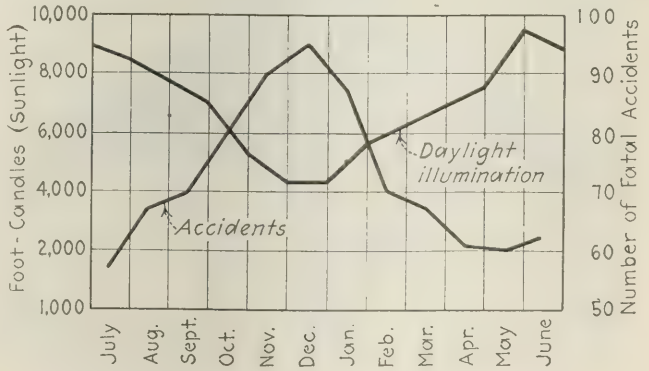


FIG. 1—SEASONAL VARIATION OF FATAL ACCIDENTS

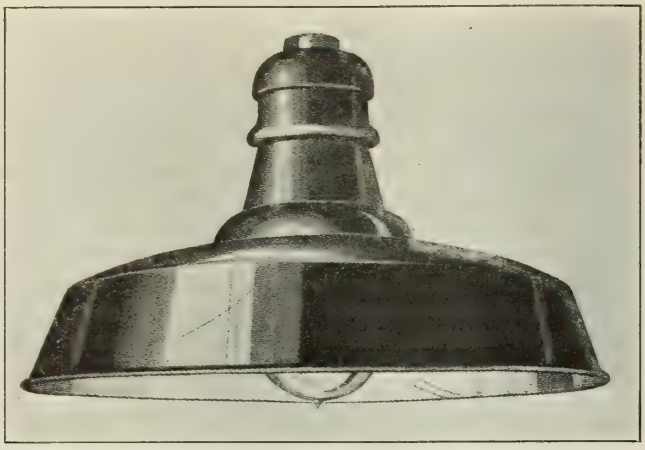


FIG. 2—STANDARD REFLECTOR FOR INDUSTRIAL USE

of outlets, greatly simplifies the maintenance problem, lowering depreciation costs and also the cost of installation.

In such plants good porcelain-enameled steel reflectors, with self-contained sockets such as shown in Fig. 2 will give excellent service. Where corrosive fumes or explosive gases are present in considerable quantities the vapor-proof type of unit (Fig. 3) will give the most satisfactory service.

Points to Be Observed in Maintenance of Lighting System

The most efficiently designed and constructed lighting unit can give good service only when it is kept clean. In buildings with high ceilings, where general overhead illumination and high (18 ft. or more) mounting heights are used, reflectors equipped with pulley-sockets or with automatic cut-out hangers will be found to simplify the cleaning problem greatly. It should also be remembered that where the equipment is kept clean, it not only will deliver all the light paid for but it will also depreciate more slowly. This is particularly true in chemical plants.

Another point worth considering in industrial illumination is the effect of voltage on the light-producing characteristics of modern incandescent lamps. Lamps operating below their rated voltage dissipate current as heat. A lamp operating at 4 per cent below its rated voltage will produce 15 per cent less light than one operating properly. If you buy light, operate your lamps at their rated voltage.

The industrial executive of today is interested in reducing operating costs, in increasing production and in eliminating wasteful methods. Good illumination is not an absolute panacea for all these ills, but can be a mighty helpful agent. It can increase your production, make your plant a better and more satisfactory place to work, reduce your labor turnover, improve the morale of your employees.

A very effective servant at your command. Put it to work.

New York City.

FIG. 3—VAPOR-PROOF REFLECTOR FOR CHEMICAL PLANT USE

Compressed Air as an Aid to Production Efficiency

Most chemical plants have compressed air available for process work. The full compressor capacity is seldom used in the processes; and there is an excess available which may be employed for blowing out pipe lines, cleaning motors and other equipment and for supplying power to various tools used by the plant maintenance department.

There are, however, some other uses to which this excess air power can be put which are a distinct aid in saving man power and increasing the operating efficiency. These uses embody the employment of the pneumatic hoist, an efficient and cheap tool which has not had the general recognition it deserves.

The Pneumatic Hoist

The typical pneumatic hoist has been brought to a a high state of efficiency. The air motor has double acting, cylinders, placed at right angles and operating on a single-throw, balanced crank shaft which is connected to the drive. This drive generally is of the worm gear type, and is cut to a pitch that insures locking of the drum and holds the load at any point, even when the air is turned off or the line breaks. With this feature the load can be raised, the air line disconnected, the hoist run on a trolley, to a distant point, another line connected, and the load placed as desired. Such a hoist can be operated at a cost of less than one-thousandth of a cent per foot of lift per 100 lb. lifted.

Some Uses for This Hoist

One of the most efficient methods of material handling in chemical plants involves the use of electric trucks or tractors and trailers. A good many of the loads encountered are too heavy to be conveniently lifted to the platform of the truck or trailer. If a pneumatic hoist, mounted on a trolley and track, is arranged to serve each station where trucks or trailers are to be unloaded or loaded, this work can be done in the cheapest and most convenient manner.

In many chemical plants we meet the problem of handling large steel drums, which, when loaded often weigh 1,000 lb. or more. It may be desired to lift the empty drum to the filling station, to move it after filling to the heading machine, from there to the scale and from the scale to storage or shipping. Many plants where this is the case are not large enough to warrant an extensive handling system and the air hoist solves their handling problem well.

The Relation of Safety to Increased Production Efficiency

Incentives to Accident Prevention—How Safety Is Achieved in Several Large Industries—Losses Through Preventable Accidents—How Safety Work Increases Production Efficiency

By Louis Resnick
Assistant to the Director, Safety Institute of America

WHEN Judge Gary in 1908 issued the memorable order which started the safety movement not only within his own company but in American industry generally, he had only one thought: to prevent, so far as humanly possible, loss of life or maiming of men through industrial accidents. The humanitarian appeal was the sole impelling motive in the case of practically all of the pioneers in the industrial safety movement.

There were no compensation laws in those days, and if anyone had suggested the possibility of preventing accidents and increasing production by the same stroke he undoubtedly would have been laughed at. The Steel Corporation and the other pioneers in the movement were quite willing to spend millions of dollars to safeguard life and limb in their plants without any expectation of a financial return through increased production. They were, in fact, reconciled to a lowering of production through accident prevention activities, for the earliest safety devices and educational methods were crude affairs.

Incentives to Accident Prevention

As soon as the Steel Corporation had demonstrated that it was actually possible to reduce accidents, industrial men throughout the country began to give serious attention to the accident causes in their own plants and to means of eliminating them. Then came the wave of compensation legislation, a decade or so ago, and this drove thousands of manufacturers who were not inclined to mix sentiment with business into accident prevention work as a matter of self-preservation. Safety does decrease compensation costs, and that fact soon became the second great impelling force in the safety movement in America.

But today there is a third incentive for giving serious attention to accident prevention in industry, and that is the effect of such activities on production efficiency. The chemical and metallurgical industries are rich in examples of safety work which also—sometimes by design and sometimes much to the surprise of the safety engineer himself—increased the production of the individual machine or workman, decreased the production costs through some other means, or increased the quality of the product.

One of the big paint manufacturers set out to eliminate the health hazard to the men in his principal manufacturing department, and in revising its processes with that one end in view, stumbled upon a means of increasing his production efficiency through all three of the channels just enumerated. What started as a bit of safety work in this plant has revolutionized a century-old manufacturing process. Today this company is engaged in tearing out equipment which is being replaced by new machines occupying approximately a fifth as much space and which turn out a better and cheaper product with a very heavy reduction in the number of lead-poisoning cases among its employees.

In the so-called dope room of the Armour & Co. can factory at Chicago there is another good example of much the same thing. In this room there are a dozen or more oven-like machines known as compound driers in which the grooves of can covers and bottoms are coated with a benzene composition. For years this department justified its name. Operators and inspectors at the driers would become "dopey" and frequently would actually fall asleep at work. It was difficult to retain employees in this department, and a great deal of time was lost through headache.

"My principal job," the foreman tells us, "used to be to walk from machine to machine and talk to the operators and inspectors so as to keep them from falling asleep."

Perhaps the most expensive result of this condition was the heavy percentage of defective can covers which were passed by the semi-conscious inspectors. Every defective cover sent to the canning department meant a leaky can and spoiled food. The "leakers" sometimes ran as high as 7 to 10 per cent—quite an expensive item when you consider a production of 50,000 cans a day. Sometimes the room became so full of fumes that the department had to be shut down, and this in turn meant the temporary closing of the entire can factory and the can-packing departments.

Remedy for the Fume Hazard

Then along came the superintendent of the can factory and, independently, hit upon the same scheme that solved a somewhat similar problem at the plant of the Ford Motor Co. He devised an exhaust system to draw off the benzene fumes, the pipes of which ran directly into the drying machine instead of terminating in hoods several feet above the machine, and in addition he installed another set of pipes through which fresh air was constantly blown into the room. This enabled the department to increase its production 25 per cent, to get a much better class of employees, and to retain them; it made possible so much better inspection that this department received a large share of credit for the reduction of "leakers" from an average of 4 per cent to less than one-half of 1 per cent; and there hasn't been a single case of an operator or inspector falling asleep in this department since.

An Example at the Ford Plant

The experience of the Ford Motor Co. presents this example. There is in one of the buildings at the Highland Park plant a department including ninety-seven cyanide furnaces and seventeen annealing furnaces. Up to 2 years ago this department was one of the most troublesome in the plant. The furnaces were heated to 1,560 deg. F. and it was necessary for the workman, standing directly before the open furnace doors, to work in a temperature of 133 to 135 deg. It was impossible to keep men in this department for any length of time, and during the summer months eight to ten cases of heat prostration a day were a common experience. The situation became so serious that the general super-

intendent, P. E. Martin, made a special study of the department and as a result a metal canopy was placed around each furnace, making possible the continuous exhaustion of the hot air. At the same time cold air was blown down on the heads of the furnace tenders, bringing the temperature where the men worked down to 80 deg.

This installation was completed at a cost of $100 per furnace—$11,400 in all. And this is how Frank Donovan, superintendent of the department, described the results: "The canopies have done away with heat prostrations in this department, the labor turnover has been reduced 25 per cent, the output has been increased, and our working force has been reduced 50 per cent. This ventilating installation paid for itself the first month in the saving of labor alone, by enabling one man to take care of two furnaces instead of one as before."

An Example From a Dye Plant

The dye works of E. I. du Pont de Nemours & Co. at Carney's Point, N. J., affords still another example. The operation necessitated the constant employment of two workmen to shovel the material into barrels and their consequent exposure to fumes. During July and August of 1919 work on this operation was stopped; the drying operation was replaced by an automatic machine which discharged directly into carriers, where the material was permitted to drain before being dropped into the barrels; a new neutralizing plant was installed with proper fume exhausts; a new catch tank was installed; and the wooden platforms were replaced with concrete. When the process was started up again in September production materially increased, while the number of industrial malady cases decreased.

Loss Through Preventable Accidents

So much for specific instances. The loss to industry as a whole through preventable accidents and preventable illness runs into billions of dollars annually, and few industries are immune. For instance, every morning when the whistle blows more than a million workers are missing from their benches. Every day 3 per cent of all workers are absent on account of sickness. At the very low average wage of $3 a day this means a yearly loss of over a billion dollars in wages and an additional equal amount lost to employers through the disorganization of their working forces. The waste in industry survey conducted by the Federated American Engineering Societies disclosed the annual loss of another billion dollars through accidents. The full significance of these two tremendous items of loss to industry becomes apparent when we accept the statement of safety engineers and industrial physicians that 75 per cent of all industrial diseases and industrial accidents are preventable.

Production Increased by Safety Work

Probably the greatest opportunities for increasing production efficiency through safety work lie in such simple mediums as lighting and ventilation. The bureau of illuminating engineers of the New York Edison Co., which has conducted a good deal of research along these lines, for instance, reports the following as results of revision of lighting facilities in industrial plants:

Increased production	79.4 per cent
Decreased spoilage	71.1 per cent
Reduction in accidents	59.5 per cent

The library of the Safety Institute of America contains many records of marked reductions of accidents in plants in the chemical and metallurgical industries. Each such reduction spells increased production efficiency. The methods of preventing industrial accidents are neither secret nor mysterious. There are in the United States several national and scores of state or local safety organizations where employers interested in the subject may meet and exchange experiences. There is an abundance of literature on the subject, and several safety museums, the oldest and largest of which is the American Museum of Safety in New York City. The employer who is interested in accident prevention or who wishes to learn of the possibilities in this field today has everything in his favor and nothing to hinder him.

New York City.

The Dollar Side of Safety

In an editorial in the *National Safety News* for June, 1922, Holger Jenson makes the following pertinent comment:

"The idea of safeguarding human life and limb is as old as history, but the introduction of modern machinery brought an economic loss, through industrial and public accidents, that fast became a menace to the nation's future welfare. At first, the safety movement was accepted, not as an economic proposition, but strictly as a humane one. The extensive precautions necessary to prevent accidents meant a financial outlay and were observed only to a limited extent; beyond a certain point safeguarding methods were looked upon as extravagance.

Safety Precautions in a Steel Mill

"I recall a steel mill which reached its peak in the number of accidents, including three fatalities, all within a period of 90 days. Suggestions for the adoption of safety precautions and devices were received by the remark that a steel mill could not be operated without accidents; that it was impracticable to fence in the mill equipment. The workmen themselves showed an antagonistic attitude toward the installing of safeguards. The management, however, agreed to make some of the improvements which, from a humane standpoint, were considered necessary. Great was the surprise when it was found that not only were the accidents greatly reduced, but the output of the plant increased. The company at once proceeded to go the limit in safeguarding and in convincing the workmen of the importance of being cautious—all of which involved a large monetary expenditure.

"After a period of one year, the general manager stated that the money invested to prevent accidents had paid better dividends than any other similar outlay he had ever made for production.

Ventilating System Pays Dividends

"In another case poisonous dust and fumes destroyed the vitality of the workers, greatly reducing production. Working hours were reduced, but still the management had to refuse orders, it being impossible to fill them. The installation of a ventilating system solved the dilemma. In the manufacturer's own words, "Our output is twice as large as before, with the same number of employees; the company and the workmen are making more money than we ever dreamed of and everybody is healthy, happy and contented.' That manufacturer and his employees now appreciate the dollar value of safety."

The Budget as a Means of Industrial Control

Successful Conduct of Business Must Be Based on Facts—The Elements of the Cost of Manufacture—Analysis of These Elements the Basis of a Budget—How a Budget Helps the Manufacturer to Control His Business

By Walter Rautenstrauch
Vice-President, J. G. White Management Corporation.

THE unusual circumstances surrounding the conduct of business affairs during the past several years have impressed manufacturers and others with the fact that many of the rules of business procedure upon which they had depended in times past were not adequate to meet the new conditions. Old standards by which progress was measured, costs determined and results predicted proved faulty, with the result that losses arose where there should have been profits and many business enterprises failed which should be in satisfactory operation today.

It is unfortunately true that overspeculation in markets and inventories is responsible for the situation in which many manufacturers find themselves today. Aside from the fact itself, it is unfortunate because it has misled some to overlook the real reasons which underlie embarrassing situations for which the failure of the market cannot be held responsible. When judgments were based on adequate facts—not mere records, but facts—there were rarely any occasions for excuses in regard to lack of profits.

Necessity of a Means of Forecasting

Many a business man, looking toward the future, is asking himself if there is not some means by which he can foretell and thus control the situations he will have to meet; does a business have to be run on an emergency basis or can it be operated with a reasonable knowledge of tendencies and the consequence of these tendencies. It is no tax on the imagination to contemplate the fact that nothing ever happens by chance. In every field of activity, whether in the chemical laboratory or in the business office, there are natural laws of action and reaction which are irrevocable, and success depends upon conformity to these laws.

Nature of the Economic Problem in Business

The chemical and metallurgical sciences have made more progress than economic science because chemical reactions are of relatively short duration, so that facts are immediately discerned and easily impressed upon the mind. In economic science the reactions are of longer duration, covering periods of months, or even years; and the results are often obscure because they are remote from the causes. We fail to appreciate the warnings of our physician because we are not immediately a candidate for the hospital when we do not regulate our diet or procure glasses or take exercises prescribed. I am inclined to believe that the same psychology is operative in our attitude toward business problems.

We seem to need a more fundamental basis for the exercise of competent judgment on business problems. One step toward this end appears to be in the use of a budget system of control by means of which proper standards are set up and performances compared with these standards.

There is scarcely a business enterprise which does not have some method of accounting by means of which periodic statements are prepared showing the results of operation of the business. A careful analysis of these operating statements will show for any business that the elements of the cost of manufacture are as follows:

1. Fixed charges, which do not vary with the rate of production or quantity produced in a given period. Such charges are depreciation, interest on funded indebtedness, insurance, local taxes, salaries of officials and office help, etc.
2. Variable charges, which vary with the rate of production or quantity produced in a given period. Such charges are indirect labor, indirect materials, supplies, sales commissions, etc.
3. Direct materials, varying with the rate of production.
4. Direct labor, varying with the rate of production.

Analysis of Accounts

Unless the accounts have been classified with some reference to the uniformity of the items of expenditure grouped under each account, the operating statements must be very carefully examined if a reasonably accurate determination of the above elements of cost is to be made. It must also be recognized that certain major items of expense are of a dual character with respect to their relation to the volume of production. The cost of power, for example, has certain elements which are fixed and others which vary with production. Insurance against fire, etc., is fixed; but employees' liability insurance varies directly with the payroll and hence with production.

The operating statement examined may also contain certain items of expense which are abnormal for the period covered by the statement. Major repair charges, for example, accumulating in any period must be distributed over the time during which the wear occurred. So also there may fail to appear in the operating statement certain charges which should normally appear, but which have been covered by expenditures in prior periods. By the exercise of a little common sense, one may take an operating statement covering a given period and determine the cost items which are normal; and by comparison with the sales accomplished during the period arrive at ratios of fixed charges, variable charges, direct labor cost and direct materials cost, to sales, which are very useful in establishing the essential cost characteristics of the business.

A Graphic Analysis to Form the Basis of a Budget

These values may be used to set up a graphic analysis as shown in Fig. 1, which relates to a certain manufacturing plant recently examined by the writer. Analysis of the operating statement shows that for a volume of sales of $650,000 the direct labor is $130,000, or 20 per

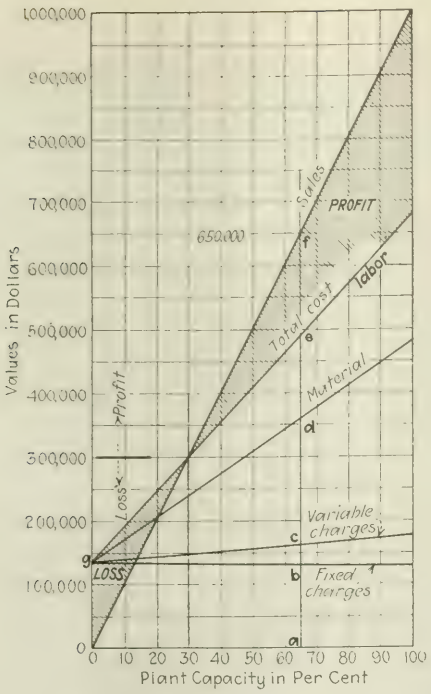


FIG. 1—THE GRAPHIC BASIS OF A BUDGET.

cent of sales. The direct materials cost is $195,000, or 30 per cent of sales. The variable charges are $32,500, or 5 per cent of sales, while the fixed charges are $130,000. The plant is producing $1,000,000 sales annually. These values are set off in Fig. 1 as follows:

Let the ordinates represent dollars value and the abscissas percentage of plant capacity. At 65 per cent of plant capacity, which represents $650,000 sales, erect an ordinate and set off

ab equals $130,000 equals fixed charges
bc equals $ 32,500 equals variable charges
cd equals $195,000 equals direct materials cost
de equals $130,000 equals direct labor cost
af equals $650,000 equals sales

Construct *of*, *gb*, *gc*, *gd*, *ge*.

How the Graph Is Made

The intersection of *of* (sales line) with *ge* (total cost line) will indicate the volume of sales at which the company will "break even." In this case the sales must be at least $25,000 monthly, or $300,000 annually, before profits begin. This analysis is in many respects very valuable to the plant management. It establishes a budget limit of expense for labor, material and overhead (variable and fixed charges) for different plant outputs, with which the actual costs of these items may be compared and the profitableness of the business approximately established. These budget items may be subdivided to any degree which the requirements of the business may demand, and comparisons may be made not only with the total but with the elements which make up each major item.

Some Uses of the Graph

This analysis establishes the danger point of the business below which losses are incurred. It may be used to determine the effect of changes in material and labor costs, or changes in sales price, on the profitableness of the business. It indicates the variation of overhead with plant output. If, for example, the overhead (variable plus fixed charges) is estimated as a percentage of direct labor cost, it will be found that at 40 per cent capacity the labor cost is approximately $75,000 and the overhead is $150,000, or 200 per cent of labor. At 75 per cent capacity the labor cost is approximately $150,000 and the overhead is $165,000, or 110 per cent of labor. At 100 per cent capacity the labor cost is $205,000 and the overhead is $180,000, or approximately 88 per cent of labor.

If, for example, it has been the custom to base a cost estimate on an overhead of 100 per cent on labor, which may be satisfactory when the plant is operating at about 80 per cent capacity, the same percentage when used for a 40 per cent capacity will result in the determination of a selling price which will not cover costs. Competition may of course fix the price at which goods may be sold, and the situation may have to be met regardless of the plant capacity being used. Nevertheless the facts of the actual costs incurred should be faced, for nothing can be gained by a false method of cost determination.

In times such as the present, when plant output is below normal, it is very important for the manufacturer to know how the overhead varies with plant output, as indicated by the above illustrations. The all too frequent custom of using a fixed percentage for overhead, regardless of output, is very dangerous. The above analysis may be made for each department of a business as well as for the business as a whole. This is particularly valuable in case a variety of products is being manufactured and the profitableness of each line is to be determined from time to time. The industry as a whole may be profitable, yet certain products may be sold at a loss.

An Example From Practice

In a plant examined by the writer some time ago it was the custom to use 100 per cent on labor cost to cover overhead in preparing cost estimates. It was true that for the plant as a whole one dollar was spent in overhead for each dollar of productive labor cost. It was also true that the several products made by the company did not pass through the same departments. Some products were made in departments in which the factory overhead was 300 per cent on labor, and other products incurred a factory overhead of only 50 per cent on labor. The result was that some products were sold at a loss, while others were sold at a high profit; and also that orders were readily booked for the products which were underestimated, and the business in the higher priced products was not readily obtained.

Advantages Following Use of a Budget

There are many factors which control the successful operation of a manufacturing plant, and one cannot hope to correct all unsatisfactory conditions by merely establishing a budget system of operation. It is believed, however, that a prediction of expense items for varying plant capacities, such as is briefly set forth above, will be very helpful to many manufacturers who have never attempted it. Standards will be established which are useful not only in cost determination but also in measuring decreases or increases in given expense items. One never hears of a race being run to determine the distance which may be covered, say, in 10 minutes. The race is run over a measured course. The race for profits is, no doubt, governed by the same principles.

New York City.

Cost Accounting And Factory Efficiency

The Technical Executive Who Uses His Cost System Without Being Dominated by It Is Well Equipped for Intelligent Control of the Factors for Efficient Production and Distribution

By George P. Comer
Chief Accountant, United States Tariff Commission

THE basic reason for a cost system in manufacturing establishments arises from the continual development of industrial technique into more and more complex forms. In the days of rule-of-thumb methods both in production and management serious errors of judgment were corrected by personal observation in the plant or sales department. Under modern conditions no such personal contacts can be established, and a substitute for them must be found. This substitute is in large measure supplied by the cost systems in operation in the modern factory. Only rarely, if at all, can the manager follow the daily and hourly movements of materials through the plant in the literal sense, but the "shadows" or "echoes" of the operation may pass across his deck in the form of cost and production records. It is not meant that the management may properly sit at desks a thousand miles away and look at paper slips to the exclusion of actual contact with the factory, but a man with some imagination, corrected periodically by personal observation, may reproduce in his mind a whole series of operations by examining well-organized cost records.

If the development of cost and production records has resulted from the growing volume and complexity of industrial processes, it follows almost necessarily that the records will be more or less behind the pace of industry. During the rapid expansion of the dye business, for example, in 1919 the chief accountant for a large dye plant informed the writer that although he visited the works weekly his records by processes were always several weeks behind the actual methods of operation. For that reason the management was seriously handicapped in correcting errors of production by study of the paper records. The redeeming feature in the situation was the fact that both the accounting force and the management knew that the records were lagging behind the factory processes and consequently many accountants were employed to keep up with the changes in the plant.

Attitude of the Management

If flexible and progressive cost records are required in a modern factory, so likewise must the mind of the man who interprets them be flexible and progressive. This is no place for an essay on managerial qualifications, but the bias of managers is so pronounced in many cases that the best cost system may be rendered nugatory or even positively harmful by the use that is made of it. So well defined are some bias attitudes that textbooks have begun to name them "production bias," "cost bias," "sales bias," etc. Some men, for example, are dominated by the cost records to such an extent that they see no inconsistency in charging, or attempting to charge, $2.50 for a product one month and $3.50 for it the next month. The "cost plus 10 per cent" theory figures out that way, so what more can be done?

On the other hand, many men are convinced that the main function of the management is to sell goods, leaving the weather and the factory superintendent to determine costs. At times, in periods of chaotic costs or uncertain markets, the records of the past or even the cost of the day may be temporarily neglected, but in the long run unless the cost of produtcion dominates the sales policy dividends will fall off. In some cases sentiment or the necessity of a full line may dictate that some products should be sold at a loss, but as a general rule that management is most successful who first discovers the cost of production for all lines and then gradually lops off the unprofitable parasites.

There is a sense, however, in which, under certain conditions, it may be profitable to sell at less than the so-called cost of production. This situation arises when the "marginal cost," as the economist would say, is different from average costs. Every superintendent knows that although the cost of the average product in the factory may be $10 per unit, yet at certain times, especially in slack periods, additional units of the same product may be manufactured for a cost of $5 per unit. Under such conditions it may be advisable to fill some special orders for less than the average cost. Stated in other terms, these marginal orders will be profitable if the price is anything above the actual cost of material and direct labor which go into the fabrication of the article. Stated in still another way, any portion of the general overhead expenses borne by the marginal orders is a gain for the year's operation.

It will be recognized that this obvious industrial fact may cause more harm than good when practiced by indiscreet executives. The temptations to overexpansion, cut-throat competition and ill-advised booking of orders when the factory is already under full production may turn the scale from profit to loss. "Marginal orders" become "average orders" under such conditions, and the full market price must be charged for them. In short, it is a wise man who can use his own cost system without being dominated by it.

Cost Accounting and the Control of Production

In order to show the function of a cost system in relation to the control of production it is necessary to outline some elementary principles of cost accounting.

In the first place, cost accounting must not be confused with the regular routine of bookkeeping which most plants carry on. Bookkeeping is a record of the past. Cost accounting is largely estimates for the future. In every well-organized system there are two streams of records flowing side by side, with occasional junctions between the streams. The one stream is made up of the multitude of cost records, which enables the management day by day to estimate the cost of the processes current in the plant. The other stream is the regular course of bookkeeping which, for the most part, records actual transactions. The purchase of raw material, the payment of wages and the cost of repairs

flow along under the hands of the bookkeeper into the monthly trial balances, balance sheets and profit and loss statement. Such a stream may go on with little or no reference to the unit cost of production of particular products. The cost stream is much more intimately connected with the manufacturing processes. Weekly, and daily if necessary, the management may know approximately where it stands with respect to any order on its books.

The two streams touch and, in a sense, become identical at the end of the fiscal period. Cost estimates are matched against actual expenses, and adjustments for errors are made. The ledger record of the past fiscal period becomes the basis for the cost estimates in the future period, and in all cases the basic cost accounts must be closed out into an account representing the cost of the finished product where the cost stream is set over against the income stream from the sales department. This twofold relation of the cost and ledger records is fundamental. On the one hand estimates of the current and future costs must be based on the facts of the past and on the other hand such estimates must be checked against the actual annual expenses when the bookkeeping records are finally closed.

Failure to make such adjustments is often serious and sometimes ludicrous. One company whose books were recently examined by the writer charged to the cost of production interest on the investment for every department in the factory. Having charged the interest to cost, the bookkeepers neglected to tie the cost records to the bookkeeping records by crediting the interest account, and therefore Profit and Loss, with the amount imputed in the cost charges. The result was that they had large hidden profits that appeared nowhere in earnings—6 per cent on the whole factory investment of about $10,000,000.

Basic Schemes of Distribution

To the superficial observer there are almost as many cost-accounting systems as there are independent manufacturing establishments. Each one seems to be different from the other, and in the eyes of the accountant, especially if they have been long accustomed to one system, their own methods seem unique when unrelated to that of any other establishment. To the experienced accountant, however, who is not confused by details, it is equally obvious that fundamentally there are only two or three different cost systems. The chief differences in most systems grow out of the methods of distributing overhead expenses. The costs of material and of direct labor are relatively simple. Therefore they are not the chief points of interest in the system.

So complex is the allocation of general expenses to the cost of particular products, however, that several different schemes of distribtuion are current at the present time. In general these may be divided into distribution on the basis of direct labor, on the cost of material, the value or quantity of output, the departmental investments or the cost of machine operations. Each of these methods may be further subdivided into more refined or, as some would say, more sophisticated processes of distribution. Direct labor, for example, may be considered from the point of view of man-hours or from the point of view of labor cost. Distribution on the basis of material may be either in proportion to the cost of material or to the quantity used. In some cases the quantity or value of both labor and material may be combined in arriving at a basis of distribution. Another method often used in the chemical industry may be called the "process method," by which all possible charges are allocated to different unit processes such as grinding, nitrating and sulphonating, after which the general expenses not chargeable to any process are distributed in proportion to the various process costs in the factory. Perhaps the most detailed and in some respect the highest type of cost accounting grows out of the machine cost method of distribution. The particular type referred to is usually called the "machine-hour" method—that is to say, all possible cost items are centered upon a machine, or more properly upon each type or battery of machines, and the cost of operating one of them for an hour is determined. In some cases the machine operator himself is considered an adjunct to the machine and his wages are charged in with the cost of operating the machine.[1]

The Essential Elements of Cost

The main elements of the cost of operating a given class or battery of machines are as follows: First, the cost of the space which they occupy; second, the fixed charges on the machines, such as interest and taxes, whether they are in operation or not, and third, the direct cost of operating them. These main divisions of expenses are further subdivided into a multitude of items involved in the operation of the factory. Schematically the main elements of cost may be outlined as follows:

ELEMENTS OF COST OF MACHINE-HOUR

I. Space cost:
   1. Interest on real estate.
   2. Repairs.
   3. Taxes.
   4. Depreciation.
   5. Insurance.
   6. Light and heat.

II. Fixed charges on the machine:
   1. Interest on the machine.
   2. Repairs.
   3. Taxes.
   4. Depreciation.
   5. Insurance.

III. Operating charges:
   1. Repairs and depreciation from use.
   2. Oil and waste.
   3. Share of foreman expenses.
   4. Power.
      A. Power cost consists of:
         1. Space cost, fixed charges and operating charges on the machinery in the power plant.
         2. Fuel.
         3. Labor, in power plant.

From the strictly accounting point of view each of these subdivisions of cost is worthy of lengthy consideration, but for present purposes a bare outline of the method of determining the machine-hour rate from these cost elements is all that is necessary. The machine space cost is determined by allocating to a particular battery of machines space charges according to the ratio which the battery occupies to the total machine floor. If a battery requires one-tenth of the total factory space for operations, other things being equal it should receive one-tenth of the space charges. The fixed charges and many of the operating expenses are directly chargeable to the machines. Power is allocated to them by various methods commonly known to the engineering profession. When the total cost of maintaining and operating a machine is determined for the fiscal period the "machine-hour cost" is obtained by dividing the total cost by the number of hours the

[1] It should be understood that in the following discussion the term "machine" is not necessarily limited to a single mechanical unit made up of wheels, cams and pulleys, but it may include a whole installation of process equipment or in fact any arbitrary group which operates more or less as a productive unit.

machine was in operation during the period. Thus if all charges, such as rent, interest, depreciation and operating costs for a machine are $1,000 for a year and the machine was in operation 2,000 hours during the year, the "machinery-hour rate" is 50 cents per hour. In other words, during the subsequent fiscal period each job will be charged 50 cents per every hour the given machine is used on it.

The Departmental Cost Sheet

Having determined the machine-hour rate and caused each production order to be charged with the machine-hours expended upon it, the next step is to assemble the charges against each order in the various departments. For illustrative purposes a hypothetical Departmental Cost Sheet is shown in Fig. 1. It should not be assumed that this exact form can be used in practice, because, for the sake of brevity, more classes of departmental expenses are assembled on it and each class is shown in briefer form than is feasible in practice.

DEPARTMENT COST SHEET

Production Order #1001. Department D.

MATERIAL

Description	Amount	Unit Cost	Value	TOTAL
Total			$20.00	$20.00

Man Number	Machine Number I	II	III	IV	V	Man-Hours	Rate per Hour	Amount
10	5	3	2	2	1	13	$.50	$6.50
11	3	2	1	1	1	8	.40	3.20
12	3	3	2	1	1	10	.35	3.50
13	2	..	2	2	..	6	.30	1.80
14	5	3	3	..	1	12	.25	3.00
Machine Hours	18	11	10	6	4	Labor Cost $18		18.00
Rate	$.25	.20	.15	.30	.50			
Amount	4.50	2.20	1.50	1.80	2.00	Machine Cost $12		12.00
Idle Hours	....	3⅓	5	4	6			
Idle Rate	$.10	.08	.04	.13	.20			
Idle Cost	$...	.33	.20	.52	1.80	Total Idle Cost		$2.85
						Superintendent and Management		10 00
						Other General Expense		5 00
						GRAND TOTAL		$65.00

FIG. 1—A HYPOTHETICAL DEPARTMENTAL COST SHEET

The first significant figure on the Departmental Cost Sheet is the "Production Order Number." The "Production Order" is the beginning and end of real cost accounting. This order, signed by someone in unquestioned authority, starts the process of manufacturing and its final O.K. is the record of a completed job. By it the unending stream of production is broken into sections or units for costing purposes. These units may be determined by a given quantity of output, such as would be occasioned by manufacturing goods to order, or they may be determined primarily by time periods. Each day or each week a new production order may be initiated whose size is fixed by the predetermined factory output for the season or fiscal period. Each order bears a number and all records pertaining to it must show the number in unmistakable figures.

Heading the tabulation of each Departmental Cost Sheet is a record of the material used for this production order in the department. In the lower checkerboard table is the record of labor and machine cost. The columns "machine number" and "man number" record the number of machine- and man-hours required on the order. As a matter of fact, each man number in practice may stand for a whole group of men whose hourly wage is the same and each machine number may represent a battery of "machines"—vats, nitrators or equipment of various kinds.

After the record of each man and of each machine is compiled on the sheet, calculations of costs are made. The total machine-hours for each machine are added in the perpendicular columns and these sums are multiplied by the particular "machine-hour rates," which rates were determined in the manner indicated in the previous discussion. The man-hours are added horizontally and the sums multiplied by the wage rate per hour. By adding these results the total direct labor cost and the total machine cost on this order for this department is obtained. Other departmental charges not included in the machine rate, such as superintendence and management of the factory, may be included at the bottom of the sheet as indicated.

The Costs of Idle Equipment

On this form there will be noted the cryptic expressions "idle rate," "idle cost," etc. These items are sufficiently important and sufficiently different from other cost items to justify their being written in red in practical accounting. They refer to the burden of idle time imposed upon this order by the idle machines and equipment. A clue to the calculation of idle cost is given by the fractional index numbers accompanying each machine number. The fraction ⅔ connected with machine III for example, means that, in the last fiscal period, this unit ran on the average two-thirds time. The record of idle hours for this production order is derived by the use of this index. Obviously there will be no idle time for a machine when it is occupied on a production order (unless of course there is time occupied in the preparation and setting up of the machine), but each hour a machine works on an order must bear a proportionate share of the idle time expenses for the fiscal period. If a two-thirds time machine is used 10 hours on a job, then the other one-third for idle time must be included in the cost. If it has been determined that the idle rate or fixed charges on a machine is 25 cents per hour and the machine is used 10 hours, then a simple calculation gives the idle charge. ⅔ = 10 hours, ⅓ = ½ of 10, or 5 hours, and $5 \times 25 = 125$ cents, the idle cost for machine III on this production order. The idle charges for all the other machines are similarly calculated for each particular order and a total idle cost is written in red at the place indicated in the form.

It will be observed that this total idle cost is not carried over into the main cost column for the depart-

ment. It does not follow, however, that the idle charge is not in total cost. As a matter of fact, this amount is included in the machine cost item discussed above. It will be recalled that the total cost of the machine for the entire year was divided by the actual number of hours the machine was in operation during the year. This gave a machine-hour rate which automatically takes care of all idle time charges. If a machine was in operation 2,000 hours out of a total of 3,000 hours for the year, the machine-hour rate would be 50 per cent greater by dividing the total cost by 2,000 than it would be by dividing it by 3,000. These hour rates then, when applied to the machine-hours on this job, give a machine cost which includes the idle time charge.

The reason for stating idle cost separately is found in its paramount importance in factory management. The red figures are a record of inefficiency—a mark of failure as compared with a perfect co-ordination of operating factors.

The Indices of Maladjustment

The indices themselves assume great importance to the discerning manufacturer. Sometimes the idle time charge is large because of business conditions over which the management has little control, but in many cases they hang on month after month because of maladjustments within the factory. Some simple arithmetic applied to these indices gives an interesting result. It will be observed that the least common denominator of the fractions $\frac{2}{5}$, $\frac{3}{5}$, $\frac{3}{4}$, $\frac{3}{4}$ and 1 is 60. If the denominators are raised to 60 the numerators become 24, 36, 40, 45 and 60. That is to say, under the given conditions, if the department had sixty batteries of type I machine, forty-five units of type II, etc., down to twenty-four units of type V, all machines could be run full time so far as the physical organization of the department is concerned. Under the conditions assumed on the cost sheet, however, machine V, operating only two-fifths of the time, can take care of the full-time output of machine I, while number III can perform its share of the operations in two-thirds of the time.

The indices likewise suggest the idea that there are recurring sources of good and bad adjustments within the factory. A given plant with a well-balanced equipment may begin to show heavy idle time charges when enlargements are undertaken, and only after the next common denominator is reached will the balance be restored. It is not implied that in actual practice any such simple arithmetic as this can eliminate idle time, but if the factory is carefully scrutinized for these causes of maladjustment a substantial reduction in idle time charges will result.

Another difficulty met with in the treatment of "idle time" arises in periods of depression under severe competition. It was stated above that the idle time charge is included in the cost of production through the machine cost figure. However, in the recurring periods of depression when competition is keen, these expenses may so burden particular products that market prices cannot be based upon cost figures which include idle charges. When half the looms in a textile mill or half the equipment in a chemical plant is idle, any attempt to make the small volume of products actually sold bear the full overhead charges for the whole plant may result in prohibitive prices. Under such conditions the management should temporarily charge the expense of idle machinery directly to profit and loss rather than in detail to particular products. Here again the executives must be the complete masters, so to speak, of their cost system and must know precisely what loss each underpriced order involves if disastrous results are to be avoided by the competitive price policy.[2]

Cost and Sales Summary

In the previous discussion attention has been centered on a departmental cost sheet. Another tabulation of even more importance than this sheet is the Cost and Sales Summary, in which is assembled the cost of each order from all departments and the sale or market price of the product. Such a summary is illustrated by the form reproduced in Fig. 2.

In the first place, it will be seen that the detailed cost of each production order is shown both by departments and by cost elements such as material, labor and overhead expenses. Beside the total cost for the order is placed the selling price, and this figure is followed by the loss or gain on the order. The idle time charge for each department is repeated and the totals for each job are shown. This is a statistical figure, however, because, as stated above, idle charges are included

[2]From the foregoing discussion it appears that idle time is the *bête noir* of factory management. The writer knows personally of but one case in which idle machinery was a blessing. In a chemical plant near Philadelphia there is one department idle the year round, but figuratively, if not literally, the dust is brushed off the machinery every morning. The product formerly made in this department is purchased under contract from a competitor. Once a year as the time for the renewal of the contract approaches the competitor is given a good lunch and shown through the idle department for a white-glove inspection. The management is then ready to talk business for the coming year.

COST AND SALES SUMMARY

Production Order #1001

Departments	Material	Labor	Machine Cost	Supt. or Mgnt.	Sundry Expense	Total Cost	Selling Price	Loss or Gain	Idle Time Cost	Machine-Hours	Man-Hours
A	$20	$10	$7	$2	$1	$40	....	....	$1.75	30	32
B	25	15	12	6	2	60	....	....	3.00	42	45
C	18	7	5	2	3	35	....	....	2.00	29	30
D	20	18	12	10	5	65	....	....	2.85	49	49
Totals	$83	$50	$36	$20	$11	$200	$225	$25	$9.60	150	156
			Production Order #1002, etc.								
Periodic Summary Jan. 1 to Apr. 30											
Cost ledger estimates	$4,000	$3,500	$3,000	$2,000	$1,000	$13,500	.....	.....	$1,100	900*a*	1,300*a*
Actual costs from ledger	4,000	3,800	2,900	2,200	950	13,850	$20,000	$6,150	1,050	1,350*b*	1,350*b*
Error in estimates		300–	100+	200–	50+	350	.....	.....	50+	450*c*	50*c*

a Actual machine- and man-hours from job sheets. *b* Full-time factory hours. *c* Actual idle hours per period.

FIG. 2—A HYPOTHETICAL COST AND SALES SUMMARY SHEET

in the departmental cost sheets through the use of the machine-hour rate.

Other statistical columns for each production order are machine-hours and man-hours. The special significance of these columns appears to best advantage in the periodic summary shown at the bottom of the Cost and Sales Summary sheet. In this summary the whole 6 months' operation is recapitulated and the stream of cost records meets the current of actual cost for the fiscal period. The first line shows the cost ledger estimates for all classes of expenses. The total estimated cost of all orders, for example, according to the cost ledger, were $13,500 for the period. This figure is to be compared with an actual cost figure taken from the ledger of $13,850, or an excess of actual over estimated cost of $350.

The estimated idle time cost is also seen to differ from the actual idle time charge. This discrepancy is due to the fact that the estimating figure was determined from the records of the previous period. A new index to be used next year will be calculated for each machine from the current departmental cost sheets.

The summary of machine-hours and man-hours is also significant. From the cost records the actual machine-hours are much less than the total factory hours. This figure of course is a part of the idle time problem and requires no further discussion. The difference in the man-hours obtained from the cost ledger and the actual labor hours obtained from the time clock is also a matter of interest. Naturally there will not be as many idle man-hours as idle machine-hours, but in all cases there will be a substantial number of labor hours which cannot be accounted for in the production records. This discrepancy is a total loss to the management. Naturally it cannot be expected that every man will work on productive labor the full operating time and if any man's record shows the full time the circumstance is sufficiently abnormal to justify a search for error. If the management cares to go into the detail, a continuous record or index may be kept of each group of men to determine how nearly the labor hours from the production records approach the full factory hours.

Other summary tables not shown here may be compiled from the "Departmental Cost Sheets" in which the efficiency of the plant for the current period is shown as compared with previous periods. When similar production orders are passing through the factory periodically, such as a given kind of paint, dye or heavy chemical, the current records set over against the records of last month and last year are important. The machine-hours and man-hours as well as the idle time charges per unit of product may be shown for each order for various fiscal periods. In short, a panorama of the year's operations may be presented by proper grouping of the essential facts in each period.

From the foregoing discussion it is apparent that a cost system, no matter how well devised, cannot increase the efficiency of the factory unless the management is willing and able to profit by the facts revealed by it. An X-ray photograph cannot mend an aching molar, but it is often indispensable in revealing the seat of the trouble. Cost methods are but one of the tools by which the management probes into the vitals of a business in order to discover the ailing members. The remedies, however, can be administered only by the master who is superior to any of his own methods or systems.

Washington, D. C.

Uniform Cost Systems

Uniform cost-accounting methods have been adopted by approximately 120 commodity lines, according to a survey completed not long ago by the fabricated production department of the Chamber of Commerce of the United States.

According to its report, forty lines have gone the whole distance in the adoption of uniform cost systems and in securing general use of them in their industries; approximately the same number have adopted complete uniform methods and are now facing the important problem of installing such systems, while the remainder have only worked out plans for simplification of accounts.

As shown by the survey, the following commodity lines are successfully using uniform cost methods: Steel barrels, malleable castings, cotton finishers, hosiery, west coast lumber, newsprint paper, printing, biscuit and cracker, portland cement, electrical contracting, knit goods, pressed steel, writing paper, wooden ware, caskets, chairs, envelopes, laundry, millwork, power piping and stoves.

Advantages to Manufacturers

A uniform cost system will give the manufacturer comparable results—that is to say, it will give him assurance that the other manufacturers in his line have included and excluded the same items into costs, that their enterprises have been substantially departmentalized in the same way as his own, that there exists a common treatment of overhead, a tying up of the financial and cost records, a control of raw materials. In other words, when the manufacturer studies his summary of manufacturing cost, he will be able to say that A, B and C are figuring their cost in the same way he is, and that any difference in costs is based on superior efficiency and not because of cost ignorance.

While making the survey, the department received scores of letters from trade associations and individual manufacturers pointing out the benefits of uniform cost accounting. Some of the advantages enumerated are:

1. It strengthens the position of industry in dealing with governmental or regulatory bodies.
2. It inspires confidence that selling prices are determined upon a fair and equitable basis.
3. It solves disputed points of accounting within the industry authoritatively.
4. It makes possible a more intelligent competition.
5. It reveals lines within the industry which have been marketed on an unprofitable basis.
6. It shows the danger line below which goods cannot be sold at a profit; thus serving as an insurer of profits.
7. It acts as a common guide to the value, efficiency and waste of workers, machines, methods, operations and plants.
8. It becomes a reliable guide and basis for estimating prospective business, thus acting as a forerunner for comprehensive production statistics.
9. It furnishes current reports for comparing major cost items with standards which are predetermined and thereby measuring and increasing operating efficiency.
10. It establishes a standard code of accounting practice, so that if your cost clerk or bookkeeper leaves you, his successor will step into a system whose operation has been fully and completely formulated.

In announcing the result of the investigation, the department let it be known that it stands ready to suggest the various means by which interest in cost methods can be aroused so that manufacturers will demand uniform cost accounting, rather than have it thrust upon them.

Some of the Effects of Labor Turnover on Production Efficiency

Lack of Harmonious Relations Between Employer and Employee Is Cited as the Most Serious Deterrent to Industrial Progress — Management's Problem Is to Maintain the Intimate Contact That Fosters Loyalty and Industry

By Philip Brasher,
Assistant to the President, Tide Water Oil Co.

EFFICIENCY of production has so many perils which beset it that ordinarily the more obvious of them are the only ones given consideration.

First of all, of course, in any organization there must be adequate financial equipment allowing the proper planning to be made and providing the necessary reserves of stock, spare parts and machinery. Operations must be so planned that no unit or component will be delayed by the lack of sufficient other components to make the complete assembled part. I well remember a factory in which I was called upon to inspect and improve production about 15 years ago. This concern was manufacturing hose couplings, and one of the first things that was called to my attention was the fact that the local manager considered that he was improving production efficiency by making up enormous numbers of one or the other components of the coupling, with the result that frequently for a considerable period it was not possible to ship complete couplings until sufficient parts of the other type could be made to fill the order.

Employer-Employee Relations

Most of us know what it is to be hampered financially and to have various and sundry setbacks in our plans, but really the most insidious, certainly the most vexatious and probably the greatest cause of delay in production efficiency is the lack of harmonious relations between employer and employee. The lack of harmony may be indicated in a number of ways, showing itself in the simplest form by excessive turnover, in a more aggravated form by various types of sabotage and reaching its climax in the form of complete cessation of work by strike or lockout. While I speak of the strike or lockout as the "climax," it is a very great question in the minds of those who have made a serious study of the subject whether or not the strike or lockout really results in as large a loss as excessive turnover. The effects of the strike or lockout are so very apparent compared with the insidious losses occasioned by turnover that they might well be likened to an acute type of disease like pneumonia or appendicitis compared with the wasting type of disease such as tuberculosis or cancer.

Breaking In the New Man

Unless an executive has come up from the ranks he can scarcely appreciate the delays occasioned by the constant employment of new men. The new man is, in 50 per cent of the cases at least, an inexperienced man and the foreman has the double duty of teaching the man his way around the shop and also his particular job. Of course, if the new employee is simply a pick and shovel man, he will not require a great deal of instruction but he probably will require an unusual amount of supervision. If, on the contrary, the new man is engaged in any kind of semi-skilled or skilled work, he will certainly need a great deal of both instruction and supervision. A foreman is but human and when he is busily engaged watching one unit of his outfit, it is manifestly impossible for him to pay the proper attention to the others, with the result that the work of a hundred men may suffer more or less while the foreman is concentrating his attention on the one.

As you go up the scale and employ a higher and higher type, the cost and the effect on production efficiency becomes more marked. Take, for instance, the case of employing a new foreman, and keep in mind that the foreman represents the management to the men. He is their real point of contact and no matter what your ideas and ideals are as head of your organization, unless your foremen understand and are in sympathy with them, your men will never know what you really are trying to do. It makes little difference for what reason the foreman previously occupying the position had to be replaced. He may have died, his work may have become unsatisfactory or he may have obtained a better position somewhere else. In any event, he probably knew his department. He unquestionably had certain men in whom he trusted and who were loyal to him. He most assuredly knew many things through experience that the new man will have to learn.

Loyalty, Intelligence and Industry

There are three outstanding attributes that any executive looks for in his subordinates. The greatest of these is loyalty, the second, intelligence, and the third, industry. No matter how industrious and intelligent a man may be, he is worse than useless if not loyal to his superiors. Therefore if the new foreman comes in from the outside, his job is first of all to ascertain the men in his department who are willing or able—and there is a very decided differentiation there—to be loyal to him. It is certain to take him some time before he can feel sure that he can depend on many of his subordinates. Until he reaches that point he can be of no great value in speeding up production because the men will be suspicious and possibly subconsciously hostile until they decide what type of man the new foreman is.

In order to illustrate the effects of the vicious circle caused by labor turnover, let me cite a specific case. A certain concern was manufacturing rifles for the British

Government. These rifles were inspected before acceptance by a corps of British inspectors, the head of which was presumably a younger son. The British were in great need of these rifles, but the rejections for trifling reasons increased to a point where it was almost impossible to get any of the rifles accepted at all. For example, a rifle which, under trench usage, would probably not last more than 4 weeks was rejected owing to a slight check in the stock which did not in any way affect the serviceability but merely the appearance of the stock.

The general manager of the company, probably not realizing the exact condition of affairs, called the production manager on the carpet and after a rather acrimonious discussion, a new production manager was needed. The new production manager, being a man of a great deal of force and very decided ideas, chose to begin his term of office by a very frank talk with the foremen of the various departments. This talk was forceful and probably effective with a number of them. It proved, however, a little too forceful for one of them who, on returning to his department, vented his displeasure on operative No. 594 who had charge of running five milling machines which performed operations 1 to 5 on the body of the rifle, there being a total of 157 operations on the component part. Operative No. 594 took the attitude that he was not going to have any foreman talk to him in that way and he quit, leaving a vacancy to be filled by the employment department.

Unfortunate Management All Around

This department, on receiving the requisition, employed John Jones, who represented himself as having been a machinist in the factory where a majority of the motor cars of the world are manufactured. The employment department, being very busy at the time, assumed that a man who had been a machinist anywhere would be capable of performing the semi-skilled work of running automatic machines and possibly did not realize that Mr. Jones' experience as a machinist had consisted in tightening certain nuts on the left hand rear wheel of the aforesaid car. Mr. Jones was escorted to the department where rifle bodies were being produced, the five machines were pointed out to him, he was given brief instructions and particular emphasis on the necessity for speed and was left to his own devices.

Until he had to replace one of the cutting tools all went very nicely, but when this became necessary, he unfortunately did not call upon a more experienced hand and attempted to fit the thing himself, with the result that every subsequent cut made was just deep enough to ruin the body completely and as there were over a hundred and fifty operations after this one, all of them were a complete loss and it was some time before the inspector in charge discovered the defective cut. By that time one-tenth of the production of that department for the day had been ruined. The foreman was notified and he very naturally interviewed Mr. Jones and gave him his opinion of his previous training and general character. Jones, being indignant, took it out on his machine and the gears were unable to stand the strain, two of them being smashed. One-tenth of the total production of rifles was thereby put out of commission for an indefinite period. Mr. Jones was invited to leave with dispatch and it became necessary to hire still another man.

As in all efficiently operated plants, the production of one department is ordinarily very much dependent on the production of the department immediately preceding it, and the loss of one-tenth of the production of this particular component was passed along down the line until every department was short at least one-tenth of its productive capacity. The foreman of the body department was called on the carpet with the result that he was discharged also. The resultant delay through all the departments eventually produced the release of the new production manager and so the circle became complete.

The release of the original production manager had worked itself down through the ranks and back up again with a loss of at least 10 per cent of production, two production managers, one foreman, two operatives and unquestionably others indirectly. In addition there was incredible damage to the morale, considerable expense incident to employing the new men, delay necessary to instruct these new men by their immediate superiors, breakage of tools and machinery by the new man and, finally, the spoiled work and decreased production which was inevitable under the circumstances. These are only the results directly traceable to the discharge of the original production manager and it would be impossible to estimate the indirect results. Any experienced man can easily guess how serious they were also.

Getting at the Essence of Industrial Relations

The whole question of proper industrial relationship has apparently won the reputation of being exceedingly difficult and complicated. As a matter of fact, in the writer's opinion, it is so extremely simple that it misleads many into elaborate explanations which do not explain.

Several years ago, while a certain country was engaged in a large war, the Secretary of Labor of that period decided to make a tour of the various industries in the country and give the executives in charge some valuable points on how their industries should be run. It is related that he arrived early one morning at a plant located far out in the middle of a desert, and presumably being hot and dry, the Secretary was not in the best of humor. He was met by the general manager, who expressed his desire to co-operate in every way, but the Secretary cut him short with a curt demand to see the grievance committee of the plant. He was informed that there was no grievance committee, upon which the Secretary burst forth with: "What? No grievance committee? I never heard of such a thing. It is outrageous. I can't imagine a plant without a grievance committee. Have a committee appointed at once to wait upon me at 3 o'clock this afternoon."

The manager went out to the plant, called his men together, stated the case to them and left them to appoint the committee. At 3 o'clock the committee waited upon the Secretary of Labor. "Well, gentlemen, what are your grievances?" said the Secretary. The chairman of the committee was an old Irishman and answering the Secretary of Labor, he said, "Sor, we have no grievances."

"What? No grievances? I never heard of such a thing. It is impossible. How do you account for it?"

"Sor, the manager of the plant, Mr. Coward, knows every man in the plant by name. He's in every part of the plant every day and if any one of us have any

grievances, we step right up to Mr. Coward and talk it out with him then and there. Sor, we have no grievances."

That story in addition to being true has the added merit of stating concretely the essence of industrial relations—contact. In my opinion, it is entirely possible for one man to manage and to keep in touch with a plant of 500 men. It may be possible, although I doubt it, for one man to keep in touch with and manage 1,000 men, but it has been demonstrated to be impossible time and again for any one man to keep in touch with more than 1,000 men if he has any other work to do.

There is a point of diminishing returns in the size of industrial organizations just as there is a point of diminishing returns in any other problem, economic or otherwise. I do not think it can be questioned that a number of our present-day organizations are too large for the men that control them. There are a few men in the country such as Mr. Schwab who can inspire an exceptionally large number of men with profound loyalty and consequently can handle exceptionally large organizations. In far too many cases, however, the executive at the top attempts to depend upon machine-like methods of control, leaving out the personal element entirely and thereby sacrificing the human interest and loyalty of his men. The result is inevitable—increased turnover and decreased production.

New York City, N. Y.

What Is a Living Wage?

In view of recent difficulties between railroad employer and employee there has been some talk of a movement in the Senate to amend the Cummins-Esch act in order to impose more clearly on the Railroad Labor Board the duty of assuring a "living wage." The provisions of the present law under which the board must act in labor disputes are as follows:

> In determining the justness and resonableness of such wages and salaries or working conditions the board shall, so far as applicable, take in to consideration among other relevant circumstances:
> (1) The scales of wages paid for similar kinds of work in other industries.
> (2) The relation between wages and the cost of living.
> (3) The hazards of the employment.
> (4) The training and skill required.
> (5) The degree of responsibility.
> (6) The character and regularity of the employment; and
> (7) Inequalities of increases in wages or of treatment, the result of previous wage orders or adjustments.

Discussing the language of this part of the law, Prof. Frank H. Dixon of Princeton, who is a specialist in transportation, has recently made the following statement, reproduced here from the August bulletin of the National City Bank of New York:

> No mathematical rule has been discovered for the determination of a reasonable wage. But so long as we maintain our régime of private industry, one of the determining influences that must be accepted by any wage-adjustment board is the first-named of the seven conditions listed in the statute, "the scale of wages paid for similar kinds of work in other industries." Granted that the statistics of wages have been honestly and intelligently gathered and that no manipulation of wage rates has occurred through undue pressure of combined capital, the price that must be paid for similar labor in the open market is one of the conclusive factors in determining the reasonableness of a prevailing wage standard. Moreover, in connection therewith the board should adjust wages in harmony with the industrial conditions of each locality. Standardized wages effective over wide areas can with difficulty be defended on any economic basis. Their reason for existence is political and strategic. Testimony submitted by the employees themselves in Chicago recently is a virtual recognition of the need of restoring those differentials between town and city and between one section and another that were largely destroyed during the period of the national agreements.

The provisions of the law seem to be comprehensive and reasonable. It is right that conditions peculiar to railroad service should be taken into account, but there is no justification for setting up a special standard of living for railroad employees. The conclusive reason against it is that other people, many of whom have a lower standard of living, would have to pay the bill.

Standards of Efficiency of American Labor

The much-discussed question of the efficiency of American labor, particularly in comparison with the standards of output which prevailed prior to the war, is the subject of a recent article in the *Monthly Labor Review*, contributed by Ethelbert Stewart, U. S. Commissioner of Labor Statistics. Mr. Stewart shows that the basis for much of the current belief that the American workman is not as efficient now as formerly is found in general statements which have no backing of statistical proof. Against this state of affairs he presents considerable data from particular industries showing that a proper consideration of all the elements entering into production does not evidence a general slackening of effort on the part of the workers, but in a number of industries increased efficiency is shown. Mr. Stewart urges the need of time-cost studies as a basis for scientific measurement of labor efficiency, not with a view to "speeding up" industry but for the purpose of establishing a definite standard for judging work.

In connection with the subject of labor efficiency, a review of a recent speech by a prominent coal operator shows the excessive amount of "idle-day costs" in the coal mining industry because of the overdevelopment of the industry which results in the non-operation of many of the bituminous coal mines of the country for a large proportion of each year. The total annual loss to capital and labor because of the closing of the mines for approximately 100 days each year is estimated at more than $400,000,000, more than three-fifths of which represents lost wages. Moreover, no consideration at all is given in this figure to the loss to the general public of the productive effort of this large aggregation of men for about one-third of the working year.

The Industrial Physician

That the introduction of the physician into the industrial organization, often made during periods of stress or to comply with legislative enactments, has produced many interesting and beneficial results is the conclusion reached in a report issued by the National Industrial Conference Board, for the Conference Board of Physicians in Industry, which acts as adviser to the National Industrial Conference Board on industrial medical problems. The physician's work in the organization has revealed to the employer many sources of economic waste and to the worker the unnecessary price he is paying for inattention to his health and the health of the family; while to the physician himself has been given a broader view of the value of his services in creating and maintaining better living and working conditions.

The Increasing Importance of Research Demands That It Be Placed Upon a Stable Foundation, Not Subject to Fluctuations of Business Nor the Whims of a Non-Technical Executive — Creative Research Is Otherwise Impossible

The Relation of Research To Production Efficiency

By C. G. Derick

CAN you picture a vehicle making progress whose wheels have no hubs? A modern chemical business without a research organization is making about the same rate of progress. The recent period has been an exceptional opportunity to witness the collapse of business vehicles lacking this hub.

You can picture a vehicle making some progress on the hubs. They will turn over, they will decrease friction. Research organizations can be made self-supporting by the sale of their products manufactured during the developmental stage.

But how much more efficient is the vehicle when the hub is drawing support from the tire and the rim through its spokes. Efficiency is at its maximum: friction is reduced to a minimum. No business is operating at its maximum efficiency if the sales department tire is not properly supported by the operating department rim and these properly connected through the spokes of co-operation with the research hub.

The research hub must firmly surround the axle of finance. A perfect understanding and belief in each other must lubricate the two, while a spirit of service to mankind must drive the whole business vehicle.

In any large industry it requires 5 to 10 years to develop a proper research organization. Unfortunately, it requires a decision of a few seconds to wreck it completely. The form may remain to decay slowly after the spirit of accomplishment has departed. The spirit of a research organization is the difficult motive power that requires years to develop, and all the accomplishments of such an organization hinge upon this spirit. Given the correct type of men possessing the research spirit, years are required to familiarize them with the details of the particular business and to weld them into a co-operative unit of production.

Research Should Not Vary With Business Fluctuation

The research organization is the incubator of all lines of future development of a particular business. For this reason a carefully selected group of men must be left absolutely free to explore in all branches of science that are in any way connected with the industry. These men must have the necessary equipment and surroundings to accomplish their tasks and be guaranteed a permanency by a proper mode of financing that is independent of the fluctuations of business. Indeed, this is true to a lesser degree of the entire research organization, but on the developmental side of the research organization expenses may usually be more closely synchronized with business conditions. The exploratory side of a research organization can absorb limitless amounts of money and usually the results will be directly proportional to the investment when the organization has been properly developed. These facts demand the definite financial policy of creating a fund—yes, an endowment—to carry on this work which is properly balanced against the average earning power of the particular business.

The developmental side of a properly balanced research organization does not, except by accident, create new processes or make fundamental discoveries. It furnishes the machinery for developing into efficient *commercial* processes the useful results of the exploratory side. It can be made self-supporting. It can and should be subjected to correct methods of business control. It should become the training school for plant operators, salesmen, accountants, executives, etc. It must be properly housed and in large organizations have its separate manufacturing buildings where experimental results may be tested out on a commercial scale. It must not interfere with production, it must accelerate production. In other words, it should be a small model of the complete business. In no department of a large industry can the spirit of the industry be taught so quickly. Consider the enthusiasm and intelligence of a staff which had grown up with the processes as they had developed. This condition must exist in the not distant future if we are to meet competition.

The Research Organization

A research organization must be further divided into small groups responsible for the different functions of the laboratory. For example, the exploratory side must be divided into groups centering about strong personalities and the developmental side into the groups—business (including accountancy), research chemical engineering, research operating, chemical (doing the actual research of development), library (controlling scientific and business literature, patents, etc.), research analytical, etc.

The co-ordination of the various groups of such a research department is best brought about by the conference system. Most of the groups should hold regular weekly conferences with a secretary present who records the discussions and conclusions. Concise minutes of these conferences should be placed in the hands of each important member of the group and each of the other group leaders. These group leaders and designated members of their group should be free to attend the conferences of any other group. In this manner the freest interchange of ideas and information is obtained.

When a laboratory process which has business possibilities has been developed by any of the exploration groups, a member of this group may be transferred temporarily or permanently to the chemical development group that will perfect the process and the connecting link be established. The attack of the problem having been thoroughly developed in conferences and the developmental work completed in the laboratory, a process write-up with recommendation as to suitable manufac-

turing apparatus is forwarded to the research engineering group, which draws up a report determining the necessary equipment and locations for experimental manufacture, including a complete cost estimate of the installation. These two reports are forwarded to the research operating group, which determines the material, labor and general operating costs for the manufacture of sufficient batches of products to establish proper operating procedure and costs. The three reports are returned to the chemical development group for comments. In case of disapproval of any report by any group, the difficulties are settled in conference. When final agreement is reached, the research engineering group installs and tests the equipment and the research operating group carries out the operation under the advice of the developmental chemist.

Careful cost accounting is maintained throughout the exploratory and developmental stages. Proper credits are given this expense for the sale of products made during the experimental manufacturing period.

Before the process is established upon a commercial scale, the sales department should have already probed the market for the product with the production of the research department, and now must establish an intelligent sales program. Upon the basis of this program the plant operating and the research chemical engineers lay out the finished plant. With proper executive approval the plant is erected and operated during a test period by the research operating department and when operating normally the research department withdraws, leaving a former member and trained operators in charge of the operations.

In a similar manner members of the research department are transferred to sales, engineering, accountancy, executive, etc., departments and gradually the business is operated by men with a comprehensive conception of the entire business and the requisite sympathy through understanding to force success. Thus the spokes of coordination are developed and the wheel is ready to roll.

Technically Trained Men as Executives!

This is no idle dream. There are organizations in existence built more or less upon this plan. It if takes 5 to 6 years to build a proper research department, other departments are being built simultaneously, drawing the backbone of their organization from the research department during this time. So at the end of the period a complete business structure has been erected.

Is it too much to hope for accountants in chemical industry who are graduates of chemical courses? Is it too much to expect librarians in chemical industry to be graduates of chemical courses? The writer found little difficulty in obtaining such men. And how fast the plant accountants were to draw such men from the research department!

Is it too much to hope that all chemical industry may be directed by executives with chemical training and financed by financiers with chemical training? The conspicuous success of the few daring chemists who have tried these fields is just an indication of the future. The universities must aid in this and the professors of chemistry must stop impressing upon the formative minds of the young chemists that it is degrading to leave the direct paths of chemistry for those of business based upon chemistry. A noble success is the greatest reward of the teacher no matter in what line his students make that success.

The research manager must be a member of the board of directors, as must all of the main heads of the business. He must be more than a consultant, he must have a vote. The financial interests must not monopolize these boards. It is not enough that the members of the board of directors may have had a chemical training, it must include the active chemical and engineering and sales leaders of the particular business. Such a directorate can properly serve its stockholders. The present unrest beween labor and capital would find in such an organizaion one less cause for discontent.

Business Wrecks From Neglect of Technical Man

Of course, most business has been built up around some research, but usually a production and a sales department have been organized and operated long before a research department has been established. It is a peculiar fact that money can be readily obtained to float new enterprises upon someone's say-so that there is a profit in the business. A beautiful prospectus extols the charms, but a critical study of the same by a research expert usually reveals not a single concrete bit of evidence for the claims. When, however, he suggests that the financial interest expend a few thousand dollars to test out the claims, the atmosphere becomes chilly. After an enormous expenditure of money there is built up a business that faces bankruptcy in a crisis. Then the expert is called in. He states that the business is economically sound and that such a sum is needed to work out an efficient process. He does not get it, but may get sufficient to make a start. He tries to repair a broken down machine. He pleads for money to make a complete investigation of all possible competing processes. He does not get it. But if he is financially strong enough, his love of a properly completed job forces him to finance these additional investigations. At a cost only a small fraction of that already spent in process development in the pot-boiling fashion of the plant he determines a new process operating at a fraction of the cost of the going process. Step by step he develops his work to a manufacturing scale. The old process is abandoned and the new process makes a small income on an enormously excessive capitalization. Due to the unwillingness to invesigate thoroughly before attempting manufacturing, a return of 3 per cent during bad business years is obtained instead of 15 to 20 per cent. Industry is burdened with such cases.

Again, a financial executive scorns the opinion of his research and other advisers in the actual work, and he purchases a process. He cannot purchase a trained personnel to operate it under local conditions. In a few months a million dollars has suddenly disappeared from the business. Then the research staff is forced to develop the same product and the business to carry this additional load. Another group of executives swollen by their own importance desires to operate a number of plants which the technical members of the company insist are unnecessary, and in a couple of years several millions of dollars have disappeared. Ultimately through necessity the technical adviser's opinion has to be followed, often after bankruptcy has given control to others and the public has paid the bill.

Again, an organization with a few broken spokes finds an individual who thinks he has arrived and to feather his own nest prevents the results of his experts being turned into marketable products because of some pet products of his own. Millions of dollars are lost.

A sympathetic organization built about a research department could often prevent and usually greatly decrease such losses. The interest on the money squandered by many firms in this manner would support enormous research organizations indefinitely.

Another phase difficult to understand and fatal to efficient research is partly illustrated by the last example. It is more common than is usually admitted that large organizations often prevent the marketing of superior products that their organizations have developed. They put them on the shelves until competition forces their use. They argue that the cost of junking old equipment justifies the end. There is no excuse for doing a thing in a less efficient manner than is known. But the deadening effect of such a policy upon the spirit of a research organization is beyond human ability to estimate.

The Remedy

In what directions can we look for relief from such conditions? Educate the business public to insist upon a research report before investment. A difficult problem! Educate the chemical professor that his students need the principles of economics and business as well as chemistry and physics and that he should not give special courses in cement analysis because John Jones has a cement mill in the neighborhood and will pay his recent graduates over a hundred dollars a month upon graduation. He won't tell the trusting professor that that is all the student will ever get unless the latter makes a good fight. Educate the chemist that if he is to be anything but a glorified laborer he must be willing to enter business like the lawyer, the physician, the dentist and the untaught business man by financing himself at the start and to expect a few lean years. Of course all chemists will not build a successful business of their own, but enough seed will fall into fertile ground to cause scientific business built about research organizations to develop and drive out the inefficient and unscrupulous.

Buffalo, N. Y.

Editor's Note: The subject which Dr. Derick has so ably presented is one which we believe to be of vital importance. Dr. Derick's apt simile that a modern chemical organization without a research department is like a vehicle whose wheels have no hubs is grimly accurate. Yet in spite of the obvious truth, chemical organizations in the interest of a false economy have dispensed with their research organizations during the last few years of stress. This statement can almost be made general, so widespread was the elimination of research men.

Should the Dyestuff Industry Die?

Let us be specific for purposes of illustration. Manufacturers of dyestuffs developed during the war large research organizations. It is an essential in this industry so obvious that even the capitalists recognized it. But at the first sign of depression the old cry was raised—"Where can we cut? We must maintain only that force necessary for minimum operations." Research is not necessary for minimum operations, and so research must go! The ultimate result is inevitable. Instead of being an alert organization, strong in its own right, progressive, welcoming competition because it is ready to meet it, we find a fearsome spirit born. Germany will swamp us. We must have protection, embargo. Foreign patents must be worked in this country or licensed to people who will work them. That this is unnecessary is evidenced by one courageous firm which has been able to sell in Germany. What the dyestuff men need most is not protection or embargo or patent rights—all of these things tend to pamper and nourish the industry artificially—but an infusion of some of the pioneer spirit which will establish confidence in research and a realization that by and through research the industry must emancipate itself or die.

Ready Made or Made to Order

Heavy chemical manufacturers have felt that their processes were so standardized that "fundamental research" was foolish and a waste of time. And yet they have been paying tribute money to those research men who developed contact sulphuric acid, and now synthetic ammonia. Why will they not realize that it is healthier, cheaper, better for the country and themselves in general to invest in research rather than buy it?

Some industries have courage and vision. It is a heartening thing to hear of the establishment of a large research department by the Standard Oil Company of Indiana. Some of the most promising young talent in America will go to it. Our prediction is a foregone conclusion that the Standard Oil Company of Indiana will never be worried by foreign competition, will not have to lobby for protection or embargo even if the Russian oil fields should be run for nothing a month and the American oil fields simultaneously evaporate.

Corporations can now talk about economic inequality and a thousand other misfortunes which militate against them, but some day the public will be convinced that the pinch-penny methods of saving the immediate dollar (which after all is the real reason for no research) is too expensive for it and it will not tolerate a pampering of industrial sloths.

This must not be interpreted to mean that we are not in sympathy with a tariff. But a tariff which protects a growing young industry is a very different thing from a tariff which removes all need for progressive effort and amounts in the end to a tax on the general public for the manufacturer's benefit. Tariff should be a spur to action, a stimulant to progressive effort, and not a narcotic which lulls the manufacturer to a comfortable somnolence and without which he wakes to a whining plea that he cannot live without it.

Co-operation Pays Dividends

There is still another idea which seems to go hand in hand with research and increased production efficiency. It is co-operation. Not long ago a young chemical engineer told us that in his work he had been associated with three separate acid manufacturers. Each surrounded his plant with so much secrecy that practically no one except the men directly connected with each unit knew anything about operation and yields. The operating flaws in one plant were corrected in another and vice versa. The thought which struck this young engineer was, "If they only would pool their knowledge, all of them would be better off." It is so in metallurgical work. A competitor is invariably a welcome guest and metallurgy is an outstanding star in American industries for efficiency and progressiveness. Perhaps it will be the millennium before chemical manufacturers arrive at that same point. Perhaps it won't. For the sake of the industry speed the day!

The Business Cycle as a Factor In Production Efficiency

A Study of the Recurrent Ebb and Flow of Business Activity Reveals Many Practical Ways in Which the Individual Executive Can Forestall the Disastrous Effects of an Industrial Crisis and Depression

By Ernest T. Trigg,
Vice-President, John Lucas & Co.

AN OBSERVANT MAN can scarcely pick up a newspaper or magazine nowadays without seeing the term "business cycle." It has been receiving considerable attention in recent months, especially after President Harding's Conference on Unemployment appointed a subcommittee to study its causes and effects. Many have called such a study "highbrow" and have dismissed it with a contemptuous shrug and perhaps the comment that it was something for college professors to play with, but of no serious consequence to the business man.

But it is the opinion of the writer that it is of vast importance to the business world of the United States—this study of the business cycle. Is the country helpless to prevent it? Have we got to have good times and bad times every so often, willy-nilly? Is there no solution to this problem?

But before attempting to solve such a difficult problem, let us look to the term itself: What is this so-called "business cycle?" Briefly, it is that recurring process of booms and slumps that affects our industry and our business directly, and our agriculture indirectly. Obviously the solution is to lop off from the peak in boom times to fill up the trough in depressions—in other words, to temper an industrial crisis by acting before the crisis becomes inevitable. The idea, then, is to plan for the future by applying a knowledge of the past.

Let me quote from a document which came before the recent conference:

> The vast majority of the unemployed were recently on the payrolls of private business enterprises. These men lost their jobs because their employers were losing money. Over 15,000 business enterprises have been forced into bankruptcy since the present period of depression began, and the number now operating at a loss must be very large. Unemployment on a vast scale is always a result of business depression. The problem of preventing or mitigating unemployment is therefore part of the larger problem of preventing or mitigating alternations of business activity and stagnation.
>
> Such alternations have been a prominent feature of business experience for a century or more not only in the United States but also in all other countries that have attained a high state of commercial organization.

Careful Planning During the Upward Swing

> The business cycle is marked by peak periods of boom between valleys of depression and unemployment. The peak periods of boom are times of speculation, overexpansion, extravagance in living, relaxation in effort, wasteful expenditure in industry and commerce, with consequent destruction of capital. The valleys are marked by business stagnation, unemployment and suffering. Both of these extremes are vicious, and the vices of the one beget the vices of the other. It is the wastes, the miscalculations and the maladjustments grown rampant during booms that make inevitable the painful process of liquidation. The most hopeful way to check the losses and misery of depression is therefore to check the feverish extremes of "prosperity." The best time to act is at a fairly early stage in the growth of the boom.

Business is improving. Times are better. But that is not enough. Business must continue to improve and in hundreds of offices today business men are sitting down and trying to figure out how to maintain the increase in their business that has started.

In the past 20 years we have had five business slumps. Things were dull in 1903; there was a depression in 1904; improvement in 1905; boom in 1906-07; depression in 1908; activity in 1909-10; a minor crisis in 1911; a gain again in 1912-13; a depression in 1913-14; improvement in 1915; uncertainty in early 1916; then the war boom, interrupted after the armistice, 1918-19; then the post-war boom, and finally the depression of 1921. How are we going to make such periods more even—that is, take something off the top of the booms and fill it in the troughs of the depression?

The Work of the President's Committee

The standing committee of the President's Unemployment Conference is trying to answer that question. A subcommittee has been appointed. Owen D. Young of New York, vice-president of the General Electric Co., is chairman, and with him are Clarence Mott Wooley, Detroit; Joseph H. Defrees, Chicago; Matthew Woll, Chicago, and Miss Mary Van Kleeck, New York. The survey of the business cycle has been undertaken by the National Bureau of Economic Research, Inc., of New York, of which Dr. Wesley C. Mitchell, the American authority on the business cycle, is director.

Among other proposals for stabilizing employment, it will take up long-range planning of public works and of construction and maintenance work by private employers; unemployment insurance and unemployment prevention by governmental agencies; depression insurance by private employers; employment offices, public and private; out-of-work benefits by labor organizations; financial devices for controlling the business cycle; and improvement of statistical indices of employment and other "business barometers."

These recurring periods of inflation and deflation in general business are intimately reflected in each individual business, and each individual needs now to study his own business cycle. The organizations which have done this in the past have reaped prompt benefits. Some of these are the Dennison Manufacturing Co., the American Radiator Co., and the American Telephone & Telegraph Co., and a rapid survey of American business shows more than fifty other examples of intelligent anticipation of the business cycle by American business men.

It is worth noting that this intelligent anticipation results not merely in greater security on the job for the employees—and of course the President's Conference on Unemployment is interested in that—but also it has resulted in profits to the employer and work for the

worker, at a time when other people's business was in the doldrums.

There was a time when the country had a financial panic about every so often, precisely as it now has the business depression. But the Federal Reserve system has taken away this threat of financial cataclysm. And so we ask, Why not something to fit the business cycle as well? Secretary Hoover feels exactly that way and he hopes to find the answer by the study in which the committee is engaged.

The Seasonal Slumps

But these larger movements of booms and slumps are not the whole story. In every year comes the minor problem of seasonal intermittency and unemployment. Generally speaking, the summer months, with their slackening of activity, and the vacations, which interrupt the flow of business, are followed by the busy autumn period; after the rush of the holidays comes another dull season.

Particularly building, of course, slows down in winter; manufacturers of agricultural implements have their maximum number of employees in the late winter; automobile building falls off in the autumn. Hosiery, garments, shoes, have two peaks of employment a year—early spring and autumn. Twice as many factory workers are idle in Massachusetts and New York State, for example, at the end of March as at the end of September of the same year. We all know that there is an off-season on the farm after the crops have been gathered and the fruit picked. Road building slows down in winter, and logging camps are idle in summer. The fisheries fall off during certain seasons and so it goes.

Just as some business men have controlled the cycle of their own affairs, so these seasonal waves admit of control within certain limits. How far this policy can be carried by the industrial business man cannot be ascertained until he tries it with his own business. Anticipation of demand, analysis of markets, extra sales effort—all these have been used with surprising success.

Application to the Individual's Business

The important point to realize is that unless the American business man has studied his business over a period of many years and is laying his plans accordingly, he is missing something this year and by that much is the helpless victim of so-called "blind economic laws." Working together, American business men, manufacturers and farmers can do even more. They can deal not only with the management inside their own particular industry but with some of the forces which affect them from the outside. Right here is where the study of unemployment and business cycles may be depended upon to increase the year-around efficiency of production. Already the value of organized effort in modifying the evils of booms as well as of slumps is very clear.

For example, the policy of holding back construction work in boom periods and of expanding plans and equipment in dull ones will enable the business man to take advantage of lower costs at the right time. He will not be paying high prices for material and labor in boom periods by overbidding his competitor. In other words, the business man will not throw away his money in good times, but will set aside a portion of it to keep the industrial wheels going in the off-years, thus creating employment for more men and a demand for more goods.

On the other hand, every mistake in judgment by those responsible for commercial and industrial decisions results in waste. In the year 1921 alone, 19,652 manufacturing and trading companies went into bankruptcy, with liabilities totaling over $627,000,000 and with thousands thrown out of work. Practically every one of these failures was the result of mistakes in judgment. Thousands of other business firms also made mistakes, which resulted in a waste of capital, material and resources and unemployment, but for one reason or another they have not been forced into bankruptcy. The elimination of this waste of capital and resources which is continually going on is one of the big problems of today.

Support and Co-operation Needed

Preliminary surveys already made by the Committee on the Business Cycle clearly indicate that there are many practical constructive measures for stabilizing production and mitigating off-years. Statements of theory and principle are of little value unless they are worked out so that they may be applied to actual business. And that is just what the President's Conference on Unemployment wishes to bring about—to show to the business men and employers of the United States that they have in themselves the power to ward off the business cycle completely, or else so to mitigate its evil effects that only a little self-denial and prudence will enable everyone to carry on until the turn of the business tide. Sound thinking and intelligent planning can largely control the cycles of depression by forecasting the course of business. But how can this forecasting be done? By the use of statistical material placed at the disposal of business men by the government. That is what should be given the industry of this country. If the business men of the United States will give this committee enough leads in successful experiences in stabilizing production and in long-range planning of construction, the way will be found out of the difficulties of the business cycles. Secretary Hoover says:

> The President's Conference on Unemployment has been hampered in its work by lack of definite knowledge concerning the extent of enforced idleness in the United States.
>
> The defects of present unemployment statistics are due to the fact that government departments and other agencies cannot now obtain regular, comprehensive and authenticated information from industry and commerce.

What Secretary Hoover says on the lack of employment statistics is even more painfully apparent concerning the other phases of industry. Present figures on production and consumption are utterly inadequate. They do not cover the field; they do not bring to one business what is going on in another. Such a knowledge is possessed by the few today, but if present plans work out it will be the property of the many.

The business cycle has been for centuries a world-wide industrial problem; a dismal economic phenomenon too long endured by civilization. For the first time in history an organized attempt is being made to overcome it. If it can be done, the credit should go to American inventiveness and persistence.

Philadelphia, Pa.

The Importance of Scientific Control in Increased Production Efficiency

An Analysis of the Reasons for the Comparative Neglect of Scientific Control — A Study of Its Technique — An Estimate of Its Advantages—The "Sine Qua Non" of Increased Production Efficiency

By Charles H. MacDowell
President,. Armour Fertilizer Works

OUR first industries were located with reference to available supplies and easy transportation to consuming centers. We used our richest and most accessible raw materials. As labor cost was our greatest concern, we developed labor-saving machinery, and as capital became more available, we adopted large unit and standardized repetition methods. As our supply of technically trained men was limited and as our pioneer experience had developed an ability to simplify and extemporize, our lumbering, mining and manufacturing growth proceeded along practical, hard-headed lines. We laid great stress on immediate costs, with but little regard for the future or for making the most out of what we had in hand. An inspection of the tailings and slag piles of the past shows how crude and "main strength" we were in our methods in mining and metallurgy.

As we worked out our most available supplies and as demand for finished products increased, we went further back into the woods and hills for our materials or increased our purchases of foreign water-borne crude products. We still specialized on the mechanical side. In metallurgy, especially in copper and precious metal recovery, the need for cunning as well as main strength was appreciated earlier than in many other lines, and technical advice was sought and utilized. Other industries have followed in a way and the technologist is now having his day. We are still too much inclined to worship exclusively at the shrine of the "practical" and "self-made," and do not yet fully appreciate that the "know why" adds to the "know how" in arriving at the "how much."

Scientific control in manufacturing begins at the bottom and starts at the top—speaking in a Gaelic manner. If those in top control don't start it, the ones at the other end don't do it. It follows, therefore, that the head executive must appreciate its need and get it under way, and there's the rub—he is the fellow who must be shown. He pitches the tune, he is responsible for results, for the selection of his colleagues, for their ability, capacity, willingness, his breadth and vision is their breadth and vision, his grasp theirs.

Control in Industry Analogous to Orchestra Control

Control is positive in principle and is based on mental, moral or physical characteristics. One of the highest types of control is exercised by the leader of a great orchestra. The individual musicians are thoroughly skilled in the technique of their art and have mastered their individual instrument, and yet must accept the positive control of their leader if the orchestra as a whole is successful. The leader must be able to obtain the hearty co-operation of all members of his organization. He need not necessarily be an expert with a single instrument in the orchestra, but he must know and understand not only the possibilities of each instrument and performer but he must know the effects that may be obtained with the co-operation and combination of the various instruments.

The leader of an industry has the same problems to solve as has the leader of the orchestra. He must surround himself by skilled men capable of the fullest co-operation. They must be as competent to receive direction as to give it. The leader sets the pace and on his ability, capacity, intelligence, breadth of vision, positiveness of decision and general friendliness rests the success or failure of the undertaking. Those whom he leads, those to whom a portion of his responsibilities are delegated, must be under his control, and these men, in turn, must control the actions and operations of their subordinates.

More Advanced Control Methods in Europe Than in America

Manufacturers in Europe, working with comparatively small units and competing for world's business, have been compelled through necessity to maintain a closer day-to-day control of their manufacturing than have many American manufacturers. Our genius has run along the lines of repetition, obtaining our efficiency largely through mechanical means. We have had our home markets to supply. Our buyers were willing to accept standardized products and our greatest industrial successes have come through supplying these. Because American payroll rates are high, we have often placed the type of man in control of our plant management who could best speed up labor handling, who thought out large unit methods of handling to get economies in labor. In many instances such men have not appreciated the fact that there were other elements of cost which might be reduced, through closer study of yields and quality, inspection of incoming materials and the greatest possible utilization of raw materials purchased or manufactured. The time is now here when we must study more closely the control of our manufacturing processes from the scientific and engineering standpoint. Many of our industries are doing this now. In order to bring this about, those in charge of manufacturing must thoroughly appreciate the need of using the scientifically trained man in carrying on actual production in the plant. Such a man today is too often kept in the laboratory, in the office or in the machine shop.

Some of the Technique of Control

Efficient control starts by knowing what you are buying; whether what you buy is best suited for your purposes, and that the specifications on which purchases are made insure such deliveries; by seeing that material is carefully weighed and inspected when it comes into the plant and that shrinkages in handling are known and figured into cost. The ultimate cost of raw materials is fixed by the amount of finished product a

given quantity will make. The original cost may be no measure of final cost. Material that has to be culled before using has added to its cost not only the rejected goods (for which credit may be received) but there is a labor cost and a loss of time, all of which affects costs. Shrinkages are often ignored in factory cost accounting, yet in some industries this item amounts to a very considerable percentage of the raw material cost. Careful inspection of all scales and other measuring or testing devices is necessary to keep them in efficient condition and, what is more, a continuous inspection of the work of the men who are handling these devices to eliminate, as far as possible, carelessness or spite work errors which so often creep into plant handling. Without control, there would be little inspection of machinery, with many breakdowns resulting.

Rigid Inspection by Trained Men

Efficiency in this department comes in such rigid inspection by trained men that the worn parts are always replaced before they break and at times when the machine can best be idle without curtailing output. A mild form of sabotage is not uncommon among present-day labor, in allowing a machine to break down with a resulting rest for all hands rather than reporting its condition so that it might be fixed in time. Efficiency is furthered by good housekeeping, so that from day to day materials are kept clean, in their proper places and uncontaminated, as far as possible, from admixtures with other materials. An intimate knowledge of the composition of each incoming shipment, that the greatest yield may be obtained from that particular consignment, is also necessary. Concise, up-to-the-minute reports of the result of the day's work are needed by the superintendent that he may avoid hidden losses and correct any errors which may have crept into the day's operations. A careful study of what is the largest practical unit to handle a given material is necessary. It sometimes happens that hidden losses result from too large operations more than offsetting the labor gains coming from handling the larger unit. An immense amount of capital may be invested in machinery for a certain operation. The interest charges and depreciation can be charged only against the output of that unit. If its capacity is greater than necessary, it may often stand idle and the operation cost per unit be increased to a point where the job might have been done by simpler methods at a cheaper cost. Machinery operating costs cannot be figured by the job, day or week, but the year's cost must be borne by the total output. It may well be that the greatest economies are lost from treating materials in too small batches, that too much labor is used and unnecessary motions made.

Study of Cost of Multiplication of Grades Essential

The factory makes what the sales force calls for. Careful study of the cost of multiplication of grades on the part of the factory and a forceful report to the sales end as to what these diversions cost in plant operation may result in economies to the business through a better understanding on the part of the distributing organization of the effect of this kind of salesmanship.

We might go on at some length detailing these causes of financial loss, which we all know but of which we so frequently do not appreciate the importance.

Far too many of our plant and department superintendents do not yet comprehend how the prosperity of their companies can be augmented by a greater use of scientifically trained men—men from the technical high and manual training schools as well as from the universities. They are too prone to relegate the chemist to the laboratory and to keep the engineer bent over his drawing board, considering both necessary evils. They are overlooking the fact that these men can frequently be made efficient operating men, helpful in every way to a better handling of plant product. Men trained to analyze, synthesize and properly handle can become of great value to any concern manufacturing intermediate or finished products from raw materials. In order that proper manufacturing control can be exercised by the executives, they must have placed before them periodically a correct cost analysis of the business. Such work must be handled by scientific cost accountants. If it be not accurate it is practically worthless. Each operation must bear its proper proportion of all expense. Adequate depreciation must be charged so that the cost of any machine or even factory will have been written off when it is necessary to renew it or it becomes obsolete. Only by such accounting is the factory executive able to discover unprofitable operations so that he may eliminate them or revolutionize them, till their cost is not excessive. The plant accountant thus becomes a very important factor in scientific control. An organization built up in part and run in part by such men cannot but know daily where it stands, can avoid hidden losses and can carry on a scientific control of its operations which should give it a decided advantage over competitive companies not similarly organized.

Do it right today—post mortems are often unpleasant.

Hearty Support by All Is Necessary

In furthering a scientific control it must be fully appreciated that it must be heartily supported down the line, that each department head, foreman and subforeman must know why a certain method is to be followed and be in sympathy with the end sought. He must be kept in a constructive as well as an executive frame of mind that improvements in methods may follow and that he may have opportunity for advancement. The personal side of control is all important.

A leading French official, during the peace negotiations in Paris, ventured the opinion that the greatest loss which had come to Europe as a result of the World War was the loss of command. He believed that, as a consequence, Europe would suffer severely for many years. He had in mind the losses from death and disablement of so many men who were mentally and morally capable of sound thinking and of leadership. He also had in mind the disinclination of many of the rank and file to submit to the discipline necessary to carry on in an orderly way the methods necessary for efficient creation of new wealth. The man with whom I was talking was a liberal in politics, experienced in production and a far-seeing, clear-thinking man.

The attitude of the executive toward those with whom he is associated—superintendents, foremen and workers—have much to do with securing control. Control is essential in the working out of any project.

Scientific, carefully studied, humanized control is necessary if the world is to solve its present problems.

Chicago, Ill.

The Modern Chemical Plant

The Successful Conduct of Industry Today Depends on Good Plant Engineering—Plant Engineering Begins When the Plant Is Designed—The Factors Which Must Be Taken Into Account Are: Location, Layout, Design, Construction and Equipment

By Frank D. Chase
President, Frank D. Chase, Inc., Engineers and Architects

SOME DAY someone will write "The History of an American Industry," and the reader and student thereof will learn some valuable lessons applicable to his own business.

The chemical and allied industries are comparatively unexpanded, although not new; but through the lessons of other industries many manufacturers are going to profit, not only by their own mistakes and those of their competitors, but by the history of other lines of manufacture.

The chemical industry is going to follow other American industries through a period of radical evolution. Nearly every manufacturer, regardless of his product, recognizes this; and the more progressive and far and clear thinking men not only recognize this fact but understand just what this is and what it means to them.

To continue in business, to exist as a going concern, one must meet this revolutionary situation and master it.

Success in Past Due to Horse Sense and Hard Work

For generations American manufacturers have prospered and expanded, and it has not been extremely difficult to do so. The markets for products have grown faster in scores of instances than the manufacturer could supply. Raw material and labor were abundant and cheap. Competition was usually negligible. Horse sense and hard work counted about 99 per cent.

All this is changed. Raw material prices are usually controlled by interests powerful enough to dictate prices. Labor is paid more, is organized and demands, deserves and is receiving more than in the past. Advertising is a necessity. Competition is keen—new plants, some small, many with large capital, are entering the field. Scientific management, in two words, is the summation of this radical revolution.

The Modern Role of Plant Engineering

While horse sense and hard work still bulk large in the successful business—in fact, no business prospers without them—there is one more factor to be taken into account in modern business. This factor is science. We all know that the chemical factory would not function long without the laboratory. This is science. The chemists have developed materials, processes and equipment which can be used only with a knowledge of chemistry. This is science. Your raw materials and your process and finished product are dependent upon chemistry. This is science. There is one other branch of science which is today recognized in almost every industry in this country. I refer to plant engineering, as playing an essential and increasingly necessary part in not only the layout and design of the chemical or other plant, but in its location, layout, design, finance, operation and management. These factors properly engineered make scientific management.

This subject is big enough to fill volumes, so I may only describe briefly and in outline the development of a plant, and while it all seems obvious, I know, from the experience of one who has been laying out plants for 20 years, that a scientific analysis of these factors is, at least until very recent years, usually neglected.

Scientific Plant Development Formerly Neglected

Until within recent years the manufacturer regarded his buildings merely as structures housing the equipment and consisting merely of four walls, roof and floors. Neglect of consideration of the type of building best suited to the occupancy or manufacturing processes was followed by neglect of the arrangement of the buildings comprising the plant or their interrelationship.

The result has been in most plants a hodge-podge of buildings built one at a time without reference to co-ordination of manufacturing operations, without thought for future growth either as a whole or for single units or departments, and without thought, in very many instances, of the physical comfort and welfare of employees.

Development of a Plant

This analysis may be the work of a plant engineering staff or of a consulting engineer. Few corporations can command the exclusive services of engineers of broad experience and for this reason has developed the profession of industrial engineering—i.e., the engineer of industry.

The development of an industrial plant project can best be outlined by the steps to be taken. These steps may be listed in their order as:

1. Location.
2. Layout.
3. Design.
4. Construction.
5. Equipment.

Location

Location should be considered with reference to:

(*a*) Supply of raw materials.
(*b*) Market for finished products.
(*c*) Labor supply.
(*d*) Transportation for raw materials from source to supply.
(*e*) Transportation for finished products to market.

Each of these factors requires careful and scientific analysis.

Raw Materials

Raw materials must be of the proper quantity and quality. The supply must be constant, stable and inexhaustible. Substitutes for materials ordinarily used offer large opportunities for increased production and profits. Industrial chemistry enters into this question very largely. New materials developed through chemical research frequently develop entirely new industries. Many existing industries and most new

industries owe their being to the chemical research of the industrial engineer. Freight rates and speed of rail or water transportation affect the raw material supply.

Market

The market for finished products takes into account the amount of consumption within the economical limits of distribution. This applies to the corner cigar store as well as to the tractor plant which ships to points within a radius of a thousand miles.

Labor Supply

The number of people available in a given section, their nationality, training, experience, education, availability, all affect the labor supply. The steel mill, the foundry or the factory employing men, women or children must be accessible to the type of people whom it desires to employ. Many factories are failures because they cannot obtain the services of the class of employees they require, in competition with other plants in locations more accessible or otherwise attractive to the employee.

Transportation

Transportation as a factor of cost of the product must be considered with reference to both raw material and finished product. Not only are there limits above which freight rates cannot go, but the rail or water service must be continuous, direct and of minimum time. If intermittent, surplus supply must be contracted for and provision made for handling and storage. The ore from the Lake Superior mines and coal to points on the Great Lakes can be transported during only 8 months of the year. Mountains of ore and of coal must then be stored to provide for the consumption of the winter months. Labor can be moved and markets created, but the necessity for and cost of transportation remain fixed, and so are often determining factors in locating a plant. Assuming that the city in which the plant is to be located has been determined upon, it is necessary to analyze the needs of the location within the city:

(*a*) Transportation of raw materials and finished product by water, rail or truck.
(*b*) Labor supply accessible to plant.
(*c*) Transportation of labor within reasonable limits of time and cost.
(*d*) Special requirements such as water, power, coal, sewage disposal and waste disposal.
(*e*) Adequate and suitable shape and size of land for present and future building operations.

It is granted that these points seem obvious, but the fact remains that however important may be their consideration, the failure carefully to consider, investigate and study has resulted in very many poorly situated plants.

Layout

The second part of the engineer's problem is the making of a layout which embraces the following essentials:

(*a*) Delivery of raw materials to plant.
(*b*) Storage of raw materials.
(*c*) Introduction of raw materials into manufacturing process.
(*d*) "Straight line" process of manufacturing.
(*e*) Storage goods in process.
(*f*) Storage finished product.
(*g*) Expansion of each or every department for future needs.
(*h*) Handling of materials through and between departments.
(*i*) Machine layouts.
(*j*) Special equipment—ovens, furnaces, vats.
(*k*) Employees' facilities for physical and mental well being.

A detailed analysis of all these points is a matter of indefinite length and in no two instances are the conditions identical; therefore no hard and fast rules can be set.

A few fundamentals may be mentioned, however, which are universally applicable and which should always be considered.

Elimination of Man Power

On the assumption that somewhere between ten and fifteen thousand dollars can be spent to eliminate permanently the employment of one man, careful consideration should be given to the problems of delivery, storage and handling of raw materials. The use of bridge cranes, gantry cranes, jib cranes with monorails, chutes, bins, vats, tanks, buckets and elevators should all be analyzed and the merits of each one carefully considered with a view to eliminating man power and substituting therefor mechanical handling equipment.

Routing of Materials

The second fundamental is the routing of goods through the plant—in other words, the employment of a straight line flow of materials, or expressed in still another way, the placing of all manufacturing processes in their logical sequence in the plant. It is frequently possible to reduce a travel of goods from raw to finished stages from 1,000 ft. to 200 or 300 ft. of travel. This means reduction in the floor space and cost of handling. Frequently entire departments can be relocated to secure advantageous flow of material and effect reduced production costs.

Handling of Materials

The third fundamental is the handling of parts, either in process or finished. Economy is effected by careful distribution, and an accurate knowledge of quantities required for each operation leads to enormous savings in the amount of stock carried. A lack of materials in necessary quantities and at the right place makes a delay in filling orders and a consequent loss of time that could be entirely eliminated by a careful study of the materials required and the location at which they are needed.

Automatic Equipment

The fourth fundamental is the use of modern equipment. This means equipment by the operation of which savings in man power are effected. A machine which will save the permanent labor of one man can well be installed at a cost of ten or fifteen thousand dollars and there are new plants where large economies could be effected by modernizing the equipment. Instances can be cited by the score where production has been doubled by the installation of labor-saving equipment and machinery. The result is larger wages to the employees, the larger wages being cheerfully paid to increase the production without the making of other capital investment, such as larger floor space, to obtain the same reduction.

The fifth fundamental is the introduction of new processes or equipment developed for special purposes.

This is so obviously a specialized problem that generalities are valueless.

Considerations of Welfare

The sixth fundamental is the consideration of the welfare of all employees. This involves the question of better surroundings with abundant light and air, adequate rest rooms, lunch rooms, recreation rooms, retiring rooms and other rooms for mental as well as physical well being and development.

Volumes have been written, and are being written, on each one of these phases of industrial development. The solution of these problems makes for the welfare of every man and woman connected in any way with industrial operation, and it remains for those in responsible charge of industrial operations to make the most of this opportunity for the good of themselves, their industries and their country.

Design

The physical plant which comprises the buildings can be determined after the layout is made. First must be determined the necessary clearances, both vertical and horizontal. This means heights necessary for manufacturing purposes, including vats, tanks and piping. It also means the shape of the cross-section of the building which is necessary to give these facilities and at the same time to provide light and ventilation. This means warmth in winter and coolness in summer. This is not always easily obtainable and it is only through experience and careful analysis of governing conditions that a satisfactory solution may be obtained. For instance, a foundry requires better ventilation than a machine shop, and in turn a machine shop with its equipment requires better light and ventilation than a plant in which there are comparatively few operatives. A chemical plant requires, as a rule, a maximum of ventilation to comply with increasingly rigid state laws.

Light and Ventilation

It is obvious that both light and ventilation may be classed as natural and artificial. Natural ventilation depends entirely upon the contour of the building, as does natural light. There are many instances where artificial ventilation is beneficial to the manufacturing process, as well as to the operatives. Proper artificial light is responsible, as tests have conclusively proved, for 15 to 25 per cent in increased production. Good lighting therefore means a good investment. Proper ventilation means increased production.

Heating of Buildings

Heating is akin to ventilation and a uniform proper temperature must be maintained in order to obtain maximum production. The question of heating involves that of power, and there is a nice balance to be determined between the costs of heating with purchase power versus heating plus manufacturing power. The engineer must be competent to make a careful analysis of heat and power costs. In this connection, too, are involved the use of steam, air and electric current for power and heating.

Sanitary installations must embody the up-to-date features which mark the modern building. Consideration is due this subject from the standpoint of health and happiness of the employees.

Buildings may be built of timber, steel, concrete or a combination of these materials. The market price of the materials, the rates of insurance, the anticipated life of the buildings and charges for maintenance and depreciation are all items to be considered and each individual case must be settled on its merits. The day of flimsy firetraps for the occupancy of human beings are rapidly passing and the science of fire protection and prevention not only means adequate protection for fire-fighting facilities, including standpipe, sprinklers, hose connections, etc., but also the consideration of fire-proof partitions, inclosed stairways and proper spacing of buildings with ample entrances and exits.

The question of design cannot be passed by without a word regarding the desirability of worthy architectural treatment. It costs no more to design an attractive building than a building which is ugly, and the basis for an attractive plant is an attractive building. The modern industrial building is frequently as attractive as a modern hotel or apartment house, and deservedly so. The morale of an entire organization is lifted and benefited by attractive surroundings. The worker acquires a pride in the plant where he works which is attended by a definite improvement in production and loyalty.

A further advantage to be derived from the attractive plant, and one to which far too little notice has been given, is the advertising value inherent in it. A photographic cut of an ugly, ramshackle or unkempt factory would do anything but establish the prospective buyer's confidence in the product. On the other hand, a good product has a natural mental association with a good-looking plant. Also, travelers passing a plant of good appearance retain the picture and the company's name imprinted on their memory, while the plant of undistinguished appearance soon fades from the mind.

Construction

The proper construction of a plant means the execution economically and in a minimum amount of time of the plans and specifications of the designing engineer. The method of execution of construction varies, obviously, with each job and is dependent on factors of materials, labor costs and supply. Nothing is gained by the employment of irresponsible contractors, or in an attempt to curtail costs below a reasonable figure which must include a legitimate profit to all parties concerned.

Equipment

Equipment installation has been mentioned in connection with plant layout, and the only comment necessary is to emphasize the point that modern labor-saving equipment frequently means the difference between profit and loss. No manufacturer can afford to keep in his plant a dollar's worth of equipment which does not show a profit, and he cannot afford not to purchase new equipment when the further investment shows a saving of labor or material costs which will result in profits on the capital invested. This is the essential of equipment.

The elements of a successful business are—plant, equipment and personnel. It is only when these three essential functions are co-ordinating properly that we have successful operation—i.e., low cost production—and all of the elements which have been discussed in various paragraphs above are worthy of serious consideration to the attainment of this end.

This is the science of man and material—mental and physical. The co-ordination of these spells success in plant operation.

Chicago, Ill.

Increased Efficiency Through Industrial Training

The Training of Foremen in Production Methods Offers the Best Opportunity to Enlist the Key Men of Industry in Teamwork, Loyalty, Watching Costs, Cutting Wastes and Increasing Quality and Quantity of Product

By B. M. Nussbaum
Vice-President, Business Training Corporation

TWO years ago a large sugar refinery on the west coast became interested in industrial training. It was frankly looking for some plan that would raise the level of efficiency of its force and enable it to introduce economies that the descending business depression made absolutely necessary. The management finally decided that foreman training promised the largest measure of results. A program of 3 months' intensive drill in production methods was accordingly adopted, and more than 200 of the foremen and leading men were enrolled.

At the time this course was being given the refinery was running full capacity and full force, but a few months later the demand fell off sharply, production had to be reduced to 1,000 tons melt per day, which is about half the normal capacity, and of course this meant that a considerable number of men had to be laid off. There came a time last fall, however, when a sudden spurt in market demand called for a quick temporary increase in production. For 2 weeks it was necessary to raise the production to 1,400 tons per day.

It may seem a remarkable statement, but the simple fact is that this sudden 40 per cent increase in production was accomplished without making an increase in the force. The foremen displayed a brand of resourceful teamwork in meeting the emergency which exceeded the superintendent's highest hopes, and the production was got out on time and up to the highest standards of quality. The superintendent attributes the showing made in large measure to the industrial training program which had taught the foremen how to pull together, and the principles of which they were quick to apply under the severe strain of an emergency.

Increased Production Following Training

Production in the rolling mill of the National Stamping & Enameling Co. at Granite City, Ill., increased 34 per cent after the company had installed a system of foreman training. This statement was publicly made by an official of the company at a convention, and he attributed the increased production largely to the greater teamwork and individual ability developed among the foremen by their training.

Swift & Co. have applied foremanship training on a truly comprehensive scale, nearly 5,000 of their foremen and other production executives in twenty-eight of their plants in the United States and Canada having followed through to completion a course in production methods. This company's experience records many examples of efficiencies accomplished through the effects of the training. An outstanding example is given in the production record of an Eastern plant, where one department manager by applying principles drawn from his training increased output from 400 units per man to 700.

In a paper mill the production of one department was increased 42 per cent through an improvement made by a foreman after he had been a short time in a training course. The foreman frankly admitted that the improvement had been suggested by what he read in one of the textbooks of his course.

Many more examples might be cited to illustrate the effect of training on ability. In many cases the concrete result is an improvement in the quality of the production. In others, as in those cited above, definite increases in output are attained. In many more it is impossible to trace concrete results that may be set down in exact figures. Here the influence of the training shows up in better human relations within the plant, more capable handling of the men by the foremen, a stronger loyalty to the plant organization as a result of the clearer understanding of what the organization is, better teamwork all around as a result of the keener sense of one's place in industry as well as better understanding of the production principles and methods taught. Very often these intangible fruits of training, which do not lend themselves to recording in the cost sheet or the profit-and-loss statement, really affect costs and profit and loss in a way that is far reaching and undeniable, even if indefinite.

What Is Industrial Training?

Perhaps it will be worth while to consider the type of education that has produced such results. Industrial training is a broad term, and may mean different things to different people. The education embraced under that heading may range all the way from highly technical instruction in technological subjects to elementary education in reading and writing such as is given by some plants in night schools for the benefit of foreign employees. But strictly speaking, we rule out classes in general subjects as belonging to common school education, and all the higher technological training as being really professional or engineering education, and what is left we classify as industrial education in these two classes:

1. Vocational and continuation courses in the plant or under its auspices. Such courses are intended mainly as preparatory, to break in new employees, fit beginners for jobs, and prepare present employees for promotion or assignment to other work. Examples of how this training is organized may be seen in apprentice schools, vestibule schools, shop schools, continuation schools, and the like.

2. Training in the job and on the job as an integral part of the operation of the plant. The object here is not primarily to break in beginners or to fit employees for promotion, but rather to give the individuals in the organization an understanding of their work and of its interrelations in the plant and in industry, to inform

them of the basic principles and approved methods of production, to motivate them for greater efficiency, and to stimulate them in accomplishing it. Of course not every training system accomplishes all of these results; some may narrow their purpose more than others. Examples of this training are given in the production classes and study groups organized in a number of industrial establishments within the last 5 years, and more especially the courses in foremanship training.

Of all this educational work, foreman training is to my mind the most important and the most resultful. All industrial training has value. There can be no question that if a suitable training program is intelligently applied to any group within a plant, the results will be beneficial to the individuals and to the plant as a whole. But I know of nothing that will work such results as a system of foreman training, carefully adapted to the requirements of a given group of foremen and systematically followed by them. The foreman is the key man in industry. It is difficult for the men of a department to accomplish improvements without the leadership of their foremen. It is practically impossible for them to make much headway without his sympathy and encouragement. All of the examples of increased production cited at the beginning of this article are results of foreman training.

Why the Foreman Is Important

"Most of the improvements, policies and ideas of a company stop at its foreman," said H. L. Willson, vice-president and general manager of the Columbia Graphophone Manufacturing Co. "They are not transmitted to the rank and file of employees. The most elaborate safety campaign may be entirely negatived by a careless and indifferent foreman. The most convincing health campaign may be rendered futile by the foreman with a sneer. The most patient study of operations and most scientific reorganization of working methods may be entirely wasted by the foreman who tells his men to 'fergit it' when the reorganizers are on the other side of the door. The smoothest and most successful of production routines may be disorganized or smashed by the whim of a foreman who is ignorant of the working of the whole plant. The friendliest kind of relations between executives and employees, the most careful of employment methods, may be wiped out and a high labor turnover piled up by a tyrant foreman. The most enlightened and earnest labor policy may be distorted into an object of bitterness and resentment by a few words from a cynical foreman with a grouch. In every phase, at every point, the work of the executives may be made or marred by the foreman."

And the opposite of this picture is also true. If the management has a new working plan that it wishes to put across with the force, if it has a new schedule to be installed or a revision of rates to be announced, it can have no better ambassador to the men than a foreman who is clearly informed of the management's policy and in intelligent sympathy with its plans and purposes. The necessary salesman of new ideas within the plant is the foreman.

The head of a large textile company estimated recently that his company saved more than $100,000 in 1921 through improvements resulting from employee suggestions. These suggestions, he says, were in large measure the result of good foremanship. Most of the suggestions really came from the mill and department heads and their assistants, and the remainder came from the rank and file who through better foremanship were stimulated to better teamwork and more intelligent thinking about production problems.

Production efficiency comes from the maximum utilization of men, machinery, methods, materials and money. The foreman does not have committed to him much direct spending of the firm's money, but he is directly responsible for the utilization of the four other elements enumerated. And by his handling of these elements he influences the spending of money.

When training is applied to the foreman, therefore it is applied at the most strategic place in the entire plant organization. The foreman in the average American plant is the management to the men under him. They judge the management by their foreman, and their respect for and loyalty to the plant is in direct ratio to their attitude toward their foreman. Train a foreman, and you not only put a key man to thinking intelligently in terms of production efficiency, but you can be certain that the men under him will also receive some of the foreman's training. He will pass it on. As the personnel manager of a Western plant put it, in describing some of the results of a foreman course in his organization: "The foremen become instructors and inspirers of their men in the training. Each foreman becomes a center for its propagation. Thus through the foremen themselves, the ideas reach the rank and file."

Four Kinds of Training

After a plant management has decided to provide training for its foremen, the problem is by no means settled. What kind of training? The choice is a wide one. There are highly technical courses, popular lecture courses, round-table conference systems, extension courses provided by universities, standarized courses, individual plant courses conducted by the management, courses conducted by outside training organizations. While there is this apparent great variety, it is possible to classify the various systems into four groups:

1. *Company Training Systems.* Several industrial companies have organized and conduct training for their foremen. Examples are the General Electric, Goodyear Tire & Rubber, American Steel & Wire, and International Harvester companies. For the most part, these courses are fairly technical, and, while comprehensive, stress the individual processes and problems of the particular industry.

2. *University Efforts at Foreman Training.* Some of the universities that are located in industrial cities have taken up this problem. An example is the work of the University of Pennsylvania, under Prof. Joseph H. Willits. Meetings were held in the auditorium of one of the city high schools attended by about 500 foremen selected from different industries in and around Philadelphia. At each meeting there was a lecture on some industrial topic. The lecture lasted from 35 to 45 minutes, after which the meeting broke up into smaller groups, each group adjourning to a room in the building for discussion and questions. A mimeographed digest of the lecture was distributed among the foremen a week in advance, thus giving them an opportunity to prepare themselves somewhat on the subject to be discussed.

3. *The Informal Conference System.* This is the plan for foreman training proposed by the Federal Board for Vocational Education in November, 1919, and it has been applied in various ways in a number of industrial plants. In brief, this is a system of periodical meetings of the foremen in small groups under a leader for informal discussion of plant problems by the foremen themselves.

4. *The Standardized Course.* Here the training is based on a standardized course which makes use of specially prepared textbooks and requires problem work. It is usually conducted by some outside training organization. In some of these courses lectures are used to reinforce the textbooks, and also to tie the training directly to the work of the individual plant, as well as to bring an element of inspirational leadership into the course that mere textbook study or classroom routine cannot give. An important feature of this system also is the group conference for questions and discussion.

Some Differences in the Training

Each of these four methods of training has its advantages and its disadvantages, and before adopting any system a careful management will give close attention to the differences inherent in these systems and to the special requirements of his own foreman-training problem.

There is one conspicuous advantage of the company course. It is planned especially for its own organization, built with one specific industry and group of foremen in mind. Too often this advantage is lost by overelaboration or too much specialization. The creation of such a course is, moreover, expensive and venturesome. Such a project should not be entered on without the most careful planning and balanced execution on the part of those intrusted with the training. Foreman training does not mean highly specialized instruction in the technique of the industry. In the temptation to make it highly technical lies the great danger in planning any foremanship course—and very often it is just this overemphasis that handicaps the success of a company course.

Universities have the advantage of organization, prestige and, to a rapidly increasing degree, experience in the field of business and industrial education. For picked foremen of an exceptionally high type of mind, lecture courses by specialists on the various subjects of industrial management may be extremely helpful, informing and stimulating. But for the average foreman they are no substitute for courses conducted in the plant or near to it, and therefore under less formidable auspices than the name "university" suggests to the average man of mechanic type. Moreover, the method of instruction, while suited to the exceptional foreman, would soon lose the interest of the average. Few managers regard this plan as a satisfactory substitute for organized training in the plant.

The Federal Board plan is the very opposite of the highly specialized comprehensive course, and it has the advantage of not being complicated or cumbersome in installation and operation. Nor is it expensive. It has the further advantage of being easily focused on plant processes and problems. But its very informality of study material and method involves a serious weakness in that only the exceptional foreman can be brought to make the most of a conference. In a typical group of foremen, meeting together with their feet under the table for free and easy discussion of plant problems, one or two natural-born "talkers" will monopolize the meeting. The rest of the foremen will sit around, silent for the most part, occasionally putting in a word or a laugh, maybe, to show some apparent interest in the meeting; but in general they will get little out of it. If any real ideas are developed at such a conference, too often they are just so much talk to a majority of the men and fail to sink in. The typical foreman is a slow thinker; he learns for the most part by the slow process of experience. That is why any process of training that requires the quick reaction of mind to mind in the hit-or-miss discussion of a round-table conference is less successful with foremen than one which organizes the study material onto a form easy to read and understand, and then adds to this simplified presentation some incentive to follow the study and apply the principles and methods taught.

This brings us to the standardized course. The standardized course deals with the problems of foremanship in terms of basic principles, and seeks to lay a broad foundation of fundamental facts of industry and of human relations within industry that will help the foreman to function better no matter what size of type of plant may be the scene of his foremanship. It is my belief, based on several years' experience training foremen in several hundred industrial plants of the United States and Canada, that the standardized course offers the manufacturer or industrial executive the most competent and practicable means available today for developing foremanship ability. The system has been used in practically every type of industry, it is elastic and easily adapted to various sizes and types of plants, and lays a foundation of basic knowledge about production work upon which more advanced educational efforts can be successfully built. Perhaps the only disadvantage ever voiced against this system was by those who wished a course built especially for their plant and who objected that the standardized course was too general. By reinforcing the study work with lectures given by men who are capable teachers, this objection has been overcome, and in hundreds of plants the standardized course has been focused upon the individual problems of the plant, with results truly remarkable.

Four Training Essentials

In the organization and operation of a successful standardized course, four elements have, in my experience, been found essential to the best results: (1) Text material containing the basic teaching of the course written specially from the foreman's angle and in a style easily grasped by the average foreman type of mind. (2) Lectures in amplification of the text material and applying the principles and methods taught to the processes and problems of the individual plant; an essential feature here is the personality of the lecturers—they must be men who not only know industry and production methods, but also have teaching ability. (3) Problem work calling for definite home study on the part of the foremen-students and giving them experience in applying the production principles taught. (4) Group conferences for discussion of the principles and methods taught in the course and for clearing up questions that arise.

Text, lectures, problem work and group conferences must not only be properly balanced, but the foundation of success in such a training system lies in the proper choice and presentation of the subject matter. As I have said before in this article, foreman training does not call for highly specialized instruction in the technique of the foreman's job or department. The average foreman is pretty well informed in his own line of work. He knows his machine, his process, his department better than any one else—at least, he thinks so—and is apt to resent anyone's coming in to teach him his own job. But when you come in to tell him how other plants are managing, what foremen are doing to meet their problems of organization, discipline, spoilage and the like in other industries, you immediately get a reaction. The foreman is interested in these concrete examples; and unconsciously he is influenced to apply these new ideas to his own production problems.

One of the executives of Swift & Co., discussing this question of what material should go into a foreman course, said: "Let him find out how other plants are managing men, selecting, disciplining and training them; how they are keeping track of materials, learning costs and eliminating wastes; how they are organizing so that the functions of each man fit into those of his associates, thus making for better teamwork. Let him find out these things, and he will rise above the walls of the rut he has dug and see possibilities in his job that he never dreamed of. He will learn that there are ways of doing his daily tasks better than he has learned to do them; that the responsbilities of his position are really greater than he imagined. And his ambition, pride, alertness will be aroused; he will produce more for himself, and in so doing produce more for the company."

Proof That Foremen Will Study

A short intensive course, organized and conducted as suggested, sustains the interest of the foremen students to a remarkable degree. One of the stock objections to foremen training has been that foremen won't study. They may attend lectures, they may sit in at conferences, say these critics, but very few of them will really apply themselves and study. I have records of foreman training in more than 300 plants, in groups ranging from several hundred down to less than a dozen; in only 6 per cent of the plants do the results show a completion record of less than 50 per cent; in the majority the percentage is far above that figure. From these records I cite the following examples from industries that may be of special interest to readers of *Chemical & Metallurgical Engineering:*

	No. of Men Who Enrolled	No. of Men Who Finished	Percentage of Men Who Finished
Carpenter Steel Co.	69	63	91
Corning Glass Co.	244	232	95
Detroit Steel Castings Co.	28	25	90
Federal Rubber Co.	93	81	87
Gutta Percha Rubber Co.	128	116	90
Portsmouth Cotton Oil Co.	24	23	98
Simplex Wire & Cable Co.	35	34	97

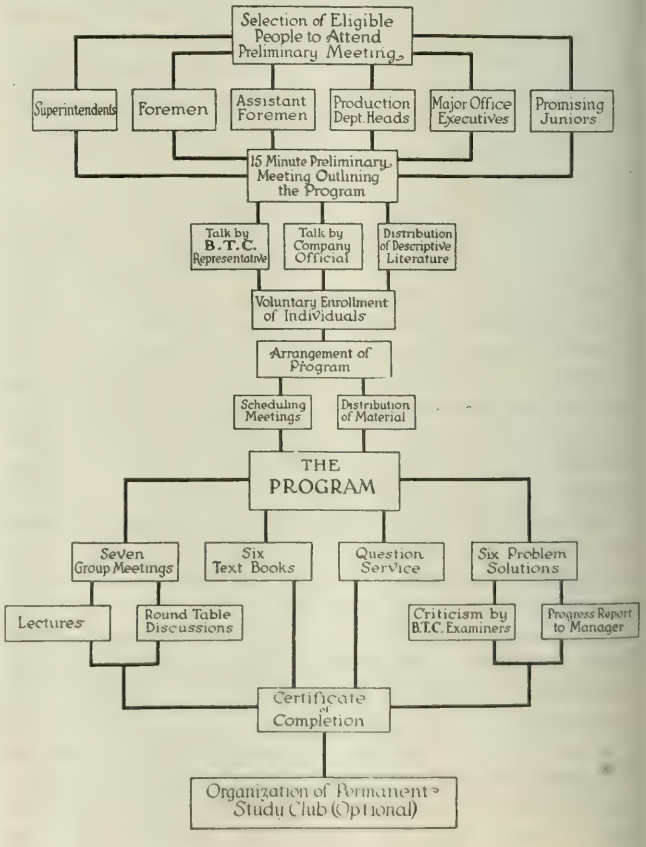
The proof that they benefit by the result of their study is found in the innumerable instances of improved work, better direction of a department, reduced friction in the handling of men, increased quality and quantity of output and other evidence that might be cited from the experience of plants where foreman training has been conducted. A few examples have been given at the beginning of this article, and many more are on record. Many companies have used the training as a foundation on which to build more specialized courses. Such courses have been found practical after the foremen have received the bedrock of basic production principles taught in the course and have been accustomed to study methods. In a number of instances, in fact, the men themselves have demanded some sort of continuation work; and this has usually taken the form of "Production Clubs" organized and manned by the foremen for the discussion of production problems, to keep abreast of production technique in the industry and to furnish a sort of foreman's council or cabinet for handling the questions that come up.

Thus a course in foreman training, if it is rightly conceived and conducted, becomes more than a temporary focusing of attention on production. It becomes the starting point and the foundation stone for continued work and for permanent improvement in the foremanship of the plant.

New York, N. Y.

Procedure in Foreman Training

Next in importance to the actual training of foremen is the method of procedure by which they are interested in and familiarized with the course of instruction. Manufacturers and executives who may have convinced themselves that foreman training is a good thing may still be in doubt as to the correct answer to the big question, "How shall the training be organized and conducted?" Those who have had experience in this sort of work have developed certain fundamental facts that apparently are requisite for success. The Business Training Corporation, for example, has charted its idea of the best procedure in the accompanying diagram which we reproduce from that organization's recent publication entitled "Twenty Thousand Better Foremen." The chart quickly visualizes the essential steps in organizing classes in foreman training.



The Design of Chemical Plants

Chemical Plants Generally Not Good Examples of Studied Design—Opportunity Is Good for Introducing Improvements From Analogous Industries—The Controlling Factors in Plant Design Should Be Efficiency in Material Handling and Allowance for Future Expansion

By A. E. Marshall
Consulting Chemical Engineer

When a survey is made of operating costs in a chemical manufacturing plant, labor often bulks high, and while in high-priced commodities this may not cause inquiry or create a desire for investigation, yet in a low-priced article a high labor cost may mean not only a loss of profit but even a loss of business if demand is small and competition keen. Elsewhere in this issue various phases of cost and suggestions for lowering cost by increasing efficiency are discussed. This article is concerned with one important phase of operating cost—the handling of materials through the plant and the influence of plant design on the cost of pre-process and process labor.

Chemical Plants Not Examples of Good Design

Chemical plants as a whole are not striking examples of studied design arranged to obviate the use of labor in everything except its minimum essential form. The reasons for this vary—some plants have grown up around a small semi-commercial experiment, expanding as demand for the product arose; others, operating by rule of thumb, are equally rule of thumb on the engineering and design side. Still another reason lies in the fact that many plants operating today have not been changed in any essential detail for years, possibly since their original construction.

Most of the plants built during the war period were designed not for low-cost production, but by force of prevailing circumstances were arranged for the use of equipment which was available for delivery within a reasonable period.

There is, in the writer's opinion, room for considerable revision of engineering practice in chemical plants and for close study of the results obtained in other industries where the problems of manufacture are analogous to those presented in the chemical industry.

Material Handling a Controlling Factor

The need for efficiency in handling materials through the stages of chemical processes is more pronounced today than at any previous time in the history of chemical manufacture. Labor has not gone back to pre-war rates, and studies of the cost of living and correlated subjects indicate rather clearly that a return to pre-war figures cannot be counted on in any serious consideration of costs of operation.

The consumers of chemical products demand today standard grades at low prices, and the manufacturer who has consistently cut out surplus hand labor by the substitution of cheaper mechanical labor, who has routed movements of material, thereby shortening travel, is the manufacturer operating close to capacity and employing high total labor, but on a basis of low labor-hours per ton of product.

Conditions Governing Handling Equipment

In any consideration of mechanical handling there are certain fundamental conditions which must be met by the mechanical device. Interest on the capital expenditure involved, depreciation, repairs and labor cost for supervision must be less than the cost of the same operation carried out entirely by man power. This would seem to be a condition which would always receive first consideration, but examples could be cited from many plants to prove that a complete study of the cost of operating some mechanical device had not been made prior to its installation. Another essential is that the device must be capable of withstanding the unusual conditions of chemical plant service. A loading machine which handles sand will not necessarily have the same life when used on acid phosphate. It is not unusual to find that excessive corrosion, which is so often a feature of chemical plant work, makes it necessary before success is obtained to rebuild, with different materials, a machine which has given excellent results in some other industry.

Another important consideration is continuity of operation. Mechanical failure must be taken into account, and it often happens that too much trust in mechanisms, without provision of a safety bypass in the shape of a transfer of material by hand power, leads to a prolonged shutdown and to lessened output. In chemical manufacture, continuity of operation is generally much more important than in other industries. The volume and cost of output of a chemical process usually depend on the simultaneous carrying on of a number of stages of manufacture, and a shutdown of one stage adversely affects the other stages. This calls for close study not only of the desirability of being able to arrange temporary bypasses but also of the possibilities of failure in mechanical devices. Mechanisms adopted without change from other industries may give trouble, because the parts, while sufficiently strong to take care of materials of fairly uniform density, consistency, etc., are not strong enough to stand up under the variations of load and quality of load which result from some temporary disarrangement of a chemical process.

The question of plant design is so closely linked with the use of mechanical handling devices that beyond pointing out, as has already been done, some essential features of satisfactory mechanical equipment, the two subjects will be treated together.

Factors to Consider in Design of a New Plant

In considering the design of a new plant, the chemical engineer has several important factors to take into account. One which has received least attention in the past and one which has caused later on in the life of chemical plants either unnecessary cost of product or prevented possible reductions is the lack of provision for future expansion.

A successful plant necessarily meets with a demand for increased output, but unless the original design took care of the future need, the expansion either takes the form of a replica of the primary layout or the additions are crowded in wherever a vacant space is found.

In either case, lower costs are not likely to follow increased output.

If the design properly takes care of expansion, then certain parts of the plant mechanism can be worked at full load instead of being duplicated, and the same labor will perform more work. There should be greater economy in producing 50,000 tons of product in one plant than in turning out the same tonnage from two 25,000-ton plants or from a 25,000-ton plant which has been painfully stretched to give 50,000 tons.

Indefinite expansion cannot be provided for in design except by arranging for duplication, but doubling or even trebling the output can usually be taken care of by adding equipment in locations which were fixed by the layout of the original plant.

Other essential considerations are the receiving and storing of raw materials, the storage of finished products and the flow of materials from the raw to the finished product stage.

The Flow Sheet in Plant Design

In the metallurgical industries, a flow sheet is the starting point for consideration of any process or new plant. In the chemical industry it often happens that a flow sheet, when one is made, is worked up after the plant has been built and operations have been begun.

A large-scale flow sheet, showing daily tonnages moved at all points, and with maximum storage capacities for raw and finished products, should be the first step in designing a chemical plant.

Study of the flow sheet will bring out the salient features of the operation, and will suggest various arrangements of equipment and buildings which can be further studied by making experimental layouts in outline.

The flow sheet with its indicated tonnages and the outline layouts will show the points where handling of materials take place, and a decision can be reached as to whether a mechanical device or hand labor is desirable.

Possibilities of Equipment Developed for Other Industries

The chemical industry has been rather slow in the adoption of mechanical handling equipment, and even if there is no known parallel use of machinery for a certain purpose in chemical plants, it generally pays to make a survey of the use of equipment in other industries.

As an example, the use of bridge cranes may be mentioned.

Up to a few years ago bridge cranes were not employed in chemical plants, although in other industries they were enabling large savings to be made in the handling of materials.

Bridge Cranes for Handling

Today many chemical plants, particularly fertilizer factories, rely on bridge cranes for the movement of raw, intermediate and finished products, and by refinements in the design of the plants all the stages of production have been placed within range of the crane. A bridge crane represents a high initial investment, but it shows a good return when given sufficient tonnage to handle. As an example, a single bridge crane in a fertilizer factory can be utilized for all of the tonnage movements including:

Raw phosphate rock to storage.
Rock from storage to mills.
Acid phosphate from dens to storage.
Acid phosphate from storage to bulk shipping poin
or mixing department.

If the plant includes a mixing department the sam crane can handle potash, ammoniates, tankage, etc., t and from the storage bins and mixing and screenin machines.

Proper Arrangement of Departments

Careful planning of the operations cycle is neces sary when a bridge crane is called on to serve variou departments, otherwise the crane will waste time i travel with an empty bucket. Also the placing of de partments demands study so that in a fertilizer plan raw phosphate rock does not have to be moved ove the storage piles of acid phosphate. A leaking gral bucket, loaded with phosphate rock, which had to trave over stored acid phosphate might mean a serious los through a portion of the rock finding its way into th official sample. Here again a study of a flow sheet in plan, will obviate the need for changes after construc tion is completed.

Where a Monorail Should Be Used

While a bridge crane represents the maximum facility of tonnage movement, it frequently happens that the total weights to be handled do not justify either the installation or operating cost. In such cases it is often possible to incorporate a monorail crane system in the design, and to move materials by monorail grab cranes or tubs at much lower cost than a combination of conveyors, elevators and hand labor. The disadvantage of a monorail is its fixed position, which differentiates it from the free traverse of the bridge crane. A proper arrangement of plant units will, however, in most cases give the monorail system an opportunity to perform all the tonnage movements. It should be remembered that a monorail system is not really limited to the use of grab buckets. Movements of materials originating off the direct line of travel can be taken care of by a hook crane which picks up tubs transferred under the monorail by means of hand cars on a narrow gage track.

The inclusion of a weighbridge in the monorail track is often desirable, as it permits the weighing of furnace charges, etc., without the expense of double handling to and from a platform scale.

In the case of handling problems where there are two active lines of travel at right angles, it often proves advantageous to utilize two monorails at different levels. Transfers of material can be made by hook cranes and tubs or a transfer pit can be built for the use of grab cranes at the junction point.

Other Types of Handling Installation

Elevators and belt conveyors are familiar devices in chemical plant practice, and call for no special mention. Pan conveyors capable of handling hot or abrasive materials are now coming into use, and have already solved some problems which previously had been considered as capable of solution by hand labor only.

Each plant has of course some special handling problem which lies outside the general treatment of this article, so a tabulation is given of some of the labor-saving devices which have found application in such work in recent years.

Pneumatic conveyors of the air pressure or vacuum types.
Vacuum unloaders for ships and cars.
Storage battery trucks.
Skip hoists.
Mechanical car unloaders.
Narrow-gage electric and gasoline trolley systems.
Portable conveyors.
Box-car loaders for bulk products.

Providing for Raw Material Storage

One phase of plant design work which scarcely ever eceives attention until the need presents itself is the rovision of outdoor storage for raw materials which re not affected by the weather. Convenient covered r uncovered storage for such materials is of course an ssential provision of the original design. At some ime in the plant history raw materials accumulate in xcess of the storage capacity, and as there is no op- ortunity for arranging adequate new storage, the mate- ials are piled in the factory yard either by a locomotive rane or a portable conveyor. The provision of tem- orary trackage and the difficulty of making a clean-up re serious items in the cost of temporary outdoor torage.

If space for outdoor storage is provided alongside ne of the permanent standard-gage tracks, a low-cost system of handling can be developed by the aid of a locomotive crane equipped with a grab bucket and mounted on caterpillar tracks. Such a crane has complete freedom of movement without the need for laying tracks and can recover a storage pile to the limit of grab bucket recovery without the use of a shovel gang. The locomotive crane with caterpillar tracks is also a valuable machine in other parts of the plant and has even been utilized in the case of a breakdown to replace an elevator.

The Plant Designer Must Investigate Other Industries

In conclusion, a statement is advanced that the chemical industry of today does not generally utilize to the best advantage mechanical devices for saving labor. The trend of prices makes it essential that the chemical engineer and the manufacturer study closely results which are being obtained in other industries with labor-saving devices. Some of these devices may need to be changed either in material or in the strength of parts before they are entirely suited to chemical plant usage —but the chemical engineer should be the one to investigate the possibilities, and to suggest to the equipment manufacturer the changes which are necessary to fit his machine to the needs of the chemical plant.

Baltimore, Md.

Increasing Heating Furnace Efficiency Through the Use of Insulation

Increased operating costs and keen competition have irected attention to many losses in the use of heat vhich were formerly disregarded. Prominent among hese is the loss of heat through heat-treating furnace valls.

Design of Heating Furnaces

Furnace design and operation is probably the most nexact branch of engineering science. This is because esults can be obtained that are satisfactory even if the nethods are wasteful; and because it is extremely diffi- ult to keep an accurate record of just what goes on nside the furnace walls.

Also, the prime consideration in the past has been to lesign the furnace to get the maximum production of ngh-class material; and methods of heating have only ecently come to get the consideration which they must ecessarily have in a period of high fuel costs.

At the present time, designers of heat-treating fur- aces are fully awake to the necessity of constructing heir furnaces so as to attain the greatest possible effi- iency of operation. As a basis for this design it is ecessary to find out where the heat goes and in what roportion.

Distribution of Heat

The heat generated in a heat-treating furnace goes in part to do the heating required and is in part lost through the walls and doors and up the stack. The heat required for the work and that lost up the stack are, in modern, well-designed furnaces, already kept at a minimum. It is to the reduction of losses through the walls and doors that we must look if we are to save heat through further improvements in design.

In the design and construction of heat-treating furnaces the conductivity of fireclay is of extreme importance. In oven furnaces, where a large volume of heat is required, particular attention must be paid to the conductivity of the firebrick employed, so that the thickness of wall may be determined to give the most economical working.

In the case of small furnaces which are used only during the day and require to be heated up to a working temperature each morning, the time required for this preliminary heating up will to a great extent depend upon the thickness and conductivity of the wall. In such cases the quantity of brickwork should be a minimum; 2½-in. brick backed up by 2½ in. of a good insulating material.

For large heat-treating furnaces which are working continuously the thickness of the wall should not be less than 13½ in.; a 9-in. course of firebrick, backed by a 4½-in. of insulating brick is good practice.

In general, in high-temperature wall construction, there are two separate and distinct factors which must be considered to produce an effective wall.

The first of these is to provide a material having the ability to resist the action of high temperatures, sufficient mechanical strength and, possibly, the property of resisting corrosive slags, gases, etc., without spalling or being eroded.

The second is to prevent the excessive loss of heat due to conduction from the interior of the wall to the outside, where it is lost by radiation or conduction.

It is rare that a good refractory material is an insulator; usually it is necessary to augment or back up the refractory with some material having a much lower heat-conducting capacity.

The following table gives a comparison of losses with insulated and uninsulated walls and various fuels which clearly shows how insulation increases efficiency:

FUEL LOSSES PER 1,000 SQ.FT. PER HOUR OF RADIATING SURFACE

Wall	Fuel	Loss per 1,000 Sq.Ft. per Hr. B.t.u.	Lb. Coal Loss per 1,000 Sq.Ft.	Gal. Oil Loss per 1,000 Sq.Ft.	Cu.Ft. Gas Loss per 1,000 Sq.Ft.	Calorific Value B.t.u.
Uninsulated	Coal	600,000	50.0	...	.....	12,000 per lb.
Insulated	Coal	220,000	18.3	...	.....	12,000 per lb.
Uninsulated	Oil	600,000	....	4.1	.....	145,000 per gal.
Insulated	Oil	220,000	....	1.5	.....	145,000 per gal.
Uninsulated	Gas	600,000	....	...	1,000	600 per cu.ft.
Insulated	Gas	220,000	....	...	366	600 per cu.ft.

Gas as a Source of Energy For Industrial Processes

Gaseous Fuel Not Only Gives the Highest Thermal Efficiency but Also Gives Opportunities for Increased Production Efficiency — Examples From Industry — Prospects for a More Extended Use of Gas as an Industrial Fuel

By Carl J. Wright
Technologist, Combustion Utilities Corporation

GAS, the ideal fuel, lends itself admirably to a program of increased efficiency in industry. When we think of efficiency in connection with a fuel we generally limit ourselves to thermal efficiency, or the ratio of heat output to heat input, but the subject may also be considered from the broader viewpoint of economy of natural resources and of human energy. As an industrial fuel it not only gives increased thermal efficiency, but in most cases gives increased quantity and better quality of product. It makes a clean workroom for the employees, and for this reason they are not only more contented but are healthier and can turn out better work.

Inasmuch as any fuel must be gasified before its heat energy is available, it seems logical that the fuel which is gaseous to begin with should be best adapted to give high efficiencies and close temperature control. Many industries today depend almost entirely on gas for their fuel requirements, and more and more industries are trying gas on operations heretofore carried on with some other form of fuel and are finding not only increased thermal efficiency but an increase in the quantity and quality of their product.

It should be understood that all gases are not equally efficient for all operations, but with the wide range of gases available for industrial uses it is possible to choose the kind of gas which has the proper characteristics for carrying on the heating operations in almost any industry.

Examples From Industry

The glass industry in the United States may be cited as an example of an industry which depends almost exclusively on gas as a fuel. In the early days of the industry it was thought that natural gas was essential for heating operations, and glass plants were built near each source of supply of natural gas as it was discovered. But as the natural gas fields became depleted and the demand for this gas as a domestic fuel increased it was necessary for many of the glass plants to look to some form of manufactured gas as a source of fuel. Today we find glass plants using various forms of producer gas, blue water gas, coke-oven gas, and in some cases the city gas which has been manufactured for domestic use. In all cases where they have given proper attention to furnace design and technical control of combustion they have increased the thermal efficiency of their operation and are turning out an improved product.

Several industries have found it highly advantageous to use gas as a source of heat energy in operations where temperature control and furnace atmosphere are important factors. For example, plants making porcelain enameled ware have found that they must have close control on both the furnace atmosphere and the temperature of the working chamber and they have found that gaseous fuels meet both of these requirements. For this operation the furnace atmosphere must be oxidizing and must have no carbon monoxide present otherwise a smooth finish will not be obtained. For solid- or liquid-fired furnaces it is generally necessary to inclose the working chamber entirely so that the products of combustion cannot come in contact with the work. This results in very low thermal efficiency because all the heat must be transferred through heavy refractory walls. Then too, the temperature within the muffle is not uniform, therefore a full load cannot be put in the muffle or some of the product will be second quality product. With gas, a semi-muffle or direct-fired furnace can be used. High thermal efficiencies are obtained and much more first quality material is turned out daily per furnace.

Gas as Fuel in the Metal Industries

Another operation in which the furnace atmosphere is very important is the melting of non-ferrous metals. Unless the atmosphere in the melting chamber is neutral, the metal losses will be high, and this metal loss must be charged to the fuel used. Gas and air can be mixed in very exact proportions, hence it is quite easy to control the furnace atmosphere with gas-fired furnaces so that a neutral atmosphere results. In fact, the kind of fuel used may affect all the subsequent foundry operations. In practice it has been found that metal melted in gas-fired furnaces will meet the strictest specification. At the same time these furnaces give good thermal efficiencies, low melting losses, high production per furnace and a clean, comfortable workroom. In crucible furnaces, longer crucible life is obtained with gas than with any other fuel.

The metal products industries offer numerous examples of the use of gas for heating operations, and in nearly every case the adoption of this form of fuel has resulted in higher thermal efficiency, better products and better working conditions. In annealing and heat-treating furnaces where gaseous fuels are used it is possible to have an absolutely uniform temperature throughout the whole working chamber, and this temperature can be automatically controlled; also it is possible to control the furnace atmosphere so that the material is not scaled. In heat-treating large guns gas has competed with electricity and oil, and it has shown a marked superiority in many cases.

Another use of gas in industry which is interesting and in which a superior product is obtained is in the carburizing of steel. In this case the gas is used as a carburizing agent as well as for fuel. The material to be treated is placed in a closed container and put in the furnace. A small stream of gas, rich in hydrocarbons, is admitted to the container. At this temperature the gas decomposes and the carbon is readily absorbed by the steel. The residual gas is returned to

e furnace burners and makes up part of the required el for the operation. Thus it is seen that the use city gas for this purpose eliminates the use of com-unds, packing, metal boxes and considerable labor. he parts to be treated come up to temperature uni-rmly and an excellent "case" is obtained. Another ing possible with gas and not with solid carburizing mpounds is the production of a diffused "case" which obtained by turning the carburizing circuit of gas f several hours before removing the material from e furnace. By this method an excellent "case" which ends with the core is obtained.

Some Other Economies Resulting From Use of Gas as Fuel

Many engineers believe that the day is not far dis-nt when the majority of all heating operations will e carried on by gaseous fuel, even to the extent of sing gas for firing boilers. And we may even see the me when gas will be a source of power for industry rough the medium of improved internal combustion gines. This is already done in those industries which roduce gas as a byproduct, notably the steel indust-y; r in such cases the gas would be largely wasted if it ere not so used and so its use even with inefficient gines is clear gain.

If gas is adopted as a universal source of fuel energy, ere are a large number of factors which will effect onomies of both natural resources and human energy. the atmosphere surrounding our cities and industrial nters were free from smoke, as it would be if gas ere used for fuel, much less artificial light would have be used. This not only gives a direct saving in the st of lighting but the workmen are able to produce ore and better work. Another economy which would e apparent is the saving in cost of cleaning and re-corating our buildings. This cost is due almost en-rely to the smoke and soot which is thrown into the mosphere during the combustion of solid and liquid els. If no solid or liquid fuels were burned in our ties, we would notice enormous savings in laundry lls and savings in cost of wearing apparel due to the ct that our clothes would not have to be washed so requently or so vigorously. In addition, the burden f the housewife in keeping her house clean would be aterially reduced.

Another item which should not be overlooked is that, the burning of raw coal, most of the valuable conden-ble products—particularly tar and ammonia—are lost. portion of these products is burned and some heat nergy is obtained, but these products would be many mes more valuable for other purposes than they are r fuel. Far-seeing fuel engineers are of the opinion at it will not be many years before industries in the nited States will be compelled, not only by economic ws but also by federal legislation, so to process their w coal that all these valuable byproducts will be re-vered. Some are even advocating the conversion of l coal into gas and condensible products at the mine nd transporting the gas to the cities and industrial nters through high-pressure pipe lines, to take care f the entire heating requirements of the community. Whatever may come of these larger visions, there still emains immediately at hand the direct advantage in roduction efficiency from wider use of gaseous fuels s the source of energy for industrial processes.

New York, N. Y.

Building the Plant Around the Transportation System

Production has in the past been generally considered as largely a matter of management. Today, in most chemical plants, the speed and efficiency at which men work is a matter of human control; and the efficiency of the plant is therefore a variable quantity—one impossible to forecast—and the difficulties of successful operation are manifold.

That this condition need not always maintain is the discovery of the last few years, particularly in the field of metal working. What is successful there can be applied at least in part in chemical industry. To illustrate what is meant, we quote the following from the August, 1922, issue of *Industrial Management* on the subject of the Ford plant at River Rouge:

Solving the Management Problem

"Even the major problems of management, strange as it may seem, have been solved at this plant by machinery and engineering. The 22,000 workers at River Rouge require an astonishingly small amount of supervision. Clerical and administrative labor has been reduced to an almost unbelievable minimum. Routing and dispatching are handled as engineering rather than as management problems; and solved by machinery, through transportation, rather than by management through supervision. Stock-keeping presents no unsolved problems, because the various processes, from the ore pile to the finished tractor on its freight car, have been mechanically timed to such a degree that production is a continuous flow without the need of stock reserves.

"Management difficulties that force themselves to the foreground at the average plant are non-existent or at least invisible at River Rouge. Ford and his engineers have made sure that the big basic principles are right and stay right so that details that would otherwise annoy and perplex seem to arrange themselves without obvious effort.

A Complete Industrial Chain

"Aside from all this, the River Rouge plant is of absorbing interest as a unique example of a substantially complete industrial economic chain. Ore from the Ford iron mines hauled on Ford's railroad is converted into pig at the Ford blast furnace and made into castings at the Ford foundry. Coke for foundry and blast-furnace use is produced at the Ford coke ovens. Gas for steam-electric power production, ammonia, distillates, tar and illuminating gas are produced at the Ford byproduct house and gas house. All of these units in the industrial chain are geared up as one complete machine.

The Conveying Equipment Is the Heart of the Organization

"Mechanical transportation forms the links which unite these separate units and their parts into one smooth-working, continuous process. Starting with the cranes which unload the raw materials, through the interplant conveyors that feed product parts, fuel and supplies in continuous, co-ordinated streams, everything is kept moving—by machinery. The spirit of the plant impresses the observer as an allegorical picture—a picture of engineering genius wrestling with time, for the prize of accomplishment."

Relation of Health and Happiness of Employees To Production in Industry

In This Article the Author Has Tried to Bring Out the Important Fact That Industrial Managers Should Give as Much Time and Study to Human Problems as They Give to Physical and Technical Problems of Production

By John S. Shaw
Hercules Powder Company

HEALTH: "A condition of soundness of any living organism, that state in which all the natural functions are performed freely, without pain or disease; freedom from sickness or decay."

HAPPINESS: "The pleasurable experience that springs from possession of good, the gratification of noble desires; the relief from pain or evil; enjoyment."

These definitions cover two human conditions which concern us very deeply. Much has been said and done to demonstrate the direct relation existing between man's health and happiness and his efficiency. During the years following the Civil War, and up to the present, the race for industrial supremacy has been keen and competition has extended around the globe. Leaders have toiled through a maze of factory problems, primarily leading to greater production, satisfactory quality and lower costs.

When considering these problems they naturally have concentrated on various processes, both mechanical and chemical, and on machinery or equipment in their plants. At the same time they have paid too little attention to the human side of the problem, taking for granted, more or less, that as long as men are paid the prevailing wages of their neighborhoods or calling, they should be thoroughly content to toil day after day, with no other inducement than that of earning their livelihood.

No doubt we all have experienced the fatigue due to monotony, which is a far more serious condition to humans than the mere physical or muscular fatigue. This may be explained by pointing out certain men whom we have known whose earnings are well above their standards of living, but at the same time those men are not contented, even granting that they may be healthy. Many such men do not know the cause of their discontent. They know that they are not satisfied. They will admit that they are restless, and they will seek higher wages, believing that the cause of dissatisfaction is insufficient money compensation.

In general we workers base our needs upon daily occurrences and environment, and fail to think out a clear and possible means of arriving at the greatest common good to all. The worker constantly wonders, "How much pay can I get for the least possible work?" while the employer is thinking, "How much production can I get for the wages I pay?" and the public criticises both and complains of the high cost of living.

What Is Needed to Insure Health and Happiness?

What is needed to insure health and happiness of our employees and a stronger and safer development of industry? Is it a method, preventive measure, or a cure?

Management really has two sides which should be equally developed and balanced—one the administration of production, the other the administration of those who toil and actually produce with their brains and hands. There should be no line drawn between the two, but they should be in separate departments and each equally a half of the administrative whole.

Production and costs depend absolutely upon huma efficiency and, as human efficiency depends upon th health and happiness of all of us, it is obvious that an action tending to promote health and happiness wi directly affect production and costs and greatly benef society.

Health

Before undertaking any great and important worl the worker should be in good health. He should hav complete control of all his physical faculties with th slightest amount of effort. His environment must en brace clean living, sufficient nourishment, good housin and pleasant surroundings, in order that his body ma be "in that state in which all the natural function are performed freely, without pain or disease." Healt is the foundation of happiness, for we all know ho little enjoyment there is in life to the physical sufferer The employer should see that his workers are enjoyin proper living conditions. He may have direct influenc over this through the control of "company houses" if not, he will have to make an effort to persuade an influence his workers to create proper homes from thei earnings. A good manager will go as far as assistin the employees to move to desirable and better homes.

Medical and Hospital Service

If the organization is sufficiently large to warrant company doctor and hospital, they should be employed It is strange to note that there are still many employ ers today who doubt the benefits derived from medica and hospital service to their employees. They believ that this is a delicate matter and is more or less tres passing upon the privacy of the employee to seem t thrust such service upon him. In answer to this, I ca say only that there are many instances where we owe i to the employees as well as the stockholders to see tha our employees are protected from the spread of diseas among their fellows.

Some employers also believe that the only purpose o medical service is to avoid the employment of th physically unfit who may make the unjust claim tha an injury or disease occurred after employment. Th matter of medical service is, therefore, regarded in th light of a gamble by some employers, who depend upo observations of their foremen to detect physical weak ness or disease. Unfortunately this belief may resul in very serious injury to both employer and employee The latter may unknowingly undertake work for whic he is unfit and, in consequence, become ill or injured t the extent of loss to himself and employer; to the em ployee through decreased earnings and suffering to him self and family and to the employer through risk o health and safety of his organization and lowered effi ciency and increased labor turnover. Health is th greatest capital man has. Without it the best of brain may fail.

For those organizations which are too small to affor medical and hospital service to the employees, I woul

iggest the employment of a physician for a certain our or two of each workday, during which time em-loyees requiring medical service may call upon the octor and receive the benefit of his care and advice.

Safety

A good live program of safety should be carried out. ire and accident prevention are not only humane un-ertakings, but are of great economic importance. Most mployers have found this to be true, and it is gratify-ig to see the great progress that safety work has ade. There is another real reason for safety work—amely, the psychological effect upon the help. Instead f fear of death and injury, the worker's confidence is ncreased and hence the contribution to his happiness. he most successful safety work is noticed in factories here the help are all given an equal chance to make ggestions to a committee appointed by themselves and uided by wise management.

Happiness

Creative Impulse

Isn't it surprising how many schemes and methods re in practice today under the name of scientific man-gement? We have anything from employees' repre-ntation to profit sharing. The magazines and books re full of such ideas, but very few speak of the key the worker's real happiness—viz., the instinct of orkmanship, or the creative impulse. The desire to be reative is fundamental in human nature and failure find an outlet for self-expression results in serious ifficulties. Suppression of this basic natural tendency potentially disastrous. The task of the management hould really be to find some positive and constructive utlet.

A few men in our country have practically spent their ves endeavoring to solve the problems from the human de, and since the great war the mysterious "personnel epartment" has sprung into greater prominence. Tead nd Metcalf describe personnel administration as directing and co-ordinating human relations of any rganization, with a view to getting the maximum neces-ary production with a minimum of effort and friction nd with proper regard for the genuine well being of ie workers." Notice there is not in this definition a ngle word mentioning costs! In their splendid book ntitled "Personnel Administration" they cover the sub-ct in a remarkable and interesting way.

R. B. Wolf, industrial engineer, of New York City, as spent the last 20 years seeking out the healthful nd happy way for workers to pursue their labors. oday he is one of the foremost managers and authors nnected with industry, and while he is thoroughly ractical and realizes the importance of low costs, the ain theme of his work is "non-financial incentives" and e appeal to the creative impulse of man. So import-nt does Alfred Korzybski consider the freedom of is expression that he attributes not only restlessness the individual but wars of nations to the suppression the creative impulse, or the "instinct of work-anship."

First of all, man seeks work because he must be othed, fed and housed. He goes to work and is given hat appears to be a fair wage. He may set a pace to e machine he operates, or that contrivance may be a ce setter to him. He does the same thing over and er every day in the same way and draws his pay om week to week with the same dumb monotony. He sees others enjoying more comforts than himself and he strives for those pleasures, comforts and perhaps luxuries, or, better still, he desires to possess his own home where the love of a wife and children control the center of his ambitions.

At this point, if his employer takes an interest in him, gives him a little encouragement and explains the why and wherefore of his job and the nature of the service rendered to the public through his labors, there is not much danger ahead. If he is permitted the full exercise of the creative impulse, given proper guidance and credit for his fruitful efforts, he is bound to be content. In order to accomplish this, a proper system of records and charts should be kept before the workers. Every one likes to watch a scoreboard, no matter what the game. Friendly competition is a stimulant to man's incentive. Here's where the love of creation comes in. After all isn't it something divine in man? His love of accomplishment and desire for approval are real forms of human expression. This desire is often obscured by more immediate claims and sometimes little appreciated because of the paralyzing effects of fear.

The problem, then, is to permit men working in groups to retain their individuality and for each man to feel that he is an independent human being, striving toward a definite goal to be attained only by his individual effort. To make him see that co-operation with fellow employees and his employer is the best means of attaining true individuality and self-assertion is difficult, but this can be accomplished by the principles involved. It is obvious that as the understanding of individual obligation spreads so as to include groups, a tremendous source of human energy and power which is now little understood will be made available to society.

Religion

Good "old-fashioned religion" is not to be considered too lightly. Co-operation with the religious teachers means fellowship, co-operation and an honest striving of the masses for service and common good. If a man is suppressed in or discouraged from progressing along proper lines, immediately there is trouble ahead. Selfishness and jealousy kindle and trouble brews from worker to worker, while the thoughtless manager schemes on his production and costs.

What then is meant by "proper guidance"? For instance, right now we believe that we are facing a long period of deflation. Wage cuts are in vogue and if history is to repeat itself labor will be sullen for some time to come. As the value of the dollar rises, the amount of money earned must necessarily become less and less. Such a condition should be frankly and sincerely explained and discussed with the men.

Representation of Employees and Personal Contact

In small organizations I suppose it has been recognized since before the day of Moses that personal, friendly contact with the toilers is the greatest salvation to enterprise. There is little trouble in factories or shops where the boss knows all the men and they have confidence in him. In larger organizations, say over 500 employees, where the boss is too busy to keep up his acquaintance with every one of his workers, and while he is engaged in his problems which keep him in his office a great deal of his time, there is a tendency for the value of contact to be forgotten and the kind and sympathetic policy of even the greatest hearted leaders fades out before it reaches far down the line in the organization.

If this condition exists, it would seem that a proper time should be set aside for the meeting of representatives of the employees, at which time the management will give their full time and attention to the desires and suggestions of the workers. All men can reason and most men are honest. If a request or suggestion be not granted the workers, they should be thoroughly satisfied with the reason and mutual agreement enjoyed by both sides. A great deal of time has been spent as a result of plant managers attempting to give employees what they think they should have instead of finding out in an open meeting—through free expression of employees—what they really want. It requires sincerity and frankness to point the way, so that men may enjoy freedom of expression, proper guidance and square treatment.

Progress

We all know what it is to feel the joy of progress. But because of the competitive state of industry, there is a limit to wages that may be paid. Consequently we should not relax in our effort to keep up interest among the workers by training them more and more in their work, promoting them when we can and, when we find our organization too small, going to the extent of helping them get larger positions with other employers. The incentive given the workers in any organization through this policy is great and more than compensates for the loss of a valuable employee occasionally. Then every worker will feel that if he reaches his limit in the organization he is still preparing himself for a greater reward elsewhere, and that the boss will be glad to say a good word for him, and in fact help him to obtain a better job.

Recreation

Pleasure during leisure hours is very important, and a little effort on the employer's part to put system into leisure is a very valuable thing. When the tension of work has ceased at the end of the day, the worker is naturally restless but happily in a receptive mood where pleasure is concerned, and at this moment we should endeavor to meet him and fulfill his want and give him legitimate opportunities for wholesome pastime. This may be accomplished by seeking out a few well-known and trusted employees and asking them to form a committee which will nominate officers among the help, in an open meeting, to serve on a recreational board. When this board is elected by the employees, it should be understood by all that the management shall at all times maintain the power of veto whenever it is found necessary to use it, or to maintain order and to prevent unreasonable expense. There are many forms of entertainment which by the aid of both men and women of the plant are readily worked out.

Pride of Possession

History seems to indicate that those people who own their homes or possess land are the least apt to rebel against their governments. We know that the man who is interested in his home is happy, and I believe the time is coming when industrial workers will be encouraged more and more to own their homes. It is certainly a stabilizer, for men will stop to reason when something they hold dear is at stake. Employers are realizing this and are assisting their help in purchasing their homes or by fostering some sort of thrift plan which leads to saving and financial independence.

So far we have considered the matter of honest, sympathetic and wise management of the worker and h health and happiness during work and recreation, b there is still another great power to reckon with f the building up of happier relations and a sympathet understanding between worker and manager, and th is the pride of ownership in the enterprise.

Thrift Plans

Stock subscriptions on easy term payment plans a in proper proportion to the worker's wages have in proved workers and employers alike. It is a foolish ma who tears down that which he builds himself, a dividends paid to stockholding employees have a marke effect in establishing contentment and understandin We shall hear less about "capital and labor" when mo of us who labor are "capitalists" too. The worker wh owns stock in his company soon learns that witho capital there is no labor or vice versa; that each is a equal half of the whole, that one cannot exist witho the other.

The world is getting better. Men are thinking mo of the general welfare of the race than ever befor There is more real honest effort to be frank and hones with each other, and, in spite of the present turmoil an severe loss of time and production due to strikes an their causes, men are drawing nearer the solutio Selfishness is slowly but steadily giving way to justic and it will not be many years before unjust demand will be met by such strong public disapproval tha men will strive harder and more unselfishly to co-ope ate. No profit will be considered worthy or gratifyin unless it is earned through fair service to investo toiler and the public alike. Progressive business me are accepting the belief that this is good business.

There are still too many fault finders instead of fac finders. We should remember that the procedure is after all, a simple one based upon justice, commo sense, perseverance and an abundance of patience.

Wilmington, Del.

Safety Organizations as an Aid to Health and Happiness of Employees

Harry A. Schultz, assistant manager of the bureau o safety, sanitation and welfare, U. S. Steel Corporation has published an article in *Safety* for August in whic he describes some of the functions of the safety organization. One thing stands out in the article. It is th tremendous aid which a safety campaign can be toward furthering the health and happiness of the employees not only the actual diminution of injury and conse quent gain to the organization but the mental relie which comes to the worker when he realizes that a honest, intelligent effort is being made to protect his interests and his health. Workers are quick to see through subterfuge. They realize immediately when an attitude is sincere and when it is camouflage.

Another point which Mr. Schultz mentions has to d with stimulation of the safety spirit. An obviously guarded machine is a distinct asset to shop morale.

Educational activity in connection with safety campaigns is another phase of work which must be very carefully tuned to workers' psychology. Straightforward honest substance must be the backbone. A splendid example of failure in such a campaign was a Americanization campaign carried out in many industrial plants and an equally splendid example of success is the safety poster campaign which runs continuously as a service.

Standardization Will Increase the Production Efficiency of the Chemical Industries

THE industrial significance of standardization has been ably defined by Dr. P. G. Agnew, secretary of the American Engineering Standards Committee, in a platform of sixteen points, seven of which pertain directly to increased production efficiency. These seven points are as follows:

Standardization stabilizes production and employment.

Standardization makes mass production possible.

Standardization eliminates indecision in production.

By concentrating on fewer lines, standardization enables the manufacturer to put more thought and energy into designs.

By bringing out new facts in order to determine what is best and to obtain agreement on most questions, standardization acts as a powerful stimulus to research and development.

Standardization is one of the principal means of getting the results of research and development into actual use in the industries.

Standardization helps to eliminate practices which are merely the result of accident or tradition and which impede development.

These are some of the things that standardization will do for industry in general, and there is no real reason why it will not do as much for the chemical industries.

Present Status of Standardization in Chemical Industry

To judge from the experience of other industries, such as those in the electrical and automobile fields, it would seem probable that standardization will proceed slowly in the chemical industries during the next few years, after which it will go forward on an increasing scale and with increasing rapidity. There is no doubt that if standards are agreed on properly by producers and consumers, they will come into as general use and be of as great advantage in the chemical field as elsewhere.

A great deal of valuable standardization work has already been accomplished in many of the chemical industries. Consider a few examples: In the fertilizer field there has been extensive work done in the standardization of grades. This has been worked out by cooperation between producer and consumer. In the paint and varnish field a great deal has been done in defining materials and in agreement on methods of test. Cement is in excellent shape; better, in fact, than most other industries. This results from the fact that the American Society for Testing Materials and the various governmental bodies concerned finally settled on specifications. These are now universally recognized as a real national standard. In rubber comparatively little has been done.

Standardization Work by Technical Societies

The American Chemical Society has had, for many years, a supervisory committee on methods of analysis which has done work of far-reaching consequence. The work of this committee has been of considerable help to other societies engaged in standardization.

A well-known example is the valuable contribution of the Manufacturing Chemists' Association to the movement through the standardization of the Baumé table for determining the specific gravity of liquids. It was not so long ago that there were in use in America twenty-three different variations of the Baumé scale. The result, of course, was infinite confusion. Today there is one Baumé scale in use throughout the United States; a fine example of increasing production efficiency through standardization.

Need for Inernational Standardization

The Baumé scale used in America, however, is not the Baumé scale used in Germany. This brings us to the need for international standardization. In America 66 deg. Bé. indicates 93.5 per cent sulphuric acid; in Germany 66 Bé. indicates 98 per cent sulphuric acid. There are cases where 98 per cent is effective and 93.5 per cent no better than water. Yet there are in America hundreds of students and others reading German literature on the subject, conducting experiments and carrying on research without realizing this difference in the Baumé scales of the two countries. In England there is still another scale, called "Twaddell" after the man who devised it, but it is not used in America.

Standardization of Nomenclature

If we are to increase our production efficiency, we must first of all learn to talk the same language. In other words, a prerequisite to increased production efficiency in the chemical and metallurgical industries is, as in other fields, the standardization of nomenclature. If we are to have increased production efficiency, we must first settle on definitions. Sulphuric acid, for instance, should always be designated in terms of SO_3, sulphuric anhydride, which is common to all strengths of acids. In one large American company all sulphuric acid accounts are kept in terms of SO_3, and as a result this company knows immediately the cost of any strength it needs. It is difficult to understand how the manufacturer who does not keep his sulphuric acid accounts on this basis can know what he is about in handling sulphuric acids. Yet there are few manufacturers in America who observe one standard in their records.

Standardization of Equipment

There is a tremendous opportunity in the chemical and metallurgical industries for the standardization of apparatus, tools and other mechanical equipment. In this work the chemically controlled industry appears as the ultimate consumer, instead of as a producer, its rôle in the case of materials.

Work of the A.E.S.C.

The standardization that has already been effected has been possible only because the producers, consumers and general interests were brought together. The necessity of this has been shown over and over again in the experience of those bodies which have done extensive standardization work. It often happens that before agreements can be reached the air has to be cleared of misunderstandings through disagreements and controversies, not to say fights, that have sometimes lasted for

years. Yet when these differences have been thoroughly threshed out, results of great value are almost sure to ensue. The development of the whole co-operative idea in industry has brought about the possibility of systematic co-operation in standardization work on the part of the various bodies which speak for industry, and the American Engineering Standards Committee has been developed as the mechanism of this systematic co-operation. Conversely, the very existence of the A.E.S.C. has stimulated industrial co-operation in standardization by those interested.

Standards Now Being Considered

Many of the men who are most active in the affairs of the A.E.S.C. are identified with the chemical industries or the profession, and at least fifteen of the eighty projects now under consideration are of direct interest to the chemical and metallurgical industries. This list includes the following:

Chemical analysis of alloys of lead, tin, antimony and copper.
Electrical properties of aluminum.
Standard methods of laboratory sampling and analysis of coke.
Safety code for explosives.
Specifications for galvanizing and sherardizing iron and steel.
Gas safety code.
Standard specifications for purity of linseed oil from North American seed.
Paper and pulp mills safety code.
Standard method of test for penetration of bituminous materials.
Pipe flanges and fittings.
Color schemes for pipe lines.
Safety code for tanneries.
Safety code on ventilation.
Zinc and zinc ores.

Standards Already Adopted

Nine standards of a chemical nature have already been approved:

Specifications and tests for portland cement.
Standard method for distillation of bituminous materials suitable for road treatment.
Standard method for sampling of coal.
Specifications for lake copper wire bars, cakes, slabs, billets, ingots and ingot bars.
Specifications for electrolytic copper wire bars, cakes, slabs, billets, ingots and ingot bars.
Methods for battery assay of copper.
Methods of chemical analysis of manganese bronze.
Methods of chemical analysis of gun metal.
Specifications for the testing and use of permissible explosives.

What Standardization Will Do For Industry

Standardization is merely getting together and agreeing. Among the important things which standardization will do for the chemically controlled industries are:

It will provide a more truly competitive market in which to buy equipment.

It will make it easier to repair and replace chemical manufacturing equipment.

It will reduce the cost of manufacture.

It will simplify the keeping of cost accounts.

It will eliminate most of the controversies as to whether the product is in accord with the sample.

It will increase the production efficiency of the industry.

It will give accurate definitions to enable one to know what he is talking about, what he is buying and whether he is getting what he is buying. Such definitions will go far to eliminate disputes and litigation.

Standardization of Shipping Containers

One of the most important phases of the standardiza tion campaign is that which looks toward the adoptic of standard, efficient and simple containers for shippin purposes.

At the recent meeting of the American Society fc Testing Materials a committee report was presented o this subject which shows the progress which has bee realized in the campaign for such containers.

Work by the A.R.A.

The importance of determining what shipping co tainers are proper and efficient and of prescribing cle and definite specifications for them has been recentl recognized in a very active manner by the America Railway Association. The executive committee of tha association, in connection with its drive to reduce los and damage, has ordered the bureau of explosives t expand its test and specification department to includ the investigation of shipping containers for all kinds c commodities and to prepare recommendations in th form of specifications for the efficient container.

The freight container bureau is investigating shi ping containers from a purely engineering standpoin which will, of course, involve special consideration o proper economies and the standardization of types a well as the actual efficiency of construction for trans portation purposes. Investigations are being made a plants making the containers and at plants using them shipments are also to be followed and observed at rail way stations and steamship piers to determine actua results in transit.

Reasons for Container Standardization Found Within the Plant

In addition to the economies and advantages to b realized in rail and water shipments through the adop tion of simple and standard containers, the use of thes containers aids greatly in the efficient operation of th manufacturing plant itself.

Containers must be either purchased or made in th plant, and, in either case, the fewer the types used an the more nearly uniform these types are, the less spac is required for their storage. If the containers ar made in the plant, then the parts or the material fron which they are made will be received in an unworke state. In this case, the labor cost of working thi material up into the desired form is reduced in pro portions as the number of styles and sizes of container is reduced.

The Standard Container and Automatic Equipment

To realize, in any industry, the maximum efficiency of production, we must resort to the fullest possible extent to the use of automatic and labor-saving equipment. This applies possibly more to packing and shipping the product than to any other operations which it undergoes. It will be readily recognized that wrapping and filling equipment can be applied to only a limited range of container sizes. So also, conveying equipment is limited as to the types of container which can be handled. Thus unless a plant is to have a multiplicity of this automatic equipment, much of it idle at any given time, or is to do without realizing the full advantages of this equipment, it becomes necessary to confine the containers used to the smallest number of simple types which ingenuity can devise.

Manufactured Weather And Personal Efficiency

An Analysis of the Advantages Which Accrue From the Use of Humidified Air-Ventilating Systems — Especially With Reference to the Efficiency of the Individual Worker

By Willis H. Carrier
President, The Carrier Engineering Co.

IN MANY industries the modern science of air conditioning is employed effectively to increase the process efficiency where products sensitive to atmospheric temperature and moisture are involved. The idea of manufacturing weather to meet the requirements of the many industries manufacturing such products is already firmly implanted in the minds of the great manufacturers of this country. In fact, manufactured weather, made to meet the exact requirements of these industries, has so improved their process efficiency that the manufacture of such products as cotton, wool, silk and other textiles, tobacco, candy and bakery products may be said, without exaggeration, to have been revolutionized by the application of scientific air conditioning.

It seems, therefore, quite astonishing that a conception of personal efficiency, as affected by the physical condition of the worker, has not developed coincidentally with our intense development of process efficiency. It is true that in the modern plant the physical comfort of the employees is most carefully considered with respect to sanitation, seating, lighting and arrangement of equipment to minimize the effort necessary to the given operation. But in only a few of our modern plants have the effects of the condition of the surrounding atmosphere been considered.

Elements of Production Cost

There are three elements of production recognized as determining the profits of a manufacturing process:

1. The volume and value of the product produced for a given plant investment.
2. The quality and uniformity of the product produced.
3. The cost for labor per unit of production.

Even in cases where the product is of such nature that the first two of these factors are not involved, the third factor is so directly affected by the atmospheric conditions within the plant—that is, temperature, humidity and cleanliness of the air—that scientific air conditioning will prove an exceptionally profitable investment. Although it is true that in a surprisingly large number of industries the product itself or the process of its manufacture is directly affected by atmospheric conditions so that upon the basis of enhancement of process efficiency alone air conditioning pays handsome returns, it is the province of this paper to discuss primarily the effects of air conditions upon the human being as these effects are related to the personal efficiency of the worker.

No matter how highly mechanized the given industry may be, the quantity and quality of the product always depends, in large measure, upon the personal efficiency of the workers themselves. It is a well-recognized fact that the personal efficiency of the human being is seriously impaired when he or she is subjected to improper air conditions, such as excessive heat or cold, excessive humidity or dryness, or air that is contaminated with dust, fumes or other injurious impurities. Unhealthful and depressing air conditions are inherent in the manufacture of certain products, such as the excessive heat caused by the power utilized in a large textile mill, the fumes in a chemical plant and the dust in a tobacco factory.

In most of these industries the condition is so acute that it has received the attention of employers by force of necessity. In many other industries where the condition is of lesser degree, the impairment of personal efficiency is scarcely the less serious and the question of providing healthful and invigorating air conditions is of great importance.

Conditioned Factories Capable of Holding Workers

There are, in fact, many instances where the personal efficiency of the workers themselves has proved of greater moment than the mere mechanical efficiency of the process. In any industrial community where there is broad opportunity of choice in employment, workers will seek employment where conditions in respect to health and comfort are most satisfactory, assuming that wages are approximately equal. This is particularly true of female workers, a great many of whom are willing to accept work where the factory conditions are good and the environment proper, but who would not work, unless compelled, under unhealthful or distasteful conditions.

Thus one of the first direct results of improving the atmospheric conditions within any manufacturing plant is the attraction of a labor supply which is satisfactory in both quantity and quality, permitting the selection of more efficient workers at a reasonable wage. In addition there is a correspondingly lower labor turnover because the employees are satisfied and anxious to retain their positions in the plant where healthful and invigorating conditions are assured by the installation of well-engineered air-conditioning equipment, the labor problem is greatly simplified and it is possible to develop a carefully selected personnel, so that the common dissatisfactions are practically eliminated, the turnover is minimized and there is little necessity for discharge and replacement.

Analysis of labor cost by Mr. Alexander of the General Electric Co. has shown that the cost of losing one worker and replacing him with another amounts, both directly and indirectly, to from $50 to $250, depending upon the skill and experience involved. A low labor turnover and satisfied employees are, therefore, exceedingly important elements in the cost of production. Before discussing the importance of proper air conditions, let us examine the factors which are involved and the conditions conducive to health and vigor, or, in other words, to personal efficiency.

The problem of the air-conditioning engineer is divided into two distinct phases—that is, conditioning in the winter and in the summer. In winter there are

two principal factors: the uniform heating of the inclosed space to a definite controlled temperature, and the addition of sufficient moisture to supply the deficiency in outdoor winter air which has been heated to ordinary indoor temperatures. For example, outdoor air at zero, assuming it to be fully saturated, will contain less than one-half of 1 grain of moisture per cubic foot. This air when heated to 70 deg. requires, to saturate it, 8 grains of water vapor per cubic foot. Thus the relative humidity of zero outdoor air heated to 70 deg. indoors by any of the common methods of heating, such as the steam or hot water radiator, which do not add appreciable quantities of vapor to the air, would be approximately 6¼ per cent, since the air would contain but one-sixteenth of the moisture which it could contain at its new temperature. Thus such air would be so excessively dry that it would exert an intense drying effect upon the skin and the delicate mucus membranes of the noses and throats of the workers. Such a condition inevitably produces a severe physical depression in the worker and an accompanying mental depression which are reflected in a dullness which in turn seriously impairs the personal efficiency of the worker from the production standpoint. Further, such a condition is conducive to colds, bronchitis and similar ailments which cause a high rate of absenteeism and a consequent decrease in production, together with an increase in production cost.

A suitable air-conditioning equipment will relieve such conditions of excessive dryness in closed buildings, under winter conditions, by automatically humidifying the air to that percentage of relative humidity most conducive to health and vigor. In addition, such equipment will afford a distribution of the conditioned air so uniform and so free from drafts that the general comfort and health of the worker will be enhanced.

Summer Ventilation

In the summer the problem is reversed. The presence of a large number of workers within an inclosed space, in conjunction with heat generated by power, lights and other causes, even if all of the ordinary means of natural ventilation, such as open doors and windows, are employed, will cause a vitiation of the atmosphere and an increase in temperature which will result in depression, dullness and loss of personal efficiency. It is well known that in many industries production, during the extreme heat of summer, will fall off as much as 25 per cent.

Dr. E. Vernon Hill of Chicago has made experiments indicating that the cooling effect or comfort condition of the air depends in a larger measure upon the wet bulb temperature than upon the dry bulb temperature. He found that the most comfortable wet bulb temperature under normal conditions is about 56 deg., although this point must be raised in summer time in order not to cause too great a contrast between outdoor and indoor conditions. He also determined approximately the relative effect of air velocity in producing a cooling effect. For example, we have all noticed the cooling effect of a draft of air or of an electric fan even though there was no actual change in temperature or moisture condition. This occurs because the air under velocity is capable of carrying away a greater amount of heat. Dr. Hill has related the wet bulb temperature and velocity conditions in so-called zones of comfort so that, with a given wet bulb temperature, the velocity required to insure comfort and health can be readily determined.

There are two methods by which the summer conditions can be relieved. In a building where there is a great inherent heat source, such as a textile mill where a great quantity of power is utilized, evaporative cooling may be employed. In this method all of the air enters the building through a humidifier which cools it to the outdoor wet bulb temperature* (usually from 10 to 25 deg. below the dry bulb temperature) and fully saturates it with water vapor, at the same time washing it clean and free from dust and other impurities.

The conditioned air, saturated at the outdoor wet bulb temperature, is then uniformly distributed throughout the building in such volume that the rise in temperature within the room is sufficient to depress the relative humidity to a comfortable degree, though the final temperature is an appreciable number of degrees below that of the outdoor dry bulb.

Thus, without the use of cold water or refrigeration, since the water of the humidifier is used over and over again, only that part absorbed by the air being replaced, it is possible to effect a comfortable and healthful condition within factories of certain types, in any locality. In localities where the wet bulb depression is normally very great, such as in our Middle Western states, it is possible to effect a sufficient degree of evaporative cooling even where there is no great internal heat source, the external heat being utilized to bring the air to that temperature at which its relative humidity is comfortable and invigorating.

If evaporative cooling, due to the locality, to the conditions within the plant or to the necessity of maintaining a temperature and humidity below those of the outdoor atmosphere, is impracticable, the cooling can be accomplished by the use of natural cold water from wells or other sources or by the use of mechanical refrigeration. By this method it is possible to maintain any required temperature and humidity regardless of the outdoor conditions.

Weather Can Be Manufactured Anywhere

Thus, no matter what the locality may be or the particular conditions within the given plant, air-conditioning equipment can be applied to establish and maintain whatever conditions of temperature and humidity are most desirable or warranted. It should be borne in mind, of course, that the factor of cleanliness, though not sufficiently stressed in this writing, is of great importance, and that all well-designed air-conditioning equipment provides air that is clean and pure whether the equipment be functioning to humidify or dehumidify.

The initial cost of adequate air-conditioning equipment, when considered on the basis of human efficiency and human comfort alone—that is, exclusive of process efficiency—often appears to be too high to permit consideration. This is because we are unaccustomed to consider human efficiency in terms of dollars and cents. The cost of any apparatus is not measured by the number of dollars and cents involved in its purchase, but by the number of dollars and cents which it can earn for its purchaser. When we have become accustomed to evaluating human efficiency in the same way in which we now evaluate the production efficiency of the machine, the cost of scientific air-conditioning equipment

*If partly saturated air is brought into contact with water, preferably in a finely divided state, and permitted to absorb sufficient water vapor to become saturated, it will be cooled to its wet bulb temperature.

will appear insignificant when compared with the results which it accomplishes.

Leading to the discussion of the effects of air conditioning upon labor it is worth pointing out that when labor is scarce in time of great industrial activity and a command of the labor market is of greatest importance, the condition plant invariably has first call and rarely is unable to fill all of its labor requirements.

The effect of improved atmospheric conditions upon employment may be typically illustrated by the case of a textile manufacturer in Fall River, Mass., who installed a ventilating, cooling and air-conditioning system in his new mill alongside a similar, older mill not thus equipped. All of the employees in the older mill applied for work in the new mill during the first summer of operation, during a time when there was great scarcity of labor. The manufacturer found it utterly impossible to get sufficient labor to run his unconditioned mill to full capacity and efficiency. At no time, however, did he have the slightest difficulty in getting all the labor needed in the conditioned mill. As a result the profits in the new mill during this period of activity greatly exceeded those of the older mill. Another thing that he noticed was the decreased labor turnover in the new mill as compared with the older mill. In fact, the demand for employment in the ventilated and cooled mill was so great that the management found it expedient to offer change of employment from the other mill to the new mill as a prize for exceptional proficiency as well as punctuality and attendance.

The manager of a large New England factory had been experiencing great difficulty during the hot summer weather in keeping the plant operating at capacity. The combined heat of a high outside temperature and the additional heat from the machinery was such that the girls in his employ were frequently taken ill during the day and the routine of the factory was seriously handicapped. The experience made him realize the importance of securing proper conditions, if possible, in his mills, and he made several attempts, with partial success, to improve the conditions. Finally he decided to install a modern ventilating and conditioning system in one of the smaller of his plants, with the result that the difficulties he had experienced in summer were entirely eliminated. This led him to equip all of his old factories, as well as those built later, with the same type of equipment, at great expense, the improvement in labor conditions alone warranting this procedure.

Tobacco Dust Settled and Prevented

Another concrete illustration is a tobacco factory in Richmond, Va., in which mechanical stemming machines are used to strip the leaves from the stem. The dust produced by this process was so great that one could not see the length of the room. Operators had to breathe through handkerchiefs placed over their mouths. As a result, it was found difficult to secure sufficient labor to keep all of the machines in operation and only the poorest class of labor could be obtained. The installation of an adequate humidifying system both settled the dust and largely prevented its formation, the working conditions became measurably ideal and no difficulty was experienced in getting the best type of labor to operate the plant at full capacity and at highest efficiency. Not only was the output of the plant increased, but the labor turnover and cost was reduced and the efficiency of the machines increased due to a better working condition of the tobacco. The annual saving in tobacco alone was more than sufficient to pay for the equipment, besides a material saving in the wear on the machines.

As an illustration of the desirability of properly conditioning the air of buildings in which the process itself is in no way affected, the Ford automobile plant in Detroit may be cited as a conspicuously successful example. Mr. Ford first had his office equipped with a modern ventilating, humidifying and cooling system, and the benefits from it were found to be so great during the hot summer weather that he decided that such a system would give equal or greater benefits throughout his entire machine shop. Elaborate ventilating and cooling systems of this character have now been installed throughout his plants and have become a standard feature of all new construction. The benefits derived are felt to be more than commensurate with the expense entailed.

Individual Efficiency Benefited

While the efficiency of an operator depends largely upon the individual, yet the same individual will do more and better work if in good health and working under conditions of physical comfort and mental contentment. Conditions of excessive dust, or conditions of extreme temperature and moisture, are injurious to health, thus lowering the vitality and driving force of the operative, without which he cannot accomplish the most and best work. He is apt to be frequently absent, due either to sickness or to desire for change. Even though atmospheric conditions may not be sufficiently bad to cause ill health, they may affect the comfort and mental state of the operative to such an extent as seriously to distract him from his work. Such conditions may only be seasonal, as, for example, in summer, while in other cases they may occur only in winter. In a textile mill that is insufficiently ventilated and cooled, the operators will be found opening the windows and spending most of their time standing near them, often to the neglect of their work. Such conditions result in a noticeable loss of production.

Where this condition has become customary, as in old plants, it is often found very difficult to prevent operatives from opening the windows after a cooling and humidifying system has been installed, even though the opening of the windows in no way improves the condition. This seems to be largely a psychological effect and in general it is desirable to provide such a form of ventilating and cooling system that the effect of opening the windows will not be especially detrimental to the operation of the system. In most plants it is desirable to arrange the lower portion of the sash so that it cannot be opened, with a ventilating sash provided in the upper part sufficient only for the exit of air from the building.

In many office buildings where ventilating and cooling systems have been installed, occupants still desire to open windows, although the effect is almost entirely psychological. This practice is not objectionable in summer except where there is a dehumidifying system installed to reduce the air to both a lower temperature and moisture content than that outside. Here it is essential to the efficient operation of the system that all the windows be closed. On this account it is necessary, with a system of dehumidification and cooling, that the temperature and humidity standards be established with due regard to personal comfort, so that there will be no desire to improve the ventilation.

The determination of those conditions of temperature

and humidity most comfortable and invigorating to the human being involves a study which has been prosecuted for many years. Investigations have been conducted by physicians and by engineers. Obviously it is not possible to establish any given condition of temperature and relative humidity as the most desirable, since there are many conditions of temperature and relative humidity—the relative humidity varying, of course, with the temperature—which are comfortable and stimulating. It is true also that indoor conditions which are comfortable in the winter would be extremely uncomfortable in the summer. Nature adapts our bodies to changing conditions with a remarkable facility. Everyone has noticed that in the late fall or first days of winter we are chilled by temperatures which later in the winter we resist without difficulty. It is notable too that the first very hot days of summer are much more depressing than the same conditions later in the summer when nature has adapted us to withstand the summer conditions. Most of us are accustomed to winter temperatures considerably higher than those which are most healthful. This is true because winter air heated to ordinary indoor temperature is excessively dry and does not afford the feeling of warmth, even at high temperatures, as much as 80 deg. F., which the same air would afford at much lower temperatures, as low as 68 deg. F., if the air were moistened to the proper percentage of relative humidity; in other words, 80 deg. air at a relative humidity of 20 to 25 per cent is far less "warm"—i.e., does not produce the sensation of warmth which air at 68 deg. and 50 to 55 per cent relative humidity affords.

The writer has repeatedly observed that individuals—women, for example—who habitually spend much of their time in winter in the home, require, if the air is dry or not humidified, extremely high dry bulb temperatures, even in excess of 80 deg., before they experience the feeling of warmth. Constant exposure to excessive dry bulb temperatures of this nature, the air being as dry as it normally is in an unconditioned building, induces mental and physical dullness and renders the subject highly susceptible to colds, bronchitis and similar ailments of the bronchial areas.

It is notable too that when exposed to high dry bulb temperatures at low relative humidities the human being is astonishingly susceptible to drafts. In very dry heated air nature attempts to protect the body by establishing a film of more moist air in immediate contact with the body. This is assisted by the clothing, which prevents the sudden dispersion of the film by drafts. Thus it is that the draft is most noticeable upon the unprotected skin or upon the ankles and lower limbs which are but scantily protected.

Low Humidity in Houses Is Barbarous

Humidification entirely relieves this unfortunate, indeed it may be characterized as barbarous, condition. The maintenance of a temperature of 68 deg. as a suitable relative humidity (from 45 to 55 deg.) affords complete comfort in stimulating both physical and mental vigor. The dollars and cents value of such stimulation in the case of the worker employed in productive effort, though difficult to compute precisely, is obviously very material.

In the summer, with the outdoor conditions reversed, a number of new factors are introduced. It is well known, of course, that the average person is rarely actually incapacitated by even unusually severe summer conditions, provided those conditions occur gradually, whereas it is equally well known that a sharp change either from hot, humid weather to cooler and less humid weather, or vice versa, will cause extreme discomfort even though the actual values of temperature and humidity in either case are not in themselves extreme or even ordinarily large.

Because of this inability to adapt ourselves to sudden changes in summer temperature, it is not feasible to establish in summer a fixed internal temperature and relative humidity to be maintained every day. It is necessary to establish internal conditions of both temperature and humidity which bear a definite relation to the external conditions. Thus, on a day when the outdoor temperature is 90 deg. and the relative humidity fairly high, the average person experiences a feeling of complete comfort and relief upon entering a building in which the temperature is 82 or 83 deg. and the relative humidity slightly depressed. Again, on a day of 80 deg. outdoor temperature, the relative humidity being high, as usually occurs in August in the climate of New York City, the internal condition of 74 or 75 deg., the relative humidity being materially depressed, affords complete comfort and is extremely invigorating.

Nature's Provision for Changes in Temperature

Because it may foster a more thorough understanding of the subject, it may be well to point out that nature attempts to compensate for excessive summer temperatures by increasing the rate of evaporation from the skin, and thereby affords the body the relief of the consequent evaporative cooling. If the humidity is high, the rate of evaporation is correspondingly low, and it is for this reason that humid days cause us the greatest discomfort. In fact, we ordinarily experience discomfort on very humid days when the dry bulb temperature is well below 80 deg., a temperature which would be entirely comfortable if the corresponding relative humidity were sufficiently low.

The reason why the electric fan offers a measure of relief during summer weather is the fact that the evaporating effect of the air is a function of velocity as well as of temperature and humidity. Thus the draft from an electric fan increases the rate of evaporation and therefore cools the skin, affording the sensation of coolness, although the body temperature is only slightly, if at all, affected. Used unwisely, the electric fan is the source of much physical depression since a draft playing directly upon the unprotected skin of the arms and neck causes a local concentrated cooling effect by evaporation which is extremely difficult for the body to compensate. The electric fan should never be directed immediately upon the body, but so placed that the movement of air which affects the body is induced by the draft of the fan. The danger of this localized effect is entirely avoided in a building which is regulated by means of scientifically designed air-conditioning equipment since the air delivered is distributed through a carefully arranged duct system without drafts and with great uniformity.

It is entirely assumptive that in the very near future the production efficiency of the human being will be considered as carefully as that of the mere mechanical equipment, and that air conditioning will be employed as a practicable means of assuring maximum personal efficiency in any climate at any season under any inherent conditions within the plant itself.

New York City.

Electrification of Chemical And Allied Industries

Electrification of Industry Rapidly Increasing — Use of Motor Drive Is a Help to the Executive — Controllers for Motors Should Be Chosen With Special Reference to the Industry — Proper Use of Electric Drive

By C. B. Gibson
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THE electrification of industrial plants has been a gradual process extending over the comparatively brief period of about 25 to 30 years. During the early part of this period the progress was naturally slower, but during the last 15 years the growth in the use of electricity in the various industries has been considerably more rapid. The original conception of the idea of employing motor drive arose from the necessity for a more convenient and flexible method of applying the driving force to machines.

Some of these machines were of a movable type with unusual motions and often located in some inaccessible place, which did not easily permit of driving by the methods in use then. The many advantages of this then novel method of drive were soon appreciated and motors for driving the more common machines, such as cranes, pumps, conveyors, etc., were soon adopted. A little later group drive and individual drive came into favor, until today electric drive is generally recognized as a necessity for economic and maximum production.

It is also recognized that the electrification of a plant or mill is not merely an engineering problem, comprising the generation and application of motors to machines, but it is one of the most direct, resourceful and accurate means for studying plant development. Unquestionably, electrification of industry has done more to aid executives in the study of plant problems than any other agency, because electrification is power scientifically applied and not merely an adjunct to a manufacturing process; and, further, because it is one of the important factors that lead to more efficient operation, better quality of product and general plant betterment.

Electrification in Chemical Plants

In the chemical and allied industries electrification is probably employed as extensively as in any other industry. As many of the branches of the chemical industry are users of large blocks of power in electrolytic and electrometallurgical operations, it is only natural that electricity be used for the various motor drives in the handling and preparation of the raw and finished materials.

Some indications of the rapid strides in the electrification of the industry are evident from data compiled on this subject. Considering the chemical and allied industries for the year 1914, the percentage of electric horsepower to total power, primary and purchased, was approximately 42 per cent. In 1919 it was approximately 56 per cent and it is estimated that this will reach approximately 70 per cent in 1924. These figures indicate the increasing rate at which electric drive is being adopted. In this connection it is interesting to refer briefly to the government census of manufacturers for 1919. For the fourteen major industries listed, representing the reports of 237,855 industrial establishments, the aggregate primary horsepower is 29,507,717. The number of electric motors installed is 1,483,039, aggregating 16,317,373 hp. This latter figure is made up of 9,347,556 hp. for rented, and 6,969,817 hp. for current generated in the establishment. The 1914 figures compared with 1919 indicate a gradual increase over this period.

While the figures for the strictly chemical and allied industries are relatively a small amount of the total, aggregating 2,043,525 of primary horsepower, they show the extent to which motor drive has been adopted by the industries in this country. The industries provide the major load of the central stations mostly in the form of motor drive, and it is gratifying to note that the central stations fully appreciate this. There is a co-operation and co-ordination of effort which is bound to reflect in a better understanding between the central station and the user.

Advantages of Motor Drive

The main advantages of motor drive are: Lower power costs, increased production, generally improved plant and working conditions and that the greatest return is realized when the entire plant is electrified. The larger the amount of power used, naturally the less the cost per kilowatt unit of energy, due to using greater amounts of power and on account of the diversity factor which means a more even and uniform load condition. Electric drive and automatic motor controllers reduce the amount of skilled labor very materially, as the automatic control device makes possible many self-controlled operations of the motors. Aside from these major reasons, electric drive helps in making a plant a model one in every respect, and this is an important consideration in this day when so much is being done for the welfare of workers. Other advantages are cleanliness, the absence of noise, and the suitability of the electric motor for most drives. Belts and line shafts are eliminated. One of the most important considerations is the ability of an electric motor to maintain the proper machine speed under varying and heavy loads, which in the final analysis means increased production.

Electricity is inherently more economical than steam in the great majority of applications, on account of its high electrical efficiency, low maintenance expenses of equipment, convenience and operating simplicity. Fundamentally, electrification offers one of the best opportunities to develop improvements. It provides an accurate means for determining all phases of plant problems, such as the power required by each machine or in each process. In the chemical industries many processes require extreme and accurate control in various stages of the process, and this is possible with electric drive.

Electrification Helps the Executive

The executive is concerned, among many other things, in reducing costs, increasing output and bringing up profits; and electric drive undoubtedly offers one of the greatest opportunities of accomplishing these ends. To

determine the economies affected through electrification, full consideration should be given of all the factors that may effect the results. Every factor entering into the problem should be considered, and the cost of power is only one of these factors. It is, however, the one common factor in every manufacturing industry, and by reducing the power costs, you can effect savings all along the line.

Practically all the industries welcome the opportunity to purchase power even where conditions might appear favorable for economic generation by the individual plant, because of the greater reliability of central station power and because the average executive feels he can realize greater returns by investing the capital in the business rather than in the power plant. The central stations also have made extensive studies of the requirements of motor drive for the various industries in order to have a better understanding of their problems and to stimulate a more active interest in the future extension of electric power in industry.

Choice of Cycle in a.c. Drive

As to the choice of sixty- or twenty-five-cycle power this is often determined by other conditions or processes in the plant. In several of the large electrochemical districts twenty-five-cycle only is available; and it is only natural that this same frequency be used throughout the plant—for the various motor drives, the haulage locomotives, industrial heating, lighting, etc. Outside of these few districts, sixty-cycle power is the predominating one. The sixty-cycle motors, except in very large sizes and slow speeds, are less expensive than twenty-five-cycle motors, and they offer a much wider range of speeds within certain limits. Alternating current squirrel-cage, wound rotor and synchronous motors are almost universally used, depending upon the type and character of the machine to be driven and the load conditions. Complete lines of these various motors in all standard ratings and speeds and for both twenty-five- and sixty-cycle are available from the electrical manufacturers. A few devices require direct current motors, such as on cranes or where a wide variation in speed is desired. Where relatively only few d.c. motors are used, it is customary to use motor generators for converting alternating into direct current for such purposes. If, however, large blocks for d.c. power are required, as in electrolytic processes, rotary converters are almost universally used on account of their superior operating characteristics, higher efficiency, wide voltage range, compactness and dependability.

Motor Drives in Chemical Plants

In the majority of motor drives in chemically controlled industries, squirrel-cage induction motors are used. They lend themselves particularly to this work on account of the absence of any sliding or movable contacts. This is particularly important where there are explosive fumes or materials present. Some of the applications in which motors are used are for driving conveyors, grinders, mixers, pumps, autoclaves, centrifugals, ball mills, kilns, etc.

While the large majority of drives are satisfactorily handled by squirrel-cage motors, occasionally the starting conditions are such that a motor which gives a higher starting torque must be used. For such cases the wound rotor motor, with reversing controller and resistance for speed adjustments, is most suitable. Again, some drives require mill type motors on account of the severity of the service. For driving centrifugal pumps or compressors, the synchronous motor is often used, and it offers a fruitful field for reduction in power costs. One of the inherent characteristics in the synchronous motor is its ability to improve the power factor of the system to which it is connected. As most central station rates are based on power factor, any improvement in the power factor often reacts in favor of the user.

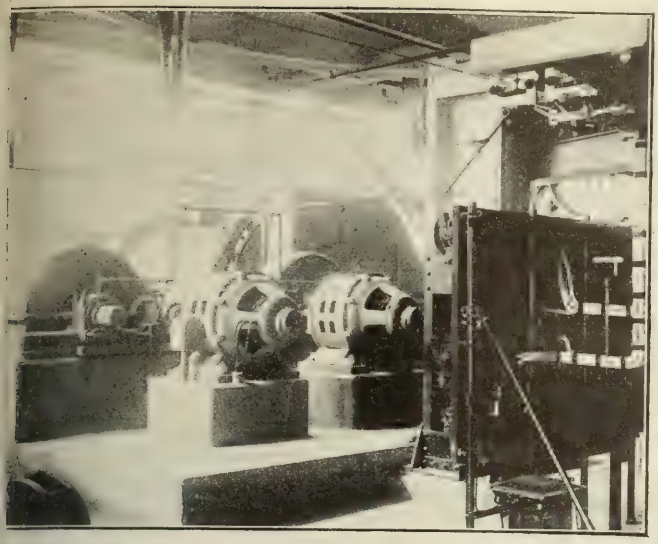
Electrical Requirements of Chemical Industry Severe

In many respects the service demanded of electrical equipment by the chemical and allied industries is more severe than in any other industry. Here we have the deteriorating effects of acid and alkaline fumes, coal, coke, abrasive dusts, smoke, steam, splashing of liquors, etc. In order to render the electrical equipment impervious to these destructive agencies, especially impregnated coils and windings must be furnished. In this connection it is interesting to note that motors are obtainable with these special impregnating treatments from the motor manufacturers. In a few cases the conditions are so severe that, in addition to these special treatments, totally inclosed or ventilated motors are used as an added precaution. The totally inclosed motor is not obtainable in sizes much above 25 hp. on account of its inability to dissipate the heat developed.

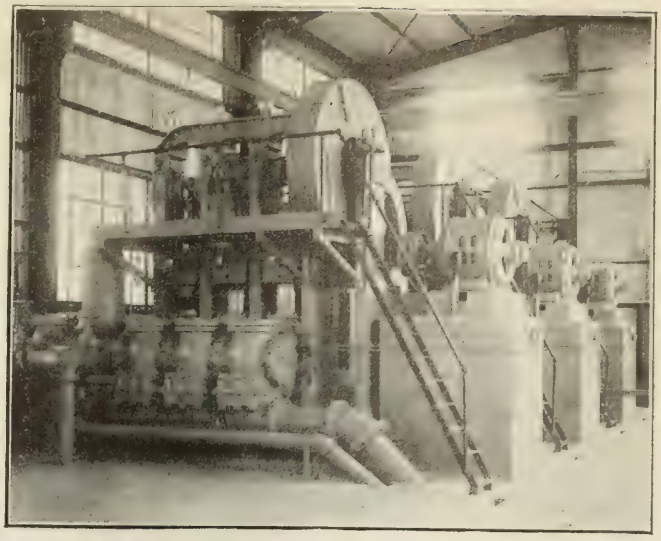
In the larger sizes, ventilated motors are sometimes used. In this type of motor the end brackets are provided with openings. Clean, pure air is piped from the outside to the intake of the motor and the air is exhausted directly into the room. When the run of intake pipe is considerable and the speed of the motor is below approximately 720 r.p.m., the fan blades on the rotor will not provide sufficient circulation of air. If this is the case, or where several motors are to be supplied with air, artificial circulation is resorted to; and a small motor-driven blower is placed in the supply pipe feeding the various motors. For several reasons many users favor the positive method of air circulation for all ventilated motors. In supplying air to ventilated motors, care must be exercised to see that the air is not contaminated with fumes or foreign materials. For some applications a motor with drip-proof covers is sufficient. In this type the end brackets are provided with vanes which divert any foreign materials or drippings of liquor from the motor.

Motor Controllers

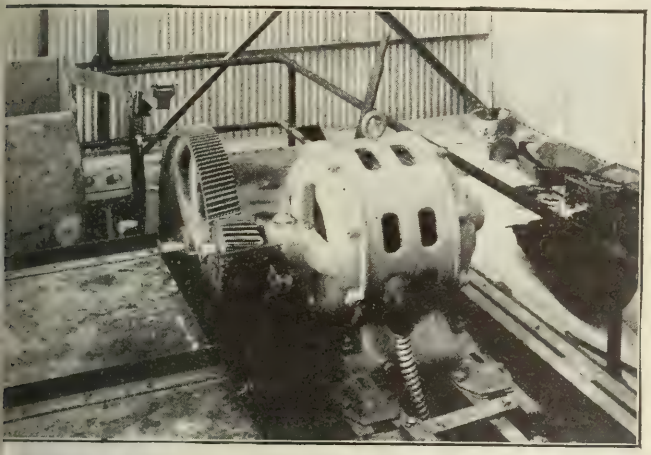
The control equipment employed for chemical plants is equally as important as the motors. There is always a type of control which is best suited and adapted to a particular type of motor. Experience indicates that a full knowledge of the motor characteristics and its performance is necessary in order to properly apply the control. Starters remotely controlled by means of a push button or small master switch are absolutely necessary for certain applications, especially when the motor is in some inaccessible place or where a life hazard is involved, such as in explosive plants. If explosive conditions exist, the completely immersed starter is generally used. In other types of starters where fume conditions are bad, special attention must be given to the contracts, flexible shunts, etc., by treating them with acid- and moisture-resisting materials. It can be con-



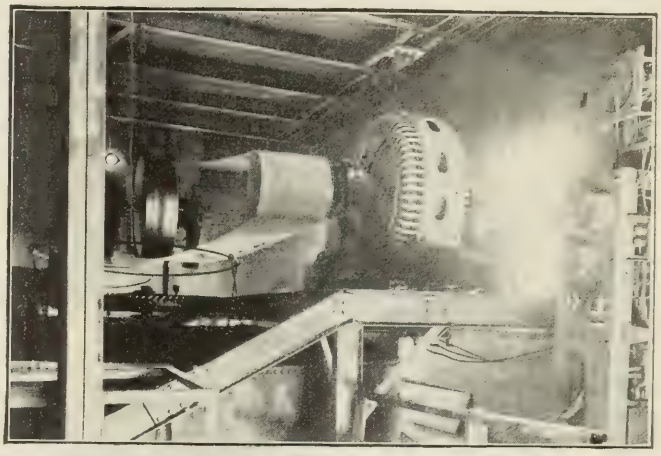
LARGE A.C. WOUND ROTOR MOTORS DRIVING MARCY MILLS



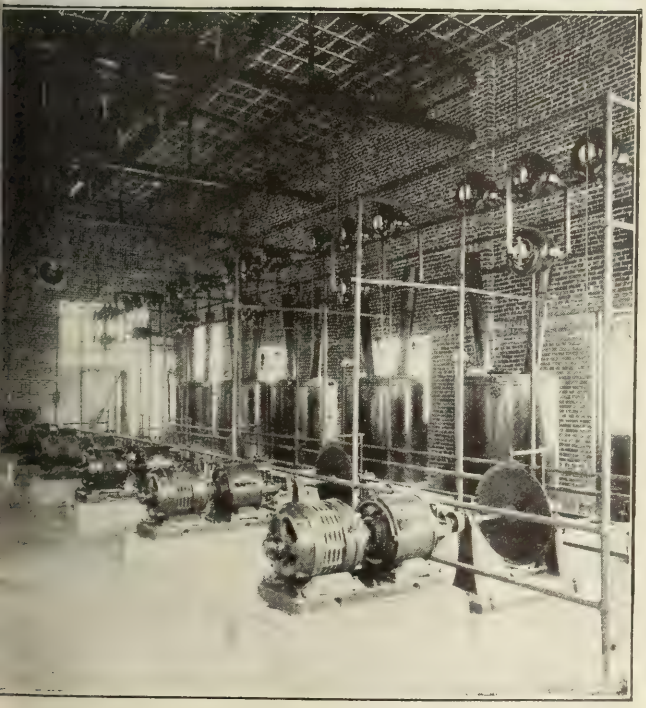
THREE 125-HP.-A.C. INDUCTION MOTORS DRIVING TRIPLEX PUMPS



25 HP.-A.C. INDUCTION MOTOR DRIVING CONVEYOR THROUGH SPIRAL GEARS



A.C. SYNCHRONOUS MOTOR BELTED TO SEVERAL AGITATORS



YNCHRONOUS INDUCTION MOTORS DRIVING GENERATORS AND RECTIFIERS IN COTTRELL INSTALLATION

A.C. INDUCTION MOTOR DRIVING CONVEYOR IN FERTILIZER PLANT

servatively stated that the executive or plant engineer in considering the electric drive can be assured of obtaining properly designed apparatus for all the applications.

While chemistry guides the manufacturing processes of the chemically controlled industries, the electric power is performing its duty silently and efficiently, resulting in increased production, more uniform product, and at minimum power requirements. There are several different types of drive either group or individual, belted or direct connected, etc. The application of these different types is pretty well determined, and is according to a well defined policy of broad plant development, including plans for future growth.

Electrification of Existing Drives

In the past but little attention has been given by executives to the rehabilitation of old plants, usually with steam engine drive; but this condition has rapidly changed and many of these plants have been electrified —using central station power, as it is then unnecessary to invest in a power plant, and the first cost of this change over is a small amount compared with the savings effected therefrom.

Other Possibilities of Electrification

Aside from the motor-driven machines in the chemical and allied industries, large blocks of power are used in electrolytic and electrometallurgical operations. It is not the intention to discuss the use of electricity in these processes, as they usually involve processes which could not be economically employed by using any other source of heat. In passing, brief mention should be made, however, of the possibilities and future of electrical heating in many of the processes. The growth in the use of electricity as a heating agency has been phenomenal. Many executives and others unfamiliar with the possible economies of electrical heating casually dismiss it from their serious consideration, on account of feeling that it is an expensive and impractical method. Fundamentally, there are many reasons why electric heat is superior to any other heat, and these reasons should receive earnest consideration. Some of these reasons are as follows:

(1) Electricity, regardless of the form in which it is used, may be applied at the desired place and in a definite quantity.

(2) The heat may be absolutely controlled.

(3) The central station power is available for heating 24 hours per day.

Applications of Electric Heat

A few of the possible applications in the chemical and allied industries for electric heat are: Heating kettles, vacuum chambers, evaporators, autoclaves, stills, vulcanizers and heating, drying and enameling ovens. The greatest advantages from industrial heating are obtained when the heating process is worked out in connection with other operations and processes. In laying out a plant for motor drive the process can often be improved or the time shortened if the heating processes are considered at the same time. A true estimate of the economies possible can be determined only from a consideration of all the factors entering therein.

The effective utilization and application of electrical power demands the broadest and widest experience and intimate contact with the industry. The executive is interested in knowing the most modern, efficient and economical method for applying power. In considering the electrification of a steam plant, he must know the maintenance cost of the entire steam plant from the coal pile to the crank pin, and balance this against the maintenance of the electric drive; and it will be found that the cost of power is the one common cost in every operation. In considering a new plant, he must consider the most economical processes and methods of handling of materials through the use of electricity; and, in the final analysis, a true valuation of these economies will undoubtedly point the way to worth-while savings through electrification.

East Pittsburgh, Pa.

Disadvantage of Low Power Factor

In a recent issue of *Industrial Management*, George E. MacLean, electrical engineer, of Sherbrooke, Canada, points out the disadvantages of low power factor. As this subject is of particular interest now when so many chemical engineers are considering the electrification of the drives in the plants under their charge, it is worth while to quote, in part, Mr. MacLean's article.

Power Factor Explained

Power factor is explained by Mr. MacLean as follows: "We contract for water at 120-lb. pressure and by some means or other send a back pressure of 10 lb., hence the water will have to be sent out at 130-lb. pressure to allow us to receive 120-lb. pressure, and we will have to pay for this extra 10-lb. pressure."

Similarly, in applications of motor drive, we have a back pressure called reactance—due to induction—caused by running many small induction motors and underloaded large motors. To overcome this reactance there must be supplied an excess of energy over that which goes into useful work. Power factor is the ratio of the useful electrical energy supplied to the total supplied and is expressed in per cent. Hence 85 per cent p.f. means that 15 per cent of the energy supplied is wasted in heating the electrical equipment, and only 85 per cent is available for useful work.

Disadvantages

"Excess heating causes a premature deterioration of insulation, which causes breakdowns and burn-outs of induction motors.

"Low power factor causes another condition with induction motors that does not show itself, as it affects the power consumption and can only be determined by making tests to find out the increase of this magnetizing current.

"Low power factor causes poor line regulation, which in turn decreases the torque of induction motors and increases the magnetizing current. This increase of magnetizing current is an added load on the system and has to be paid for at the same rate as though it was useful.

"For one who is not familiar with electrical terms and trigonometry most of the explanations of power factor are difficult to understand.

"We will say as an illustration that we contract for power at 85 per cent p.f. but can keep the power factor of our plant at only 75, and we consume 10,000 kw.-hr. at 6 mils. Our power bill equals 85/75 of 10,000 times 6 mils, or $67 instead of $60, or 11 per cent of the power bill is paid out for this wattless current."

Increased Production Efficiency in the Industries

Concise Statements by Leading Representatives of the Chemical and Related Industries in Answer to the Question, "What Would Contribute Most to Increased Production Efficiency in Your Industry?"

[N THE following pages the reader will find a group of frank statements by leading industrial representatives. They lay bare outstanding deficiencies in roduction processes, which, if remedied, will place hose industries on a more efficient production basis. lext in importance to maintaining an industry in a tate of general health is the frank recognition of weak pots that need improvement, and a vision of possible emedies. In fact, an industry cannot rightly claim to e in a healthy state unless it exhibits that forward-ooking spirit that seeks constantly to increase its efficiency in the interest of better service to its clientèle.

Judged by this standard, the chemical and related ndustries served by *Chem. & Met.* can lay claim to an xceptional degree of vigor and vitality. Certainly it an be said of the least progressive that it has within s ranks one or more men of vision who see clearly hat needs to be done in the interest of more efficient roduction. Their opinions will repay many fold the alue of the few minutes required for their reading.

A Neglected Ingredient in Acid Manufacture

By Fred C. Zeisberg
Chemical Department, E. I. du Pont de Nemours & Co.

THE chemistry of most of the acid processes in use today has been thoroughly worked out, hence it is eedless to look to any great increase in the chemical fficiency of these processes through further laboratory ork. How, then, can our acid industry be made more fficient without going to entirely new processes?

Before this can be answered with exactness for any ndividual process it can be safely asserted as a general ruism that improvement can be achieved only to the xtent that an exact knowledge is possessed of the mounts of ingredients required to make a unit quanity of the finished product. In other words, it is ecessary to have firmly established a thorough system f chemical control of processes and chemical accountng of the ingredients in process.

But this is not all. The amount of labor necessary, nd its grade; the amount of repair labor, when this s a separate item; the amount of repair material; and ast but not least, the power—all these items must be nown accurately.

There are many plants where none of these items is nown, except in a general way. There are more where he raw materials alone are known. There are a few here all of the items except power are known. And here are practically none where it can be stated, with ny assurance, that so and so many kilowatt-hours and o and so many pounds of steam were used per ton of nished product.

This is a strange state of affairs. In many processes ower is one of the most expensive raw materials, yet s shamefully wasted, probably because the coal used o generate it burns up out of sight in the power house and its converted energy flows unostentatiously into the plant through wires and pipes. If these wires and pipes were equipped with meters, so that waste of power and wrongful use of power could be checked up, it is safe to assert that 50 per cent of the power used in the acid industry in this country today could be saved.

In each dwelling house in the larger cities there are generally installed three meters—a water meter, a gas meter and an electric meter. If the public service corporations consider it profitable to install these in order to prevent willful waste of power and to make a proper distribution of the power costs, why would it not be equally profitable to install them in the various houses on a large plant, each of which uses many times the power of the largest dwelling house? Why not, indeed?

Wilmington, Del.

The Fine Chemical Industry Is Dependent on Pride and Loyalty of the American Chemist

By Carl Pfanstiehl
President, Special Chemicals Co.

IN THE production of rare and fine chemicals we encounter a new production problem foreign to the manufacturing methods characteristic of America. We are not engaged in moving tons of material, and therefore must shift our interest from that of engineering to the personal element. Germany's monopoly of the fine chemical business in the past was due largely to the fact that she had available a large body of highly trained men of Ph.D. quality, working individually to produce the unusual commodity. Due to the system under which these men worked, their services were obtained at a very low cost.

If we are to make a success of this branch of the chemical industry in America, we must develop a plan whereby the interest of highly trained men can be obtained at a profit to themselves and at a cost which will enable their products to compete with the foreign goods. There seem to be possibilities in the example of a number of young Ph.D. candidates who are making a few rare chemicals "on the side," thus assisting themselves financially and at the same time producing chemicals of value in their particular studies. Another point of equal importance is that in America we have to devise ingenious means of doing work with less labor than heretofore in order to survive. This stimulates the genius of chemists in our industry to devise methods improving on ordinary procedure and substituting automatic control, for example, to decrease the costly element of personal supervision.

In the plant, or more properly the laboratory, appeal must be made to the pride and personal interest of the man who makes the products. It is not possible to institute a discipline comparable to that of large-scale production where tons are handled on a daily schedule.

And although the problems of system and record are the chief difficulties with such chemists—for these men are largely of the research type—the solution of production problems lies in appealing to their pride. The man making fine chemicals cannot be treated as a cog in a machine. His efficiency depends on his skill and knowledge and above all on his interest. This is another argument in favor of the movement now on foot to raise the standing of the chemical profession in the eyes of the public and place it on a level with the medical, legal and other recognized professions.

The chemist must be given this sense of dignity. The intelligent production system must take into account the importance of his pride and interest and give him an opportunity in some way to participate in the profits of his work.

The fine chemical industry is extremely important to problems of American defense, industrial development and public health. It is hard pressed just now and therefore is the most interesting to American chemists and worthy of their loyalty and support.

Highland Park, Ill.

Lost Motion in Explosive Making Due to Needless Variety of Products

By G. M. Norman
Technical Director Hercules Powder Co.

THE explosive industry may be divided into three main divisions:

I. Black blasting and black sporting powders.
II. High explosives, usually containing nitroglycerin.
III. Smokeless powders (propellant).

The types of black blasting powder made do not, as a general rule, exceed ten or twelve. The machinery used is rather simple compared to that needed in the manufacture of the two other classes, while only three or four ingredients are required. In our opinion, the manufacture is so well developed at the present time that few improvements may be looked for in the future.

High explosives, comprising dynamite, blasting gelatin, etc., is the largest peace-time branch of the explosive business, judged by the capital invested and the value of the production.

Because of high transportation costs, it has been found advisable to locate explosive plants near the point of consumption. This has resulted in the construction of a large number of factories the aggregate capacity of which is in excess of the present demands or needs of the country. Because of the nature of the materials handled, the industry has not been able to use to the same extent all the various mechanical and labor-saving devices that are common in other manufacturing operations; however, the explosive industry has invented and uses numerous mechanical devices intended to save labor and to reduce the hazard always present in explosive manufacture. In this respect the industry in the United States is far in advance of our friends across the sea; it is only fair to say, however, that the explosive makers of Europe are not permitted by their various governments to introduce mechanical devices, however much they may desire to do so. Hence we think there is little room for major improvements or changes in the mechanical equipment of the industry when producing the present type explosives.

Practically all explosive plants in this country are managed by staffs of technically trained chemists and engineers. The plant efficiencies are high in practically all chemical operations and there does not appear to be very much opportunity to improve upon the results now being obtained.

In the matter of accounting, the principal companies in the explosive industry in this country have a highly developed system of cost accounting, which enables them to determine costs with accuracy.

The one thing we think that would help the efficiency of the explosive industry in the United States today is the standardization of the product. There is nothing new or novel in this statement, and several attempts have been started in the past to bring about a reduction in the almost numberless grades, sizes, styles, etc., in which explosives are placed on the market. The fact is, however, that today there is a greater variety of explosives offered to the trade than is needed or necessary. Who is responsible for this condition—the salesman or the customer—and how it can be remedied we are unable to say. We do know that the result is an increase in manufacturing costs because of a decrease in output of machines due to changing from one grade or size to another, an increase in the amount and kind of ingredients used at each plant, an increase in magazine stocks all over the country and an increase in cost accounting necessary, etc., all of which someone has to pay for.

We very much question if any practical user of explosives can tell any difference between a 17 per cent dynamite and a 20 per cent dynamite, or a 27 per cent dynamite and a 30 per cent dynamite in actual use. Furthermore, we find straight dynamite, ammonia dynamites, high-freezing and low-freezing dynamites, permissible dynamites—both high- and low-freezing—straight gelatin dynamites—high- and low-freezing—blasting gelatin, etc.

There are, of course, thousands of combinations possible under the above conditions. As a matter of fact, the number of different packages in a factory magazine will not usually exceed seventy-five or eighty. This number, however, is excessive, and in view of what has been done in other lines of manufacture to eliminate odd sizes, it would appear that not only an intelligent self-interest of the explosive manufacturers but ordinary economy on the part of the consumer demand that such reduction be made.

Wilmington, Del.

Innumerable Formulas of Fertilizers a Drawback to Production Efficiency

By F. S. Lodge
General Superintendent, Armour Fertilizer Works

FROM a strict manufacturing viewpoint the one outstanding cause of inefficiency in production in the fertilizer industry is the multiplicity of analyses that every factory is called upon to ship. It seems to be a common belief of scientific agricultural investigators that a properly selected offering of twenty different analyses should satisfy the agricultural needs of any one locality. These, with certain raw materials and bone meals, will satisfy any crop requirement in the territory served by any one factory, with the possible exception of special territories, such as Florida, with its varied fruit and truck crops. In contrast with this we find the average factory called upon to furnish in a single season at least one hundred different analyses of mixed goods, besides raw materials. Many of these

analyses vary by only a quarter or a half per cent in some one ingredient. Certainly our crops are not such fastidious feeders as to demand such slightly varying rations.

The factory, in order to be able to ship any analysis called for, must either carry stocks of individual tags and bags printed to suit each requirement or else be equipped with printing machines in numbers sufficient to print them at a moment's notice. Each extra brand requires that the chemist make out a new formula, that the factory clerk must set up a new set of records in his books and furnish the factory foreman with a new manufacturing order, that the accounting department and auditors have an additional item to carry all through their records.

The most noticeable loss, however, is in the factory, where each change in the analysis shipped by one of the mills requires that the machinery be stopped and cleaned, with consequent idleness of men and equipment. Ingredients and weights must be changed and the entire operation slowed up till familiarity with new figures becomes a routine again, for the intelligence of the average fertilizer laborer is limited and he does not readily adjust himself to varied conditions.

The secret of low cost in the fertilizer factory is maximum tonnage. Every time a mill is stopped to change the analysis being shipped, it results in a loss of approximately 2 per cent of its day's output. Ten changes a day are not uncommon, so that the manufacturing cost of goods shipped is increased 20 to 25 per cent.

This condition in the industry is brought about by the salesman selling anything the customer suggests he wants, rather than what he needs; to his practice of juggling the analysis a fraction of a per cent in the higher priced ingredients, in order to undersell a competitor, and to his offering to duplicate any goods offered by a competitor.

A secondary contributing factor of similar nature and producing the same effect is the non-uniformity of state laws, particularly as to branding of fertilizer packages. A bag of fertilizer branded according to law in one state would be barred from sale and could be confiscated in an adjoining state.

Proper adjustment along these lines will aid very materially in reducing operating costs and increasing operating efficiency.

Chicago, Ill.

Steady Production the Key to Efficient Production in Dye Manufacture

By George A. Prochazka, Jr.

QUESTION the dye manufacturer of today as to the condition of his business, and he will probably recall the latest developments on the embargo and the legislative situation and tune his answer accordingly. These are troublous times for the American dye manufacturer. Granted reasonable protection, it is not impossible for America to compete successfully against foreign dye manufacturers. But in order to do so, it is necessary to apply the same principles of good engineering practice and good business judgment that are essential to the success of any other enterprise.

There are no "secrets" in the dye business. There are a few "kinks" in operating practice which, in the hands of one manufacturer, may give him a temporary advantage over competitors, but eventually such information becomes common property, and he who survives competition will be he who maintains production efficiency by the application of technology and builds up his company by the application of sound business principles.

Production at Capacity Essential

The one outstanding factor in increasing production efficiency in the dye industry today is that of maintaining production at capacity. The dye business is decidedly seasonal. The demand for its products fluctuates in a manner which is sometimes most mysterious. A plant standing idle for a short time will eat up the profit of a much longer time of capacity production. When this fact is realized by the dye manufacturer he will devote his ingenuity to the establishment of a production schedule and a plant arrangement which will enable him to approach the goal of continuous capacity production.

The dye industry has been through boom times, just as many other industries have been, during the war and the post-war period. There are some lean years still to come. The effect of this general prosperity extended to the users of dye as well as to its manufacturers. Many of the consuming industries which sprang up during this period, when quality was a secondary consideration, are now face to face with the necessity for meeting the competition of superior products. Many of them do not know how to use dyes. The hundreds of specialized uses for dyes require a definite knowledge of the best dye for each individual purpose. While the dye manufacturer can co-operate to mutual advantage with the ultimate consumer, it is generally admitted that there is too great a distance between the dye manufacturer and the ultimate consumer. Co-operation would be much simpler if there were fewer middle men, and the manufacturer would be able to meet the individual demands of a customer to better advantage.

Research a Necessity

In an industry which is as fundamentally technical as is the dye business, a certain amount of research is a constant necessity. The value of a research organization, however, cannot be expressed in terms of the number of chemists employed, but must be recognized as directly proportional to the ability of the research staff. In other words, a real research chemist, with years of experience in research, can accomplish much more in a dye plant than a flock of chemists of less experience and ability. Not only in this respect is the personnel in a dye plant important. Eventually, the process is turned over to the operating crew. The ability of these men is analogous to that of a chef, who can concoct a delicious confection from the same recipe that will yield an unappetizing mess when prepared by an amateur. A case comes to mind where one operator had been conducting the same operation in a dye plant for 20 years. One day he died and, naturally enough, took his technique with him, and it was many months before that plant was able again to produce material which was up to specifications.

Cost Accounting of Great Importance

The subject of cost accounting is of the greatest importance in the dye industry, but here again the

extremely specialized nature of the business must be taken into account. The majority of dyes are produced in small batches. Small errors are apt to cause a heavy expense to be laid to some particular product. The production of the various units in the plant fluctuates with the demand. The material accounting must be in an extremely high state of development. The successful cost-accounting system for the dye manufacturer is the happy medium between an elaborate accounting staff, involving considerable overhead expense, and the old-fashioned method of judging the production cost by the aid of that second nature which is acquired by long experience. The common-sense attitude on cost accounting is that any system is worth just about what it saves the company which uses it.

Newark, N. J.

Fundamental Research in Cellulose Industries Must Keep Pace With Commercial Development

By W. O. Mitscherling
Wilmington Experimental Laboratory, Atlas Powder Co.

WHILE the cellulose industry of this country has reached high production efficiency in regard to automatic equipment, improved cost accounting and standardization of operating procedure, little advance has been made in the research of cellulose itself. It is this which would contribute most to increase production efficiency. Our commercial future and welfare depend to some extent upon the cellulose industry.

America is the cotton king; a great deal of wealth of foreign countries depends on our cotton cellulose. While the cotton from Egypt is of very excellent quality, the amount available is limited. This is especially true for cotton to be used as a raw material for cellulose compounds. America also has a great supply of woods of all kinds, sufficient raw cellulose to supply all demands for generations to come. And yet this tremendous industry uses a material the conventional standards of which are defective in every respect.

A bibliographic essay of investigational work on the compound cellulose, either cotton or wood pulp, shows that we have to deal with a highly complex substance whose chemical constitution has not been, as yet, fully determined. The splendid researches of our American scientists and the work of the Forest Products Laboratory give us valuable information about the compound cellulose. While we know the compounds derived from cellulose, we have no light on the manner in which cellulose itself is synthesized.

Thousands of men and women are employed in the cellulose ester industry. The paper and textile industry give occupation to additional thousands of skilled and unskilled workers. A goodly part of the chemical industry is devoted to the manufacture of materials used by the cellulose industry. Manufacturing methods have reached a high state of development, and yet we can scarcely say that our analytical methods for determining the purity of cellulose are exact. It will take time and the co-operation of universities and industrial institutions to work out these methods and to adopt standards.

Let us ask our universities to help us in this work. It is not a question of developing manufacturing processes, it is merely a question of helping the industrial worker to adopt exact methods and standards. To do this the industries must help, not only with suggestions but also financially.

Since the benefit of such co-operation is extended not only to the paper and pulp, the chemical cellulose and the textile industries, but also to the entire chemical industry, there is reason for very general interest in cellulose research.

This would mean increased production efficiency and economy, increased demand for chemists and increased wealth to our country.

Wilmington, Del.

Ceramic Manufacturing Needs More Intelligent Technical Control

By Ross C. Purdy
General Secretary, American Ceramic Society

INCREASED production efficiency calls for more ware per hour without reduction in quality or wage. The high wages paid in this country have brought the requirement for more highly productive methods and equipment, which, in turn, has brought the requirement for more positive control methods and records.

Not altogether as a consequence, but paralleling these changes, acting on and reacting with the operating developments, there has been a decrease in number of small plants with their old-fashioned methods and an increase in number of large plants with modern methods. There are 5,000 fewer brickyards in this country today than there were 20 years ago and yet the production of bricks has increased many fold.

The big building enterprises require large building material producing plants. Chain restaurants, hotels and stores call for large producing potteries to fill their current orders. These are some of the present influences that did not exist a few years back.

These are the days of large production per unit labor time of the individual workman in ceramic plants as it is in all other sorts of manufacturing; and there is in the ceramic plants that same increasing need of accurate operating control and better methods and equipment as in any manufacturing.

While there is the increasing necessity for production efficiency, there is also an increasing demand for better quality. This calls for better selection and preparation of the raw materials. Here again follows the need for better control methods.

Standardization and specifications of materials and products are not fads; they are economic necessities. Elimination of shapes and sizes is not a fad; it is an economic necessity. Cost records and their analysis are not fads; they are economic necessities.

In the manufacture of some ceramic wares they are finding some of the machine processes inadequate from the viewpoint of both cost and quality. There is today more casting of large wares, complicated shapes and even of some of the simple shapes. Just as the foundryman has learned the economies of jogging, of stacking and of gang molds, so have clayworkers. The glass manufacturer today is more dependent on automatic machines because of the necessity to increase production per labor hour, and to meet the more strict specifications of product.

New designs of kilns, driers and handling devices together with closer inspection of materials and products, are the economic requirements of the present day. The processes and equipment that effect economies in one ceramic line will not always effect them in others. Car tunnel continuous kilns have produced economies and higher quality of ware in some ceramic lines, while

in others the cost records show in favor of the periodic kilns. Under some conditions gas producers are economical, while under others they fail to show economies of any sort. But there is no kiln, process or equipment which cannot be made to produce more efficiently by subjecting its operation to close control observation. The recent demonstration by the Bureau of Mines on a variety of brickyards of the possibility of from 15 to 30 per cent saving in fuel, quicker turnover of kiln without a change in kiln, fuel or labor and with more positive control of quality and a reduction in amount of "seconds" bespeaks the economic importance of technical control in manufacturing of even so crude a ware as common bricks.

Increased production efficiency today will follow from the more searching technical and scientific investigations which the manufacturers are supporting both in groups through trade associations and singly. The consequence of these investigations will be closer and more intelligent technical control. This is the greatest need in ceramic manufacturing today.

Columbus, Ohio.

Standardization of Product and Process Needed in Pulp and Paper Industry

THE greatest present needs of the pulp and paper industry to insure increased output consistent with quality and decreased costs are the establishing of standards at commencement and throughout the stages of manufacture and such technical control through men and instruments as will maintain conditions commercially close to established standards.

Our raw material is handled in such quantity and from so many sources that any inspection and sorting much better than at present would be prohibitive in cost, so that an established standard should be such as can be reached easily and maintained through mixing and averaging lots of material received. After receipt and before going into process much good work can be done along the line of improved storage of wood, uniform moistening, rotation of piles, etc.

While in one sense not a raw material, the water supply certainly enters into the process very vitally. Equipment in settling basins, filters, chemical treatment should be ample enough to insure substantially uniform water throughout the year. Even temperature can be kept approximately uniform through use of heat interchangers, condensing water, etc.

Throughout the process the strictly chemical ends, such as preparation of liquor, bleach, etc., are pretty well measured and controlled, but the physical end as exemplified in mechanical handling and measuring of semi-colloidal stock offers a large field for effort. The work of both chemists and technical mechanics should be directed toward uniform material delivered to machines. In the case of somewhat parallel processes where raw stock is necessarily variable, very definite schemes of mixing and averaging have been adopted. The pulp mills can improve materially along this line.

Initially the chip house can be made a much more exact process, chipper and chipping put nearer on a par with planing mill practice, and screening and sizing chips can be done much more carefully, each size later being given its proper controlled cooking time.

Digesting apparently must be a batch process for some time. It is therefore all the more important that large storage capacity be provided after the digesters, so that the inequality in the various cooks be ironed out and stock going to the drainers, bleachers, etc., be average of many cooks.

Bleaching is pretty well controlled technically, although a decided weakness exists in the means of maintaining stock consistency. Devices are badly needed that will be simple and substantial, that will indicate not only stock consistencies but freedom of the stock.

Proper beating is at present far too much a matter of opinion. With proper instruments showing power input, weighting of roll, coupled with standard inspection of the condition of beater and Jordan knives, the stock to the machine chests could be delivered in a vastly more uniform condition than at present.

At the machine we need close control of room humidity and temperature, uniform speed calling for removal of vapor, drainage of driers, close speed regulation and uniform steam pressure.

In the finishing room and coating mills there is not so much room for improvement, though better humidity control when drying would make for better paper grades.

Freedom from fire in paper mills and other manufactures is largely a matter of inspection and installation of protective devices. Why will not similar anticipation of trouble in the process through technical inspection and follow-up of machinery result in equally large dividends?

The technical personnel end is perhaps the most difficult problem to solve. We have seen in the last decade the establishment of chemists as a necessity to paper making. The introduction of technical mechanics may not follow the same methods. The latter must be brought in through establishing prescribed courses leading to a fairly definite executive job about as the large electrical companies maintain their technical forces.

Sound Advice for the Petroleum Refiner

By T. G. Delbridge
Chief Chemist, The Atlantic Refining Co.

IN reviewing the problem of increasing the efficiency of petroleum refining, there appear to be three factors that warrant the careful consideration of every petroleum refiner:

(1) Utilization of experimental data now available.
(2) Further scientific study of process problems.
(3) Judicious selection of products to be manufactured.

While the scientist is rapidly becoming more indispensable to a modern refiner, there is still, in some quarters at least, a mild antagonism toward the college-trained man. His results, conclusions and recommendations are sometimes looked upon with doubt and suspicion. A perfectly practical and financially attractive process may lie dormant in laboratory files for months before being taken up. In general, the solution of any problem represents only half the necessary work, the other half being to sell the idea to the management. It is proper and necessary that every new project be carefully scrutinized. Such scrutiny, however, should be prompt and decisive. Delay is not only expensive when good ideas are neglected but is extremely discouraging to the scientific staff. It is suggested, therefore, that the first step in increased efficiency is prompt utilization of all scientific information available either from private or public sources.

The second item in the list needs but little comment.

While refining operations will probably always require the exercise of some personal judgment, it is highly desirable that this be reduced to a minimum by controlling conditions in such a manner that the desired result follows not once but always. This requires careful and thorough scientific study. The greatest foe to progress has been impatience and guessing. Obviously, scientific information can be obtained only with a competent staff large enough to cope promptly with the more important problems and so co-ordinated within itself as to function smoothly with the operating organization. Such a scientific staff will quite naturally furnish about half the operating executives of the future, and at least some of its men should be selected with that objective in view.

The third suggestion is a plea for more care in deciding what products should be made. Granting that the customer is always right and that he must always get what he wants, nevertheless it is frequently necessary to assist him in determining what he wants. The present age is one of specifications and there is a real tendency to overdo in this respect. The pendulum is swinging from the position where the customer took what he could get to that where the customer will tell the refiner what to make. While there can be no criticism of a rational specification, even for petroleum products, there are many instances where the refiner bears an excessively high cost to produce a product of inferior value to the user. There is a grave danger along this line. Highly refined products are not always desirable. For certain purposes they may easily be over-refined. The interests of both user and refiner are identical so far as petroleum products are concerned—namely, the most satisfactory material for each purpose in quantity to meet but not over-supply the demand.

Philadelphia, Pa.

Research on Design, Quality and Uniformity Essential to the Rubber Industry

By W. C. Geer
Vice-President in Charge of Development, The B. F. Goodrich Co.

THE rubber industry is distinct from the pure chemical industries, in that the majority of articles made, particularly tires of various kinds, undergo service of a character which wears them out. There is a life or endurance factor, whereas in chemicals the substances made usually must withstand a composition requirement only. In rubber goods, therefore, there is ever in front of the production engineer the question of design, which must be maintained so that each of the numerous units may render to the consumer the full measure of service.

A major problem of production efficiency is so to produce the millions of tires, heels and shoes, the miles of hose and wire in a way to maintain in each of them an endurance quality. It is probable, when one considers the tire production of over 35,000,000, a boot and shoe production of over 160,000,000 and the many millions of feet and numbers of units of the various other articles, that there today exist differences in quality.

The rubber industry today is well manned, the skill of its workers and their selection and training are high. But the production efficiency engineer should for some time bend his energies toward harmonizing labor and processes that each unit may equal in service value each other unit. This, in my judgment, is the next most essential step before the maximum achievement of production will be obtained.

Co-ordinated with greater uniformity of production lies the field of more fundamental research. Much has been accomplished, particularly during the past 5 years, along special lines, which, however, have had to do with improvement in the details of methods of manufacture of articles now known. Accelerator work and reclaiming of old vulcanized rubber are the two greatest advances made since the discovery of the fundamental one of vulcanization, but methods of mixing and methods of handling unvulcanized rubber are still much as they were 70 years ago.

Research to give greater adaptability of rubber compounds to broader uses and thus to give to the consuming public the advantages which rubber, of all substances, possesses is still another field. We know that the quantity of crude rubber to be derived from plantations is practically unlimited. Therefore the manufacture of numerous products not now made of rubber, by methods so economical as to permit of the extended use of such new products, is a field of investigation vast enough to occupy the attention of the best construction and production engineers in the industry.

Akron, Ohio.

Need of Research in the Portland Cement Industry*

By P. H. Bates
Chief, Division of Ceramics, U. S. Bureau of Standards

NOTHING has served to demonstrate to the portland cement industry the possibilities of increased production efficiency more than the results which have been obtained by the installation of properly designed waste-heat boilers and the power plant equipment required by such installation. Though it is true that some of the first to attempt the use of such waste-saving devices met with dismal failure, yet those who continued development along these lines, or the others who studied the first failures, have met with such success that now all concede the marked increase in plant efficiency obtained by the use of the waste heat recovered from the rotary kiln. If a plant with but three 150-ft. kilns can generate from the heat formerly wasted by these not only enough power to run the entire plant but sell an unrequired surplus, what more striking example of the possibilities in production efficiency could be desired?

What Is the Most Efficient Length of Kiln?

Such results have been obtained by the first intensive study of but one feature of plant equipment. There is reason to believe that the study of all the other features might produce as highly gratifying developments. Hence why not continue the study with the kiln and determine the most efficient length of kiln for any type of raw material and the proper ratio between length and diameter? Kilns now vary from 6 to 12 ft. in diameter, and from 60 to 240 ft. in length.

The settling, for the time being, of the fineness requirements in the standard specifications for cement is too recent to have dropped from the memory of many. The discussion of this will be recalled to have hinged upon the ability of certain of the common types of grinding mills to produce the fineness of product asked for by many and upon the cost of such extra grinding by any type of mill. It served to bring out strikingly the fact that the type of mill used was largely a matter of personal preference, without any basis of actual data

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of the efficiency of the various types used. Here again the question is not one of variety alone but also of size. What should be the ratio of length to diameter of tube mills, or what should be the diameter of the various types of ring mills for the greatest efficiency?

Research the Important Factor

There can be no doubt that the most important factor toward increasing production efficiency in the portland cement industry would be research, especially along the lines of operation of the mechanical plant and leading toward the standardization of plant equipment. This is suggested without even considering the need of research along chemical lines such as might lead to certain changes in composition or raw material as would reduce the clinkering temperature or the need for the usual degree of fineness of the raw material. It is suggested also without regard to the desirability of research to determine whether portland cement as now made is of the proper composition for all purposes, or without regard to investigations which might lead toward such radical changes in production procedure as recently brought forward in France with the appearance of the "fused cements."

Mechanical research is the feature which can bring in the shortest time to this huge chemical industry—the manufacture of portland cement—the greatest increase in production efficiency. While it is to the credit of the chemists and chemical engineers that this industry has grown from nothing to a value of annual production of close to $225,000,000 in somewhat less than half a century, yet for this industry to gain the efficiency of production that will be demanded of it to bring it to the level of the other chemical industries, it will be necessary for the chemists and chemical engineers to see that research is directed along these lines.

Washington, D. C.

More Engineering Research and Standardized Raw Materials Needed by Paint and Varnish Industry

By C. D. Holley
The Sherwin Williams Co.

SIXTEEN years of practical experience in the manufacture of paints and varnishes has convinced the writer that standardization of raw materials is by far the most important step to be taken in obtaining increased production efficiency in this industry. Except in a few instances it has been a matter of extreme difficulty to purchase these raw materials on a fair specification basis. Possibly this is due to the fact that very few paint and varnish companies have attempted to buy on specifications and the various sources of supply have therefore not felt the need of standardizing their products or giving to those companies which endeavor to purchase according to specification the consideration to which they are entitled.

Many of the larger paint companies attempt to run on established production schedules, and unless their incoming stocks of raw materials are uniform in quality, the rate and, therefore, the cost of production are interfered with—often quite seriously. This is particularly true on account of the fact that most paint factories use a minimum of skilled labor.

It is the writer's belief that other features which work toward increased efficiency, such as automatic process control, improved machinery and facilities for handling and conveying raw materials, efficient training of workmen, are of secondary importance as compared with the problem of obtaining uniform raw materials. This is largely because of the fact that these materials constitute a large portion of the cost of the paint or varnish in question.

Fundamental research should not be neglected, and particular attention should be directed toward a better understanding of the underlying principles of paint grinding. The necessity of this is shown by the fact that there is today no standard or generally accepted type of dressings for paint mills. Probably no other industry knows less about the possibilities of its equipment than does the paint grinder. Perhaps this is not to be wondered at, as the paint and varnish industry has until very recently given but little thought to engineering research.

Acme White Lead & Color Works,
Detroit, Mich.

Fundamental Research on Purification Methods the Greatest Need in the Beet Sugar Industry

By H. W. Dahlberg
Research Manager, The Great Western Sugar Co.

THE beet sugar industry is in one way fortunate in having only one main product—white granulated sugar. The quality of this product is all that can be desired, it being of a very high degree of purity. The greatest possible advance in the industry during future years will therefore doubtless be along the lines of increased quantity per dollar expended, rather than in improved quality.

I believe the greatest need of the industry today is more fundamental research, particularly in several of the most important steps in the process of extracting and refining sugar from beets. The lines of research which look most promising to me from the practical "dollars and cents" standpoint are the following:

1. The production of beets of high sugar content and minimum amount of soluble impurities.
2. The elimination of impurities in the refining process.

The quality of sugar beets varies greatly with soil and climatic conditions. While climatic conditions are beyond our control, we do have some control over soil and irrigation. It has been well demonstrated that beets which are grown in heavily manured soil, or soil very rich in soluble salts, are relatively low in sugar content and of a low purity. The same is true of beets which have not been carefully thinned and cultivated, or have been watered excessively with irrigation water containing mineral salts. In order to obtain beets of high quality it is necessary to start with carefully selected seed into which the desired attributes have been bred through many generations, and follow up with scientific soil treatment. In a period of 30 years preceding the war several of the European countries, by systematic seed breeding and selection and studies in fertilizer control, were able to reduce the mineral salts in beets by 30 per cent and increase the sugar content very materially. While our naturally rich soils do not respond so readily to fertilizer control as do some of the European soils, I believe research work conducted from both the botanical and chemical standpoint will yield large returns in securing beets of maximum sugar percentage and purity.

The principal purification of juices from sugar beets is done by treatment with lime and carbon dioxide. By

this treatment about 25 per cent of the impurities present in the juice are eliminated, the remainder causing a loss of sugar in the form of molasses, from which sugar cannot be extracted except by special processes. This purification step is by far the most important in the entire refining process, and it is rather surprising that no essential improvement has been made in it during the last 50 years. A great deal of research work has been done on the whole problem, but progress has been slow due to the complexity of the reactions taking place and variations in the composition of the juices. Recent work indicates that colloidal chemistry may play quite a part in securing a greater elimination of impurities, some of which are colloidal. The problem is now being attacked from this standpoint, with some promise of ultimately reducing the loss of sugar in the form of molasses.

Many other problems of almost equal importance remain to be solved. After some years of research work in the beet sugar industry the writer is firmly convinced that more fundamental research will yield very handsome returns in increased production efficiency and greater yields of sugar.

Denver, Colo.

Machinery Cannot Displace Human Factor in Food Products Industry

By F. E. Barbour
Vice-President, Beech-Nut Packing Co.

IN THE food products industry, perhaps to a greater degree than in any other, the main element of production efficiency lies in the human factor.

Give six cooks the same recipes, the same materials, the same utensils and the same kitchen; give them free rein, let them all work at the same time—and you'll get six different results.

Enlarge this kitchen to the proportions of a modern food products factory equipped with the most scientific methods and machines, and you're face to face with the same problem—how to train the people to use to the best advantage the tools given them so that a uniformity of product results.

To select and train these workers properly is a big problem. A bright, sunlit factory with ideal surroundings and pleasant conditions attracts plenty of recruits, especially if word goes out that "it's a nice place to work." But the sifting-out process requires time, patience and expense. Personal neatness, deft fingers, accuracy and speed all count. But proper credit for each, with equal debit for lack of any one, must be regulated sharply and with a kindly spirit.

Foods, to receive the approval of our pampered American palate, must reach the manufacturer's highest standard in every package. Folks are more finicky about the way their food looks and tastes and smells than any other commodity of daily use.

Machines may make the products, chemists may announce the calories contained, but, like the pancake artist in the restaurant window, the person concerned in the preparation is the greatest element of all.

Each manufacturer must work out his own methods of training, but all center around one big idea—treating folks well. The physical properties of the plant, the traditions of the product and the ideals of its maker quickly tell the worker what is expected of him. Encouragement to study his fellow workers who progress most rapidly teaches him how he may advance.

Bulletins giving testimonials of satisfaction from users of the product impress him with this personal responsibility. Occasional trade gossip, such as acceptance of the product by large users, gives him a hint that the management appreciates his efforts as well as those of the sales force.

A suggestion box asking for his ideas makes him feel that he is more than a mere machine. An inside house organ, the company library, varied recreational and beneficial activities which come under the head of "welfare" work all serve to train men and women for the best interests of the company and its products.

Improve machines as you will, all is worthless unless the operators are better than the machines. Manufacturers of food products are wide awake to the importance of cultivating their personnel. Any reader of *Chemical & Metallurgical Engineering* may satisfy himself along these lines by a visit to the plant of any well-known and nationally advertised food product, and talk to the people themselves.

The success of the product is measured only by the satisfaction of the people who make it.

Canajoharie, N. Y.

Management's Reluctance to Use Technology in Wood Distillation

By F. J. Root

FOR a term of years the writer was firmly convinced that his own industry, wood distillation, was being managed as a whole in the most unprogressive way, particularly in the attitude of its owners regarding research and improved methods. As my horizon broadened I came in rather intimate contact with engineers, chemists and laymen in other lines of endeavor who were equally sure their own industry was least progressive. So it appears the super-conservative policy has been unfortunately general; too often when a chief executive was approached with an improvement in efficiency he at once turned it down, saying in effect, "I would as soon try to pick the lock on a morgue."

This managerial attitude has led to some highly humorous disease pictures in industry. One illustration may prove of interest. The gum turpentine business in our Southern States is very old and quite extensive, consisting of scattered plants each of which must have a copper still. Up to about 10 years ago these were actually run without the use of a thermometer. But finally an enterprising man took an ordinary thermometer, put a few simple marks on the scale for convenience in remembering the boiling point and went out selling one to almost every still owner and charging them something like $100 each!

These Southern stills had been in operation for three generations and during that time there was not enough accumulated enterprise to make use of a common thermometer. Hence one must commend the man who introduced heat-measuring equipment, even though he did charge twenty times the market price.

Manufacturers are inclined to believe in authentic history if it is not technical. Why not accept the technical, provided it is well compiled and reliable? The gum still incident cited is comedy, but it is also tragic history, because all those years the stills ran without thermometers and it meant a loss of goods—probably 10 per cent of all the turpentine. This in turn meant the unnecessary cutting of many thousands of acres of prime forest.

Plants can run without research just the same as

gum stills can run without a thermometer, unsatisfactorily; just the same as an army unit can go into action without its observation balloon, blindly.

Wood distillation can do without either improved methods or research if the management is willing to keep a large percentage of its plants idle, as is now the case. Likewise it can do without raw material provided always it does not care to operate its plants.

Research is a business. Even that overlord the banker is coming to recognize this, and there are other substantial indications that the day is at hand when the ultra-conservative elements will be swept into the discard and when the technically progressive will be in the ascendant.

Chicago, Ill.

Mechanical Improvements vs. Fundamental Research in the Leather Industry

By John Arthur Wilson
Chief Chemist, A. F. Gallun & Sons Co.

MANY complicated processes of unknown mechanism and a vast amount of time and labor are involved in the manufacture of leather, making this a fertile field for studying methods of increasing production efficiency. The most obvious means of lowering production costs is the replacement of manual labor by mechanical appliances which perform the work more quickly and reliably and utilize sources of energy much less costly than man power.

In many plants the tanning of sole leather requires 6 months or longer, during which each hide must be handled many times. When enterprising mechanics began to exploit this field, the sole leather tanners were not slow to adopt the use of time- and labor-saving devices wherever it was clearly demonstrated that the introduction of new systems effected a real saving in the cost of production.

But the writer believes that the opportunities for increased production efficiency lie less in mechanical improvements than in fundamental chemical research. Six months of work is required to tan sole leather in many yards simply because the tanners have a process that requires it and they do not know how to get the same results in any less time or with any less work. Mechanical improvements may make the process operate more efficiently, but they do not change the process itself.

Fundamental chemical research on tanning has been in progress at Columbia University during the past 4 years and many valuable papers on the subject have been presented before the Leather Division of the American Chemical Society at its annual gatherings. Yet how many tanners today appreciate that the rate of tanning, the rate of penetration of tan liquor into a hide, the degree of plumpness of the leather and its color and smoothness are all controllable chemically? Much of the work that men are now striving to do more efficiently by mechanical means will probably be eliminated entirely through fundamental research.

Although a campaign of education may be necessary to show the tanners what chemistry has to offer the industry in the way of possibilities for increased efficiency, it is scarcely likely to succeed unless it clearly differentiates between the value of the science of chemistry and the mental limitations of many of its followers. A British tanner once explained to me how he had proved that chemistry had no application in his plant. He hired a young graduate for the munificent salary of 30 shillings per week and sent him straightway into his color room with the challenge to show how chemistry could improve his system for dyeing leather. The young man naturally was helpless and the tanner tolerated him only for a few weeks. Still the tanner did not begrudge the loss of the few shillings it had cost him, because it set his mind at rest on the subject of applied chemistry in the tannery.

What the industry needs are the most highly trained physical chemists available. If such men enter the industry with a reasonably clear appreciation of the truly remarkable development of the art of tanning and learn to use their training to supplement, rather than replace, the art of the tanner, the result will probably be an increase in production efficiency greater than would ever be possible by the introduction of mechanical improvements alone.

Milwaukee, Wis.

Intelligent Scientific Control Essential to the Lime Industry

By Warren E. Emley
Bureau of Standards

CONTROL—intelligent control—is undoubtedly the answer to the question, What can the lime industry do to increase its production efficiency?

Ten years ago there were few limekilns making more than 3 lb. of lime per pound of coal. Today there are few making less than 5. Fuel efficiency doubled in 10 years! This is an achievement of which any industry might justly be proud.

This was accomplished because competent engineers made a careful study of kiln design, fuel combustion, heat distribution and temperature control. The facts which were discovered were put into practice. Pyrometers and chemists have come to be important factors in the operation of a lime plant.

While congratulations are in order, one should remember that the fuel ratio theoretically possible is about 14 lb. of lime per pound of coal, so that there is still room for further improvement.

However, fuel efficiency is only one item of production efficiency. The sale of the product should be studied just as carefully as its manufacture has been, and should be subjected to the same degree of "intelligent control."

Years ago one used to hear statements like this: "The stone in my quarry is not so pure as that of my neighbor. I can't make as good lime as he can, but it is not my fault." The modern version of this story shows a radically different viewpoint: "My neighbor makes a good building lime, but he is getting only $6 a ton for it and he can operate only 8 months a year. My stone will not make good building lime, but it is much better than his for making bleach. I will sell it for that purpose, where they pay $9 a ton and the demand is steady throughout the year."

The modern lime manufacturer has discovered the fact that no lime can be called good or bad unless its use is considered. A lime which is excellent for one purpose may be unfit to use for some other purpose. For this reason it is necessary for the lime manufacturer to study the way in which his lime is used. It is only through a thorough knowledge of his customers' requirements that he will be able to make the best lime to meet those requirements.

The old idea was to make the "best" possible lime from the stone available, the definition of the word

"best" being based on the opinion of the lime manufacturer. This lime was then sold for a variety of purposes, for only a few of which it was suitable. The modern idea is to let the customer define the word "best"; to study his individual needs, and change the process of manufacture in such a way as to produce the kind of lime best suited to meet those needs. This, of course, involves accurate and continuous control not only of the manufacturing process but also of the sales organization, to see that each particular kind of lime is used only for the purpose for which it is best adapted.

Intelligent control includes not only the control over the manufacturing process and of the sales but a far more important idea: the lime manufacturer must control his opinion of the quality of his lime, and make it subservient to the opinions of his customers.

Washington, D. C.

Economic, Not Technologic, Considerations Govern in the Gas Industry

By R. B. Brown
General Manager, Milwaukee Gas Light Co.

THE technical situation in the gas business today is confused. There are so many conflicting views as to the future that any authoritative statement as to what can or should be done is not possible. But in general all will agree that economic, not technologic, considerations govern the industry at present.

Gas companies are not financially in a position to make drastic changes in plants. Rates are believed by the public to be exorbitantly high and are known by the operators to be inadequate to attract new capital that is needed to take care of anything more than needed actual extensions of plant and distribution systems.

I believe a great deal of progress will be made in the design of carbonizing equipment along lines that have not been given any thorough tryout as yet because of the fact that up to very recently drastic heating value and candle-power requirements prevented any such thorough tryout as is necessary to develop and perfect any new method of handling. However, we shall have to feel our way, partly because of ignorance of possibilities, but more because of the limitations financially.

The future of the business from the standpoint of the volume of sales is tremendous. We don't any of us know anything about the saturation point. So far as our ability to supply is concerned, it will be taxed for years to come along the lines of present endeavor. But during such a period as this, to revise all methods of manufacture and distribution, to amortize the capital thus involved and at the same time to provide earnings to attract new capital in enormous quantities—well, it is a proposition that can't be "put over."

The Question of Rates

Rate structure is another subject which is very much to the fore. The obsolete rates now generally in effect in the sale of gas in this country permit the extremely small user (who is increasing in numbers through modern methods of living in apartments and taking meals elsewhere) to abuse the privilege which, under these rates, he has of compelling the company to maintain a meter, service and a readiness-to-serve without any compensation or in some cases with partial compensation for the actual cost.

The difference in the investment required for different types of consumers, with their varying demands and load factors, is so tremendous that this problem alone will probably receive a great deal of attention for years to come before any even approximately adequate solution is reached.

Reduction of Investment Per Unit of Output the Problem

The technical problems are not being neglected in the meantime, but they do seem insignificant in contrast with the great problem of fixed charges on investment. What we need is greatly to reduce the investment per unit of output. Some progress has been made, but much more is essential to reduce the capital charges per thousand feet of gas and per unit of byproducts made.

Complete gasification of coal promises much in this direction, but as yet this means is limited by official requirements as to the heating value of the gas. Others argue for low-temperature carbonization as a cure-all. But there one finds a technologic limit. In any event these or some other such schemes must be evolved which will free the gas from the excessive burden of interest, depreciation, amortization, taxes and profit on the large investment now required for each thousand feet of gas sold. "Cheap" gas service cannot possibly carry such a load.

The byproduct possibilities of the industry suffer quite as much as the gas. They may, with high capital charges, even reach the point of creating losses rather than added net income. In fact, in many cases now there are plants which do not find it practicable to recover some available byproduct, because the investment and labor charges per unit made preclude profitable marketing of them.

Real progress in the gas industry will, in the end, certainly come from improved technology. But those who contribute to this progress must give quite as much attention to reducing investments and unit costs for labor as to yields per ton of coal or B.t.u. per foot of gas. The dominating factors in the industry will certainly for some time be financial and economic.

Milwaukee, Wis.

A Co-operative Research Program for the Vegetable Oil Industry

By L. M. Tolman
President, American Oil Chemists' Society

IT IS the opinion of the writer that the most important development of the past year and the thing that gives greatest promise of increasing production efficiency in the edible-oil industry is the plan of co-operative research along the lines of the fundamental questions involved in the refining and handling of edible oils. The joint research committee of the American Oil Chemists' Society and the Interstate Cottonseed Crushers' Association, working in co-operation with the United States Bureau of Chemistry, has under way some very important investigations regarding the composition of the non-fatty substances in crude cottonseed oil and other crude oils. This investigation is undoubtedly fundamental in the advance of our refining methods which at the present time are based on the more or less empirical methods adopted 10 or 15 years ago as the result of the cut-and-try experiences of practical refiners. Progress in the production of edible oils will undoubtedly be along the line of real fundamental research in refining methods. At the present time refining losses are admittedly much higher than they should be.

The research work which can be carried on by the

governmental departments is necessarily limited, and while the results so far obtained are going to be of great value to the industry, it would appear that the edible-oil industry itself would make much greater progress if it could organize its research work in a co-operative way, either by the establishment of research organizations supported by the industry or by the endowment of fellowships in the existing research organizations. It is the writer's personal opinion, however, that much more important results could be obtained, and they would be obtained in a shorter time, if the edible-oil industry of this country would establish a research organization of its own for studying the problems in regard to the refining and handling of crude vegetables.

Laboratories, Wilson & Co.,
Chicago, Ill.

Further Improvements in the Soap Industry Must Come From Chemist and Chemical Engineer

By Martin Hill Ittner,
Chief Chemist, Colgate & Co.

I DOUBT that there is any important industry that does not offer opportunity for increased production efficiency. As there are believed to be large fish in the sea still waiting to be caught, so too there are, no doubt, great improvements in industries awaiting the discerning eyes of wide-awake chemists and chemical engineers.

The soap industry has been subject to some intelligent investigation during recent years and most of the methods now used are good. Within the limitations of a brief statement such as this, it is possible to indicate only a few of the things that may lead to future improvements.

Small units require more labor and more steam for a given amount of material handled than large units, and the large soap pans in use in some factories show that certain manufacturers have already learned this fact to their advantage.

Just as open and closed steam coils have proved immeasurably superior to fire heating, and as pumps are more efficient than ladles for handling raw materials and products in course of manufacture, so automatic machinery has been used to advantage and its additional use and improved types thereof will continue to make production more efficient.

Physical Chemistry in Soap Making

As to the actual manufacture of soap, it would be difficult to beat the quality of material turned out by the settled soap process when properly carried out. This process gives two distinct phases or layers, the upper of which may be made remarkably free from excess alkali and other impurities. The only drawback to this process is the time it takes and the fact that approximately 20 per cent of the soap produced goes into the lower phase, or nigre, along with excess alkali and impurities, and this necessitates the reworking of an appreciable amount of the product.

If the settled soap process is to be improved, rather than replaced, it will have to come through a study of the physical chemical conditions that will promote the complete formation of the two distinct phases and their rapid separation. A low viscosity in this change is a desideratum, whether it is obtained by changes in composition or by a more perfect temperature control. The composition of the phases is influenced by the mutual solubilities of all the substances present and these are influenced by the temperature, so, as a matter of fact, a control of viscosity and consequently more rapid and more complete separation of the phases can be obtained only by a proper control of the composition of the whole mass and the temperature.

A number of years ago I found that the soap phases could be completely separated in centrifugal machines and I aimed to run them through a suitable machine to effect at once the continuous separation that has always required a considerable amount of time. So far I have not seen the machine that would compete with gravity settling, considering together effectiveness, capacity and cost.

It is possible to make good soap without the formation of nigre, but it is more difficult to get uniformity and high quality and is more expensive for labor and control than the settled soap process.

Other Lines for Improvement

The economical production of soap requires a study of the selection, treatment and apportioning of raw materials, fats, oils and alkalis, and their control through the stages of manufacture up to the production of finished soap and glycerine. There are few places where at least some improvements are not possible all along the line.

In the manufacture of toilet soap a big advance was brought about by the rapid, continuous, clean drying made possible by the Cressoniers driers and later by the several other driers using the same principles of chilling the soap on cooled rolls and sending the ribbons over endless woven wire belts through a drying chamber. An automatic or other suitable simple control of the amount of drying or percentage of water in the finished soap would add to quality and efficiency.

Soap powders are being produced on a large scale and quick and efficient methods for their manufacture are being worked out and adopted.

Jersey City, N. J.

How Process Equipment Aids Production Efficiency —Pointers for the Purchaser of Equipment

By O. S. Sleeper
President, O. S. Sleeper & Co., Inc.

IT IS essential, in all manufacturing lines, to increase production efficiency and reduce manufacturing costs. This end is largely achieved through judicious equipment purchase and efficient operation of the equipment purchased.

The tendency of the users of equipment is to buy on price or to find used material that will do. In most cases both these methods result in unsatisfactory operation. Only apparatus containing all the elements necessary for the manufacture of the product and constructed of material best suited for the purpose should be considered; and adaptability rather than first cost should be the main consideration.

If this course is followed, satisfaction should result. This satisfaction will extend beyond the purchase and installation of the equipment. It will please the workman, thus making his work more tolerable, resulting in increased production, better quality of product and more satisfied workers.

It is often a question with the manufacturer of chemicals as to what apparatus he should use; and in the effort to find what he requires, or can use, he peruses the advertisements. With few exceptions, this is his

only method of locating the manufacturer of equipment, and is the proper method. However, the advertisement is generally brief, and perhaps does not contain the information he requires.

It is necessary, then, that he write to the equipment firm for this information and for prices. He sends his inquiry, which is also brief; and, in reply, he receives a quotation and a request for additional information. This is not satisfactory, as the quotation does not cover the requirements, and further delay is caused.

These delays and unsatisfactory methods may be eliminated to a large extent and better and more satisfactory equipment furnished if the secretiveness which surrounds most chemical plants be set aside and confidence placed in the equipment manufacturer. If the chemical plant furnishes designs, then the reliable manufacturer will hold such designs in confidence. Often the standard equipment will do or it may be modified to suit specific requirements, and such modifications could be made by the builder better and cheaper if he were informed of what is necessary. It must be kept in mind that an advertisement cannot convey the complete information necessary for the final selection of equipment, as it does not explain all details of each machine.

In a majority of cases it is important to give the equipment manufacturer full information regarding the material to be handled to enable him to select from his standard designs or to make the special design required for the purpose.

This is not meant as a criticism of present methods, but is intended to convey the importance of closer relations and a greater degree of confidence between the manufacturer and user for the best interests of all concerned.

Buffalo, N. Y.

Improvements for Production Efficiency in the Glue Industry

By Jerome Alexander

IN common with other industries, increased efficiency in glue manufacture must be along lines which may be classified under two general heads: Avoidance of waste and production of an improved product. Under the first of these come power plant and fuel economies, savings in freight and handling charges, etc., which are not peculiar to the glue industry.

Steps in Process Where Improvements Are Possible

Following the raw material step by step through the process, the following points should be considered in connection wih the production of an improved product.

Receiving and Preparing Glue Stock. Avoid unnecessary rehandling and save labor by utilizing mechanical appliances. Shredded hide and crushed bone or osseine may be pumped with water or handled by bucket conveyors instead of by the manual methods still employed in many plants. By bringing the limes to the proper H-ion concentration with caustic soda, the time of liming may be shortened without injury to the stock.

Washing Glue Stock. An improvement over the old cone and paddle wheel washers, which have been in use for years, seems called for. Circulation of the stock by a screw conveyor through a trough against a stream of water seems to be an interesting possibility, for the washing would proceed continuously rather than on the batch principle. A new German washer having two vertical shafts with arms is emptied by a bucket elevator.

Boiling. Most factories depend mainly upon convection to distribute the heat, and this generally results in local overheating, besides protracting the process. The more general introduction of circulating pumps, used in some plants, should be advantageous.

Evaporation. The vacuum evaporator is so highly perfected today that lack of capital or insufficient capacity is the only excuse for not having an efficient unit—a good illustration of what scientific engineering practice can do for an industry. However, priming must be avoided or glue will be lost with the condensate.

Chilling, Cutting, Spreading and Drying. Although for years the attempt has been made to combine these into one operation, none of the older systems proposed, even that of Peter Cooper Hewitt, has survived. Most promising is the Kind apparatus, which is said to chill, cut and spread an evaporated glue liquor within about 20 minutes after its receipt. The apparatus is automatic and effects a great saving in time and labor.

Speedy drying of glue is important, otherwise an expensively large dry room is necessary to avoid a "neck" in the process. The netstacks should fit the room closely, otherwise the heated air will get by without taking its full quota of moisture.

The Ruf system, recently introduced in Germany, delivers a concentrated glue froth to a hooded steam-heated revolving drum over which a draft of air is forced. The finished glue in powder form is scraped off by a knife. Vacuum drum driers are also used to produce glue powder, but this form of product is objected to by some consumers, without good reason in many cases. Much trouble and expense can be saved by consulting firms or engineers who have had actual experience in drying glue.

Byproducts. Some plants do not use or give proper attention to catchbasins and lose grease-containing material. Others again lose grease in their fertilizer tankage, where it is rather a detriment. For some uses grease improves glue, and if the market for glue is higher, some grease may profitably be left in the glue.

Producing Better Glue

The basic principle is to get the glue dissolved out of the stock and dry it as quickly as possible and with minimum exposure to heat, both in point of time and degree, and without undesirable agitation. The observance of the principle requires attention all along the line—proper plumping of the stock to insure speedy solution; boiling at as low a temperature as possible, yet balancing temperature against time of boiling; evaporating without overheating; then chilling quickly and drying to avoid bacterial attack. Since the importance of the effective reaction of glue (hydrogen-ion concentration or p_H value) has been shown to affect its viscosity and water-absorbing power vitally, this should be more carefully adjusted than has been done in the past. Iso-electric gelatine which absorbs only 7 or 8 parts of water may absorb up to 40 parts at a p_H of about 3, though this degree of acidity is excessive.

All told, it pays to use the best apparatus and employ the best brains. But there is no substitute for common business sense. It is not profitable to produce an improved product at a cost which exceeds the added selling value.

Ridgefield, Conn.

More Efficient Distribution for the Products of the Chemical and Allied Industries

Sales Executives and Others Comment Frankly on the Marketing Problems of Their Businesses and Offer to Support Increased Production Efficiency With Better Directed and More Intelligent Selling Methods

RECORDED among the findings of the Joint Commission on Agricultural Inquiry is the conclusion that in the case of many of the basic commodities of commerce more than half of the ultimate cost to the consumer is directly chargeable to the agencies of distribution. This is not a particularly novel discovery in itself, but it hints at a state of affairs to which industry can well give serious thought. If the gap between producer and consumer is allowed to absorb 50 per cent of a commodity's cost, we can very profitably forget production for a moment and give attention to the disproportionate cost of distribution.

To say that a parallel condition obtains in the chemical and chemically controlled industries, however, is not to speak the truth. No such spread exists in the case of these basic materials, sold from industry to industry rather than from industry to the individual consumer. Nevertheless these industries offer much to justify a serious consideration of their selling problems. Many of the mainly chemical industries are comparatively young and during the period of their rapid growth every effort was made to solve the problems of production. The same intensive and sympathetic study which other industries have given to distribution has often been neglected in the zealous endeavor to lower the costs of production.

In the dozen or so brief messages that follow it is evident that our technical executives are already solving the marketing problems of their industries. Treatment is given such varied subjects as technical service, direct selling, open prices, market stabilization, standard specifications, elimination of excess varieties, the tariff and transportation. Improvement along most of these lines means lower costs to the consumer, whether he purchases chemicals directly or the products in which they are used. Industry as a whole will profit when increased production efficiency is supported by well-directed and more intelligent distribution.

A Higher Plane of Chemical Salesmanship

By Burton T. Bush
President, Salesmen's Association of the American Chemical Industry; President, Antoine Chiris Co.

NOW that the fine chemical industry has taken root on American soil the problem of closer co-operation between the source of production and the ultimate consumer is going to be solved to the advantage of both. Research will cease to find sympathy alone with the chemist; research will be carried clear through to the ultimate user of the chemicals produced. The American manufacturer must now recognize this as an integral part of the chemical business in America and must begin to arrange for it in his yearly budget.

I am a thorough believer in the fact that one day a chemical salesman's value will be based on his knowledge of chemistry, that he will step to his place as a possible counselor for the trade consuming his products, and his ultimate value will be in his ability to suggest. Having, as he will, his own personality and individual way of obtaining a result, he will be fearless to allow his objective to be known, because the objective will cease to be a secret of the concern he represents.

America takes hold of the chemical industry at a time after every marketing method is apparently known and has been tried. To my mind there is but one great method left, and that is to take the secretiveness and mythology out of chemistry, giving the American consumer the benefits of the knowlege of the producer, all of which will naturally result in a better co-operation.

In conclusion, I have no hesitancy in stating that the essential oil, aromatic and fine chemical industry of the United States will demand that open scientific research be employed in every phase of its work. Then quality will be known and appreciated and likewise it will be demanded, and the final proof of success of this industry will depend on how well the chemical manufacturer keeps the public in his confidence.

New York City.

Intelligent Distribution of Crude Coal-Tar Products

By David W. Jayne
Jayne & Sidebottom, Inc.

INCREASED efficiency through more intelligent distribution can certainly be obtained in the case of the so-called coal-tar crudes. This term has been very freely applied to the directly recovered products from coal tar in refined condition suitable for the manufacture of such products as dye intermediates. The manufacturing processes permit of considerable variation in the purity of the finished products, so undoubtedly what is most needed is an accurate knowledge of the requirements of the consumer as to quality and the corresponding price limitations.

An intelligent understanding of this question involves the use of experienced and "technically intelligent" salesmen; it also demands frankness on the part of the buyer of these products. It has been claimed by many buyers that the refined coal-tar products, such as benzene, toluene and naphthalene, are not as pure as those supplied to the German manufacturers, and this is probably true, but the problem is to increase the purity without unwarrantably increasing the price. Just what is needed in the line of quality specifications can be determined only by frank and intelligent discussion between buyer and seller, coupled with an equally frank understanding of the additional costs of such improvements in quality and the possible increased value to the buyer.

Prices are sufficiently open so that this, I believe, is not an essential question in the sale of this class of

products. Buyers and sellers pretty generally know at what prices others are buying and selling. These products have not been and are not sold on a basis of all the salesmen can get for them, but rather on a fixed price-list basis.

The production department must also have confidence in the accuracy of the reports of the salesmen. Too often salesmen recommend changes in quality or price which the production man recognizes as unattainable and which were "put over" on the salesman by some ambitious buyer. If the salesmen are men of technical training with experience and are in the confidence and in touch with the factory, then production efficiency can be increased by the intelligent exchange of information between sales and production departments.

All this can be summarized in a few words about as follows: Confidence and co-operation between the sales and production departments of both buyer and seller mean increased efficiency of distribution as well as production.

New York City.

Autumn Prospects in the Dye Industry Are a Matter of Conjecture

By Giles Low
Sales Manager, Newport Chemical Works, Inc.

IT IS no easy task to make an estimate of business conditions for the fall in the dye and coal-tar chemical industries. True, they must be good or bad; but definitely to say which precludes a foresight into the decisions of that inexorable body at Washington—the Sixty-seventh Congress. Not only for fall, but indeed for our whole future, does the making of business conditions lie now with our government, and to indicate to it what is right is at present our most responsible task.

The United States owes a debt to its chemists, who have striven diligently during the last two hard years, and to the financiers who have backed them. Moreover, she owes to our citizens the insurance of the safe and prosperous future which only a substantial domestic chemical industry can bring.

Protection of an Essential Industry

So much has already been said and written of what the chemist has done for us as a nation in the way of inventing and manufacturing medicines and drugs, as well as dyes and foods—necessities normally unappreciated—to say nothing of explosives in times of war, that a repetition of the vital importance of the industry is almost unnecessary here. Whether we shall maintain the protection and enjoy the fruits that our new chemical supremacy has given us, or humbly give them up to our erstwhile enemy, is today in the hands of Congress.

If the outcome again puts us at the mercy of Germany, business will be bad in more ways than one and for more than those now interested. If, on the other hand, some adequate protection is granted, a condition even somewhat better than normalcy will obtain. Our universities will not have educated chemists in vain; our financiers will not have wasted their vast sums invested in the industry, and our most promising infant in the industrial field will grow to be our most useful big brother.

Passaic, N. J.

Straight Talk Needed Between the Oil Producer and Consumer

By Otto Eisenschiml
Manager, Scientific Oil Compounding Co.

THE PROBLEM of marketing special oils is one that is more inherent in the buyer than in the seller. These oils are made to fill a special want not covered by standard grades of oil on the market, and one would expect to have possible customers talk frankly and straight to the point about their troubles. Unfortunately, this is far from being so. They come to the manufacturer like a sick man to a doctor, but what they want is not a cure for special ailments at the doctor's discretion, but a special 10-grain white pill to come in a blue box with a yellow label. Only a few days ago a manufacturer was asked to supply a certain cold-pressed vegetable oil. Being fairly honest, he refused even to quote on a commodity existing only in the minds of some buyers and in the mouths of imaginative salesmen. During the discussion that followed the manufacturer found that all he had to do was to supply a fairly clear oil of low acid value and good drying power—the cold-pressing having been lost in the shuffle.

Specifications for special oils, printed and otherwise, are full of arbitrary and unnecessary points, such as the one mentioned. The psychology of the buyer seems to be that the more trouble and expense he can put on the manufacturer the better the goods will be for himself, and he therefore tries to prescribe what should be done rather than what should be accomplished. Almost all specifications on linseed oil demand that it be aged by tanking. What is really wanted is a clear oil, and of all the methods possible to get this result, such as filtration, centrifugal machines, etc., tanking is the most uncertain and most expensive of all. And yet we have constantly to contend with such people and others who demand that a varnish be thinned with turpentine when they mean that they want a high flash point, that a paint oil contain no rosin when they mean that it should not liver with white lead, and so on *ad infinitum*.

I do not know whether or not the special oil field is different in this respect from other fields of endeavor. But the fact remains that, just as straight line is always the shortest distance between two points, so a straight talk between producer and consumer is the best basis for all specifications.

Chicago, Ill.

Knowing the Requirements of the Consumer of Vegetable Oils

By Henry G. Perry
Sales Manager, Cook & Swan Co., Inc.

WE ARE all interested in increased production efficiency. The theme is well chosen. Among other things, it would imply power on the part of the distributor to retain a clientèle secured by strength of salesmanship. The day has gone by when we might have been able to give a customer something "nearly as good" as that which he requires. The efficient method of distribution today is to sell your article on a guarantee of satisfaction, whether it be oils and greases for technical trades or for the refinery. Salesmanship, in itself, is a part of the business which cannot be treated lightly. But salesmanship commences only when the product is salable. In other words, the quality of a product must stand before the art of selling. The man

with the best product today will get the order. The consumer's troubles should be the troubles of the supplier, and the supplier should base his products on the requirements of the consumer. We must forget the product which was nearly as good and put in its place the product with which the consumer can register complete satisfaction. A house with a hundred satisfied regular clients is better than one with five hundred spasmodic inquirers.

New York City.

Eliminating the "Fly-by-Nights" in the Chemical Industry

By Milton Kutz

Manager of Sales, The Roessler & Hasslacher Chemical Co.

AS IS DOUBTLESS the experience of others in the chemical industry, the firm with which the writer is connected frequently finds itself underbid by importers and other firms whom we would like to characterize as "fly-by-nights" and who having had only a few years' experience, either do not realize or do not care whether their goods are suitable or meet the specifications of the particular consumer or industry for which they are intended.

On the other hand, the service given to this trade by the older chemical houses is the result of many years of experience in production and actual use of the products they produced. The knowledge derived therefrom is gladly passed on to their customers. However, no legitimate enterprise can continue to maintain a large sales organization and give service unless there is some margin of profit. A mighty endeavor to sell, which has become prevalent in many branches of the chemical industry, has been the cause of the receiverships in bankruptcy which have been occurring so frequently. The "return to normalcy" phrase has become something of a joke. It will never be accomplished until some people thoroughly learn their lesson that overhead must be considered in their selling price. Not until more chemical firms do this will a real stabilization of the market be attained.

New York City.

Resale, Turnover and Volume—The Problems of the Paint Industry

By H. D. Whittlesey

Vice-President and Managing Director of Sales, The Sherwin-Williams Co.

THE three words resale, turnover and volume sound the keynote of the endeavor we must all put forth today.

What's the answer?

A keener sales activity. If our products are better than the other fellow's, then we have a right to expect corresponding increases in volume. It behooves us to present our proposition attractively, or the other fellow will outsell us.

We must have better kept plants, better production, better looking products, better packing and shipping, fewer mistakes down the line.

Warehouses must be well located and efficiently serving the territories they are intended to serve.

Salesmen must give a type of service never before required to such an extent. There must be less duplication. There must be more emphasis on the goods and what they will do; clerks must be better educated to sell—they must know the whys and wherefores of quality, ingredients, purposes, etc. Price cuts little figure if the resale of the product is in the right hands. Put a Cadillac in poor dealer hands and you will immediately boost the sale of Lincolns.

Creative Salesmanship Is Essential

New avenues of sale must be developed. We cannot keep taking business from our competitor without building new business and new markets. Creative salesmanship is the need of the hour. It must be specific, educational and thorough. So must the advertising of today. One cannot continue advertising for "general results" or his results will be very general. He must talk his product in terms of what it will do, how it will fit into the scheme of things, and it must be told in a human, readable way. Only a few people are relatively interested in mechanics; masses of people are interested in the everyday stories of life and living.

The sales department must know who is buying its goods; who used to buy and stopped; why did they stop; what new trade is being added to the books; what dealers are being added; what dealers are being dropped; how is the volume changing geographically and why; what important towns and territories are undermanned or not manned at all; what is each territory producing per man per day per dollar of cost; what dealers are going ahead and what dealers are standing still and why; is the salesman taking orders or is he helping to resell for the dealer to make way for more goods; what classes of trade are being called on daily and what classes are being neglected; is too much time being spent on unproductive things.

We have a man-sized job ahead, but the victory will go to those who produce well, distribute wisely, turn over their investment frequently, sell hard and render a service to the buying public.

Cleveland, Ohio.

Marketing and Distribution Problems of the Alcohol and Related Chemical Industries

By B. R. Tunison

Manager of New York Sales, U. S. Industrial Chemical Co.

MARKETING and distribution problems in the alcohol and related chemical industries are complicated primarily because of the nature of the principal raw material in these industries—namely, alcohol. This material is subject to very strict regulation and control. Since the passage of the national prohibition act, the regulations and red tape have become so great as to interfere seriously with business using alcohol for industrial purposes. Not only have the users been subject to various laws, rules and regulations, as well as arbitrary rulings (not based on law or regulation) on the part of federal officers, but the manufacturers of alcohol have been unable to develop and extend their business in accordance with the law which provides for "an ample supply of alcohol and promote its use in scientific research and in the development of fuel, dye and other lawful industries."

One of the greatest problems facing the fine organic chemical manufacturers in the United States at the present time is that of technical service. Many phases of these industries are new to the United States and the utilization and development of the products call for definite technical information and advice. In the first place, it is difficult to obtain men who are able to render such technical service, and in the second place, when

such advice and service are given, it is not always easy to convince the user that the product and method of utilization indicated are to his best advantage. This inertia is due largely to the operation of some industries by rule-of-thumb methods rather than modern technical control.

Probably the most depressing factor and the one interfering most with the proper development of our American chemical industries at the present time is the tariff situation. It is impossible to develop sales, distribution, production or anything connected with a healthy chemical business when the manufacturers do not know from one moment to the next whether they are to be protected in their efforts or whether they will be subject to the ruthless competition which is the inevitable result of not keeping out of the country products which will be sold at prices far less than the cost of production by American manufacturers.

A factor which is bothering a number of manufacturers in these industries is the fact that during the war a capacity for the production of certain products was developed which is in excess of the normal consumption during peace times. Strenuous efforts are being made to develop new markets for these products in order that production can be increased to the approximate capacity so that a moderate cost of production can be maintained. This puts tremendous pressure on marketing and distribution activities in order to reduce the cost to a satisfactory level.

Although many of our American chemical industries are passing through very trying times, there is no question that they will be successful and able to compete in any world market if they are given sufficient time and proper encouragement and protection. Chemical industries such as we are building in the United States at present cannot be completed in the space of a few months. Therefore proper protection should be given them until by development products are improved and costs are reduced, so that these industries may succeed.

New York City.

The Ferro-Alloy Situation Beclouded by the Tariff

By J. W. Bradin
Vice-President, Dana & Co.

THE problems connected with the marketing of ferro-alloys are rather difficult to gage, due chiefly to the proposed new tariff rates and in part to the market position of ores. Ferromanganese will undoubtedly sell at a much higher price than today if the high tariff duties on ore and metal are passed. Already this is apparent by the willingness of buyers to pay a premium for foreign ore due to arrive shortly. We believe further that the expected increase in price of ferromanganese will stimulate the sale of spiegeleisen.

The price of ferrosilicon will probably not rise in step with the higher protective rates, due to the largely increased manufacturing capacity for this alloy, which potentially at least should act as a restraint to any substantial increase in price. In spite of a much higher tariff on ferrotungsten, we expect only a gradual increase in price, due to the very large spot supply of ore which is hanging over the market. On the other hand, ore can be bought today below the cost of mining, a condition which is not likely to continue. Marked changes in price for either ferrochromium or ferrovanadium are not expected in the immediate future.

New York City.

Distribution of Chemicals in Foreign Markets

By C. R. DeLong
Chief, Chemical Division,
Bureau of Foreign and Domestic Commerce

THE QUESTION of intelligent and effective distribution of American chemical products in foreign countries is one that is of deep interest to the Chemical Division of the Bureau of Foreign and Domestic Commerce. The marketing of chemicals outside of the United States presents problems of a character differing from those met with in domestic markets. It is only by a close and careful study of conditions existing in the markets of each particular country that the most efficient distribution will be attained. I believe that the recently created Chemical Division will be able, through the various agencies at the disposal of the Department of Commerce, to give material assistance to the domestic chemical industry in solving these export problems.

The department, by means of its commercial attachés, trade commissioners and the co-operation of the consular service of the Department of State, can place at the disposal of American chemical concerns interested in the development of foreign markets information as to the extent of markets, the competition that is likely to be met, agencies that are qualified to handle the particular products, customs duties and commercial regulations governing the sale of special commodities.

Representatives of the department in foreign countries are constantly reporting opportunities and inquiries for the sale of American goods. These "trade opportunities" are brought to the attention of domestic firms known to the department as being interested in the development of foreign trade. In this connection a list of American firms known as the "Exporters' Index" is maintained. Only concerns which are American-owned and interested primarily in the promotion and sale of American goods are included in this list. These firms receive confidential information as to financial references, commercial reputation of the foreign firm, and other comments pertinent to the trade opportunites in foreign countries.

Dependable Trade Statistics

Another factor essential to the intelligent distribution of chemicals in foreign markets is accurate and detailed statistical information on the trade of various countries, so as to determine what share of this trade is being obtained by the United States. In order to make such statistics available at the earliest possible date mimeographed monthly statements of exports of important commodities showing the countries of destination are sent to interested firms. These special reports thus make this statistical information available considerably ahead of their publication in the Monthly Summary of Commerce and Navigation.

Detailed studies are made periodically of world markets for groups of commodities or on the conditions surrounding the markets of a particular country. These published reports can be obtained at a small expense as compared with the valuable information which they contain.

The Chemical Division hopes to serve effectively the American chemical industry in the development of foreign markets and to aid in the efficient distribution of its products in these markets by placing such information in the hands of interested American firms at

he earliest date and in the most concise form. I elieve that if the chemical manufacturer will avail imself of the services of the Chemical Division the istribution of chemicals in foreign countries will be ore efficient and there will result less waste in time nd money. With complete information at hand, the ale of American chemicals in foreign markets should e no more difficult than the marketing of the same roducts in domestic markets. The Chemical Division s always ready to receive and seeks the suggestions of omestic firms as to the nature of the information hich will be of the greatest aid in marketing their roducts in countries outside of the United States.

Washington, D. C.

The Alkali Market From the Jobber's Viewpoint

By W. F. George

President, W. F. George Chemicals, Inc.

THE SITUATION in the alkali market, particulary in the less than carload jobbing trade, continues to e very unsettled, as it has been for many months past. his seems due principally to two reasons: first, the eneral business condition, which makes it practically mpossible for the small consumers to predict intelli- ently what their requirements will be over a given eriod; second, the great variety of prices quoted by he various factors in the alkali market on this kind f trade.

The open price policy advocated by many in various ines of business would go a long way toward stabilizing he alkali market if it were conscientiously adhered to y all. However, if a pretended open price policy is ombined with underhanded cut-throat competition, no enefit will be derived, but on the contrary a situation lready bad will become worse.

If this market could be stabilized at some fair level, he consumers would gradually gain confidence in their ources of supply and would feel more inclined to con- ract ahead for their requirements instead of buying rom hand to mouth as they have been doing up to the resent time. This would result in lower selling costs, nore efficient distribution and an ultimate saving to ll concerned.

New York City.

Stabilizing Profits in the Petroleum Industry by Predetermining Market Conditions

By Joseph E. Pogue

Consulting Engineer

DURING the past 18 months the problem of stabiliz- ing earnings in the petroleum industry has received vide attention. The general feeling in oil circles has een that the extreme fluctuations characteristic of this ndustry constituted a serious liability and that con- erted effort should be made to avoid the tremendous osses arising from this source. Unfortunately, how- ver, the only noteworthy attempt so far to better onditions—the policy of price stabilization started late ast year by the major purchasers of crude petroleum— was abandoned last month with drastic price slashing nd must accordingly be adjudged a failure. Thus oday the petroleum industry is in a chaotic condition, pparently further from achieving stabilization than t any time in its history. Evidently some new methods f attack are needed.

Perhaps we can see what these new methods must e if we analyze the fundamental causes of this in- stability. The underlying causes are two in number: fluctuations in price and variations in demand. Both of these conditions are primarily beyond the control of the petroleum industry itself and thus we reach our first conclusion; namely, that the basic cause of in- stability in the petroleum industry is external and arises from the instability of price and demand in the com- modity markets upon which the petroleum industry is dependent.

The losses from these fluctuations in prices and demands are tremendous and exert a disastrous effect upon earnings and profits. For example, one of the largest and most successful refining companies in the East in 1921 showed gross earnings of only $105,000,000 as compared with $169,000,000 in 1920, due to a sudden recession in price and demand; the effect upon net profits was even more destructive, these falling from $10,000,000 in 1920 to a loss of $5,000,000 in 1921. An- other very successful company, this one both a producer and a refiner, operating in the Gulf coast, suffered a decline in gross earnings from 1920 to 1921 of $32,000,000, and the net profits of this company were $19,000,000 less in 1921 than in 1920. These two ex- amples are not exceptional; they represent, on the con- trary, two of the best and most conservatively managed oil companies in the United States.

The Crux of the Matter

The petroleum industry, in common with all other industries, has devoted no end of effort to increasing its operating efficiency by perfecting its control of in- ternal conditions. The outstanding and untried oppor- tunity lies in the direction of external conditions— conditions that are responsible for the loss of perhaps three dollars for every dollar lost through operating inefficiency. But external conditions, as we have noted, are not primarily subject to control by operating units of an industry. True; but operations can be adjusted so as to fit external conditions, in so far as the latter are not subject to direct control, and this brings us to the crux of the matter: External conditions—that is to say, prices and demands—should be charted ahead with the same care that internal conditions are analyzed and projected, and when this is done adequately the oil business can be kept on the track, even though the track itself cannot be entirely straightened.

Can prices and demands be predetermined scien- tifically? The answer, with due qualifications, is yes, but not easily nor incidentally. Not until the oppor- tunity existing is recognized and proper effort is accorded it. No, in fact, until the oil industry gets up to date in this respect and does, as a matter of course, what enterprising concerns in many other lines are doing. Then the results, though far from infallible, may be expected to raise substantially the average of accuracy with which plans can be laid and production schedules guided.

The way is open. There is no need for the best companies in the oil business to have suffered the losses they did in 1921. There is no need for the best com- panies in the oil business to alternate between over- production and underproduction, to swing perennially between a feast and a famine. The answer lies in the market place; the way to the answer is through the employment of a new tool—the analysis and use of external conditions, the predetermining of price and demand.

New York City.

The Fundamental Requirements of Salesmanship in the Heavy Chemical Industry

By P. S. Tilden
Sales Manager, Lithopone, Pigments and Heavy Chemical Division.
E. I. du Pont de Nemours & Co., Inc.

LONG EXPERIENCE in the marketing of heavy chemicals has taught that each day brings its own problems, each its own lessons. Those who persist that there is a minimum of technicality in the conduct of the business suffer from the very symptoms which they claim do not exist.

A chemical salesman has nothing but his card and his personality to present to the customer. Unlike the man with a line of samples to submit and who, irrespective of personal appearances or attributes, may make sales based on the quality and price of his products, as indicated by those samples, the chemical salesman must, by his own individual force and enthusiasm, so impress his prospective customer that he becomes interested in company and products represented to him.

I have been asked whether technical knowledge helps the salesman and to what extent. It is axiomatic that knowledge of the proper kind always helps, but the extent to which it helps is governed, in my estimation, by the manner in which it is used.

Three Types of Chemical Buyers

Chemical buyers are of many types and kinds: We have the trained chemical buyer who is a part of his business, and knows its every detail from the ground up; we have the executive type who orders on requisition from his factory, with a limited degree of technical knowledge, and we have the purchasing agent, pure and simple, who will frankly confess to you that he has a "smattering" of all the products he purchases, but knows the details of the manufacture of but few, if any.

Now all these types are purchasing the same class of chemicals, highly technical in their character. The salesman, therefore, if with this technical chemical knowledge, must use great diplomacy in the manner in which he expounds his learning to the various types of buyers, or he is very likely to offend.

I have always claimed that there are three fundamentals that a chemical salesman should have at his command—viz., what his goods were made from, how they were made and what they were used for—but special care should always be used in recommending formulas, unless one is quite sure of his ground.

Each day brings the chemical salesman something of new interest—there are constantly being developed new uses for his products, so he must be wide awake and alert.

Sound Advice for the Salesman

In the days of Dana, as editor of the New York *Sun*, he had hung in his office the motto "Keep Your Eyes and Ears Open!" The chemical salesman could, with profit, bear this legend in mind. His must be an enthusiasm born of a love for his business, he must be able to convey this enthusiasm to others, he must make friends—and he must keep them. He should not be too intimate with his customers, but he must keep their respect, because his is the burden to keep them continual good-will customers of the house he represents, and he can do this, whether he can or cannot give you the formula for sulphuric acid; but if he knows it, he is so much better off.

In other words, no hard and fast rule can govern—it is the individual who can make or break his career in the heavy chemical business.

Finally, a word as to open prices. It must appeal to all that intelligent competition is far preferable to that of a ruinous character, and so if open prices will bring about the former condition, certainly they are to be desired.

Newark, N. J.

The Contract Evil in the Marketing of Steel Products

By B. E. V. Luty

FOR years the marketing of finished steel products has stood in need of one great reform, abolition of the "requirement," "option," "jug-handled" or "accordeon" contract. The practice of making such contracts was established a quarter century or more ago, the late Andrew Carnegie being reputed to have been the originator of the system. The object was to tie up a consumer, so that if the consumer had requirements the mill making the contract would get the business. If he did not, the mill would lose nothing.

The principle may have been good in certain cases, but the practice was badly overdone. Mills got into the habit of overselling, on paper, in an effort to insure full operation, while buyers in turn were moved to overbuy, since when business was good, mills could not make shipments at the full contract rate.

The usual contract of this style is not enforceable. An improvement made before the war gave the seller power to cancel unspecified monthly quotas. Mills sometimes advanced asking prices simply to induce specifying on the old contracts, then making contracts for a fresh period, advancing prices again, and so on until the market became top-heavy, thus insuring an eventual break in prices.

Since the war-time control of the steel market by the government the making of these blanket or requirement contracts has not been altogether as prevalent as formerly, one deterrent factor being uncertainty as to costs. The practice should be entirely abolished, except perhaps as to contracts for relatively short periods. A definite tonnage should be bought and sold, the mill should deliver on time and the buyer should accept and pay.

Definite extras should be charged for small lots of a size or section, to cover extra cost of production. By the establishment of such extras buyers would be moved to specify larger individual quantities at a time, carrying stocks of the sizes they require in small quantities only. When steel is scarce mills charge extra for mixed specifications, but as soon as orders become scarce they forego even the most reasonable charges.

Pittsburgh, Pa.

Taxing the Raw Materials of the Soap Industry

By Martin H. Ittner
Colgate & Co.

IT MAY not be out of place to say here that very large and exorbitant customs duties are now proposed for the first time on fats and oils that do not compete to any extent with our own production of fats and oils, which are exported by us in enormous quantities. This will not help the producer of American fats and oils and will necessarily increase the cost and selling price of soap.

Jersey City, N. J.

Production, Consumption and Prices

The Trend of Prices for the Principal Commodities in the Chemical Market Is Briefly Reviewed and Statistical Summaries Are Given for the Volume and Value of Manufacture, Imports and Exports

JUST as 1921 was a year of reaction from the excesses of the preceding year, so 1922 has been characterized by a slow and gradual recovery. Much of the damage incurred in the rigorous processes of deflation and liquidation has been repaired and industry in general has adjusted itself to the changed conditions of competition. All along the line there has been consistent improvement. The increased volume of production, wider distribution and growing consumption of commodities, easier conditions in the money market, higher security values, fewer business failures and better price adjustments—in fact all of these basic indexes of business activity point definitely to the fact that the corner has been turned and business is on the upward grade.

The chemical industry, somewhat slower than others to feel the effect of depression, has not responded quite as quickly to the stimulus of better times. If we are to judge from price trends, the year May, 1920, to May, 1921, covers the span of the most severe deflation. From May, 1921, to June, 1922, was given over to the uncertain process of readjustment, while the first 5 months of the current year witnessed a gradual and consistent recovery. Since last May, however, prices have shown the effect of the usual seasonal lull. It is perhaps significant to note that, as measured by *Chemical & Metallurgical Engineering's* weighted index of chemical prices, May was the high month for 1920, the low month for 1921, and again the high month for 1922.

This index number, whose course since 1917 may be found in Table I and is also shown graphically in the accompanying figure, was compiled to assist our readers in following the week-to-week trend in the chemical market. It is based on twenty-five commodities so selected as to represent qualitatively and quantitatively the principal branches of the chemical industry. The average wholesale prices for these commodities in the New York market were weighted on the basis of the total production plus imports in 1919, and finally these figures were compared with and expressed in terms of a pre-war base. This base of 100 represented the average monthly prices for the year July 1, 1913, to June 30, 1914.

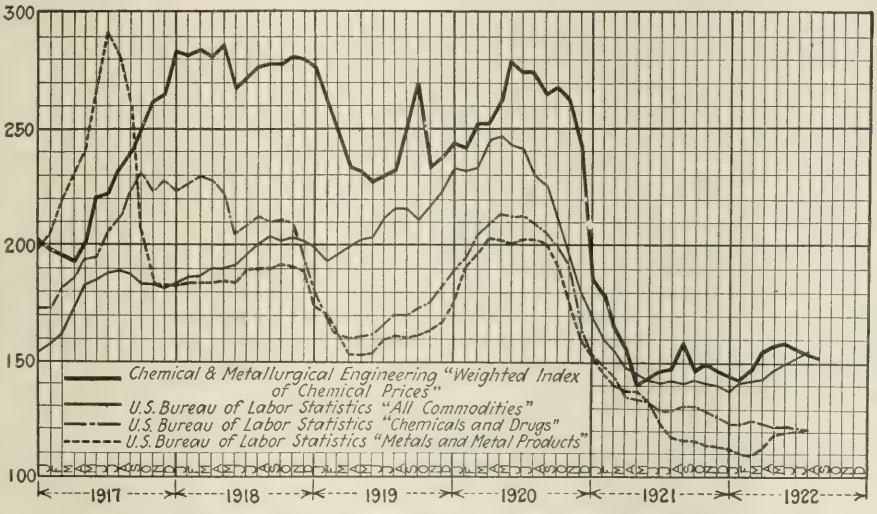

FIG. 1—THE TREND OF CHEMICAL AND METAL PRICES, 1917-1922

During the 5½ years included in this compilation the chemical market has followed an unusually interesting course. This magazine's index number rose from 191 in March, 1917, to 286 in April, 1918. Then followed a period of high prices, ending with a decline, which began at the time of the armistice and extended throughout the first 6 months of 1920. The post-war boom of 1920 had its effect about this time and prices again rose to 1918 levels. This was followed by the precipitous fall of prices during 1920, when the index number dropped from 263 in October, 1920, to 140 in May, 1921. The remainder of 1921 saw a number of minor fluctuations. During the first 5 months of the present year a consistent improvement was to be noted, but June, July and August have again shown slight declines. Prices are still considerably above the level at the beginning of the year, however, and the average for the first 8 months of 1922 is 154, as compared with 152 for 1921 and 255 for 1920.

The Trend of Production

The increasing volume of manufacture during the current year is shown in a striking manner by the statistics published monthly in the "Trend of Business Movements" section of the *Survey of Current Business*. This publication of the Department of Commerce is prepared by the cooperation of the Census Bureau and the Bureaus of Standards and Foreign and Domestic Commerce. Selected figures for certain of the more important of the chemical and allied industries are shown in Table II. From the last column of this tabulation it will be noted that with the exception of beehive coke, cottonseed and linseed oils and electrolytic copper, all of these commodities show marked increases over the corresponding periods in 1921. These range between 1.1 per cent in the case of chemical wood pulp to a gain of 112.4 per cent for the consumption of crude rubber by the tire manufacturers. The wood chemical industry,

TABLE I—CHEMICAL AND METALLURGICAL ENGINEERING'S WEIGHTED INDEX OF CHEMICAL PRICES, 1917-1922

(Base = 100 for 1913-1914)

	1917	1918	1919	1920	1921	1922
Jan.	198	281	262	242	181	144
Feb.	195	285	250	252	166	148
Mar.	191	281	233	252	157	156
Apr.	207	286	231	261	140	158
May	222	267	227	279	143	159
June	222	272	229	274	147	157
July	233	277	231	274	148	156
Aug.	240	278	251	264	158	152
Sept.	252	278	272	267	147	...
Oct.	264	280	233	263	151	...
Nov.	265	279	239	240	147	...
Dec.	283	277	245	189	145	...
Averages	212	279	242	255	152	154

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week 149.80
Last week 150.92

Included in this index are acetic, citric, hydrochloric, nitric, and sulphuric acids, ethyl and methyl alcohols, anhydrous ammonia, ammonium sulphate, barium chloride, bleaching powder, borax, caustic potash, caustic soda, copper sulphate, formaldehyde, glycerine, potassium carbonate, salt cake, soda ash, sulphur, benzene, aniline, cottonseed and linseed oils.

the only line of strictly chemical manufacture represented in this table, reports increases of 69.5 per cent in the case of calcium acetate and 34.2 per cent for wood alcohol.

Annual figures for the production, consumption and prices, 1914-1922, of the principal commodities on the chemical market are to be found in the tabulations which follow. These statistics are compiled for the most part from official sources, including the publications of the Census Bureau, U. S. Geological Survey, Bureau of Mines and Bureau of Foreign and Domestic Commerce. Production figures in the case of coal-tar products are taken from the census reports of the United States Tariff Commission, to which credit is cheerfully given for such material as is abstracted from the *Tariff Information Surveys* and the *Summary of Tariff Information.*

TABLE II—THE TREND OF CURRENT PRODUCTION IN CERTAIN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

Production of—	Feb., 1922	Mar., 1922	April, 1922	May, 1922	First 5 Months of 1921	First 5 Months of 1922	Percentage Increase or Decrease in 1922
Acetate of lime, thous. of lb.	7,942	11,134	7,836	7,107	25,088	42,513	+ 69.5
Alcohol (wood), gal.	433,024	587,928	418,271	380,237	1,692,593	2,272,160	+ 34.2
Cement, thous. of bbl.	4,278	6,685	9,243	11,176	33,172	35,673	+ 7.5
Coke, byproduct, thous. of short tons	1,795	2,137	2,227	2,537	9,047	10,599	+ 17.2
Coke, beehive, thous. of short tons	549	732	528	432	3,296	2,737	— 17.0
Cottonseed oil, thous. of lb.	91,321	72,237	27,610	12,389	607,092	304,263	— 49.9
Leather, sole, thous. of sides	1,466	1,473	1,327	1,321	6,704	7,241	+ 8.0
Leather, finished upper, thous. of sq.ft.	70,296	77,510	66,700	67,275	222,779	356,344	+ 60.0
Linseed oil*, thous. of lb.	6,647	7,232	6,069	7,952	38,294	34,357	— 10.3
Metals:							
Pig iron, thous. of long tons	1,630	2,035	2,072	2,307	8,363	9,682	+ 15.8
Steel ingots, thous. of long tons	2,072	2,816	2,794	3,099	9,149	12,420	+ 35.8
Copper, thous. of lb.	37,416	61,867	76,601	88,714	326,906	290,434	— 11.2
Zinc, thous. of lb.	45,026	53,064	51,012	54,838	188,004	251,352	+ 33.7
Paper and pulp:							
Wood pulp, chemical, sh. tons	144,568	170,995	147,608	167,197	659,138	666,318	+ 1.1
Newsprint, sh. tons	97,786	117,507	111,861	129,950	528,678	562,812	+ 6.5
All other paper, short tons	404,031	475,353	528,461	589,971	2,075,218	2,720,304	+ 31.1
Petroleum:							
Crude oil, thous. of bbl.	40,814	46,916	44,635	46,473	196,255	221,697	+ 13.0
Gasoline, thous. of gal.	398,223	472,228	472,920	513,659	2,032,050	2,291,703	+ 11.3
Kerosene, thous. of gal.	167,220	178,785	188,809	173,824	835,493	881,555	+ 5.3
Rubber:							
Crude†, thous. of lb.	18,467	26,771	43,407	35,727	124,332	264,105	+112.4
Pneumatic tires, thous.	2,084	2,646	2,401	2,722	6,439	11,908	+ 84.9
Sugar:							
Imports, raw, long tons	448,321	571,836	473,137	446,678	1,520,336	2,254,911	+ 48.3
Meltings, raw, long tons	415,723	535,357	531,962	577,330	1,512,831	2,351,973	+ 55.5

* Shipments from Minneapolis. † Consumption by tire manuacturers.

General Chemicals

Acetic Acid

The significant development in this industry is the remarkable increase in imports, which in 1920 were more than 100 times the imports of 1914. This is due in a large measure to the development of the manufacture of synthetic acid from calcium carbide in Canada. The plant at Shawinigan Falls is reported to have a capacity of about 650 tons per month of 100 per cent acetic acid. Over 90 per cent of the imports in 1919 originated in Canada. The striking decrease in imports in 1921 was due to the accumulation of large stocks in the hands of both consumers and producers. Prices for the 28 per cent acetic acid reached a maximum of 7½@8c. per pound late in 1917, but have since fallen to 2¾ cents, as compared with a pre-war price of 1½@1⅝c.

PRODUCTION AND IMPORTS OF ACETIC ACID, 1914–1921

Year	Production (Lb.)	Value	Imports (Lb.)
1914	75,303,375	$1,272,294	27,743
1915	.....	.....	312,850
1916	.....	.....	504,858
1917	80,000,000	.....	201,004
1918	.....	.....	264,997
1919	56,585,386	2,816,252	1,252,649
1920	.....	.....	2,862,068
1921	.....	.....	32,715

PRICES OF ACETIC ACID, 28 PER CENT, AT NEW YORK, 1914–1922

(Dollars per 100 lb.)

	1914	1915	1917	1918
Jan.	1.75–1.90	1.75–2.00	4.50–5.00	5.50–7.00
April	1.50–1.65	1.75–2.00	4.50–5.00	6.00–6.50
July	1.50–1.65	2.50–2.65	5.00–6.00	5.96–6.11
Oct.	1.50–1.65	3.00–3.15	6.50–7.50	4.91–5.16
	1919	1920	1921	1922
Jan.	4.91–5.16	2.75–3.00	3.00–3.25	2.75–3.00
April	3.25–4.00	3.62–4.37	2.50–2.75	2.50–2.60
July	2.75–3.00	3.75–4.50	2.50–2.75	2.25–2.50
Oct.	2.75–3.00	3.75–4.50	2.75–3.00	

Acetone

Before the war acetone was made exclusively from calcium acetate. War demands as a solvent and for use in the manufacture of the explosive cordite led to the development of several new processes, among them fermentation of corn, molasses and kelp. Acetone was also synthesized from calcium carbide and from the olefine gases obtained in cracking petroleum oils. Except for one producer by the fermentation method other processes have since been abandoned or are continued only on an experimental scale. It is significant to note that present prices are nearly the same as in 1914.

PRODUCTION AND IMPORTS OF ACETONE, 1914–1921

Year	Production (Lb.)	Value	Imports (Lb.)
1914	10,425,817	$1,099,585	2,760
1915	.....	.....	235,917
1916	.....	.....	179,497
1917	27,500,000	.....	.....
1918	.....	.....	148,082
1919	6,045,914	767,042	443,504
1920	.....	.....	6,600
1921	.....	.....	209

PRICES OF ACETONE IN NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1917	1918
Jan.	12 –12.5	17–20	22½–23	35 –36
April	10½–11½	21–23	27½–28½	35 –36
July	10½–11½	25–27	32½–33½	25½–25¾
Oct.	11½–12	30–33	35 –36	25½–25¾
	1919	1920	1921	1922
Jan.	20 –20¼	13½–14	13 –13½	12½–12½
April	15½–16	19 –20	12 –12½	11½–12
July	13¾–14	21 –22	12½–13	10 –10½
Oct.	13½–14	15 –18	12½–13	.....

Nitric Acid

Production in the war year 1918 reached almost a million tons and in addition but slightly less than 5,000 tons was imported. Exports were also at a maximum in 1918, amounting to about 20,000 tons. Production, imports and exports have all shown marked decreases since the war.

PRODUCTION, IMPORTS AND EXPORTS OF NITRIC ACID, 1914–1921

Year	Production (Short Tons)	Imports (Lb.)	Exports (Lb.)	Value of Exports
1914	78,589	.....	Not shown	.....
1915	.....	356,558	Not shown	.....
1916	.....	224,699	Not shown	.....
1917	602,000	13	Not shown	.....
1918	945,000	9,444,028	39,584,858	$23,231,892
1919	19,436	8,000,867	501,568	73,006
1920	.....	47,754	716,914	96,109
1921	.....	.....	267,119*	48,552
1922	.....	.....	234,736*	27,587

*Fiscal years ending June 30.

PRICES OF NITRIC ACID, 42 DEG. BÉ., NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.	4.9–5¼	4.9–5¼	8½–9¼	8½–9¼
April	4.9–5¼	4.9–5¼	8½–9¼	9¼–9½
July	4.9–5¼	7.9–8¼	8 –8¼	8½
Oct.	4.9–5¼	8½ –9¼	7 –7¼	8½–8¾
	1919	1920	1921	1922
Jan.	8½–8¾	7½–8	7 –7½	6½–6¾
April	8 –8¼	7¾–8	6¾–7	6 –6¼
July	7 –8	8 –8½	6¾–6¾	6 –6¼
Oct.	7 –8	7¼–7½	6¼–6½	.....

Sulphuric Acid

None other of the strictly chemical industries attains the volume of production which is shown by sulphuric acid. The domestic output reduced to the basis of 50 deg. Bé. acid in 1918 amounted to 7,500,000 tons. Before the war exports were less than one-fifth of 1 per cent of the domestic production. In 1918, however, they amounted to 40,000 tons, valued at $1,250,000. Prices at present are considerably beneath the pre-war level. The 66 deg. acid can be purchased in the New York market for $15 per ton, as compared with $20 in 1914.

PRODUCTION, IMPORTS AND EXPORTS OF SULPHURIC ACID

Year	Producers	Production* Tons	Imports (Lb.)	Exports (Lb.)
1914	194	4,071,566	6,724,911	12,131,750
1915	...	3,868,152	7,382,139	46,771,510
1916	...	5,642,112	6,286,490	82,020,246
1917	221	5,967,551	667,008	58,604,048
1918	...	7,450,000	11,374,400	80,294,643
1919	208	5,402,347	14,746,049	21,295,522
1920	...	5,600,000	10,817,784	28,987,342
1921	...	.....	.....	18,600,704†
1922	...	.....	.....	13,979,319†

* Reduced to 50 deg. Bé. basis.
† Fiscal years ended June 30.

PRICES OF SULPHURIC ACID, 66 DEG. BÉ. NEW YORK, 1914–1922

(Dollars per ton)

	1914	1915	1916	1918
Jan.	20–22	20–22	40–50	40–50
April	20–22	20–22	50–60	45–50
July	20–22	25–40	40–45	28
Oct.	20–22	35–50	30–40	28
	1919	1920	1921	1922
Jan.	25	22–25	18–19	17–18
April	17–25	24–25	19–20	17–17.50
July	16–20	24–25	18–20	15–16
Oct.	20–22	22	17–18	

Ammonium Sulphate

The bulk of the world's trade in ammonia is handled in the form of ammonium sulphate. Prior to the war Germany was the largest producer and annually exported from 40,000 to 70,000 tons more than she imported. England was second, exporting about three-fourths of her output. The United States ranked third, with France fourth. The tremendous increase in byproduct coke production during and since the war has put the United States on a parity with Germany as a producer of ammonium sulphate. This country has also developed a very important export trade in this commodity, as is evidenced by the fact that during the fiscal year ended June 30, 1922, exports amounted to 168,077 tons. Early in the present year prices were substantially below the 1914 quotations.

PRODUCTION, IMPORTS AND EXPORTS OF AMMONIUM SULPHATE, 1914–1922

Year	Production* (Short Tons)	Value	Imports (Tons)	Exports (Tons)
1914	186,749	$4,696,590	83,376	Not shown
1915	225,625	5,648,958	57,048	Not shown
1916	235,265	8,496,278	19,610	Not shown
1917	280,396	11,973,468	8,176	Not shown
1918	378,000	19,637,619	3,983	Not shown
1919	545,116	20,827,270	2,354	Not shown
1920	469,463†	.....	1,993	Not shown
1921	303,500	.....	.....	65,915‡
1922	.....	.....	.....	168,077‡

*All ammonia compounds figured as sulphate. †Estimated. ‡Fiscal years ending June 30.

PRICES OF AMMONIUM SULPHATE, NEW YORK, 1914–1922

(Dollars per 100 lb. in single bags)

	1914	1915	1916	1918
Jan.	2.95–3.00	2.50–2.80	4.00	7.25–7.35
April	2.85	3.20	3.70–4.00	7.25–7.35
July	2.47	3.25	3.40	7.80–7.85
Oct.	2.55–2.80	3.30	4.00	4.75
	1919	1920	1921	1922
Jan.	4.90–5.00	5.00–5.25	3.50–3.75	2.30–2.40
April	4.50	4.50–5.00	2.90–3.00	3.50–3.75
July	4.65–4.70	5.50	2.60–2.75	3.40–3.50
Oct.	3.75	5.00–5.25	2.20–2.25	.....

Arsenic

The maximum annual consumption of white arsenic in the United States was in 1920, when it was estimated that approximately 15,000 tons was used. In 1921 this dropped to not more than 9,000 tons. It is difficult to estimate the consumption because of its wide variance—from 3,400 tons in 1904 to 15,000 tons in 1921. Prices since 1901 have ranged between 2¾ and 14½c per lb. Prior to 1914 most of the arsenic used in this country was imported. From 1901 to 1910 the United States produced an average of only about 975 tons, as compared with import of 4,235 tons.

PRODUCTION AND CONSUMPTION OF WHITE ARSENIC, 1914–1921

Year	Production (Short Tons)	Value	Imports (Lb.)
1914	4,670	$313,147	3,034,351
1915	5,498	302,116	2,789,531
1916	5,986	555,187	2,458,694
1917	6,151	1,118,313	1,984,480
1918	6,323	1,213,000	3,746,246
1919	6,029	.....	8,778,218
1920	11,500	.....	7,479,485
1921	.....	.....	6,686,570

PRICES OF WHITE ARSENIC, 1901–1922.

(Average price in cents per lb.)

Period	Price	Period	Price
1901–05	2.837	1918	9*
1906–10	3.153	1919	8 –10½
1910–15	2.740	1920	9½–14½
1916	3½– 8	1921	7 –12
1917	8¼–15	1922	7 – 8½

*Fixed by U. S. Government.

Barium Chloride

The domestic consumption of barium chloride before the war was supplied almost entirely by Germany, but with the cessation of imports a strong domestic industry was established. Production increased from 2,106 tons in 1915 to 4,870 tons in 1917. Imports fell from 3,000 tons in 1914 to a negligible quantity for the period of 1916 to 1919. They were resumed, however, on a considerable scale in 1920 and 1921. Barium chloride has recently become one of the more temperamental commodities on the chemical market and prices since 1914 have covered the wide range between $32 and $130 per ton.

PRODUCTION AND IMPORTS OF BARIUM CHLORIDE, 1914–21

Year	Production (Lb.)	Imports (Lb.)
1914	.....	6,110,386
1915	4,212,000	4,686,029
1916	7,286,000	50
1917	9,740,000	6,614
1918	9,060,000	.....
1919	8,743,098	3,290
1920	.....	3,190,255
1921	.....	4,372,939

PRICES OF BARIUM CHLORIDE, NEW YORK, 1914–1922

(Dollars per ton)

	1914	1915	1916	1918
Jan.	32.50– 33.00	50– 60	110	65– 90
April	32.00– 32.50	60	140	65– 85
July	32.00– 32.50	70– 80	110–120	65– 70
Oct.	120.00–130.00	95–100	100–110	65– 70
	1919	1920	1921	1922
Jan.	85–87	90– 95	75–80	52– 53
April	82–85	150–175	60–65	80– 85
July	70–80	175–180	59–60	95–100
Oct.	80–85	125–130	43–45	.....

Calcium Acetate

During the period between the federal Census of Manufactures in 1914 and 1919, the output of calcium acetate has remained practically stationary. In 1917 the War Industries Board estimated the output at 200,000,000 lb., or about 25 per cent more than the 1919 production. There has been a substantial decrease in our export trade in this commodity, which before the war accounted for at least one-third of the total production. During the fiscal year ended June 30, 1922, exports amounted to 27,606,499 lb. The price range during the period 1914 to 1922 has been between 1½ and 7c. per lb. Early in the present year prices had fallen to 1¾c.

PRODUCTION AND EXPORTS OF CALCIUM ACETATE, 1914–1922

Year	Production (Lb.)	Value	Exports (Lb.)
1914	163,521,577	$2,138,909	68,160,224
1915	.....	.....	24,673,247
1916	.....	.....	18,804,972
1917	200,000,000	.....	12,959,222
1918	.....	.....	15,682,813
1919	168,956,000	2,682,232	16,362,929
1920	.....	.....	23,309,469
1921	.....	.....	12,845,700*
1922	42,513,000†	.....	27,606,499*

*Fiscal years ended June 30. †First 5 months.

PRICES OF ACETATE OF LIME, NEW YORK, 1914–1922

(Dollars per 100 lb.)

	1914	1915	1916	1917
Jan.	1.66⅔	2.00	6.66⅔	3.50
April	1.50	2.66	7.00	4.50
July	1.50	3.75	6.33⅓	5.25
Oct.	1.66⅔	4.50	3.50	6.00
	1918	1920	1921	1922
Jan.	6.00	2.00	2.00	1.75
April	4.00	2.00	1.60	1.75
July	4.00	3.50	2.00	2.00
Oct.	4.00	3.50	2.00	.....

Bleaching Powder

Production of bleaching powder fell from 310,380,000 lb. in 1914 to 177,140,000 in 1919. This can be attributed largely to the increasing competition from liquid chlorine. Imports, which in 1914 amounted to almost 50,000,000 lb., fell to less than 1,000 lb. during 1918. There has been some resumption of imports, but even in 1921 when 12,440,906 lb. was received, this was still considerably less than our export trade in this commodity. During 1920 48,826,348 lb. was exported, principally to the Latin-American countries. Present prices are approximately at pre-war levels.

PRODUCTION, IMPORTS AND EXPORTS OF BLEACHING POWDER, 1914–1922

Year	Production (Lb.)	Value	Imports (Lb.)	Exports (Lb.)
1914	310,380,000	$2,916,225	47,423,651	.....
1915	.....	.....	18,402,130	.....
1916	.....	.....	3,289,790	.....
1917	.....	.....	65,564	.....
1918	.....	.....	535	13,060,401
1919	177,140,000	3,418,500	539,596	15,639,918
1920	.....	.....	2,474,617	48,826,348
1921	.....	.....	12,440,906	18,447,579

PRICES OF BLEACHING POWDER, NEW YORK, 1914–1922

(Dollars per 100 lb.)

	1914	1915	1916	1918
Jan.	1.20–1.30	1.37–1.62	14.00	3.25–3.50
April	1.20–1.30	1.40–1.50	8.00–8.50	2.25–3.25
July	1.20–1.30	1.40–1.50	5.50–8.00	2.00–3.25
Oct.	2.25–3.00	2.50–2.75	4.25–6.00	5.50–6.00
	1919	1920	1921	1922
Jan.	2.25–3.50	2.60–2.75	2.75–3.00	2.50–2.60
April	1.50–2.75	4.00–5.00	2.40–2.60	1.60–1.75
July	2.00–2.25	6.50–6.75	2.15–2.25	1.60–1.75
Oct.	2.75–3.00	7.50–8.00	2.75–2.80	.....

Formaldehyde

Production of formaldehyde more than doubled during the 5-year period 1914 to 1919. In the former year three producers reported an output of 8,426,247 lb., while in 1919 six establishments produced 19,663,753 lb. This increase is probably due to the remarkable industrial development in the manufacture of synthetic resinlike products which are made by the condensation of formaldehyde with hexamethylenetetramine, phenol, or cresol. Imports prior to the war were practically negligible, but in 1920 amounted to 428,444 lb. It is significant to note that recent price reductions have brought the general level down to that which existed prior to 1914, although during the boom of 1920 prices were more than five times present quotations.

PRODUCTION AND IMPORTS OF FORMALDEHYDE, 1914–1921

Year	Production (Lb.)	Value	Imports (Lb.)
1914	8,426,247	$655,174	14,228
1915	.....	.....	7,700
1916	.....	.....	79,857
1917	.....	.....	23,935
1918	.....	.....	148,798
1919	19,663,753	$3,938,322	502
1920	.....	.....	428,444
1921	.....	.....	86,281

PRICES OF FORMALDEHYDE, 40 PER CENT SOLUTION, NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.	8½ 9½	8½–9½	9½–10	19½–20
April	8½–9½	8½–9½	11 –12½	19 –20
July	8½ 9½	8½–9½	13½–14	16½
Oct.	8½–9½	9½–10	10 –11	16½
	1919	1920	1921	1922
Jan.	16½	35–40	18½–18¾	10½–10½
April	22½–23	58–63	15 –15¼	8½– 9
July	20 –22	55–57	13½–14	8½– 8½
Oct.	22 –23	44–50	12 –12½	.....

Copper Sulphate

Blue vitriol, produced largely as a byproduct in copper refining, reached a maximum output in 1916, when 55,622,345 lb. was produced by the refineries. During both 1916 and 1917 the United States enjoyed an unprecedented export trade principally to the countries of southern Europe, where copper sulphate is used as an insecticide in grape culture. Late last year prices were at practically pre-war level, but increases since that time have brought quotations up to about 6¾c. per lb.

PRODUCTION, IMPORTS AND EXPORTS OF COPPER SULPHATE, 1914–1921

Year	Production (Lb.)*	Imports (Lb.)	Exports (Lb.)
1914	34,411,443	114,730	7,375,775
1915	42,086,107	45,239	10,238,808
1916	55,622,345	184,182	17,978,242
1917	50,007,856	15,952	28,128,190
1918	31,292,490	98,143	15,164,078
1919	30,964,750	120	9,140,673
1920	.....	558,450	3,783,409
1921	.....	.....	4,297,378†
1922	.....	.....	4,809,948†

*By copper refineries. †Fiscal years ending June 30.

PRICES OF COPPER SULPHATE, NEW YORK, 1914–1922

(Dollars per 100 lb.)

	1914	1915	1916	1918
Jan.	5.00–5.25	4.35–4.55	14.50–15.50	9.50–10.00
Apr.	4.80–5.00	5.75–6.00	17.00–20.00	9.50–10.00
July	4.65–4.75	7.25–7.50	9.00–10.00	9.00– 9.25
Oct.	4.50–4.75	7.25–7.50	8.50–10.25	9.50– 9.75
	1919	1920	1921	1922
Jan.	9.50–9.75	8.25–8.50	6.50– 6.75	5.65– 5.75
Apr.	7.35	8.25–8.50	5.50– 5.75	5.55– 5.65
July	7.65	8.25–8.95	5.75– 6.00	6.50– 6.60
Oct.	8.75–9.00	6.75–7.00	5.00– 5.25	.....

Glycerine

The market production of glycerine in 1919 was reported by the Census as follows: Refined glycerine, 64,342,800 lb., valued at $20,724,000, and crude glycerine, 21,304,300 lb., valued at $2,961,600. Pre-war imports of crude glycerine ranged between 13,000,000 and 14,000,000 lb. annually, 50 per cent coming from England and France. Since the war the imports of crude glycerine have fallen off markedly; in 1918 but 1,445,000 lb. was received. The three years 1916, 1917, and 1918 were the boom years for glycerine prices, which in 1918 reached 64c. per lb. as compared with 14¾c. at present.

PRODUCTION AND IMPORTS OF GLYCERINE 1914–1921

Year	Production* (Lb.)	Imports† (Lb.)	Exports‡ (Lb.)
1914	60,944,799	24,787,000	.....
1915	.....	15,616,000	.....
1916	.....	7,026,000	1,022,707
1917	.....	2,964,000	13,743,377
1918	.....	1,445,000	21,755,400
1919	64,342,800	3,966,308	3,966,308
1920	.....	22,413,025	1,737,454
1921	.....	2,806,758	2,396,364

*Refined. †Practically all crude. ‡Practically all refined

PRICES OF C.P. GLYCERINE, NEW YORK, 1900–1922

(Dollars per 100 lb.)

	1900	1905	1910	1912
Jan.	13 60	12.75	19.00	15 00
April	13 50	12 50	18.75	18 00
July	13 75	11 50	22 00	17 25
Oct.	13.75	11 50	23.00	18 50
	1914	1915	1916	1918
Jan.	19 25	20 00	48 00	64 00
April	19 10	19 50	50 00	62 00
July	21 50	22 00	38 00	59 00
Oct.	20.25	50.00	47 00	25 00
	1919	1920	1921	1922
Jan.	16 00	21 50	14 50	16 00
April	17 00	25 00	14 00	15 50
July	19 00	27 50	12 00	14 75
Oct.	20 00	18 50	13.00	...

Potassium Carbonate

Imports of crude carbonate of potash formerly averaged about 20,000,000 lb., coming chiefly from Germany. In 1916 they fell to a minimum of 444,241 lb. During the war a small quantity of crude carbonate was produced in this country from wood ashes; the 1917 output was 2,070,000 lb. In 1919 production was up to 48,664,478 lb., valued at $2,299,926. The carbonate is one of the cheapest of the crude potash salts and prior to the war sold for 3c. per lb. During the boom of 1916 prices reached as high as 85c. per lb. for the small quantities that were obtainable. Present quotations are practically at pre-war level.

PRODUCTION AND IMPORTS OF CRUDE CARBONATE OF POTASH, 1914–1921

Year	Production (Lb.)	Value	Imports (Lb.)
1914	.....	.....	9,046,302
1915	.....	.....	8,620,504
1916	.....	.....	444,241
1917	2,070,000	.....	1,069,408
1918	1,827,000	$331,000	13,183,741
1919	48,664,478	$2,299,926	1,092,792
1920	976,000	.....	16,903,544
1921	.....	.....	4,048,902

PRICES OF CRUDE CARBONATE OF POTASH, 80 TO 85 PER CENT, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.	3–3½	14–14½	45–50	50–55
April	3–3½	15–15½	90	40–45
July	3–3½	20	80–83	38–40
Oct.	6–7	23–24	50	35–38
	1919	1920	1921	1922
Jan.	30–32	23	11–11½	4½–4¾
April	17–18	21–23	7 –8	4¾–4¾
July	12–14	20–21	5 –5½	5 –5¼
Oct.	25	19–20	4½–4¾	.....

Potassium Ferrocyanide

In 1914 yellow prussiate of potash was produced in an amount which represented approximately half of the total domestic consumption. In 1918, however, production by three firms amounted to only about a half million pounds, and imports had fallen to 135,000 lb. The reason for this striking decrease both in the production and in the consumption is the substitution of sodium ferrocyanide instead of the potash salt. During the current year yellow prussiate of potash has often been very difficult to obtain, and prices have advanced from 26c. to 33c. per lb. during the last 6 months. The highest war-time price was $1.80, quoted in April, 1916. At that time the red prussiate of potash (potassium ferricyanide) was practically $3 per lb.

PRODUCTION AND IMPORTS OF YELLOW PRUSSIATE OF POTASH, 1914–1922

Year	Production (Lb.)	Imports (Lb.)	Value of Imports
1914	3,204,684	2,986,984	$331,566
1915	.....	2,316,738	255,711
1916	.....	44,156	31,651
1917	.....	41,128	32,251
1918	457,267	134,638	111,096
1919	.....	58,003	45,869
1920	.....	762,857	105,962
1921	.....	447,690	91,447

PRICES OF YELLOW PRUSSIATE OF POTASH, NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.	13½	22 –24	90–100	125–130
April	13 –13½	42 –48	175–180	125–127
July	12½–12¾	75 –90	120–130	105–110
Oct.	34 –36	82½–85	65– 75	95–100
	1919	1920	1921	1922
Jan.	75 –80	37 –38	32 –32½	24–24½
April	50 –55	35 –38	26 –27	26–26½
July	25 –30	36 – 38	24½–25	33 33½
Oct.	45 –55	36 – 38	20 –20½	.....

Potassium Hydroxide

There was but one domestic manufacturer of caustic potash prior to the war, and more than half of the domestic consumption was imported from Germany. According to a statement made before the Committee of Ways and Means in 1921, the 1914 output of this firm was reported as 6,504,000 lb. The output in 1919, according to the Census, was 8,358,834 lb. Prices as high as $1 per lb. were noted for the 88 to 92 per cent caustic potash during the second quarter of 1916. At present heavy quotations from Germany have caused prices to sag so that the present scale is around 5½@6c. per lb.

PRODUCTION AND IMPORTS OF CAUSTIC POTASH, 1914–1922

Year	Production (Lb.)	Imports (Lb.)	Value of Imports
1914	6,504,000	6,579,125	$249,030
1915	.....	4,993,471	225,002
1916	.....	39,770	9,222
1917	.....	75,720	33,648
1918	1,984,847	11,732	4,398
1919	8,358,834	466,620	124,563
1920	.....	1,712,319	451,274
1921	.....	10,910,399	487,182

PRICES OF CAUSTIC POTASH, 88–92 PER CENT, NEW YORK, 1915–1922

(Cents per lb.)

	1915	1916	1917	1918
Jan.	7– 8	65– 70	90–95	83½–85
April	22–25	95–100	88–90	83 –85
July	38–40	83– 90	84–86	80 –82
Oct.	39–41	85– 90	85–90	70 –72
	1919	1920	1921	1922
Jan.	67–70	28– 30	14–14½	6 –6½
April	50–52	30– 32	9½–10	6 –6½
July	35–40	28– 30	5 –5½	5½–6
Oct.	28–35	23– 25	5½–5¾	.....

Soda Ash

Next to sulphuric acid, soda ash is probably the most important chemical as regards the volume of production. In 1918 the output amounted to 1,390,628 lb., valued at $35,685,520. Imports are an inconsequential factor and have generally amounted to less than 1 per cent of the domestic production. Since the war the United States has developed an important export trade in soda ash. The record year to date is 1918, when 238,434,992 lb. was exported, principally to Japan, Canada, Sweden and the Netherlands. There has been considerable reduction in the prices that obtained during 1920, but present quotations are much higher than the 1914 and 1915 figures. At that time prices were around 60c. per 100 lb., as compared with $1.75 now.

PRODUCTION, IMPORTS AND EXPORTS OF SODA ASH, 1914–1922

Year	Production (Short Tons)	Value	Imports (Lb.)	Exports (Lb.)
1914	980,224	.....	2,228,991	Not shown
1915	1,175,962	.....	2,127,542	Not shown
1916	1,194,183	$16,464,774	878,175	Not shown
1917	1,390,625	38,028,000	1,047,295	Not shown
1918	1,390,628	35,635,520	1,514,765	238,434,992
1919	981,054	29,895,343	829,266	100,961,927
1920	1,238,149	38,908,726	1,515,278	166,761,603
1921	.....	.....	20,344,935	35,042,791

PRICES OF SODA ASH, 58 PER CENT LIGHT, NEW YORK, 1914–1922

(Dollars per 100 lb.)

	1914	1915	1916	1918
Jan.	.57½–.62½	.57½–.62½	1.75–2.00	2.85–3 02
April	.57½–.62½	.57½–.62½	3 50–3.75	2.80–2.85
July	.57½–.62½	.57½–.62½	2.75–3.00	2.00–2.05
Oct.	.57½–.62½	.57½–.62½	3.25–3.50	2.50–2.60
	1919	1920	1921	1922
Jan.	2.00–2.25	2.00–2.10	1.90–2.00	1.80–1 90
April	1 50 2 25	3.25–3.30	1 95–2.10	1.80–1.90
July	1.85–2.15	3.25–3.30	2.15–2.20	1.75–1.80
Oct.	1.90–2.00	2.50–2.60	2.10–2.15	.....

Sodium Bichromate

Sodium bichromate and sodium chromate are reported together in both production and import figures. The combined output of these salts in 1914 was 11,824 tons, and in 1918 this had increased to 28,334 tons. The value in the latter year was $9,868,118. Prices in 1914 were fairly stable at 4¾c. for the bichromate salt. After reaching a peak of 36c. per lb. in 1920, prices have declined until at the present time the salt is obtainable at 7½c. per lb.

PRODUCTION AND IMPORTS OF SODIUM BICHROMATE, 1914–1922

Year	Production* (Tons)	Value	Imports * (Lb.)
1914	11,824	$1,125,398	11,056
1915	.....	.....	.....
1916	.....	.....	6,154
1917	22,446	9,045,133	.....
1918	28,334	9,868,118	27,127
1919	26,526	6,233,566	.....
1920	25,973	5,531,954	.....
1921	.....	.....	64,236

* Includes sodium chromate.

PRICES OF SODIUM BICHROMATE, NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.....	4¾– 4⅞	4¾– 5½	25	17 –18
April....	4¾– 4⅞	4¾– 5½	60–70	23 –25
July.....	4¾– 4⅞	10 –11	30 –41	27½–29½
Oct.....	4¾– 5¼	16	26 –29	22½–24
	1919	1920	1921	1922
Jan.....	16½–18	17½–20	9¼– 9½	7⅞– 8
April....	10 –12	34 –36	7⅛– 7¼	7½– 7¾
July.....	7½– 8	25¾–26¼	8 – 8¼	7¼– 7½
Oct.....	13½–14	17½–19	7¾– 8	.....

Glaubers Salt

Glaubers salt is obtained as a by-product in the manufacture of hydrochloric acid and its production is, therefore, largely dependent upon that commodity. In 1914, 34,537 tons was produced with a value of $427,808. In 1918 a maximum output of 50,715 tons was reported. Imports of glaubers salt have never been large and are negligible compared with domestic production. Prior to the war, this salt was quoted at approximately 60c. per 100 lb., but during the 1920 prices as high as $2.50 were heard. At present prices are in the neighborhood of 90c. to $1 per 100 lb.

PRODUCTION OF GLAUBERS SALT, 1914–1921

Year	Production (Tons)	Value
1914.....	34,537	$427,808
1915.....	.....	.....
1916.....	.....	.....
1917.....	47,757	732,403
1918.....	50,715	1,041,070
1919.....	47,730	877,060
1920.....	50,655	990,541

PRICES OF GLAUBERS SALT, NEW YORK 1914-1922

(Dollars per 100 lb.)

	1914	1915	1916	1918
Jan....	.60–.90	.60–.75	.60–.75	.90–1.00
April..	.60–.90	.60–.75	.70–.80	1.50–1.75
July...	.60–.75	.60–.75	.65–.70	1.50–1.75
Oct....	.60–.75	.60–.75	1.25	2.00–2.50
	1919	1920	1921	1922
Jan....	1.75–2.25	1.15–1.50	1.75–2.00	1.30–1.50
April..	1.50–2.00	1.60–1.75	1.75–2.00	.95–1.10
July...	1.00–1.50	2.30–2.45	1.50–1.75	.90–1.00
Oct....	1.25–1.50	2.10–2.50	1.50–1.75	.....

Sodium Hydroxide

Caustic soda is second in importance to soda ash among the alkalis. During 1917 and 1918 large quantities of caustic soda were used in the production of synthetic phenol, which in turn was used in the manufacture of the explosive picric acid. The 1918 production was over a half million tons, valued at approximately $32,000,000. In 1917 eight firms used the soda ash method of producing caustic soda, and twenty-eight companies produced caustic soda electrolytically. About 28 per cent of the output in 1917 and 1918 was produced by the latter method. Imports in 1921, the largest on record, amounted to only about 700 tons. Exports, on the other hand, reached a maximum in 1920 of 112,000 tons. Japan, Italy, South America and Canada are the principal customers for American caustic.

PRODUCTION, IMPORTS AND EXPORTS OF CAUSTIC SODA, 1914–1921

Year	Production (Tons)	Value	Imports (Lb.)	Exports (Lb.)
1914	203,391	$6,657,514	665,319	Not shown
1915	287,239	.....	444,185	Not shown
1916	391,597	17,426,066	225,189	Not shown
1917	488,056	29,402,689	109,983	Not shown
1918	513,363	31,854,470	2,002	97,378,334
1919	311,388	20,091,978	42,724	164,235,420
1920	382,680	25,894,641	97,798	224,137,406
1921	.....	.....	1,401,211	49,865,219

PRICES OF CAUSTIC SODA, 76 PER CENT, NEW YORK, 1914–1922

(Dollars per 100 lb.)

	1914	1915	1916	1918
Jan....	2.00–2.25	2.00–2.25	5.50–5.75	6.50–7.00
April..	2.00–2.50	2.25–2.50	6.10–6.25	4.25–4.50
July...	2.00–2.50	2.25–2.50	5.00–5.50	4.00–4.25
Oct....	2.00–2.50	4.00	5.00–5.50	4.50–4.75
	1919	1920	1921	1922
Jan....	4.25–4.90	4.50–4.60	3.75–4.00	3.75–3.80
April..	3.50–4.00	6.75–7.00	3.60–3.70	3.65–3.70
July...	3.33–3.50	6.50–6.75	4.15–4.25	3.50–3.60
Oct....	3.33–3.50	4.00–4.35	4.00–4.10	.....

Sodium Ferrocyanide

Sodium ferrocyanide or yellow prussiate of soda is obtained as a by-product in the purification of coal gas. It can also be prepared from sodium cyanide. Production in 1917 was 4,173 short tons, valued at $2,577,667. Since 1917 there has been a consistent increase in the import of yellow prussiate of soda. In 1921 approximately 1,250 tons was imported. This commodity has shown a wide range of prices in recent years. From a pre-war price of less than 10c. per lb. quotations rose until in 1916 as much as $1.25 per lb. was being obtained. Since that time the general trend of the market has been downward, although after reaching a minimum of 12½c. in July, 1921, there was an upward reaction to over 20c. per lb. during 1922.

PRODUCTION AND IMPORTS OF YELLOW PRUSSIATE OF SODA, 1914–1921

Year	Production (Tons) *	Value	Imports (Lb.
1914	6,623	$1,947,582	2,295,714
1915	.....	.....	1,529,958
1916	.....	.....	527,130
1917	4,173	2,577,667	175,980
1918	4,525	2,690,110	271,063
1919	3,437	1,346,285	1,299,521
1920	2,930	1,318,049	2,201,662
1921	.....	.....	2,510,848

* Includes sodium and potassium cyanide in 1914.

PRICES OF PRUSSIATE OF SODA, NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.....	10½	14 –16	67½–70	35 –36
April...	9½–9¾	12	1.20–1.25	36½–37
July....	9½–9¾	35 –40	90 –92	60 –63
Oct.....	20–22	41 –45	45 –55	40 –42
	1919	1920	1921	1922
Jan.....	33–34	24 –24½	17 –17½	17 –17½
April...	17–22	32 –35	13 –13¼	17 –17¼
July....	18–20	25½–27	12½–12¾	21½–21¾
Oct.....	19–20	26 –27	13 –13¼	.....

Sulphur

The primary problem of the sulphur industry is to enlarge its market. The potential production of the domestic mines is in the neighborhood of 2½ million tons, whereas the actual production at present is not over one-half of that. Sulphur is in direct competition with pyrites in the acid-making industry and over one-half of the one million tons of sulphur sold in the United States in 1920 was used in the manufacture of sulphuric acid. A consideration of the following tables will show that during the last 10 years production has been considerably in excess of domestic shipments. There is at present an accumulation of approximately two million tons of sulphur, mined and ready for the market. Except for a short period during 1918 and 1919 the price of sulphur has been remarkably stable. At present quotations of $18 per ton f.o.b. New York are considerably under the pre-war figures.

PRODUCTION AND CONSUMPTION OF SULPHUR, 1909–1920

Production in tons

Year	World	United States	Domestic Shipments	Gross Value
1909	804,690	273,983	258,283	$4,783,000
1910	775,286	247,060	250,919	4,522,000
1911	764,358	205,066	253,795	4,573,000
1912	773,436	287,773	305,390	5,289,000
1913	793,645	491,080	319,333	5,614,000
1914	863,143	417,690	341,985	6,214,000
1915	846,412	520,582	293,803	3,955,000
1916	1,199,842	649,683	766,835	12,247,000
1917	1,548,023	1,134,412	1,120,378	23,987,000
1918	1,655,629	1,353,525	1,266,709	27,868,000
1919	(*a*)	1,190,575	678,257	10,252,000
1920	(*a*)	1,255,249	1,517,625	(*a*)

(*a*) Statistics not available.

PRICES OF CRUDE SULPHUR, NEW YORK, 1914–1922

(Dollars per ton)

	1914	1915	1916	1918
Jan....	22–22.50	22–22.50	22–22.50	35–40
April..	22–22.50	22–22.50	29–30	Nominal
July...	22–22.50	22–22.50	35	Nominal
Oct....	22–22.50	22–22.50	35	30
	1919	1920	1921	1922
Jan....	28–35	22	16–20	18–20
April..	28–35	22	20–22	18–20
July...	28–35	22	20–22	18–20
Oct....	28–32	16–20	18–20	.....

Coal-Tar Products

Aniline Oil

Aniline oil occupies the same position of relative importance among the coal-tar intermediates as does sulphuric acid among the general chemicals. It is used in the production of a wide range of important dyestuffs. In 1920 the output of this intermediate alone amounted to 39,234,186 lb., valued at almost $11,000,000. The marked decrease that occurred in dye production during 1921 is well evidenced by the fact that the production of aniline oil shows a decrease of 86 per cent from that of 1920. The production of aniline salts (aniline hydrochloride and aniline sulphate) fell from 2,024,956 lb. in 1920 to 366,533 lb. in 1921. Imports of aniline oil have been of practically no significance since 1914. Prices have followed an unusually wide range, from 10c. per lb. in 1914 to as much as $1.10 per lb. during the shortage of 1915 and 1916. Present prices are around 15c. per lb.

PRODUCTION AND IMPORTS OF ANILINE OIL, 1914–1921

Year	Number of Producers	Production Lb.	Value	Imports
1914	1	*	.....	1,444,772
1917	23	28,806,524	$6,758,535	.....
1918	16	24,102,129	6,572,684	.....
1919	14	24,345,786	5,932,536	.....
1920	14	39,234,186	10,923,648	.....
1921	9	5,259,598	1,161,381	11,243

* Made by a single company on a scale below domestic consumption.

PRICES OF ANILINE OIL, NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.	10¼	60	68	23½
April	10½	110	65	25¾
July	11	90	39	27
Oct.	43⅓	70	25	28
	1919	1920	1921	1922
Jan.	27	34	22	17½
April	24	34	20	16½
July	22	35	20	14
Oct.	32	32	17½–18	..

Benzene

A striking increase in production has been noted in the case of benzene, the most important of the so-called coal-tar crudes. In 1914 the production of crude light oil was 8,464,274 gal., equivalent to a production of about 4½ million gallons of benzene. In 1918 44,804,900 gal. of benzene was produced in this country. Much of this, however, was used as raw material for explosives. In 1920 the Geological Survey reports on the production as follows: Crude, 8,747,572 gal., refined, 16,977,556 gal., and motor fuel 57,645,462 gal. The latter varies in benzene content from 50 to 100 per cent. It is evident from these figures that the productive capacity for benzene is far in excess of that required for the manufacture of dyes or other chemical products. Directly following the armistice prices of benzene dropped to less than pre-war, but since that time have increased until at the present writing benzene is quoted at approximately 29c. per gal.

PRODUCTION OF BENZENE, 1916-1921

Year	From Byproduct Coke Ovens (Gal.)	Value	From Other Sources (Gal.)	Value
1916	21,079,500	$13,159,374	.....	.....
1917	36,804,228	16,576,865	3,082,774	$1,536,495
1918	44,804,900	12,341,779	4,420,010	1,281,803
1919	44,697,615	7,776,669	1,826,373	560,547
1920	87,370,390*	27,142,754	875,561	287,586
1921	.....	.....	2,171,631	463,205

* Includes 57,645,462 gal. of motor fuel containing 50 to 100 per cent of benzene.

PRICES OF BENZENE, C.P., 1914–1922

(Cents per gal.)

	1914	1915	1916	1918
Jan.	23	27	70	35
April	23	29	70	28½
July	28	55	60	22
Oct.	29	60	55	22
	1919	1920	1921	1922
Jan.	22	30	30	27
April	20	31	27	29
July	24	37	27	29
Oct.	36	37	27	..

Beta Naphthol

Technical beta naphthol is the most important of the napthalene derivatives. The output in 1921 was 2,959,049 lb.—a 75 per cent decrease from that of the previous year. The maximum production in 1920 corresponds with the period of greatest output for the industries using para reds and other important colors in which this intermediate is used. The price of technical beta naphthol prior to the war was usually less than 10c. per lb. Prices were over ten times this figure in 1915 and 1916, but with the increasing production in 1918, 1919 and 1920 prices have shown a rather consistent decline and at present the quotations are in the neighborhood of 23c. per lb.

PRODUCTION OF BETA NAPHTHOL, TECHNICAL, 1917-1921

Year	Number of Producers	Production (Lb.)	Value	Value per Lb.
1917	16	5,913,846	$3,950,166	$0.66
1918	10	5,117,683	3,009,773	.59
1919	11	4,835,778	2,365,804	.49
1920	6	11,920,714	5,592,007	.47
1921	7	2,959,049	1,154,033	.39

PRICES OF BETA NAPHTHOL, TECHNICAL, 1917–1922

(Dollars per lb.)

	1914	1915	1916	1918
Jan.	.10	.85	1.30	.65
April	.9⅜	.85	1.25	.65
July	.10½	1.01⅜	1.16⅜	.65
Oct.	.30	1.16⅔	1.10	.61⅜
	1919	1920	1921	1922
Jan.	.60	.55	.38	.30
April	.55	.65	.33	.28
July	.50	.88	.38	.23
Oct.	.50	.75	.32	....

Naphthalene

It is difficult to give reliable figures for the production of naphthalene, due to the fact that it is produced from several different sources and in at least two grades. The figures in the accompanying table are those reported to the United States Tariff Commission as the production of refined naphthalene (solidifying at 79 deg. C. or above). The 1921 output of 13,183,142 lb. is a decrease of 55 per cent from that of 1920. It should be pointed out, however, that these figures do not include the output of naphthalene at coke ovens, data for which are usually collected by the Geological Survey. An idea of the extent of the production of crude naphthalene in the United States during 1918 may be gained from the following figures reported by the Survey: From tar distillers, 40,138,092 lb., valued at $1,281,440; from coke ovens, 10,614,799 lb., valued at $292,868; from gas houses, etc., 428,088 lb., valued at $11,558. This is a total of 51,180,979 lb., valued at $1,585,866. Imports during the 1914 fiscal year were 3,880,108 lb., valued at $70,428. Since the passage of the tariff act of 1916, imports of refined naphthalene have been less than 1 per cent of the domestic production.

PRODUCTION OF NAPHTHALENE, REFINED FLAKE, 1917–1921

Year	Number of Producers	Production (Lb.)	Value	Value per Lb.
1917	12	35,342,911	$2,334,302	$0.07
1918	10	28,112,165	2,162,168	.08
1919	7	17,625,235	1,160,815	.07
1920	9	30,230,734	2,308,536	.08
1921	9	13,183,142	740,955	.06

PRICES OF NAPHTHALENE, REFINED FLAKES, NEW YORK, 1914–1922

	1914	1915	1916	1918
	(Cents per lb.)			
Jan.	2¼	3⅛	13½	10
April	2¼	8¾	13⅞	10¼
July	2¼	15	8⅞	9
Oct.	3⅞	12⅞	8	9
	1919	1920	1921	1922
Jan.	9	8	8	7
April	7	10	8½	6½
July	6½	16	7	6½
Oct.	6	13	6½	..

Paranitraniline

The output of this important intermediate used in the manufacture of para reds and various color lakes reached a maximum in 1920 of 2,138,492 lb., valued at $2,500,000. The 1921 output showed a decrease of 61 per cent as compared with the previous year. The pre-war price of paranitraniline was 16c. per lb., but for 6 years following the cutting off of German imports prices were well over $1 per lb. During 1921, however, there was a gradual and consistent lowering of prices.

PRODUCTION OF PARANITRANILINE, 1917–1921

Year	Number of Producers	Production (Lb.)	Value	Value per Lb.
1917	9	1,724,008	$1,952,229	$1.13
1918	9	1,320,064	1,722,319	1.30
1919	8	1,310,658	1,388,627	1.06
1920	6	2,138,492	2,503,886	1.17
1921	9	621,559	526,403	.85

PRICES OF PARANITRANILINE, 1914–1922

(Dollars per lb.)

	1914	1915	1916	1918
Jan.	.16	1.25	1.45	1.15
April	.16	1.25	1.48	1.30
July	.16	1.25	1.36½	1.55
Oct.	.50	1.28	1.35	1.65
	1919	1920	1921	1922
Jan.	1.75–2.00	1.30	.93–1.00	.77–.80
April	1.25–1.50	1.45	.85–.90	.75–.77
July	1.00–1.25	1.45	.85–.90	.72–.75
Oct.	.95–1.00	1.20	.79–.82	..

Phenol

Phenol is another commodity which offers difficulties to the statistician, largely because of grades and varying sources of production. The years 1917 and 1918 showed enormous outputs of phenol, which, of course, was used almost entirely in the production of explosives. Much of the 106,794,277 lb. produced in 1918 came from synthetic phenol plants operating under government contracts. With the signing of the armistice, large stocks of government phenol were placed on the market. Approximately 25,000,000 lb., or nearly three times the normal annual consumption, was offered for sale. Naturally, this had a most depressing effect both on production and marketing of this article. The 1919 output was only 1,500,000 lb., valued at about 10c. per lb. There were but two producers during 1920, and their production could not be published. In 1921, the output had fallen further to less than a third of a million pounds.

PRODUCTION OF PHENOL, U.S.P. AND TECHNICAL, 1917–1921

Year	Number of Producers	Production (Lb.)	Value	Value per Lb.
1917	15	64,146,499	$23,715,805	$0.37
1918	17	106,794,277	37,270,284	.35
1919	6	1,543,659*	155,624	.10
1920	2	.....	.....	.....
1921	3	292,645	41,617	.14

* Cessation of military demand and disposal of army surplus.

PRICES OF PHENOL, U.S.P., NEW YORK, 1914–1922

(Cents per lb.)

	1914	1915	1916	1918
Jan.	7½	88½	1.31½	54
April	7½	1.21½	.79¾	52
July	21½	1.46½	58	44
Oct.	44½	1.51½	55	41
	1919	1920	1921	1922
Jan.	30–35	14	9	11½
April	10–12	20	11	11½
July	10–12	18	11	15
Oct.	12–14	12	8½	..

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CHEMICAL & METALLURGICAL ENGINEERING

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The Travelers Returned

ARRIVING within 10 days of each other, Dr. ELLWOOD HENDRICK and J. S. NEGRU of *Chem. & Met.'s* editorial staff recently returned from extended sojourns in England and on the Continent respectively. Dr. HENDRICK spent 2 months among the chemists of Great Britain, while Mr. NEGRU traveled for more than 6 months throughout the length and breadth of Belgium, France, Italy, Switzerland and Germany. That they have returned with fresh and original points of view on the chemical industry of those countries is the natural consequence of their interviews with men of high and low degree. They had unusual opportunities for observation and will be able to interpret foreign conditions in the language of our readers. Mr. NEGRU'S contributions will begin in our next number with a summary of his views on the cause of the financial breakdown in Germany. Considering the variety of causes that have been assigned for this condition it is interesting to note that Mr. NEGRU feels that Germany has brought disaster upon herself through an unsuccessful effort to wage an economic war on the rest of the world.

In this issue Dr. HENDRICK portrays in intimate detail the peculiar condition of the dye industry in England. There is a point in the history of the British corporation that reminds us of one of the cardinal errors made in the administration of the National Analine & Chemical Co. before it was incorporated into the Allied Chemical & Dye Corporation. Business is an art, and those responsible for the administration of business affairs must make things go. There is no excuse for failure to get along with the men who are needed. Again, business is like the institution of marriage: nobody knows how the parties to the contract are going to get along together, but they *must* get along or make a failure of it. In Buffalo there were the SCHOELKOPFFS, J. F. 2nd and 3rd, who were competent to make dyes and who knew the business. They were bought out because they couldn't agree with men who were lacking in the very knowledge which they enjoyed. They had had unique experience. The art of business required that these two singularly equipped men should have been kept in the organization so that it might profit by their help and their understanding. Conditions in the dye industry in the United States today would have been far better if they had remained active.

In England there was surely nobody having the wide experience in making dyes enjoyed by Dr. HERBERT LEVENSTEIN and quite aside from whatever his administrative ability may be or his capacity to get along with Sir JOSEPH TURNER, he should have been retained as part of the organization. In America we started well and then piffled out. In England they started badly, grew better, but lost a leading trick in the process.

But the most striking feature of the foreign situation is the part that Germany undoubtedly desires and is planning to play in the international control of dye manufacture. It is doubtful if Great Britain will succumb to the German wiles as France and Italy have—at least not on terms that will emasculate the industry and leave Great Britain helpless in time of national emergency. But the situation holds its lesson for those in whose hands rests the welfare of an American dye industry. With France and Italy already controlled and with the possibility of an industrial alliance with Great Britain, the German I.G. may well snap its fingers at the efforts to build a dye industry in this country. If ever conclusive proof were needed of the necessity of tariff protection until technical knowledge and business skill can work out our own salvation, it is to be found in the story disclosed in Dr. HENDRICK'S article. The helplessness of France and Italy will be our portion unless our law-makers get an intelligent comprehension of the importance of the chemical industry to our national welfare.

A Hopeful Prospect for Leadership in the House

FREQUENTLY the chemical industries have looked despairingly toward Washington for an intelligent, if not sympathetic, understanding of their problems. The leaders in the national legislature have often understood other industries, have been sympathetic with and even partial to them, but the chemical industries have enjoyed few friends at court. This is distinctly to be deplored. The chemical industries do not need partiality or even sympathy, but they do need an intelligent understanding.

It is, therefore, with a distinct feeling of hope that the news is received that NICHOLAS LONGWORTH probably will become Republican leader in the House of Representatives on the retirement of Mr. MONDELL next March. LONGWORTH has served his constituency and the country well and ably. In his tenure of office he has won for himself a high regard, not by reason of any spectacular brilliancy but because of his balance, his sane and informed opinion on a great many subjects. His rivals for the post of leader of the party in the House have all suffered severe blows in their own districts in the primaries, and LONGWORTH stands in line for the well-deserved honor.

Chemical industry has reason to rejoice that LONGWORTH will assume a commanding position, for he has held an enlightened opinion on chemical legislation. This does not imply by any means that he has been partial or in any way played the chemical industry as a favorite, but he has understood its problems, and that is the thing most to be desired by any industry as far as Congress is concerned.

Electrochemists Go to Canada

IN OUR news columns will be found the detailed program of the forthcoming Montreal meeting of the American Electrochemical Society, Sept. 21 to 23. It is seldom that the usually excellent programs of this lively organization have afforded so good a prospect of technical discussion and social diversion as the one for the Canadian meeting this month. The sessions on industrial heating under the direction of BRADLEY STOUGHTON of the electrothermic division give promise of unusual interest. Electrodeposition will also receive special attention at one session. The industrial feature of the meeting will be a special excursion to Shawinigan Falls for the inspection of industrial plants at that great Canadian center of hydro-electric power and electrochemistry. Social features will not be lacking. Older members particularly are likely to grow reminiscent over the note that "an old-fashioned smoker" will be given by the local committee, while the novice can be assured that he will be entertained right royally if he attends. The excellence of all the arrangements insures a large attendance and an unusually profitable meeting.

Living Wage And Performance

THE matter of a "living wage" continues to be pressed upon the Railroad Labor Board. In the hearings preceding the decision of the shopmen's case B. M. JEWELL insisted that a living wage was $2,637 a year. Recently the maintenance-of-way men formally demanded that the board recognize the "living wage," claiming that the transportation act requires that this be considered, but the board had ruled otherwise.

The transportation act prescribes as the second of the seven points that are to govern the board: "The relation between wages and the cost of living." Taking this statement by itself, the natural interpretation is that wages are to fluctuate according to the cost of living. In analyses accompanying its decision the board has made comparisons between prescribed wages and those in force in December, 1917, the month before the government took over the railroads; also comparisons between the existing cost of living and that in December, 1917. Confirmation of this view of the intention of Congress is found in the seventh point: "Inequalities of increases in wages or of treatment, the result of previous wage orders or adjustments." Thus even the "inequalities" are limited to those that result from recent acts. Congress plainly assumed that railroad wages in general had been about right, and the chief duty of the Labor Board was to correct divergences.

From the viewpoint of the general economic good and the peace and contentment of the people at large it is to be regretted that the Railroad Labor Board, with the great prestige its decisions must command, is not forced to go into this subject of the "living wage." There are some who consider the whole subject entirely nebulous, because the unions have made the living wage, by inventory, so many shredded wheat biscuit, so many pairs of children's shoes, etc., and each item is open to discussion. Others consider it out of the question, on the ground that "it can't be done"—i.e., can't be paid.

The latter objection brings out the very point that should compel attention to the subject, rather than abandonment of it. The argument is that the total income—i.e., the total production, including the rendering of service with the production of commodities—is not sufficient to give each worker what the alleged "living wage" would buy at present prices. What mor sensible thing could be done, then, than set down wha is the supply, and allocate it to the workers?

This would furnish the true basis of the "livin wage," not what a man ought to have according to hi notion of an alleged "American standard," but accord ing to what he contributes to the total. Suppose it b found that the total income is $60,000,000,000 a yea that 25 per cent should properly go for the use of capita and the services of those who manage and invest an 75 per cent to those who work and that there ar 40,000,000 workers. The figures taken are near enoug the fact to be suggestive. Then rate the workers on scale with 100 as the base or average. Many would b worth 60, 70, 80, 90, 100, 110 and 120. Some woul run up to 150, 200 and 250 and a few would run sti higher. The 40,000,000 people would receive a tota of $45,000,000,000, an average of $1,125 per capita Some would receive 90 per cent of this, some 110 pe cent, and so on.

Objection may be made that anything of this sor would raise a terrific clamor. The 90 per cent me would claim the 110 per cent men didn't do anythin worth while and would be overpaid at 80, and so on Precisely. That is just what is needed. The psycho logical influence would be of tremendous value. Th trouble today is the public doesn't realize that it pay the coal miner, the bricklayer and the other workers It thinks the wicked employer merely has to dig dow into his pocketbook for the money.

Celebration of Fire Prevention Week

FROM Oct. 2 to 9, Fire Prevention Week will b celebrated throughout the United States and Canada This campaign will be given all the publicity possibl through the newspapers, and will be the subject o meetings, parades, moving picture programs and a special campaign for school children.

With the coal situation in mind and most of us wit empty bins, it may be more difficult than usual to con centrate on prevention of fire. But a short contempla tion of the present fire situation will amply convinc the most worried householder that this campaign wil repay all the attention he is able to give it. The annual losses from fires—most of which are preventable—have averaged 15,000 lives and $500,000,000 in property for the past few years. And the yearly figures show these losses to be on the increase.

Fire prevention is an item of daily care to all those in responsible charge of industrial plants. There is no need to remind them that every week is fire prevention week so far as they are concerned. Their chief problem is to sell the idea to all those, employees and others, who may help in this work or who may be the unthinking causes of these losses.

It is in selling this idea that the value of Fire Prevention Week lies for the plant executive. We all remember, from Liberty Loan and War Chest drives, that one of the great lessons of the war was the value of the intensive campaign—the full effort concentrated over a short period—the campaign which drives the idea home and clinches it. By means of posters, motion pictures and mass meetings the need for the utmost care in fire prevention can be made clear to every employee.

We hope everyone responsible will see his way clear this year to putting in the energy, thought and money which are necessary to make Fire Prevention Week really fruitful. Such expenditure will be fully repaid.

Chromium Steels And Alloys

ONE of the first lessons an editor learns is to refrain from superlatives—leave them to his advertisers—so we refrain from calling chromium a "master metal." Perhaps it has been so dubbed. Iron is truly worthy of the title. Other metals doubtless have been given it as well, particularly tungsten, which during the war was hailed as one of the "keys" to victory and economic independence. Tin was another "key," and nations were hard put to discover how they could insure an adequate supply, despite war, embargoes and U-boats.

Tungsten, as a requisite for high-speed steels and a relatively scarce metal at that, doubtless warranted all the attention it got during those busy days of enormous munition production. But its more common partner chromium is no less an indispensable ingredient of high-speed steel—indeed, it is the combination of the two which gives those unique characteristics of modern tools: hardening on slow cooling, gain in hardness on tempering and retention of hardness at red heat.

Nor is chromium's usefulness limited to high speed and air hardening (Mushet) tool steels. Nickel-chromium steels are without doubt the most widely used type of alloy steels; the tonnage comprises a very large fraction of the whole. Inasmuch as they ordinarily contain more than twice as much nickel as chromium, it might be thought that the latter was of distinctly secondary importance. But this is by no means true.

Plain nickel steels are tough and ductile, whereas the addition of chromium hardens the alloy without materially impairing those other advantages. The result is a very strong, tough alloy, which possesses high endurance under repeated loads, and it is therefore widely used for high-speed gas engines and automobiles. No less than fifteen separate analyses have been standardized by the Society of Automotive Engineers, containing some most excellent grades for case-hardening. Carburized nickel-chromium steels give pieces of very hard surface, not nearly so brittle and likely to flake off as the plain carbon steels. Furthermore, the reactions induced in nickel-chromium steels by heat-treatment go forward at such a modest speed that even the interior of fairly large masses of metal can be treated and cooled at a rate which will develop the correct physical properties to the very center of the piece. In other words, mass has singularly little effect on heat-treatment, and this explains why nickel-chromium steels are favorites among armor makers.

Despite the temptation, it would carry us somewhat far afield to cite the properties of the more familiar steels, low, medium and high in alloy content. Suffice it to say that oil-quenching gives them very high strength, with fair ductility but relatively low impact values. (An analysis recommended by the Midvale Steel Co., for structural purposes, containing 0.40 per cent carbon, 0.75 per cent chromium and 3 per cent nickel, may have an elastic limit of 245,000 lb. per sq.in.—near the peak for commercial heat-treated steel.) Tempering such steels must be done with circumspection to avoid embrittlement, but when properly accomplished is able to raise the ductility and impact resistance enormously, although not without a considerable sacrifice in strength.

But plain chromium steels have themselves a unique place in the field of alloys. Chromium, either alone or in combination with iron, forms a very stable carbide, diffusing itself throughout the metal, inducing a very fine grain and corresponding great toughness because of its reluctance to accumulate into sizable masses. The carbide is very hard, and causes the quenched steels to be very hard. Furthermore, the chromium remaining after all the carbon is satisfied enters into solution in the iron and confers great corrosion resistance to the base metal. All these properties produce metal tough and hard, extremely resistant to wear and rusting, suitable for well bits, cold chisels and other shock tools, files and knives, ball bearings, rollers, crusher liners, safes, burglar-proof metal and armor-piercing projectiles.

As the chromium goes above 10 per cent, the region of "stainless steels" is entered. Most excellent and deservedly popular cutlery contains 13 to 15 per cent chromium with about 0.4 per cent carbon. In low-carbon steels, less chromium is needed to retain a silvery finish; furthermore it is cheaper and more easily worked into sheets and forged into shapes. Consequently "stainless iron" is appearing on the market and is said to be winning favor rapidly in England for metal trim of all sorts. But the older "stainless steel" analyses are by no means confined to cutlery—they can assume a wide variety of physical properties by appropriate heat-treatment, and are logical contenders for many machine elements and engineering purposes, from turbine blades to mine cables. Even higher alloys of iron-carbon-chromium have unique properties. Containing 20 per cent and more of chromium, they were developed for their remarkable resistance to oxidation, but have been discovered to possess great tensile strength, even as high as 700 deg. C. Furthermore, the high-carbon alloys resemble white cast iron in hardness and resistance to wear, yet are as tough as a good steel.

This account of a remarkable metal would not be complete without mentioning the importance of certain nonferrous chromium alloys. Much might be said of alloys of nickel and chromium. They have made electrical heating a commercial possibility. Wires and ribbons of it are universally used in laundry irons, hot plates and toasters, baking ovens and cookers of hundreds of varieties, for bread making, enameling and all sorts of heat-treatment. (In addition to these electrical resistors, several cheaper iron-bearing alloys for resisting high temperature contain more or less chromium as a prime essential.) Another alloy, stellite, is used for machine tools and for surgical instruments. Stellite is essentially an alloy of chromium and cobalt, and contains some tungsten.

However, all these advantages are not to be had without serious effort and expense. Chromium metal and alloys low in carbon, silicon and aluminum are difficult to make, and at present are quite expensive despite the relative abundance of the ores. Chromium oxidizes scarcely at all below its melting point, but when molten apparently oxidizes very readily. Most chromium-bearing alloys, unfortunately enough, are extremely sensitive to oxide inclusions. In steel making, for instance, if there is the least carelessness in the manufacture, if the charge is of inferior scrap or is badly oxidized during melting, if the refining stages be slighted in the least, if the casting and rolling are done in a slipshod fashion, a whole train of troubles and disappointments is in store. Surface cracks, from hairlines to roaks, will abound, flaky fractures will appear, soft spots will follow case-hardening, and a ground and polished surface of a roller or ball will develop markings like an alligator skin.

Like most good things, it doesn't come easy!

Readers' Views and Comments

Dr. Hendrick's English Tour

To the Editor of Chemical & Metallurgical Engineering

SIR:—The visit to England of Dr. Ellwood Hendrick, consulting editor of *Chemical & Metallurgical Engineering*, terminated on Saturday, Aug. 19, when he sailed on his return to the United States. His visit covered just exactly 2 months, and it enabled Dr. Hendrick to see a great deal of the leading personalities in British chemical industry and to inform himself at first hand concerning the special problems now engaging their attention. I saw him a few days after his arrival and a few days before his return. He looked at least 10 years younger for his holiday, was full of praise for the hearty hospitality showered upon him, and more deeply impressed than ever with the essential unity of the two great English-speaking nations. What we shall remember most is the spacious social atmosphere he carries about with him and the large-hearted human qualities which have made him welcome everywhere. He has become a sort of institution at the Chemical Industry Club, London, and at the annual meeting of the Society of Chemical Industry in Glasgow he was one of the most picturesque and popular figures. In fact, he seems during the past 2 months to have been present at every gathering worth attending, and everywhere he has been accepted as a true friend. His big, genial figure, his infectious smile, his good humor, good fellowship and real largeness and kindness of heart will long be remembered by all who met him during his stay; and on his side, one fancies he will carry back to the States equally pleasant memories of the friends and colleagues he dined, and smoked, and chatted with —in public and in private—during his 2 months in the old country.

FREDERICK E. HAMER,
London, England. Editor, *Chemical Age*.

Black Fractures in Carbon Tool Steels

To the Editor of Chemical & Metallurgical Engineering

SIR:—I was much interested in the article on "Black Fractures," particularly so as this phenomenon has been fairly well understood in the tool steel industry for a number of years. It is commonly regarded as a precipitation of graphitic carbon from cementite. This precipitation takes place on prolonged annealing in the region of and immediately below the Ar_1 point. A reference on this subject which has been in print for considerable time is on page 416 of Dr. C. M. Johnson's book on "Rapid Methods for the Chemical Analysis of Special Steels." At the moment I do not recall a paper which gives complete quantitative information upon this phenomenon. Such an account should be written.

J. V. EMMONS,
Cleveland, Ohio. Metallurgist, Cleveland Twist Drill Co.

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is a little surprising that Mr. Green does not recognize this peculiar appearance described in his article on "Black Fractures" in your journal for Aug 9, 1922, p. 265, as due to the existence of temper carbon. The exact conditions under which high-carbon steel sometimes deposits free carbon are not known, but in general we do know that it is the result of bad mill practice. Excessive temperatures in the first cogging operations and low temperatures below the recalescence point in the annealing represent the two conditions which most frequently account for temper carbon.

It is possible for temper carbon to exist up to a considerable amount without showing "black fractures." It is also recognized by experienced tool steel men that steel containing temper carbon can be hardened, but the result in the hardened steel shows a characteristic dry and stony fracture and is very weak in strength. It appears that about 0.90 per cent carbon dissolves readily above the Ac_1 temperature, and this is sufficient to produce hardening. The balance of the free carbon goes into solution with greater difficulty in the heated steel unless the temperature be carried too high for good hardening results. The excess carbon remaining in its graphitic condition accounts for the weak dry structure. The cementite usually passes into globular form just prior to decomposing into iron and carbon when conditions for such decomposition are right.

JOHN A. MATHEWS,
New York City. President, Crucible Steel Co. of America.

To the Editor of Chemical & Metallurgical Engineering

SIR:—The trouble described by Mr. Green as "Black Fractures" has been well known for many years, in connection with the annealing of crucible steel, or any steel of relatively high silicon content, and not containing appreciable amounts of non-ferrous elements that deter, or entirely prevent, the formation of graphitic carbon under favorable conditions of temperature.

It is the property of iron that it cannot retain carbon in the combined state when silicon is in excess of about 0.10 per cent and the carbon is much in excess of 0.90 per cent, if the steel is held for *prolonged* periods at or below 700 deg. C. As H. M. Howe stated in his "Metallography of Iron and Steel," p. 215, graphite is the stable form of carbon and cementite is only a metastable form always striving to change over into graphite by the reaction:

$$Fe_3C = 3Fe + \text{Graphite}.$$

Silicon is the greatest promoter of graphite of any non-ferrous element found to any extent in iron and steel. Mr. Green mentions in his article a steel containing 0.25 per cent silicon. This is quite sufficient to promote readily the "black heart" fracture in a steel where the carbon is as high as 1.15 per cent. If the silicon is much under 0.10, it is quite difficult, if not entirely impossible, to obtain black fracture in the higher carbons—1.15 to 1.35 per cent—by prolonged anneals at the favorable range of 660 to 700 deg. C.

For example, the only way the writer was able to get a precipitation of graphite in "washed metal" which contains about 3 per cent carbon and is very low, usually under 0.05 per cent, silicon, was to heat it for several hours at about 1,050 deg. C. So great is the influence of silicon that Charpy and Thenard were able to graphitize completely all the carbon in steels from as low as 0.40 to 0.14 per cent carbon by raising the silicon content to 4 per cent. In this case the graphitization

was complete in 3 hours at 800 deg. C. With 2.20 per cent silicon, no graphite formed.

Assuming the absence of modifying elements, hypo-eutectoid steels generate cementite at or below 700 deg. C. and hyper-eutectoid steels at increasingly higher temperatures as the carbon content rises, so that for the 3 per cent carbon "washed metal," a temperature just under its melting point is the most favorable.

The presence of two or three-tenths of 1 per cent of chromium is a great deterrent of graphite formation. Also manganese is said to act in the same way. This is due to the formation of much more stable carbides of chromium and manganese. It is quite likely that tungsten and molybdenum act as deterrents also. As spheroidizing anneals and long heating periods tend to promote graphite formation, the heating periods should be made as brief as possible. Repeated reheatings at lower temperatures also tend to produce black steel.

The best use for steel containing considerable graphite, as far as good tool steel is concerned, is to drop it quietly on the scrap pile for remelting.

C. MORRIS JOHNSON,
Research Department,
Crucible Steel Co. of America.
Pittsburgh, Pa.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I must admit to Dr. Mathews that I did not recognize the existence of "temper carbon," but did acknowledge that poor or bad mill practice was at times responsible for the production of black fractures. I have found that the steel when hardened has a dry and stony fracture as stated in his letter, and regret that I did not include that observation in my article.

Mr. Johnson's letter I find particularly interesting, and have found in my experience with black fractures that I have verified his statements regarding the rôle of silicon in the production of black fractures. I also agree with him that the scrapping of the material is quite necessary.

Although I never entertained the thought that I was writing anything new when I wrote the article for publication, I am very much interested in the amount of comment it has aroused. It may ultimately lead to the publication of a very conclusive article on this subject.

ARTHUR W. F. GREEN,
Metallurgist, The John Illingworth Steel Co.
Frankford, Philadelphia, Pa.

Chemists in Public Life? Why?

To the Editor of Chemical & Metallurgical Engineering

SIR:—After reading S. L. Redman's communication in "Chemists in Public Life" in your issue of Aug. 16 I left my workbench and sat down in the "office" of the laboratory to reflect. Just why do chemists want to get into public life anyway?

Chemists are chemists because they possess an interest in nature. For my part I look upon my 22 years in chemical laboratories about the same way an art student does. I don't want to be in public life; I leave that to lawyers and professional politicians. Lots of us don't want to be executives either; we just want to be left alone. I have been an executive. I became one once because my friends said I ought to be one and that I would obtain a big salary. I was successful. I managed blast furnaces for 3 years, to the entire satisfaction of the owners.

Every time I went to the laboratory and saw my chemist working on the analysis of pig iron, slag or iron ores, I said to myself, I wish I was back in the laboratory again, it is much more interesting than simply being an executive. My work as an executive consisted in trying to see how few men I could employ to man the blast furnace, the smallest pay I could offer to fill vacancies, the lowest coke consumption I could use to make merchantable pig iron, and to doctor the troubles of men, plant and process. I tried for 3 years to feel satisfied as an executive. I found the work uninspiring, tiresome and boring. I resigned to go back to the laboratory. I have been back 14 years and feel glad that these 14 years have not been wasted by simply "being an executive."

RANDOLPH BOLLING.
Norfolk, Va.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read the letter of S. L. Redman in your Aug. 16 issue with much interest. I heartily agree with Dr. Redman that the laboratory inclination of the product of colleges and universities is traceable directly to the ideas that are instilled at these institutions. But in spite of this training there are some who never regard a laboratory position as other than an introduction to other activities.

There is a class of organizations that should be as severely condemned for fostering this conception of the field open to the chemist. I have heard executives, on receiving applications from men of chemical training, state that their organization did not have any openings that would be of interest to a chemist *because they did not maintain a laboratory.* These managers regard a chemist as useful merely for analytical work and entirely incapable of responsibilities outside of the laboratory. Unquestionably the chemist, individually and collectively, is responsible for this attitude. Many chemists as well as others are willing to accept the order of things as they find them.

The employer who has never retained a chemist in another capacity is loath to try the experiment, usually contending that because a man has never before performed a given operation it is beyond the realm of possibility that he will be able to succeed. When the institutions of learning stop teaching the chemist that his field of endeavor is the laboratory, and the manufacturer, sales organizer, etc., stop conceiving of chemists in terms of laboratories, analyses and expenditures and consider him as a possible asset, economist and producer, then the bulk of our graduates will not be seeking laboratory jobs and the employers will have to find another alibi for "we do not have a laboratory."

A. E. MAZE.
East Orange, N. J.

New Source of Creatin

To the Editor of Chemical & Metallurgical Engineering

SIR:—So much research is apparently being carried out by biochemists and others upon creatin and related compounds that it seems desirable to note that a new source of this substance has been discovered which will make it available in much larger quantities than heretofore. Pure creatin will soon be purchasable through regular supply houses at a price which will be a fraction of 1 per cent of the present price; or the writer will be glad to distribute reasonable quantities direct, for research purposes.

It is hoped that this new source of creatin may serve to stimulate research in this field, since the quantities now available will permit research by the synthetic organic chemist as well as by the biological chemist.

The writer will be glad to give further details to anyone interested.

GRAHAM EDGAR,
Professor of Chemistry.
University of Virginia,
Charlottesburg, Va.

Canadian Meeting American Ceramic Society

THROUGHOUT the week of Aug. 14 Canadian ceramists were hosts to visiting members of the American Ceramic Society on one of the most enjoyable summer excursion meetings on record. Exceptional opportunities for recreation, instruction and good fellowship were afforded by a trip which covered points of ceramic and historic interest from Montreal to Hamilton. The success of the meeting was due in no small measure to the local committee at each point, who arranged programs of plant visits and entertainment and in many other ways looked after the comfort of their visitors. The inconveniences of traveling were minimized through the courtesy of the Canadian Pacific Railway officials, who furnished special parlor cars and sleepers. And no expression of gratitude could be complete without mention of the untiring general secretary, Ross C. Purdy. He alone knows the trials encountered in attempting to keep the little band of explorers intact, particularly when it became necessary to leave behind the shores of Quebec.

As is customary at summer meetings, no technical sessions were held, but three evenings were devoted to Section Q in the most approved pre-Volstead style.

Boat Trip to Montreal

About fifty members boarded the steamer Kingston at Rochester Sunday evening, Aug. 13, for the trip to Montreal. All day Monday as the steamer passed through the Thousand Islands and the famous rapids of the St. Lawrence, old friendships were renewed and new ones formed. It made an ideal start for a week of companionship.

Montreal

Tuesday morning an inspection trip of the magnificent harbor facilities was arranged. Some members also visited the plants of the National Brick Co., Ltd., across the river from Montreal in Laprairie. Excellent common brick, face brick and hollow tile are made at the four plants operated by this company. The common brick plant shown in Fig. 1 has a capacity of about 65,000,000 brick a year. A battery of thirteen dry pans feeds a pug mill and an auger with a wire cutter which turns out brick at the rate of 220,000 to 240,000 per day. Clay is brought from the clay bank, Fig. 2, on dump cars shown in the foreground, Fig. 1. Only half of the building is in use at present, so that the capacity can be doubled when conditions are favorable.

After a delightful lunch in a quaint old French tavern in Laprairie, the main group was rejoined at the Consumers Glass Co., where O'Neill semi-automatic machines equipped with Federal Glass Co. feeders were seen in operation, producing bottles of various shapes and sizes. Certain shapes were also being blown by hand, so that it was possible to compare the two methods. The practice of shipping bottles in bulk by simply stacking them in the cars with a layer of heavy paper between stacks attracted a great deal of attention. Breakage has been found to be extremely low.

Wednesday's activities began with breakfast at sunrise, for the two special parlor cars were attached to the 6:15 train for Ottawa.

Derry Feldspar Quarry

Upon arrival at Buckingham, about 30 miles from Ottawa on the Quebec side of the Ottawa River, automobiles conveyed the party over 10 miles of picturesque roads winding through the east side of the Lièvre River Valley to the Derry feldspar quarry.

This deposit, opened by O'Brien & Fowler in the fall of 1920, contains feldspar which is cream to white in color, analyzing 12.5 to 13.5 per cent potash and 1.75 to 2.15 per cent soda. The deposit has a maximum width of 150 ft., about 50 ft. being practically pure feldspar, while the remainder consists of mixed feldspar and quartz. The richer portion, which is about 300 ft. long, is being worked as an open cut. The method of working is shown in Figs. 3 and 4.

The material blasted from the face of the quarry is inspected as it is placed on 1-ton flat dump cars, small pieces being eliminated through the use of stone-forks in loading. The cars dump into a 100-ton bin on the hillside. Transportation to the railroad varies with the season of the year. In summer, the feldspar is handled 2 miles by wagon to the river and placed in scows, which are towed to the railway siding at Buckingham. In winter, the entire trip is made by sleighs, the frozen river forming the highway for the greater part of the distance.

After a thorough inspection of the quarry under the guidance of the superintendent, N. B. Davis, full justice was done to an excellent dinner served camp-style in the mess hall at the quarry. Many will agree that this was one of the most delightful experiences of the whole trip.

Ottawa

Arriving at Ottawa late Wednesday afternoon, the party registered at the Chateau Laurier and then took dinner at Ye Olde Homestead Inn just across from Ottawa on the Quebec side of the river. Later in the evening several members were conducted through the well-equipped ceramic laboratories of the Department of Mines by Mr. McLeish, director, Mines Branch, and Howells Frechette, in charge of ceramic work.

Thursday morning one of the mills of the E. B. Eddy Co. at Hull, Que., was visited. Products of this mill

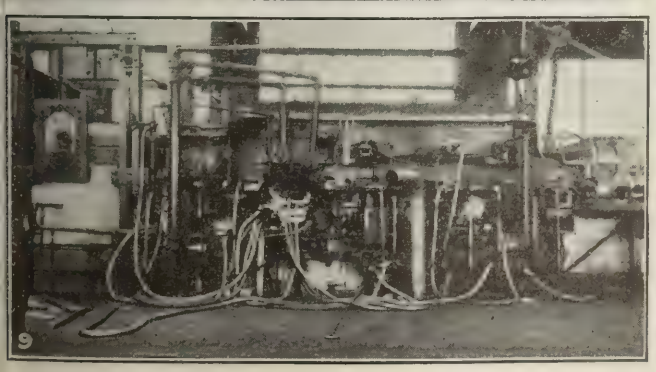


Fig. 1—National Brick Co., Laprairie.
Fig. 2—Clay bank, National Brick Co.
Figs. 3 and 4—Derry feldspar quarry.
Fig. 5—Party leaving mess-hall, Derry quarry.
Fig. 6—Hull, Que. Sulphite mill, E. B. Eddy Co., in center

Fig. 7—Richardson feldspar quarry.
Figs. 8 to 10—Canadian Libbey-Owens Sheet Glass Co.
Fig. 8—Feed end of tank.
Fig. 9—Sheet drawing machine.
Fig. 10—Leer (above) and loading platform (below).

include ground-wood pulp and a wide variety of paper and paper products, such as paper bags, tissue paper and crepe paper.

The sulphite mill of this company is shown in the center of Fig. 6.

Richardson Feldspar Quarry

Near Verona, in Frontenac County, Ontario, is located the famous Richardson quarry, which from 1901 to 1918 furnished most of the feldspar shipped to the United States. The quarry is so situated that a series of handlings was required to place the feldspar at the nearest railway spur. Prior to 1918 labor was cheap enough so that a small margin of profit remained after transportation charges. Since then the cost has become prohibitive and the mine has not been operated. The present owner, R. F. Segsworth, of Toronto, who was active in the development of the Seneca-Superior mine at Cobalt, has interested the Canadian Pacific Railway officials so that the spur is being extended to within 2 miles of the quarry. The connecting wagon road is being finished by the Ontario Department of Highways, so that transportation difficulties will soon be a thing of the past.

About 3 o'clock Thursday afternoon the special cars were carefully pushed to the end of the spur extension. The remainder of the journey—a matter of 3 or 4 miles over the crushed rock sub-base of the new road in lumber wagons provided with rough pine boards for seats—was enjoyed most by those who walked up and back. Those who had the courage and endurance to stick to the wagons insist that the distance was at least 10 miles each way. All were amply repaid, however, by the opportunity to inspect one of the largest deposits of high-grade feldspar on this continent.

The extent of the deposit is apparent from Fig. 7. The pit is about 400 ft. long by 150 ft. wide and 100 ft. deep. All told, about 500,000 tons of material has been removed. About half of this has been high-grade feldspar, while the remainder, which requires sorting, has been left in the form of stock piles, one of which is visible at the upper right, Fig. 7. Pending completion of the new transportation facilities, operations at the quarry are confined to working over and sorting these dumps.

In anticipation of a strenuous return trip, several of the party refreshed themselves by a plunge in the clear waters of Thirteen Island Lake.

Kingston

Although an elaborate program of entertainment had been arranged by the Kingston Council, there was only time for dinner at the Frontenac Club and a hurried inspection of the new Memorial Hall before boarding the special sleepers for Toronto.

Toronto

Friday morning the wonderful harbor developments at Toronto were studied at close range from motor launches.

In the afternoon the party divided for plant visits, some going to the Standard Sanitary Works, others to the Jefferson Glass Co. At the latter plant a pot furnace was in operation and large arc light and street light globes were being blown by hand. After passing through continuous leers the surplus glass is neatly cracked off and the edges ground smooth.

Electric lamp shades of almost every conceivable shape and design are made and the decoration of these forms a most interesting part of the operations at this plant. Some designs are brushed on by hand, plain colors are applied by air brush either with or without the use of a stencil, while many designs are obtained by the method used for decorating china. The design is first etched on a steel plate and the lines filled with wax containing the desired pigments. The wax design is then transferred to a sheet of paper, which is applied to the glass to be decorated. The wax adheres strongly to the glass and the paper may be removed, leaving the design ready for burning. All designs are fixed by heating to a temperature approaching the softening point of the glass used.

Before returning to the King Edward Hotel, the parties reunited for a motor bus trip through the beautiful residential sections of the city.

Hamilton

Arriving at Hamilton by boat Saturday morning, the party at once proceeded to the plant of the General Porcelain Co., where the operations in the manufacture of high-tension insulators were explained briefly. An interesting feature was a test of a large insulator at 300,000 volts.

Next the most modern process for making window glass was seen at the Canadian Libbey-Owens Sheet Glass Co. The mixture of raw materials is fed from overhead bins into a regular producer-gas-fired tank furnace having a capacity of about 600 tons. The feed end of the furnace is shown in Fig. 8. At the back end of the tank is the drawing mechanism shown in Fig. 9. Here a continuous sheet of glass is drawn from the pool of molten glass, the thickness of the sheet being controlled by the speed of drawing. The sheet rises vertically for about 3 ft., makes a right-angle turn while still soft over a roller and then passes horizontally through the long annealing leer, emerging at the far end as a continuous sheet of glass about 6 ft. wide. Two men with cutters trim off the edges and cut the sheet into pieces, which are later cut to size and packed in boxes. Fig. 10 shows the leer on the upper level, the boxes of glass below and the loading platform in the center of the building. There are two complete machines at this plant, each having a capacity of from 3,000 to 3,500 100-ft. boxes per week. When drawing ordinary window glass, the sheet is delivered at the rate of about 6 ft. per minute.

After lunch a small group also visited the plant of the Dominion Glass Co., where Owens automatic bottle machines were seen in operation.

This concluded a week which will long be a pleasant memory in the minds of all who participated and one which did much to knit more firmly the bonds of friendship and kindred interest which have long existed between ceramists on opposite sides of the invisible boundary.

What Goes Into Paper

One hundred pounds of paper, according to a compilation appearing in the house organ of a large paper manufacturer, represents the following commodities in approximately the quantities indicated: Wood, 13.4 cu.ft.; sulphur, 12.7 lb.; limestone, 17.5 lb.; kerosene, 5.7 oz.; bleaching powder, 14.3 lb.; rosin, 3 lb.; soda, 0.515 lb.; alum, 4.2 lb.; color, 1.8 oz.; coal, 320 lb.; iron sulphate, 0.79 oz.; copper sulphate, 0.19 oz.; lime, 3.17 oz.; and 7,500 gal. of chemically treated and filtered water.

The Circulation of Molten Metal by Means of Electrodynamic Forces

By Oscar Brophy

IN CERTAIN types of electric furnaces in which the heat is generated by passing the current through the molten metal, it is absolutely necessary that sufficient circulation be maintained in order that the heat will not accumulate in any one part of the furnace. If the heat does accumulate, the furnace will fail to operate successfully, due either to the volatilization of the metal or to the failure of the refractories.

This statement applies to that type of furnace which is composed of a molten metal bath and a molten metal resistor. The metal is heated in the resistor and at the same time circulated into the bath.

Pinch and Corner Effects

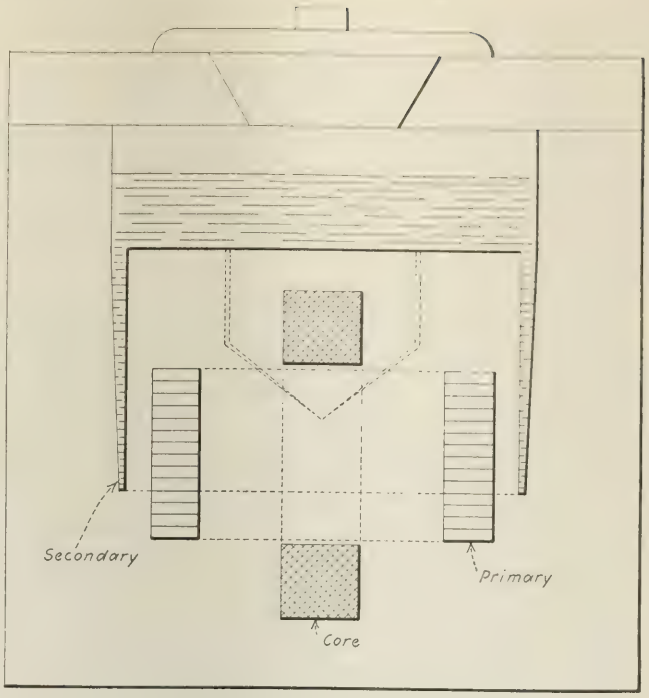
The first furnace of the above type to attain prominence and which depended on an electrodynamic force to attain this circulation was that described by Hering (U. S. Pat. 988,936). This furnace was operated by what is known as the "pinch effect." The explanation of this force which is most easily understood depends upon the fact that conductors carrying currents in the same direction attract one another. Assume that the molten conductor is composed of innumerable strands of molten metal each carrying its current. Then all of these strands will be attracted to one another and will set up a pressure at the center of the molten conductor and cause the liquid metal to flow lengthwise through the conductor.

This "pinch effect" is not dependent on any other external force such as would occur if another part of its own circuit or another circuit entirely were brought near it. We may then say that "pinch effect is the action of a current upon its conductor."

A second electrodynamic force that is used to circulate molten metal is known as the "corner effect" and was also first described by Hering (U. S. Pat. 1,105,656). This force has also been named "motor effect," but this is misleading, because in most types of motors the effect is obtained by the reaction of two separate and distinct circuits, whereas the "corner effect" mainfests itself in a single circuit. Whenever a liquid conductor carrying a current is made to take the form of an angle there is a force set up in the liquid. This force is strongest at the apex of the angle and decreases as one recedes from the apex. This force depends upon the fact that conductors carrying currents in opposite directions repel each other. Here the turn of the conductor gives the condition of two conductors of the same circuit carrying the current in opposite directions. We may then say that "corner effect is the action of a current upon a conductor in another part of the same circuit."

Motor Effect

A third electrodynamic force that can be used to circulate molten metal is that set up between the current carrying conductors of two separate circuits. The method of using this force in an electric furnace of the resistor and bath type was first described by the writer (U. S. Pat. 1,296,752) (see figure). This force is made use of in the constant current transformer in which the primary coil of a transformer is made stationary and the secondary coil is permitted to move in a vertical direction and is balanced by weights. The current flowing in the secondary coil is in the opposite direction to that of the primary coil and therefore there is a repulsive force between them. By adjustment of the balancing weight a certain current only is permitted to flow in the secondary coil. If the current should tend to increase, the repulsive force between the two coils will move the secondary coil away from the primary coil and cut down the secondary voltage.



This force was a detriment in the old open channel induction furnace. It tended to repel the molten metal from the primary coil toward the outside when the primary was placed inside the molten secondary. This force was so great as to cause the inclination of the bath of an 8-ton Kjellin furnace to be about 24 deg. (*Stahl und Eisen*, 1910, p. 1071). The uneven level of the metal caused the slag to run always to the inner side of the channel, where the refractory was quickly destroyed.

The action that takes place in most types of electric motors may properly be said to be due to the two separate circuits therein. Therefore this electrodynamic force may be properly termed "motor effect."

We may then say that "motor effect is the action of a current in one circuit upon the current carrying conductor of another circuit."

There is one characteristic of these three forces that it may be well to state. In what parts of the circuit can each force manifest itself? The "pinch effect" will show itself in the resistor or restricted part of the circuit. The "corner effect" will show itself only at corners in the circuit, but the third effect may show itself in every part of the circuit, if properly designed. This is desirable, as the more circulation the more efficient will the furnace operate.

Conclusions

In conclusion, there are three important electrodynamic forces that may be used to circulate molten metal: 1 Pinch effect. 2. Corner effect. 3. Motor effect.

Pinch effect is the action of a current upon its conductor. Corner effect is the action of a current upon a conductor in another part of the same circuit. Motor effect is the action of a current in one circuit upon the current carrying conductor of another circuit.

Notes on Iron Ore Smelting in California

Pig Iron Was Made in a Small Blast Furnace Operating at Clipper Gap in the Early '80s, and More Recently in an Electric Furnace at Heroult

By R. C. Gosrow
Consulting Metallurgist

SHORTLY after the gold rush in 1849, the necessity of developing an iron industry was foreseen by many of the early pioneers. California was the center of mining activity, and the transportation of iron from England and Scotland and the Eastern United States was slow.

In 1867 the "cost of importing pig iron from Europe to San Francisco was $40 per long ton;" the freight rate varied from $12.50 to $15 per ton. The word "cost" is taken from the old record, and it is assumed to mean the price of the iron laid down in San Francisco. The freight on iron from the Atlantic Coast was $12 to $16 (U. S. currency) per long ton. In 1867 Australian iron cost $40 (gold) per long ton at the wharf in San Francisco. Iron imports in 1866 were 9,388 tons; and for the first half of 1867 they were 2,063 tons.

California naturally had a limited demand for iron products. In 1850 the population of California was only 92,597; in 1860, 379,994; and in 1870, 560,247. In 1880, when the first real smelter was built, the population of the state was 864,694. So from the time the first interest was taken in iron ores and iron production in 1869 up to the actual building of a smelter in 1880 the population of the state had increased 54.5 per cent.

First Location of Iron Ore

In 1854 a deposit of iron ore was known, and had been given some attention on account of its surface croppings, near Clipper Gap, in Placer County. This deposit first had the attention of S. W. Lovell, at that time president of the Bear River Water & Mining Co., and was described by J. Ross Brown, Washington, 1868, in a report on "Mineral Resources of the States and Territories West of the Rocky Mountains," p. 223:

"Robinson, Brown & Co.'s iron mines are located here, about 3 miles from the railroad and 3 miles from the Bear River. These mines were located and patents for the land from the federal government applied for in May, 1866. The company purchased the title of the railroad to the even sections of the land, to the extent of 1,500 acres . . . The ore crops out from the mountain in many places. There are two qualities in the deposit; on the east side it is highly magnetic, while on the west it is very much like the Oregon limonite. Assays made by Kellog & Hueston of San Francisco in March, 1866, gave the following results: the magnetic ore, 64.37 per cent metal; the hematite, 44.67 per cent metal. Professor Jackson of Boston, Mass., states that it contains no phosphorus, sulphur, titanium or other substances injurious to the manufacture of iron . . ."

Early Developments

In order to determine just what might be expected in the smelting of this ore, it was arranged with Coffee, Risdon & Co. to erect a furnace on the property to test out the ore on a practical scale. After many urgent efforts the scheme was abandoned. In June, 1857, a sample of the iron ore from the Lovell property was sent to San Francisco for testing. In tests run on this sample it was found that the ore "yielded 83 per cent iron." Nothing more was done with this property for many years, and although the property was inactive, its early publicity seemed to promise more for the state.

From 1858 to 1862 very little is reported on the development of iron ore mining. In 1862 and 1863 several deposits of iron ore were reported in Sierra County and elsewhere.

In 1867 magnetic iron ore was found on Grouse Ridge, 14 miles from Washington, Nevada County. Magnetic ore was also discovered near Chapparal Hill, Butte County, near Grizzly Creek; it was reported that this ore contained 65 per cent iron. In Sierra County the ore deposits were considered of great value. A deposit was discovered by its surface croppings 12 miles from Downieville at an elevation of 6,200 ft. Baron von Richtoven said of this ore in a report to the owners: "Your mines consist altogether of magnetic iron ores, and the same as from which the celebrated Swedish and Russian iron is manufactured. A total amount of ore which may be extracted from different deposits by quarrying I estimate to be 1,400,000 tons—average yield 45 to 50 per cent iron. Even the removal of the ore next to the surface will be the work of a generation."

In 1869 the firm of Robinson, Brown & Co. shipped ore from the Clipper Gap mine to the Pacific Rolling Mills in San Francisco. It was reported 20 tons was shipped in July of that year. No analysis of the ore is given in the records.

First Incorporation

In December, 1869, a company was incorporated in San Francisco, under the name of the Iron Mountain Iron Co., with a stated capitalization of $500,000, and was composed of the following men: J. R. Brown G. W. Applegate and A. G. Neal. They are described as "men of limited means." The purpose of the company was "the mining of iron ore and the smelting of pig iron." This was over 15 years after the deposit was first discovered, and the year following Mr. Brown's examination.

As pig-iron manufacture was a new industry in California, it was expected it would need all the support it might be possible to acquire to encourage its establishment and growth. State legislation was one of the means considered suitable, and in February, 1870 Assemblyman Waldron of Placer County presented a bill known as "An act to encourage iron mining." The provisions were: that when the company had reduced 2,500 tons of merchantable pig iron the state should

pay the company a bonus of $12 per ton; also, the state should pay to the company annually for 10 years an amount of money equal to the taxes that would be due on iron and products of the mine, if they were assessed at the market value in San Francosco; and refund to the company money paid as taxes on its other property. The bill also gave the company 5 years in which to produce the 2,500 tons of merchantable pig iron, and in default of such production the state did not pay the company anything. Gov. Haight vetoed the bill.

Like many new enterprises, the company was short of the necessary capital to carry out its program. It was forced to discontinue, and the ore was left to remain in the hills. But in 1874 a Mr. P. Fitzhue came to examine the property at Clipper Gap. His interest was derived from reading the report of Professor Whitney, in his volume on the "General Geology of California." Plans were laid for the formation of a new company to work the property, but nothing of note was accomplished until 5 years later.

Blast Furnace Built at Hotaling

In 1879 the California Iron Co. was incorporated by E. Judson, A. P. Hotaling, Mr. Scott and Mr. Fitzhue. This new company purchased the property at Clipper Gap and at once commenced the construction of a smelting plant, and the establishment of a town site, called Hotaling, 3½ miles from the Central Pacific R.R. In 1880 this company erected a modern blast furnace at the property, with the necessary buildings, to carry on the mining of iron ore and the smelting to pig iron.

The blast furnace was constructed on the same lines as a furnace at one of the South Chicago steel plants, but was smaller in size, having an expected production per 24 hours of 25 tons. The stack was 47 ft. high, 13 ft. in diameter and had five tuyeres. The furnace building was 150x200 ft., and accommodated thirteen pig beds. A 135-hp. horizontal blowing engine supplied 4,000 cu.ft. of free air per minute. The pressure at the tuyere is not given. Blast was heated in a stove, consisting of 56 tons of iron tubes, heated by furnace gases. Marble was available for flux. The reducing fuel was pine charcoal made from local woods. The company operated three charcoal camps, 3, 6 and 8 miles respectively from the works. The kilns were the beehive type, 29 ft. high, 32 ft. in diameter, and held 45 cords of wood, producing 2,250 bu. of charcoal from a charge. Production figures cannot be derived, but as the furnace had a production of a ton of iron per hour at least 30 tons of charcoal was needed per day.

The first iron was tapped on April 24, 1881. A typical charge was: ore 800 lb., marble 30 lb., charcoal 500 lb. From this charge the charcoal to pig iron was 1 to 1, or a ton of charcoal to a ton of pig iron. The pigs cast weighed 90 lb. each. Labor at the plant was distributed as follows:

Furnace hands	50
Mining ore	40
Charcoal burners and teamsters	75
Incidental	12
Total	177

The grades of iron produced were Nos. 1, 2, 3 and 4 foundry; some forge iron was also made. This iron brought $8 to $10 a ton more than Eastern iron in the local markets.

In September, 1881, the foundry and the machine-shop buildings were destroyed by fire and the plant was temporarily closed down. It was the intention to resume operations in the spring of 1882, but the plant was not opened up again, and the California Iron Co. retired from business in the latter part of 1882.

During the operations from April 24 to the closing down of the plant in September, 1881, 4,414 tons of pig iron was produced, an average of 800 tons a month. Records do not say, but in all probability the greater tonnage was shipped to San Francisco and the iron foundries around the Bay.

The operations of this company were attended by many adversities. "Some of the construction work was defective and required being done over." Many blunders were made in the design of the equipment, as well as in operations, all of which absorbed the profits of the venture.

The California Iron & Steel Co. succeeded the California Iron Co. in 1882 with the intention of enlarging the scope of operations by producing steel bars and shapes. There seem to be conflicting records on further operations at Clipper Gap smelter. One record states: "In 1882 production was somewhat larger than the preceding year," but the "History of Placer County" states that the smelter closed in 1881 after the fire and did not resume operations. While 1,002 net tons of iron ore was produced in 1882, it did not necessarily go into pig-iron production, as the lead and copper smelters used considerable tonnages of iron ore. By this time there were also some steel furnaces in San Francisco.

Rolling Mills in San Francisco

An outlet for California-made pig iron was a certainty. In May, 1866, the Pacific Rolling Mills was organized and in July, 1868, the first bars were rolled. In 1881 this works employed, together with other iron-working establishments in San Francisco, 1,200 people. Eventually the company consumed 18,506 tons of pig iron annually, and produced 16,500 tons of bars. The Benicia Agricultural Works made plows and agricultural machinery; it melted the Clipper Gap pig "with a little Scotch mixed in to get the best combination of toughness and hardness." A plant in Oakland was also run in connection with the Clipper Gap mine, converting its product into iron and steel.

In 1880 there was imported into the state 13,200 tons of pig iron. Pig-iron consumption in California is given at 12,250 tons in 1881, of which 4,500 tons was produced locally, and the remainder imported. The value is given at $337,000, or $27.50 a ton. From 1875 to 1880 the average price of pig iron in San Francisco was $29.75 a ton. With locally produced pig iron, furnace owners promised to lay iron down in San Francisco for $24 a ton. With the Clipper Gap iron selling at $8 to $10 a ton over Eastern iron, a good profit must have been made on this iron at $33 a ton for No. 3 or 4 grade.

Noble Steel Co.'s Operations on Pitt River

In the following years some new deposits of high-grade iron ore were discovered. Notable among these was the Pitt River iron mine in Shasta County, near the Pitt River, a rich magnetic iron ore, averaging 65 per cent iron with under 0.02 sulphur and 0.02 phos-

phorus. The Herz Mountain deposit contributed iron ore to the Bully Hill copper smelter, as did the Pitt River iron mine also.

No developments on a commercial scale took place until 1907, when H. H. Noble of San Francisco formed the Noble Electric Steel Co. to smelt the Pitt River ore by the electrothermic process. Dr. Paul T. Heroult was engaged to come from France and design and build the first furnace. The townsite, named Heroult, was located 8 miles from the junction with the Sacramento River.

Initial operations at Heroult were coincident with the development of large waterpowers on the west slope of the Sierra Nevada Mountains, and within a short transmission distance from the proposed smelter. It was hoped to convert electrical energy into heat in a proper furnace and smelt the local iron ore to pig iron. Adjacent to the iron ore there was a deposit of pure limestone for flux, and the wooded hills presented a supply of wood for charcoal. In 1908 the first furnace was completed and put in operation. A plant was built later to make charcoal from pine wood, and to recover the byproduct.

Experiments With Electric Furnace

The first electric furnace was a rectangular type of furnace with three electrodes—large blocks of carbon, built up from smaller pieces. No one in this country was making carbons of the size required for this furnace, and as a consequence they had to be imported from Europe. Many interferences developed, and this furnace was operated intermittently for only about 3 months.

From 1909 to 1911 a new furnace was developed of the circular type, using a superimposed shaft down which the ore and charge descended to a larger crucible below. The electrodes entered the crucible at an inclined angle, through a dome-shaped roof. This furnace had an electrical capacity of connected transformers of 1,500 kva.; it produced about 10 tons of foundry iron daily, consuming on an average 0.34 hp.-yr. per ton of iron.

In 1911 the furnace was changed back to the rectangular type, but instead of the straight delta connection with the three electrodes in a line as in the first furnace of Dr. Heroult, the furnace had four vertical graphite electrodes in a straight line, and the delta connection was open, with the first and fourth electrode at the ends.

This furnace presented many features which required perfecting before it could be pronounced a success. The transformers connected had a capacity of 2,250 kva., but certain power conditions required the installation of a fourth 750-kva. transformer on one phase, to carry a circulating current due to low power factor. It was difficult to feed the furnace properly and keep the stacks open for the charge to come down into the furnace. Hang-ups in the stacks caused the refractory arches through which the electrodes entered the furnace to burn out. No end of delay was caused by such improper feeding. Often, after a hang-up the charge would drop and break an electrode.

Throughout 1911 and 1912 the features which caused trouble were gradually eliminated, and the furnace steadily produced 20 tons of foundry iron a day. Power consumption was about 2,700 kw.-hr. per ton of pig, and the furnace averaged 20 hours a day on load. In 1913 a second furnace of the same general design as the one just described was built, with six 750-kva. single-phase transformers (two transformers on each phase connected in multiple). The furnace was 27 ft. long, 10 ft. wide and 10 ft. deep from the bottom to the electrode holder. It was operated through the winter of 1913, but closed down in the spring of 1914. Severe power troubles in the mountains caused many delays in the winter of 1913.

In 1913 the company built a modern twenty-retort byproduct charcoal plant; to supplement this production some charcoal was purchased from Mendocino County.

All through these operations on pig iron the fact was demonstrated that for an electric furnace to produce a concentration of heat, a steady, even feed of the charge must be provided; electrically a constant load must operate over a constant period of time. The best operations showed 5 per cent of delays; "power-off" was the worst interference—it always took at least twice as much time to come back to normal working. In 1914 the company ceased making pig iron and turned its plant over to ferromanganese.

This plant at Heroult presented many advantages as well as disadvantages for the production of pig iron. It was considered that the proximity of power, ore, limestone, wood and transportation would assure the commercial success of the enterprise. Situated only 280 miles from San Francisco and the Bay cities, a market awaited the product. Being in a region where other smelters were operating on copper ores, skilled labor was available. But many things acted with equal force in the opposite direction.

Possibilities of Electric Smelting

Electric smelting of any ore was a new branch of metallurgy. There existed no precedents derived from the experience of others in this particular art. No one knew of the fitness and adaptability of the proposed equipment; if unsuitable, it was discarded before its use had even paid for itself. Another serious handicap was the difficulty of obtaining men to design and build the equipment. The decision to smelt iron ore in an electric furnace patterned after the shape of an iron blast furnace did much to delay the development of the right type of furnace. Reactions in the electric furnace take place in an entirely different way than those in the blast furnace, and this caused many mistakes in the grade of pig produced. Often when foundry iron was wanted, white iron resulted. Shortcomings in the electrical equipment often caused much trouble, so that the required load to generate the necessary smelting heat could not be carried. Charcoal was considered to be the ideal fuel on account of its bulk, its electrical resistance, its freedom from sulphur and phosphorus and its availability. But the cost of even byproduct charcoal was so high that when 800 lb. of charcoal was required per ton of pig iron, it made the price of pig too high for local purchasers.

When electric pig iron was first sold to foundrymen, they objected on account of the close grain as compared to blast-furnace iron. They graded the iron on fracture, and the electric iron was sold on analysis. As the fractures did not compare for the same silicon and sulphur contents, the foundrymen were skeptical. This prejudice had to be overcome, and it eventually was.

As byproducts from oak wood are more valuable than the byproducts from conifers, it was not possible or feasible to get sufficient oak, so the cost of the charcoal was higher than it should have been.

However, electric pig iron, wherever it was used, produced castings of extreme fineness and softness. Foundrymen liked the iron, but unless they could get a higher price for their castings made from electric iron, they would not buy it. As a consequence electric iron had to be sold in competition with Southern and Midwest blast-furnace irons. Often foundrymen used electric pig to mix with other irons when they had particular castings to produce.

These and many other causes contributed to the circumstances which made the establishment of the electric smelting process so difficult and so slow.

It must be considered, however, that in the early years at Heroult the process was by no means a commercial one. Production of pig iron was carried on under restricted schedules, during which time the correct furnace was evolving. Simultaneously the development of the company's iron ore property was going on, and in 1914 there was enough ore blocked out with an average iron content of 65 per cent to run the smelter 50 years on a 50-ton-a-day basis. With the development of the Pitt mine, the mills in and around San Francisco purchased this ore for their open-hearth and other furnaces. It was mined in an open pit, and delivered to standard railroad gondolas a mile distant.

With the World War instigating every metal producer to do his utmost, the company went into the manufacture of ferro-alloys in 1915, and did not again produce pig iron, with the exception of a small amount made in some experimental work. During the Noble Electric Steel Co.'s operations on pig iron during 1911 to 1914, it produced approximately 3,500 tons of salable pig iron. The charcoal ratio to pig iron was about 1 to 2.5.

Reduction of Iron Ore With Fuel Oil

Just prior to the electric smelting operations at Heroult in 1907 and 1908 there were many attempts made to reduce iron ore by the use of California fuel oil. While these efforts never developed beyond the experimental stages, historical mention should be made of them. Generally the idea was to utilize the fuel oil as the prime heating agent, and by the use of pressure or suction force the mixed oil and air into the furnace through a tuyere. Experimental furnaces were often built along the general lines of a vertical blast furnace, and fed through an air-tight bell at the top. Many types of burners were used, so that the correct mixture of air and oil might be taken into the furnace. Reducing material was charged separately with the ore. These processes were never a metallurgical success, because the reduction of the iron ore in such a manner could not be controlled. Instead of reduced iron being tapped, the furnace more often discharged ferrous oxide and an iron silicate slag.

Contemporaneous with these attempts experiments were carried on to reduce iron ore to sponge iron, and then melt the sponge iron to steel in an electric or other furnace. One such installation comprised a 15-ton, double three-phase electric hearth furnace, with a gas outlet in the side above the metal bath. This gas outlet was connected to a hopper-bottom concrete tower, about 20 ft. high and 42 in. in diameter lined with refractory brick. It was attempted to reduce a charge of iron ore in the reducing tower to an iron sponge, draw off the iron sponge, charge it in the electric hearth furnace and melt it, and build it up to the desired steel analysis required. Gases from the reactions in the steel furnace were to furnish the heat required to reduce the ore in the stack. After the first charge was made in the reducing stack, the process was started and the cycle was supposed to repeat itself. This process was in actual operation, and while the metallurgy of the process was simple, yet the mechanical features were far from a success. The charge in the reducing tower partly fused and the whole mass would hang in the tower and prevent further gas circulation. Due to the heavy expense of conducting experiments on such a scale as this, and with the small measure of reward, this process was discontinued.

Dreamers, and even metallurgists, had hoped that in some way a process might be revealed to them that would bring together iron ore and California fuel oil in such a manner that pig iron would result. Types of equipment of every conceivable design were proposed in patents and plans by those interested. No attempt is made to list these; only those that have actually been tried on a considerable scale have been referred to. None of these schemes has consumed enough iron ore to classify it as a commercial process.

Present Situation

Thus, in California there have been only two plants which have really entered the market as commercial enterprises. These two have been described in some detail, even though neither is now operating. Other plants, including the steel plants in the Bay region and in southern California, have tried direct reduction of iron ore, but nothing has yet resulted from these experiments. As consumers of iron ore, and one might say in the broad sense "smelters" of iron ore, the steel mills are the largest, so that outside of some chemical industries the steel furnaces now consume practically all the iron ore mined in California.

The iron ore resources of the state are quite well outlined in several bulletins issued by the State Mining Bureau. Principal among the potential iron ore properties are deposits in San Bernardino County, in the Eagle Mountains, the Minaretts of Madera County and the Placer County and the Shasta County deposits. Given shipping facilities from any one of these to tidewater, a reduction plant could operate on a scale large enough to furnish the Pacific Coast with its pig iron.

Catching Zinc Fume

At the recent Vancouver convention of the American Institute of Electrical Engineers, it was stated by E. P. Dillon, general manager of the Research Corporation, that it has now become possible to catch zinc oxide from furnace gases. An application of recently discovered principles (described by Evald Anderson in this journal, Jan. 25, 1922) has made successful several commercial installations handling up to 20,000 cu.ft. of gas per minute, at temperatures as high as 700 deg. F. The fume content of these gases has been as high as 5 grains per cu.ft. (standard conditions).

It is necessary to "condition" these gases by adding steam or water. Even from these humid gases the deposit comes down dry.

The Dye Situation in Great Britain and Elsewhere

A Survey Based on Authoritative Information Gathered by the Author at First Hand in England — Outline of German Proposals to Participate in Dye Industries of Other Nations

By Ellwood Hendrick

IN GREAT BRITAIN they have the British Dyestuffs Corporation Ltd. besides Scottish Dyes, the British Alizarine Co. and one or two others making specialties. British Dyestuffs is the leading company. In France there is the Compagnie Nationale des Matières Colourantes; in Italy there is a somewhat similar establishment, and what we in America have the Lord knows. In Germany there is the Interessengemeinschaft der Deutschen Farbstoffwerke, or the I.G. as it is called.

British Dyes started during the war with a great blow of trumpets and a large expenditure of money, taking in the works of Read Holliday's Sons at Huddersfield, and building elaborately, expensively and in haste. At the same time Levenstein's Ltd. of Manchester waxed great, the works extending over a mile in length, with about 3,700 men employed. In the course of time Levenstein's Ltd. was taken in. British Dyes became British Dyestuffs Ltd. and a dual management was established, with Sir Joseph Turner of the former Holliday concern to look after business matters, including purchases and sales, and Dr. Herbert Levenstein, an acknowledged authority in the subject of dyes, as technical head. The British Government had a large investment in the works and has had considerable to say in recommending appointments.

Changes in Management

Levenstein's Ltd. and Read Holliday's Sons had always been rivals and Dr. Levenstein and Sir Joseph Turner were not meant to work as a team in double harness. But development proceeded. Professor Green, discoverer of the primaline dyes, was retained for research, and Professor Robinson, who is said to be a second Emil Fischer in organic chemistry, was also brought in for the same purpose. There was lacking, however, any co-operation between research and manufacture with the department of sales, purchases and business. So Dr. Levenstein tendered his resignation unless Sir Joseph Turner were replaced by somebody he could get along with. Here the guiding voice of the government urged harmony and waiting, until an impasse was reached and then both Dr. Levenstein and Sir Joseph Turner were replaced by Sir William Alexander, the present head.

Sir William is a man of signal ability in business affairs. He has been largely interested in the making of heavy chemicals, was closely assosiated with K. B. Quinan in the manufacture of munitions during the war, and has been heretofore signally successful in all his undertakings. He is a man of high character and reputation. He found that research had so far outstepped production that about 20 per cent of the research chemists were dismissed. Manufacture was reduced so as to be made co-ordinate with sales, and for the general works manager, C. J. Burnham was selected, a gentleman who had been successful in the production of munitions in England during the war and associated with Quinan in making explosives in South Africa and India. The sales force was generall reorganized and co-ordination of research, manufactur and sales departments was established. The variou men in authority in the three departments of researc manufacture and sale now meet with the managin director every Wednesday and work is planned ahea with a view to meeting every need as it arises. Ne dyes are introduced as soon as factory practices, even ness of quality and the satisfaction of all three depart ments are attained—and not before.

British Public Supports Industry

Now it is a long, long road to Tipperary and t several other places, among which is the goal of makin dyes for the British or any other market in the fac of German competition. Even with the 10 years' em bargo, when Germans offer goods at an amazingly lo price—at a dumping price—the temper of manufactur ers and of the dye commission is strained. But th British public is alive to the fact that, given complet failure of the industry in England and America an elsewhere outside of Germany, and given also the suc cess of the Junker Partei in Germany (under whateve name it functions), then the next generation is likel to know what gas attacks mean as never was know before.

The position which Sir William Alexander is strain ing every effort to attain, and it goes without sayin that he is bringing all his great abilities to this end is to keep the good will of British dye users so that the will take native dyes in preference to those of Germa make, provided always that they are as good and a regular as German goods, *but not otherwise*. In regar to prices he holds it to be his obligation to meet th needs of British dye users before the interests of stock holders are considered. Further in regard to prices he holds that these should be standard for the sam dyes over the whole world. He is willing to make inter national trust agreements as to quotas of sales an markets, but provided only that the British corporatio remains inviolate as it was founded: a dye-making con cern. If such agreements cannot be made adequate t British needs, both in peace and in war, then the profit of the business are bound to be small all around, bu he has faith that the industry will still endure in Grea Britain.

At the annual meeting held on June 23 there wa shown profits on operations for the year of £437,683 but owing to reductions in stock values the management wrote off £1,444,343, indicating a loss of £1,006,660, bu leaving cash assets in excess of £1,000,000. The meet ing was not harmonious, although the regular ticket wa elected by about two-thirds of the shares represented Dr. Levenstein, who is the largest shareholder, refuse to make any comment on the chairman's report on th ground that the corporation's best interests would b served by such a course.

The opposition held that the corporation now lack

proper scientific and technical control. The dye industry, according to the opposition, differs from others in that it is an establishment of standardized processes rather than products, which must frequently be supplanted by new dyes, and that it is, therefore, always in a state of flux. Novelties must be brought out, not only for profit but for the welfare of users of dyes. Again, far greater patience and faith are required than in making other products; and any attempt to organize this industry along lines familiar to other branches of manufacture except, perhaps, fine chemicals, cannot succeed. The management holds that provision has been made in these respects.

Sir William Alexander declares that government participation in the corporation is in no sense a burden and that indeed from the government he gets the very strongest support. This is fortunate, because in the formative period, according to current expression, the hand of the government was heavy, appointing men to represent it and in authority who were wholly uninformed as to the needs of the business. In other words, it made political appointments. Of course, the only way to make progress in this very complex industry is to let the real leaders develop themselves and then to recognize them as such.

Conflicting Views on British Dyes Ltd.

Now, in England, one hears conflicting stories about British Dyes. One is that they are working along against serious odds, but that they have the backing of the color users, that they are proceeding under sound business administration, with good *esprit de corps* and general good will and the advantage of a license system with 7 years to run. They are overcapitalized as a result of war conditions and mistakes, rather than of high finance. They are proceeding on good principles of business, but from many sides one hears the criticism that the weak point is in technological experience. They lack any outstanding dye technologist such as one may find in every works that has achieved success. They are starting largely without experience; with no one like J. F. Schoellkopff 3rd or Dr. Herbert Levenstein to look ahead for them.

Now let us take an entirely new view of the problem. On July 20 the *Chemiker Zeitung* (No. 86, p. 656) contained the following note: "Farbstoffe: The efforts of the I.G. to close a contract with the English works similar to that closed with the French and Italian works (cited from *Chem. Zeit.*, 1922, pp. 404 and 448) has thus far not resulted in any definite conclusion. The first meeting took place, according to the *Yorkshire Evening News*, shortly before Christmas in 1921, in Paris, at which Carl Weinberg of the I.G. and W. Alexander of the British Dyestuffs participated. In May of this year they met again in Berlin, at which Lord Ashfield, the government representative of British Dyestuffs, was also present. Now the Englishmen await new proposals from the German representatives, inasmuch as they are not disposed to conclude any arrangement which will place the English industry where it stood before the war. And the conclusions of the British representatives will require also the approval of their own government."

Franco-German Working Agreement

Of course that does not tell everything. In the *Times* of London on Aug. 1 there is an article headed "French Dyestuffs, An Alarming Rumor," and there follows a quotation from the annual report of the Compagnie Nationale des Matières Colourantes as follows:

> The work of even the best technicians must be sterile unless they are in possession of all the knowledge accumulated in the past—knowledge which is essential to success. All who understand the complexity of the manufacture of organic coloring matters will realize why we have been compelled to acquire the patents, the processes, and the technical aid of our principal foreign competitors for exclusive use in France. Thus we have at our disposal the results of 50 years of investigation and processes minutely studied and methodically put into practice, and so we are immediately placed in a position equal to that of the most modern and most specialized firms in our industry.
>
> Certain sections of the French press affect to perceive in this statement confirmation of a rumor long in circulation that the Compagnie Nationale has entered into an alliance with its German rivals.
>
> It is recalled that not long ago the *Chemiker Zeitung* announced that an agreement had been entered into between the German and French dye industries, in which seven great German firms and the Compagnie Nationale des Matières Colourantes were associated, by which the German firms were to give the French company detailed technical assistance and full information concerning the processes of manufacture and to supply German chemists to supervise the application of the processes in French dye works. In return, it was stated, the Compagnie Nationale undertook to limit supplies of certain synthetic dyestuffs to France and her colonies, and to allow the German firms a share of the profits.
>
> There is therefore a national anxiety to know to what extent the French industry is dependent upon foreign, and particularly German, aid.
>
> It is not merely a question of supplying French industries with French dyes. It is remembered that before the war the dyestuffs factories in France were in the hands of Germans. When war broke out there were neither materials nor workmen to produce dyestuffs, and in consequence no adequate provision for the manufacture of asphyxiating gas and explosives. If the Compagnie Nationale ceased to manufacture dyestuffs, it is argued, and if the day should again come when the rapid manufacture of explosives is necessary, France would find herself unprepared as she was in 1914.

This confirms the statement of the *Chemiker Zeitung* as to the agreement between the I.G. and the French company, and we learn from competent authority that the working agreement is already closed.

Will Government Approve an Agreement?

A subject that one hears occasionally discussed is whether the I.G. and British Dyestuffs will come to some similar agreement and whether, then, the government will approve. In Sir William Alexander's address to the stockholders he said in regard to this: "While we would welcome an arrangement with the German undertakings, it must be on such terms as will leave inviolate the principles on which your undertaking was founded—namely, the establishment of a dye industry adequate to our needs both in peace and in war. So far, however, the German interests are not of the opinion that circumstances are such that they are prepared to accept the fundamental principle which we have laid down as a basis for close negotiation."

An opinion that one hears occasionally expressed at clubs and over lunch tables when the subject is brought up is somewhat to this effect: "The Germans are beaten in war and it is up to them to make good. We don't want their steels or their textiles, because by taking them we cause our own mills to shut down. Real money they haven't got, and yet they owe for damages. Very well, let them pay in giving over their 40 years' advantage in dye-making experience and mark off some of their debt by the operation. Within the past 2 months this

idea seems to have gained some currency, but the writer is unable to record how widespread or how generally it is held or whether such a thought has been touched upon in authoritative conferences.

The German idea seems to be to establish a British working agreement similar to that closed with the French and Italian companies: the I.G. to remain German and the other corporations to remain native with no exchange in ownership of stock. Information to be made common property and chemists and engineers familiar with processes to be transferred back and forth as needs arise. The *quid pro quo* to be a division of the profits before payment of dividends, and allotments of tonnages and territory to be agreed on, all for a long term of years. It makes the I.G. the nucleus of an international industry, participating already in that of France and Italy and prospectively with that of Great Britain. It is evident that on this basis the minds of the British and German negotiators have not met.

We do not know what arrangement has been made between the I.G. and the French company in regard to products or processes that may originate in the French company's laboratories or works.

Now let us do a little guessing. Suppose the minds of the British authorities and those of the I.G. should meet as to terms. The British Government, with its large interest in the enterprise, would have to approve. It dare not proceed too sharply counter to public opinion. And what has public opinion to say?

Are the Germans Sincere?

Here, for instance, is a question that one hears frequently today and that may be asked with persistence when the problem at issue is discussed: Are the Germans to be trusted? In England as in America the impression is widespread that the Germans have done things of which civilized people would be ashamed, and if they do not know it was wrong it is because they do not know what other people do know in the art of living at peace with the world. Time was when Germans were hailed and made welcome almost everywhere; now they are, in a way, *declasée*. Germans do not admit this; against the charge that they should be ashamed they claim that they are an ancient and a proud race, but all the time they know of their inhibition and it hurts.

Today they are a crippled people and they want to get back into the sphere of international comity. Without admitting fault or wrong, they admit this much. International agreements in so overadvertised a domain as dyes would help to bring it about. But is that all? How does the German mind work? Do they propose to fall on the necks of their late enemies and give them of their best, their most cherished possession, to establish an era of good feeling? To make a great gift and then to hope for the best? The German mind is addicted to habits of careful planning and to the study of situations, according to its lights. Therefore, to a proposal so loosely drawn as this appears to be we should expect lively objection from Hugo Stinnes, Professors Duisberg and Nernst, from General Ludendorff, Herr Helferich, "Organization C," the "Selbschutz" and associations of professors and teachers and leaders of German thought who seem unanimous about the "crime of Versailles."

So let's do a little more thinking about the subject. The wealth of a nation is not in its dye business. To forego profits on some goods exported and to get part of them back on goods made and sold abroad is not such a great loss. In view of the present difficulties of export the German proposal might involve no loss at all. And surely international agreements would do more than anything else to bring about international comity.

But future warfare is chemical warfare. Politicians do not know this outside of Germany. Neither do the majority of military men—outside of Germany. The Germans failed to take Calais because even their own military leaders did not know it when they made their first gas attack. And what would ensue from the participation of the German trust in this key industry of other nations? Observe, please, it is not proposed that allied industrial corporations participate in the I.G. The German trust would then be posted as to the situation in, and the facilities of, every other country.

Success in Chemical Warfare

Now the philistines are right when they say that making dyes and intermediates does not alone provide for offense and defense in gas warfare. Offense in gas warfare is provided by the capacity and equipment to produce in great quantity unknown gases of great lethal power for a strategic surprise. Knowing the gases and even how to make them does not meet the conditions. Gas warfare as it is developing is more sudden, more violent and more unexpected than any other method. The only way to succeed in gas warfare is, first, to be willing to launch it and second, to be in complete readiness. Germany is the only nation equipped to fulfil the second requirement of readiness. Her position in regard to chemical warfare is similar to that of Great Britain's sea power for many years, except for the fact that battleships and cruisers are growing obsolete while aircraft and chemical destructives are still undeveloped.

Well, what of it all? Is Germany going to war again? Herr Stinnes, the late Dr. Rathenau and others have tried to avoid clashes with other nations. The old military crowd and the same old government bureaucrats seem impatient to re-establish the empire, to "lead the world" again. But even so, what of it? Suppose such international arrangements are made: it will aid toward comity if Germans with fevered brows can be kept enough in the background. Suppose, on the other hand, they are not made. The leadership in dye technology enjoyed by the I.G. leaves them still at the head. German works will be able to produce gases in quantity for a strategic surprise just as well as but no better than before. British Dyestuffs will have a long, hard pull to go it alone. The good will of other peoples, so frankly desired by Germany, will be much slower in coming to them.

Whether it is wise or not to make such treaties as have been made by the French and Italian corporations the writer of these lines does not profess to say. The question "Are Germans to be trusted?" like the proposed manufacturing agreement, is in the air. It seems better to us to trust them than to mistrust them—provided the trustor can keep awake and has sharp eyes. But far more important than dye agreements for each nation that would be free and always in a position to defend itself is the intensive study and understanding by her sons of the science of chemistry. Without this knowledge, this understanding, this prescience of what chemistry can do, we shall all be at the mercy of any people that prepares itself adequately and secretly to conquer the world.

Rapid Calculation of Theoretical Maximum Temperatures*

By George Granger Brown
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Four Methods for Computing the Temperature Developed by a Reaction—Graphical, by Trial, Algebraic and Slide Rule Methods Described

TO COMPUTE the temperature developed by a chemical reaction, such as the combustion of fuel or detonation of an explosive, the heat available o raise the temperature of the reaction products must qual the thermal capacity of the reaction products. ut as the specific heat varies with the temperature, hich is unknown, it is necessary either to estimate ie temperature for a tentative value of the specific eat and solve by trial, or to use an expression for the ean specific heat or thermal capacity as a function of ie temperature and solve the quadratic equation for mperature rise.

The various methods of estimating maximum temerature are best shown by demonstrations. Below are iven five different methods of arriving at this figure ith relative advantages indicated:

Graphical Method of Damour[1]

In his book Damour applies this method to find the mperature of combustion of a number of industrial els. For the present purpose it is sufficient simply o outline the method by a single application to find ie temperature of combustion in burning pure carbon ith the theoretical amount of cold dry air.

Damour uses a gram mol as a unit and assumes the ir to be composed of 4 gram mols of nitrogen to every ram mol of oxygen. This is equivalent to 80 per cent itrogen and 20 per cent oxygen by volume. It is not ecessary to use a gram mol as a unit; a pound mol, a ound, or a cubic foot might be used as well, provided ie equivalent values for heats of formation and ermal capacities or heat content are used. He repreents the reaction as follows:

$$C + O_2 + 4N_2 \rightarrow CO_2 + 4N_2 + 97{,}600$$

Estimating the final temperature as between 1,800 eg. C. and 2,200 deg. C., he computes the heat content f the products of combustion over this range as llows:

TABLE I—CALCULATED HEATS OF COMBUSTION

oducts of Combustion	Thermal Capacities, Cal. above 0 deg. C[2]. 1,800 deg. C.	2,000 deg. C.	2,200 deg. C.
O_2	27.2	31.8	36.6
N_2	56.8	64.2	71.6
Total	84.0	96.0	108.2

The total thermal capacities at the temperatures ken are plotted as indicated by points *a*, *b*, and *c* in ig. 1. A smooth curve (*abc*) is then drawn through ese points. As 97.6 Cal. from the reaction are vailable to raise the temperature of the gases, the final mperature will be that temperature at which the gases ill have a heat content of 97.6 Cal. and is indicated y the abscissa ($X_1 = 2{,}040$ deg. C.) of the intersection f the ordinate ($Y_1 = 97.6$) with the curve of thermal apacity.

This method requires an estimate of the final temperature and at least three computations of thermal capacities. However, if a number of computations are to be made upon the same reaction such a chart is very convenient, as the same chart serves for all calculations of the same reaction products.

Temperatures by Trial

If pure carbon is burned with 100 per cent excess cold air, the temperature of combustion may be found in the following manner, using more modern values than those given above.

We know that one gram mol of carbon burned to carbon dioxide liberates 97,200 cal. according to the reaction,

$$C + O_2 \rightarrow CO_2 + 97{,}200 \text{ cal.}$$
$$12 \quad 32 \quad 44$$

97,200 cal. per gram mol of carbon is equivalent to (97,200 × 1.8) B.t.u. per pound mol. As the molecular weight of carbon is 12, one pound of carbon burned to carbon dioxide according to the above reaction will liberate

$$\frac{97{,}200 \times 1.8}{12} \text{ or } 14{,}580 \text{ B.t.u.}$$

The above equation also indicates that 12 lb. of carbon requires 32 lb. of oxygen. Then 1 lb. of carbon will require 2.66 lb. or 31.44 cu.ft. of oxygen. 100 per cent excess air will then be 62.88 cu.ft. of oxygen and 236.4 cu.ft of nitrogen, assuming air to be 79 per cent nitrogen by volume

1 lb. C + 62.88 cu.ft. O_2 + 236.4 cu.ft. N_2 →
31.44 cu.ft. CO_2 + 31.44 cu.ft. O_2 +
236.4 cu.ft. N_2 + 14,580 B.t.u.

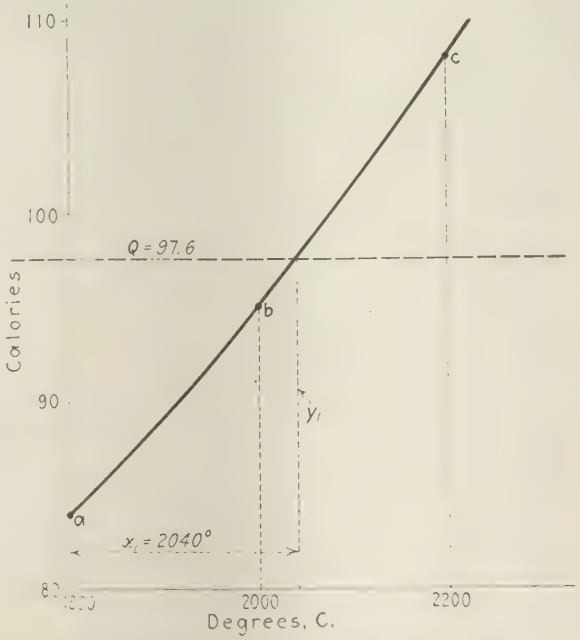


FIG. 1—THERMAL CAPACITY-TEMPERATURE CURVE

*This paper is a revision of one presented at the New York eeting of the American Chemical Society, September, 1921.

[1]Emilio Damour: "Le Chauffage Industriel et les fours a Gas," anslated by A. L. J. Queneau, "Industrial Furnaces and Methds of Control," *Eng. Mining J.*, 1906.

[2]Mallard and LeChatelier. *Ann. des mines* (8) 4 (1884), pp. 9 to 559.

If the air is supplied at 60 deg. F., the mean specific heats between 60 deg. F. and t deg. F. are used.[3]

Estimating 2500 deg. F. as the final temperature, the mean specific heat between 60 deg. F. and 2500 deg. F. of the products of combustion may be computed by multiplying the number of cubic feet of each gas by mean specific heat over the required range and adding. That is, (Total mean specific heat) $\times$ (degrees rise) = (heat content) = heat available.

TABLE II—CALCULATION OF MEAN SPECIFIC HEAT

Products of Combustion Gas	Cu.Ft.	Mean C_p[4] (60 to 2,500 deg. F.)	Mean Specific Heat
CO_2	31.44	0.0307	0.967
O_2	31.44	0.0191	0.601
N_2	236.40	0.0191	4.520

Total C_p (60 to 2,500 deg. F.) = 6.088.

Then total $C_p \times (t_2 - t_1)$ = heat available.

or $6.088\ (t_2 - 60) = 14580.$

$(t_2 - 60) = 2400.$

Therefore $t_2 = 2400 + 60$ or 2460 deg. F. which is a satisfactory check with the estimated 2500 deg. F.

The final temperature as calculated must check the temperature estimated for determining the specific heat. Usually a satisfactory check can be obtained in two trials.

This method is satisfactory, providing a table of mean specific heats over the particular range desired is available. Otherwise it becomes necessary to reduce the computations to the datum plane of the initial temperature of the available table and the method loses its advantage.

Algebraic Solution

A method of wide application uses an expression for the mean specific heat in which the temperature occurs as a variable. This leads to a quadratic equation which is solved for the variable—the temperature rise.

This method may be applied to the same computation as above, the combustion of carbon with 100 per cent excess air, using the expression for the mean specific heat instead of a numerical value from the tables. If the mean specific heat is multiplied by the temperature rise, in this case t, the expression for the thermal capacity is obtained, which may be used directly as indicated below.

As above

1 lb. C + 62.88 cu.ft. O_2 + 236.4 cu.ft. N_2 →
31.44 cu.ft. CO_2 + 31.44 cu.ft. O_2 +
236.4 cu.ft. N_2 + 14580 B.t.u.

TABLE III—CALCULATION OF THERMAL CAPACITY

Products of Combustion Gas	Cu.Ft.	Thermal Capacities[5] (0 deg. to t deg. F.)
CO_2	31.44	$(0.0227t + 0.385t^2\ 10^{-5})$
O_2	31.44	$(0.01786t + 0.883t^2\ 10^{-6})$
N_2	236.4t	$(0.01786t + 0.883t^2\ 10^{-6})$

Total thermal capacity = $5.694t + 0.357t^2\ 10^{-3}$

The thermal capacity must equal the heat available to raise temperature.

Heat content = $14580 = 5.694t + 0.000357t^2$.

[3] A. H. White, Technical Gas and Fuel Analysis. McGraw-Hill, p. 393, 1921.

[4] Mean specific of one cu.ft. of gas measured at 60 deg. F. and 30 in. mercury calculated from equations of Holborn and Henning, *Ann. Physik*, 22, 1907. Über die spez fische Wärme von Stickstoff, Kohlensäure und Wasserdampf bis 1,400 deg. C.

[5] Calculated from values of A. Langen. Mitteilungen über Forschungsarbeiten auf dem Gebiet des Ingenieurwesen Heft 8, S. 8. Berlin, J. Springer, 1908.

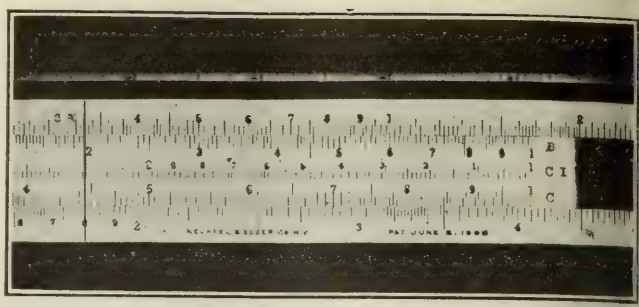


FIG. 2—SLIDE RULE SOLUTION OF QUADRATIC
$t^2 + 15950t - 40{,}890{,}000 = 0$

$$0.000357t^2 + 5.694t - 14580 = 0$$

$$t = \frac{-5.694 + \sqrt{(5.694)^2 + (4 \times 14580 \times 0.000357)}}{2 \times 0.000357}$$

t = 2250 deg. F.

This differs from the solution above, as Langen's values for the specific heat above 0 deg. F. were used instead of Holburn and Henning's above 60 deg. F.

Slide Rule Solution

The quadratic equation obtained above

$$0.000357t^2 + 5.694t - 14580 = 0$$

may be easily reduced to

$$t^2 + 15950t - 40{,}890{,}000 = 0$$

by dividing the equation by the coefficient of t^2. In this form it may be conveniently factored into

$$(t - 2250)\ (t + 18200) = 0$$

on the slide rule, using the CI and D scales, as shown in Fig. 2; 11 on CI being set over the constant term (40,890,000) on D, the product of any coinciding numbers on scales CI and D must equal 40,890,000. The hair glass is adjusted so that the difference between the corresponding values on CI and D equals the value of the coefficient of the t term (15,950). Thus 18,200 — 2,250 = 15,950. The two values so determined, with their signs changed, are the roots of the equation:

$$t = 2{,}250 \text{ or } -18{,}200.$$

Obviously, the positive value only is of interest, so the final temperature is 2250 deg. F. This method is convenient and can be executed rapidly and accurately with a little practice.

Graphical Solution of Quadratic

The same quadratic equation

$$t^2 + 15950t - 40{,}890{,}000 = 0$$

may be very conveniently solved for the positive root by the chart shown in Fig. 3. The constant term (— 40,890,000) is taken along the ordinates and the coefficient of t (15,950) is taken along the abscissas. The intersection of the indicated abscissa and ordinate is on the temperature line corresponding to the solution of the equation in this case midway between 2200 and 2300 or 2250 deg. F. Such a chart is very easy to construct, being made up entirely of straight lines, and may be used for any and all substances or mixtures in any units, English, metric, or otherwise.

The accuracy of any such calculation is limited by the accuracy of the specific heats used. For industrial work the following expressions derived from the work of Pier[6], Bjerrum[7] and Siegel[8] are accurate and very satisfactory.

[6] M. Pier, *Z. Elektrochem.*, vol. 15 (1909), p. 536; vol. 16, p. 517 (1910).

[7] Niels Bjerrum, *Z. Elektrochem.*, vol. 17, p. 731 (1911) and vol. 18 (1912). *Zeit. für Physikalische Chemie*, vol. 79, pp. 513, 537 (1912).

[8] Wilhelm Siegel, *Z. physik. Chem.*, vol. 87, p. 641 (1914).

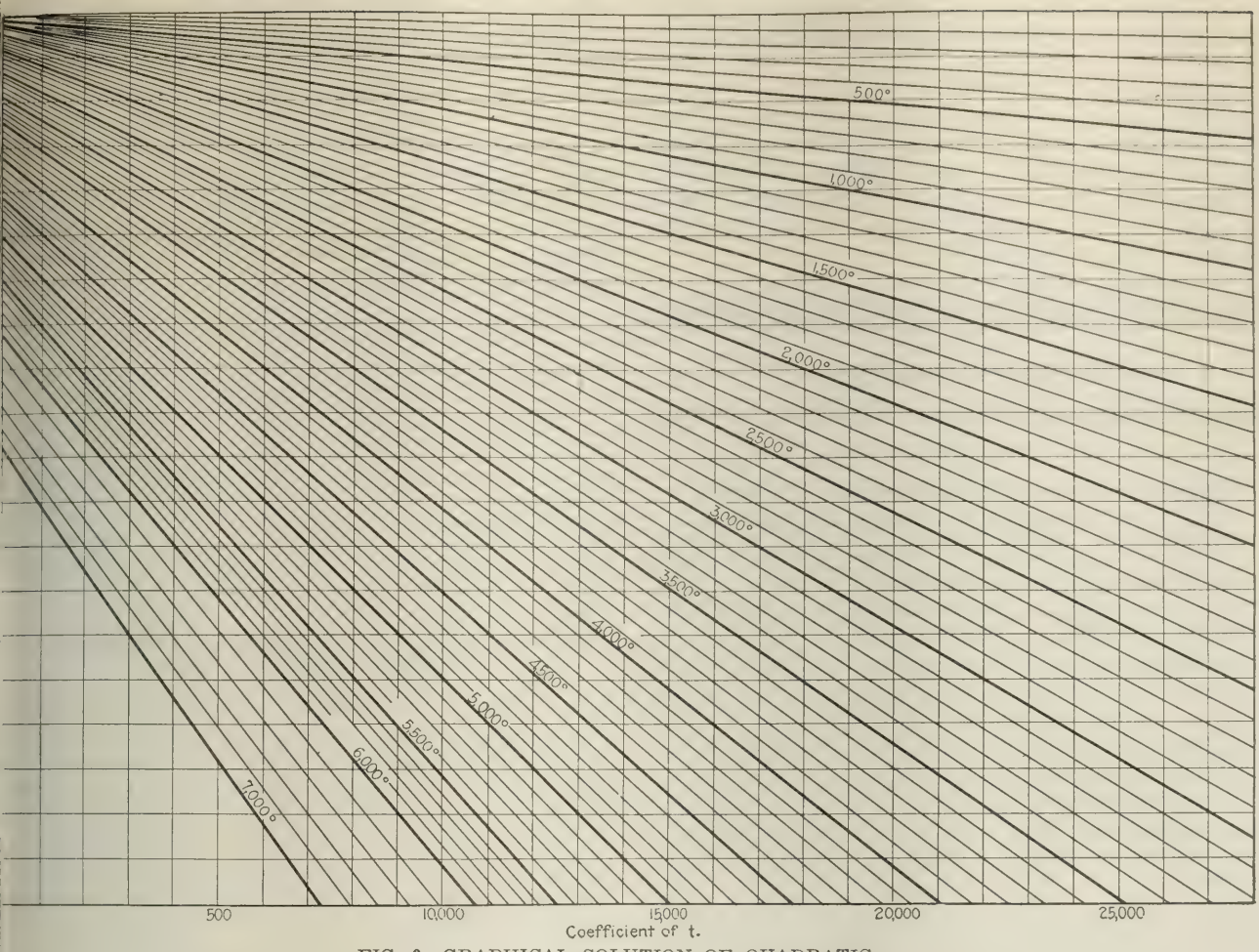


FIG. 3—GRAPHICAL SOLUTION OF QUADRATIC

MEAN C_p (0 TO t DEG. C.) IN CAL. PER GRAM MOL

Diatomic gases (N_2, O_2, CO) $= 6.9 + 0.00042t$.
CO_2 (up to 1250 deg. C.) $= 8.8 + 0.0024t$.
CO_2 (above 1250 deg. C.) $= 10.02 + 0.00072t$.
H_2O $= 7.8 + 0.00175t$.

EAN C_p (0 TO t DEG. F.) IN B.T.U. PER POUND MOL

Diatomic $= 6.88 + 0.000234t$.
CO_2 (up to 2300 deg. F.) $= 8.7 + 0.00135t$.
CO_2 (above 2300 deg. F.) $= 10 + 0.0004t$.
H_2O $= 7.75 + 0.001t$.

MEAN C_p [t TO $(t + x)$ DEG. C.] IN CAL. PER GRAM MOL

Diatomic gases $= 6.9 + 0.00084t + 0.00042x$.
O_2 (up to 1250 deg. C.) $= 8.8 + 0.0048t + 0.0024x$.
O_2 (above 1250 deg. C.) $= 10.02 + 0.00144t + 0.00072x$.
O $= 7.8 + 0.0035t + 0.00175x$.

MEAN C_p [t TO $(t + x)$ DEG. F.] IN B.T.U. PER POUND MOL

Diatomic gases $= 6.88 + 0.000468t + 0.000234x$.
O_2 (up to 2300 deg. F.) $= 8.7 + 0.0027t + 0.00135x$.
O_2 (above 2300 deg. F.) $= 10 + 0.0008t + 0.0004x$.
O $= 7.75 + 0.002t + 0.001x$.

Any of the expressions given above may be converted mean C_v over the same temperature range by subcting 1.985, or more simply 2, from the constant term. To convert from cal. per gram mol to cal. per gram, or m B.t.u. per pound mol to B.t.u. per pound, divide the tire expression by the molecular weight of the gas.

The above equations for calories per gram mol may be converted to calories per liter, or Calories (kilogram cal.) per cubic meter at 0 deg. C. and 760 mm. by dividing the entire expression by 22.4. The equations for B.t.u. per pound mol may be converted to B.t.u. per cubic foot at 60 deg. F. and 30 in. by dividing the entire expression by 378.

In every case, the thermal capacity or heat content of a gas over a temperature range is equal to the mean specific heat of the gas over that temperature range multiplied by the number of degrees in the temperature range. For example, the heat content of a pound mol of water vapor at constant pressure (C_p) between 1,000 and 3,000 deg. F.:

C_p [t to $(t + x)$ deg. F.] $= 7.75 + 0.002t + 0.001x$

Heat content $= 7.75x + 0.002tx + 0.001x^2$

Heat content (1000 to 3000 deg. F.)
$= 7.75\ (2000) + 0.002\ (1000)\ (2000) + 0.001\ (2000)^2$
$= 2000\ (7.75 + 2 + 2)$

Heat content, or thermal capacity at constant pressure (1000 to 3000 deg. F.) $= 2000 \times 11.75 =$ 23500 B.t.u.

Similarly the heat content between 1000 and (1000 + x) deg. F. may be computed for water vapor per pound mol from the following:

C_p [1000 to (1000 + x) deg. F.] $= 7.75 + 2 + 0.001x$

Heat content $= 9.75x + 0.001x^2$

where x is degrees rise above t deg. F. and may be determined graphically as outlined above by placing this expression for thermal capacity equal to the number

of B.t.u. available to raise the temperature and solving the quadratic equation for the positive root of x.

Summary

All of the methods given have been tried thoroughly. The last two procedures have been found for general work the most rapid and accurate methods, and no close estimate of the final temperature is required. Under the special conditions outlined, however, the first two procedures may be preferable.

Legal Notes

By Wellington Gustin

Duty of Seller and Shipper to Ship at Lowest Freight Rates—Court Reverses Itself

A dispute over the shipping of creosote resulted in an action brought by the F. J. Lewis Manufacturing Co. against the American Creosote Works, Inc., and decided by the Supreme Court of Louisiana. Plaintiff sued for $3,399.25, balance due on an oral contract in excess of $16,000, for 10 cars of creosote oil. Defendant set up a counter-claim in the amount of $3,361.68, as damages caused by shipping the 10 carloads of creosote over the Illinois Central R.R. at a cost of 50c. per 100 lb., when by proper attention and care, it was alleged, the oil might have been shipped over the New Orleans & Northeastern R.R. at a cost of 8c. per 100 lb. (90 Southern, 566.)

Both parties had offices or representatives in New Orleans, La., while plaintiff has a plant at Southport, La., and defendant's plant is at Louisville, Miss. The parties had been doing business together for some time, while plaintiff had a tank at Chalmette, just below New Orleans, and the creosote had been sent over the N. O. & N. R.R., to Louisville, Miss., at a rate of 8c. per 100 lb. from Chalmette. But it abandoned this tank at Chalmette and established a plant in Southport, which also adjoins New Orleans. These three points are in what is called the "New Orleans district." There was some confusion in the evidence as to where the creosote was to be shipped from.

It was shown that the custom of the trade was for the seller to do the shipping, and in this case the shipping was attended to by the plaintiff selling company.

Point of Shipment Uncertain

Plaintiff claimed that the creosote was to be delivered f.o.b. Southport, while defendant claimed that it was to have been delivered f.o.b. Chalmette. Correspondence and the evidence made the point of shipment uncertain, but the Supreme Court on the first appeal held the point to be New Orleans. Further, it held that the plaintiff was negligent in not looking up the published railroad freight rates and shipping to defendant over the best route at the best rates. It said the plaintiff could not select the road which made the greater charge at the expense of defendant whom it was pretending to serve, but that it must bear the loss for this failure and negligence in the part of its manager. Therefore judgment was given for the excess freight rate paid.

However, on a rehearing granted in this case the court found that a certain letter and correspondence showed the purchase was f.o.b. Southport, La., as the creosote, about 250,000 gal., was then in storage at this point and plaintiff no longer had or kept oil at Chalmette, having ceased doing business there before this transaction. Defendant in one letter confirmed sale of oil f.o.b. Southport to be shipped direct to Louisville, Miss. The court, in reversing its former decision, says the defendant was not in a position to claim a freight rate of 8c. per 100 lb. on this oil because the rate from Chalmette to Louisville used to be 8c. per 100 lb., in former dealings between the parties.

Further, there was no evidence to show what the rate was from Chalmette to Louisville at the dates of the shipments in question and there was no evidence to prove that the rate from Southport to Louisville via the Illinois Central was any different from that from Chalmette to the same destination via the New Orleans & Northeastern R.R., when these shipments were made.

Therefore the court reversed its former judgment and entered judgment for plaintiff for the amount due on the account for creosote and disallowed the counter-claim for excessive freight paid by defendant.

Natural Right in Secret Process Independent of Statutory Right in Patent

The United States Circuit Court of Appeals has stated the proposition as law, that the common law right of an inventor to the exclusive benefit of his invention so long as he can keep it secret from competitors is a separate and independent right from his statutory right under the patent laws to exclude others from its use for a limited term in return for the full disclosure of his invention to the public. This in the suit by the Nye Tool & Machine Works against the Crown Dies & Tool Co. (276 Fed., 377.)

In an advisory way, the court says that an inventor is not compelled by law to apply for and take out a patent. If he has produced a new composition of matter of such a nature that the ingredients and the process are safe from discovery by others either by observing his use of his invention or by independent investigation and experiment, he would have a much more enduring monopoly by refusing to make the "full disclosure" that our patent statute invites. Such is his natural or common law right. One seeks a patent only when he fears others may discover his invention and exercise their common law right to copy and use the same. So, as the court points out, the common law right and statutory right are separate and independent, neither infringing upon the other. Whether an inventor exercises or refuses to exercise his natural or common law right has nothing to do with his assertion of his statutory right, which consists exclusively of his power, through the courts, to restrain others from practicing his invention and to call them to account for having done so in defiance of his monopoly granted by the patent statute. This view of our patent system has been established in Supreme Court opinions. (97 U. S., 501; 210 U. S., 405.)

From another angle in this case the defendant contended that a patent could be assigned only as an entirety. But section 4898 of the U. S. Revised Statutes says that "any patent, or any interest therein, shall be assignable in law by an instrument in writing." The court said that the words "any interest therein" gives the patentee the right to subdivide and deed or lease his property as he pleases.

Notes on Aluminum Alloys for Casting*

Useful Foundry Alloys Contain Relatively Low Percentages of Copper, Zinc or Both — Other Metals Are Alloyed in Smaller Percentages—Physical Properties of Aluminum Alloys Used in America and Other Common Metals and Alloys Are Tabulated

THE two principal alloying ingredients of aluminum casting alloys at the present time are copper and zinc, usually taking the form of aluminum-copper or aluminum-zinc-copper alloys. Manganese and magnesium are frequently used. Nickel, chromium, tin and other metals have been alloyed with aluminum with varying degrees of success.

When commercially pure aluminum is alloyed with one or more of the common metals, the usual effects are an increase in the tensile strength and hardness, a reduction in the shrinkage and an improvement in the machining qualities of the metal.

Increased tensile strength and hardness are not always accompanied by a decrease in the elongation. However, there is usually a decrease in elongation when the increase in strength and hardness is caused by a change in the chemical composition of the alloy; but any change in the casting conditions which increase the tensile strength of an alloy also increases the elongation; hence there is a double gain of tensile strength and ductility.

What is true of alloying aluminum with small quantities of other metals is also generally true when other metals are alloyed with small amounts of aluminum. When this is done the good effects, as in the previous case, at first predominate, but the tendency for the ductility to decrease is present and it increases as the amount of aluminum increases.

Aluminum-Copper Alloys

All the useful alloys of the aluminum-copper series may be placed in one or the other of the two classes: Those containing less than 15 per cent copper, and those containing less than 11 per cent aluminum. The first class embraces the alloys most applicable to general casting purposes in the aluminum industry. Because of the nature of their constituents, alloys of this class are not subject to burning in the foundry, as are alloys containing more volatile metals.

The copper content in this series of alloys is now fairly well standardized. After years of experimentation and commercial practice in which almost every combination of aluminum and copper has been tried, trade sentiment has gradually crystallized in favor of an alloy containing from 7.0 to 8.5 per cent copper. This amount of copper produces a tough alloy the tensile strength of which will vary from 15,000 to 20,000 lb. per square inch, depending upon the casting conditions. It casts well and gives little trouble from checking and drawing of the casting, and is the one most generally used for all-round aluminum casting work. It is commonly known as No. 12 Alloy and will be discussed in detail later.

Alloys containing a higher copper content than this are sometimes used in the United States for castings which are to be subjected to high temperatures, water or steam pressure. A high-copper alloy is frequently used in the die-casting industry because of its relatively low shrinkage. Castings made from such alloys may fail if subjected to repeated shocks and stresses.

Alloys of the second class, containing less than 11 per cent aluminum, are known as aluminum bronzes. The aluminum content usually ranges from 1 to 10 per cent, that containing 10 per cent aluminum probably being most popular. A greater amount makes the metal hard and brittle, for the effect of aluminum is very similar to that of copper in the light alloys of aluminum. The tensile strength of aluminum bronzes is high, and ranges from 80,000 to 110,000 lb. per square inch. These bronzes do not corrode readily, and have a great resistance to alternating stresses, being superior to some steels in this respect.

Intermediate alloys of the aluminum-copper series, ranging from 15 to 90 per cent of copper, give crystalline and brittle grayish-white alloys of no use. After about 80 per cent of copper is reached the red color of the copper begins to show.

Aluminum-Zinc Alloys

The useful alloys of the aluminum-zinc series may, like those of aluminum and copper, be divided into two classes: Those containing less than 33 per cent zinc, and those containing a relatively small amount of aluminum.

Zinc produces a very strong alloy with aluminum, the tensile strength running as high as 38,000 lb. per square inch for the alloy consisting of 50 per cent zinc and 50 per cent aluminum. Such an alloy, however, is excessively brittle. The decrease in ductility of these alloys as the zinc content increases places the maximum of zinc at 33 per cent, and even this is much too high if the casting is expected to withstand stresses. The best aluminum-zinc alloys usually possess considerably less zinc than this. Zinc tends to give additional fluidity to aluminum, and produces sharp and sound castings when skillfully cast.

For forging, few metals excel an alloy containing from 10 to 15 per cent zinc. This alloy is tough, flows well under the forging dies and produces a finished product which is solid, easily machined and remarkably strong per unit of area. Castings made from aluminum-zinc alloys machine well, and the machining qualities improve with aging of the metal.

Alloys of this class seem to be unusually sensitive to irregularities in the casting process. If the metal is overheated there is danger that the zinc may be burned out. In addition, these alloys are more subject to drawing in heavy parts or lugs than are the copper alloys. This tendency, however, can in most cases be overcome by proper gating, suitable chills and risers, and adequate temperature control. Zinc alloys are unusually sensitive to high temperatures, and therefore can-

*From sales department condensed data prepared by the Technical Department, Aluminum Company of America.

not be used where the casting will be subjected to considerable heat. A casting made from a 25 per cent zinc alloy when raised to a temperature of 100 deg. C. loses one-third of the tensile strength it possessed at 20 deg. C. Zinc alloys have never been very popular in the United States. Doubt in the minds of many as to their freedom from deterioration with age has probably had much to do with their limited use.

Alloys in the second class of the aluminum-zinc series, those composed of relatively small amounts of aluminum, are known as aluminized zinc. The aluminum content is usually 5 or 10 per cent. These alloys are used in zinc-galvanizing baths to make the bath more fluid and to clear it of oxides, and in the manufacture of aluminum brass, but they are never used directly as are the aluminum-zinc casting alloys.

Aluminum-Zinc-Copper a Favorite Alloy

As previously stated, an alloy of aluminum and zinc has never been very popular in the United States. Where zinc is used the trade favors the addition of small quantities of copper. Copper increases the tensile strength, improves the casting qualities and gives greater rigidity to the aluminum-zinc alloy. In England an alloy composed of 13 per cent zinc and 3 per cent copper is used quite extensively. In the United States an alloy containing 15 per cent zinc and 3 per cent copper finds most favor, and is known to the trade as No. 31 Alloy. These alloys, either with or without the addition of copper, have never been as popular in the United States as they are in Europe.

In general, manganese influences aluminum in much the same manner as copper, renders it first both harder and stronger but less ductile, and subsequently decreases the strength as well as the ductility. Manganese alloys are very resistent to corrosion, being superior to the pure aluminum in this respect, the resistance increasing with increase in the manganese content. These alloys are most frequently rolled into sheets, but as 1½ and 2 per cent manganese alloys are dense and close grained, they are not infrequently used for casting small parts, such as pipe fittings, which are to be subjected to water or steam pressure.

Alloys of magnesium with aluminum are usually known as magnalium. Because of the great affinity of magnesium for oxygen, these alloys tend to form considerable dross on remelting unless the magnesium content is low. As a result, it is not generally good practice to add more than 5 per cent magnesium. Most alloys possess even less than this amount, and few commercial alloys carry over 2 per cent magnesium.

Magnesium alloys are harder, stronger and lighter than pure aluminum. Their tensile strength is practically equal to that of No. 12 Alloy, and their elongation is greater. Magnesium tends to make the mixture more fluid at low temperatures.

Magnesium may be introduced in the following manner: The pure magnesium is held in a pair of iron tongs and pushed slowly to the bottom of the crucible after it has been removed from the fire, or in the ladle just before pouring. It must be stirred slowly until the magnesium has completely melted from the tongs as determined by the sense of touch. The magnesium should be added in small amounts. If a long stick is pushed into the crucible it may break and the broken pieces float to the surface, where they will catch fire before they are melted, taking oxygen from the air instead of from the aluminum or the dissolved gases. After sufficient magnesium has been added more vigorous stirring should be continued for a short time in order to give the oxide of magnesium a chance to float to the surface. Then it should be poured and skimmed in the usual way. No other flux is necessary. Care should be taken to see that the tongs and magnesium are dry, to eliminate violent action and danger in introducing the magnesium.

Other Alloys Less Useful

Nickel is sometimes used as a hardener for aluminum, and produces practically the same effect as copper. However, nickel costs more than copper, and it has been found very difficult to make the nickel-rich alloy for incorporating the nickel in the melts. The nickel content should never exceed 5 per cent, for a 5 per cent alloy develops practically the full tensile strength that can be obtained without decreasing the elongation to such an extent that the casting would be unsuitable for commercial foundry work.

Small proportions of tin are sometimes advantageously used with aluminum to give greater strength and rigidity to heavy castings as well as to reduce the shrinkage of the metal. Tin also serves to give sharpness to the outline of the casting. The tendency, however, to reduce the elongation to the point of impracticability prevents the general use of tin-aluminum alloys.

No casting alloys of any value are formed by alloying aluminum with iron. A small amount of iron always occurs in aluminum as an impurity, but is only detrimental when it exists in amounts exceeding 1.5 to 2.0 per cent. The effect of more than these percentages of iron is to dangerously reduce the elongation. It also makes the molten metal sluggish, necessitating a higher temperature in the furnace with the consequent tendency toward blow holes and shrinkage cracks in the finished casting.

TABLE I—DENSITIES OF METALS

(Data for aluminum from Research Bureau, A. C. O. A. Remainder of table compiled from Smithsonian physical tables and other sources. Values for 20 deg. C., 68 deg. F.)

	Grams Per Cubic Centimeter	Pounds Per Cubic Foot	Weights of equal Volumes With No. 12 Alloy = 1
Magnesium	1.75	109	0.612
Aluminum (Al, 99.7)	2.70	169	0.944
Aluminum (Al, 99.0)	2.71	169	.....
Aluminum (Al, 98.0)	2.73	170	.....
No. 12 Alloy (Al + Cu. 7.0 to 8.5)	2.84 to 2.87	177 to 179	1.00
No. 31 Alloy	3.0	187	1.05
Zinc	7.1	443	2.48
Iron, gray cast	7.1	443	2.48
Tin	7.3	456	2.55
Manganese	7.4	462	2.59
Soft Steel	7.8	487	2.73
Brass, cast (Cu 70; Zn 30)	8.4	524	2.94
Bronze, cast (Cu 80; Sn 20)	8.7	543	3.04
Nickel	8.8	549	3.08
Copper	8.9	556	3.11
Lead	11.3	705	3.95

Silicon in the ordinary casting alloys hardens the metal, reduces elongation and affects adversely the machining qualities when it occurs in too large quantities. Care should always be taken to keep the silicon content low, not exceeding 1.0 to 1.5 per cent.

The density of a metal is subject to variation from changes in both composition and structure. For this reason the values which are given in various books are frequently conflicting because the exact composition and structure are not stated. In general an attempt has been made in Table I to select values which are representative for the metals listed. In the case of aluminum and No. 12 alloy the values hold for dense castings. If the castings are somewhat porous they will have cor-

TABLE II—MODULI OF ELASTICITY

Metals	Lb. Per Sq.In.
Lead	2,500,000
Aluminum	9,000,000
No. 12 Alloy	10,000,000
Cast Iron (gray)	12,000,000 to 14,000,000
Soft steel	30,000,000

TABLE III—TENSILE STRENGTHS

Metal	Tensile Strength Lb. per Sq.In.
Pure aluminum, cast	12,000 to 14,000
No. 12 Alloy	18,000
No. 31 Alloy	25,000
Cast brass (Cu 70 Zn 30)	40,000
Cast bronze (Cu 80 Sn 20)	32,000
Cast iron (gray)	25,000
Cast steel (soft)	60,000
Cast copper (electrolytic)	25,000
Cast zinc	4,000 to 12,00

TABLE IV—RELATIVE THERMAL CONDUCTIVITIES AT 100 DEG. C. (212 DEG. F.)
(Compiled from Smithsonian Physical Tables)

Silver	100	Tin	14
Copper	91	Iron, wrought	14
Gold	71	Iron, cast	11
Aluminum	51	Steel, soft	11
No. 12 Alloy	40	Steel, hard	6
Magnesium	38	Lead	8
Zinc	26	Graphite	4

TABLE V—LINEAR THERMAL EXPANSIVITIES
Average Expansion Coefficient, 0 to 100 deg. C. (32 to 212 deg. F.)
(Compiled mainly from Smithsonian Physical Tables)

	Per Degree Fahrenheit	Per Degree Centigrade
Zinc	0.000017	0.000030
Lead	0.000016	0.000028
Magnesium	0.000015	0.000027
Aluminum	0.000013	0.000024
No. 12 Alloy	0.000013	0.000023
Tin	0.000013	0.000023
Cast brass (Cu 71; Zn 29)	0.000011	0.000019
Copper	0.0000095	0.000017
Nickel	0.0000078	0.000014
Cast steel	0.0000067	0.000012
Cast iron	0.0000056	0.000010
Invar steel	0.0000006	0.000001

respondingly lower densities, while if the impurities present are greater, the density may be increased somewhat.

The thermal conductivity of aluminum is relatively high and this property makes the use of aluminum particularly advantageous in the construction of water-jacket walls, oil-pans and other motor parts which it is desirable to keep cool. Table IV lists some of the metals in the order of their relative thermal conductivity.

It is important to know the thermal expansion of a metal when it is to be used for castings such as automobile pistons, which are subject to considerable variation in temperature. The linear thermal expansivity of aluminum is intermediate between that of zinc and brass or copper, and about twice that of iron and steel. Table V shows the linear thermal expansivity per degree for unit of length of various metals. The volume expansion coefficient may be taken as three times the linear expansion coefficient.

The shrinkage of a metal is the linear contraction in cooling from the melting point to room temperature and determines the allowance the patternmaker must use in order to obtain a finished casting of the correct size. The shrinkage of aluminum alloys is somewhat greater than that of cast iron but less than that of steel. (See Table VI.

The purest aluminum so far obtained melts at a temperature of 658.7 deg. C. or 1217.7 deg. F. as shown in Table VII. The commercial grades of metal melt at somewhat lower temperatures. Aluminum has the relatively high boiling point of about 1,800 deg. C. and is not appreciably volatile under ordinary conditions at temperatures below 1,000 deg. C. It is not good practice, however, in making castings of aluminum to heat the metal much above its melting point or to allow it to remain molten for a great length of time.

Alloys differ from pure metals in that they do not melt at constant temperature but over a certain temperature interval. Alloys of eutectic composition are an exception to this rule and melt at constant temperature. The eutectic or lowest melting alloy of the copper-aluminum series contains 32 per cent copper and melts at 540 deg. C. (1,004 deg. F.). No. 12 alloy contains 8 per cent copper; it begins to melt at 540 deg. C. and is completely molten at 636 deg. C. (1,177 deg. F.).

The specific heat of aluminum is 0.21 at room temperature. This means that the quantity of heat that would raise the temperature of a given weight of aluminum through one degree, would raise the temperature of the same weight of water through 0.21 of one degree. The specific heat of aluminum increases with rise of temperature and is about 15 per cent greater at 500 deg. C. The mean specific heat in the temperature interval, 20 to 100 deg. C., for a number of metals, is given in Table VIII.

TABLE VI—SHRINKAGES OF METALS
(Inches per foot)

Pure aluminum	0.21	Brass	0.19
No. 12 Alloy	0.18	Gray iron	0.12
No. 31 Alloy	0.18	Steel	0.25

TABLE VII—MELTING POINTS
(These are the values accepted by the Bureau of Standards and given in their Circular No. 35. They hold for samples of the highest obtainable purity; less pure samples will in general have a lower melting point.)

Metal	Degrees Centigrade	Degrees Fahrenheit
Aluminum	658.7	1,217.7
Magnesium	651	1,204
Copper	1,083.0	1,981.4
Manganese	1,230	2,246
Nickel	1,452	2,646
Silicon	1,420	2,588
Iron	1,530	2,786
Zinc	419.4	786.9
Lead	327.4	621.3
Tin	231.9	449.4

TABLE VIII—SPECIFIC HEAT
Mean Specific Heat, 20 to 100 deg. C. (68 to 212 deg. F.)
(Compiled mainly from Smithsonian Physical Tables)

Water	1.000	Zinc	0.093
Magnesium	0.248	Copper	0.093
Aluminum	0.216	Brass	0.09
Cast iron	0.12	Tin	0.055
Manganese	0.121	Lead	0.031
Nickel	0.109		

The electrical conductivity of pure aluminum is 61 per cent of that of copper. No. 12 alloy has an electrical conductivity only about 32 per cent of the conductivity of copper. Alloys have been developed which have conductivities less than 20 per cent of that of copper and which have temperature coefficients of resistivity less than half that of pure aluminum.

Strengthening Springs by Overstrain

It is a known experimental fact that if a metal is loaded somewhat beyond the limit of proportionality, the load then released and then retested, the limit of proportionality will be found at a higher stress than originally. However, it is not so well known that this obscure physical phenomenon has long been applied in industry.

In manufacturing helical springs, these are first of all coiled to a height considerably above their finished height, then hardened and tempered. Then they are compressed to the limit, which overstresses the metal beyond its yield point, and the spring acquires a slight permanent set, so that upon removal of the load the spring returns only as far as the designed height. This has always been done to lift the elastic limit, so as to have the advantage of the greater strength thus induced.

Temperature-Pressure Curves of Petroleum Products

By M. B. Cooke
Assistant Refinery Engineer, Bureau of Mines

In the course of investigations now in progress by the Bureau of Mines into the nature of "gum forming" constituents of gasoline, several gasolines and other petroleum products were heated in a small bomb and pressures of considerable magnitude were developed. As the bureau has received many inquiries for data showing the pressure that may be developed in a still when gasoline or other oil is subjected to elevated temperatures, it was thought advisable to record the pressures observed at various temperatures in the course of this work. These data were merely a byproduct of the main investigation.

Gasoline and similar products are very complex mixtures and it is difficult to determine accurately the true vapor pressures; hence the vapor pressures of the oils used in these tests have not been studied in detail, but the data obtained may be taken as representative of the pressure-temperature relations of the various oils in commercial work.

Apparatus and Procedure

The apparatus for the tests consisted of a small steel bomb designed to carry a working load of 1,000 lb. per sq.in. with a factor of safety of 20. This bomb was constructed from a hexagonal piece of steel bar, and the outside dimensions without the cover were about 2½x6 in. The lid was made in one piece from the same material, was ⅝ in. in thickness, and was threaded on the inside of the rim. The bomb proper had inside dimensions of 1½x5⅜ in. and was threaded on the outside of the rim. The lid was also provided with a male rim which fitted into a groove, containing a lead gasket, machined in the top of the bomb. A pressure gage mounted on a ¾x6-in. brass nipple of ¼-in. bore was screwed into a hole in the center of the lid. The total capacity of the bomb and gage connections was 160 c.c. The bomb was heated in a bath of steam cylinder oil which was stirred thoroughly.

The apparatus was tested by placing in it 100 c.c. of distilled water, closing the bomb, and heating it in the oil bath to a maximum temperature of 200 deg. C. At intervals during the test the temperature of the oil and the pressures developed in the bomb were simultaneously recorded. These results are given in Table I together with data taken from the work of Marks and Davis.[1]

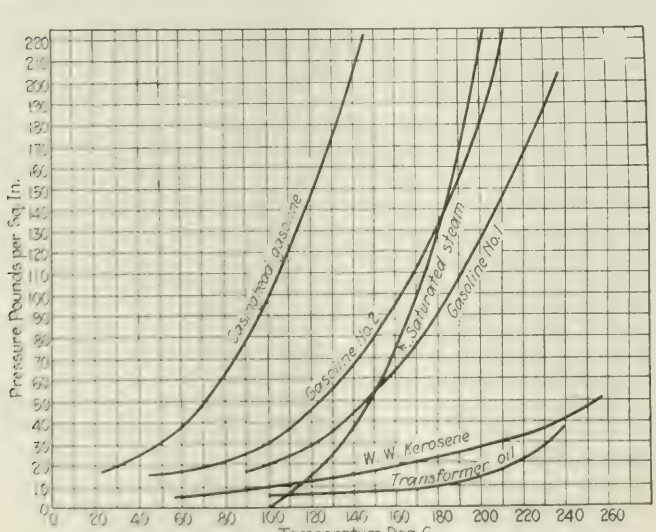


FIG. 1—TEMPERATURE-PRESSURE CURVES

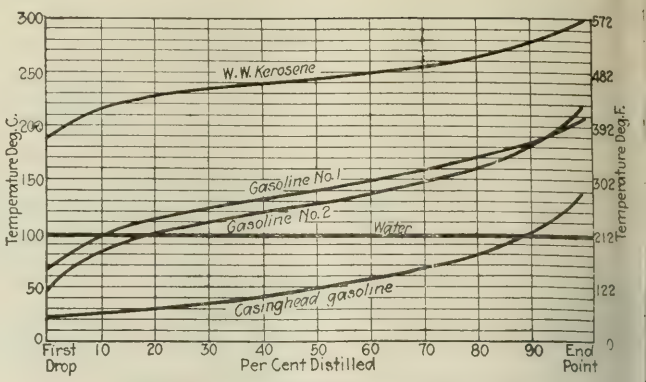


FIG. 2—DISTILLATION RANGE CURVES

TABLE I—COMPARISON OF PRESSURE EXERTED BY 100 c.c. WATER IN BOMB AND THEORETICAL PRESSURES

Temperature of Oil in Bath Deg. C.	Deg. F.	Pressure, Lb. Per Sq.In. (Gage)	Pressure, Saturated Steam (Marks and Davis Tables)
160.0	320.0	70	73
181.0	358.0	130	133
190.0	374.0	163	167
193.0	379.0	175	179
198.0	388.0	200	202

In comparing the results actually obtained in these experiments with data taken from the tables, it will be noted that the maximum error (probably due to the presence of air in the bomb) was 4 lb. per sq.in. It can be assumed therefore that the determinations on gasoline represent fairly closely the pressures that would be developed under theoretically perfect conditions.

Temperatures and pressures were recorded also as the bomb cooled down and showed that the lag between the oil bath and the bomb was probably not more than 1 deg. C.

Discussion of Data

One sample of casinghead gasoline, two of motor gasoline, one of kerosene, and one of transformer oil were heated in the bomb as described above and the resulting temperature-pressure curves for the various products are given in Fig. 1. The distillation range as determined by the standard A.S.T.M. method[2] is given in Fig. 2. The distillation range of transformer oil is not given because it is too high to obtain by the standard A.S.T.M. method.

It will be noted by referring to the curves in Fig. 1 that petroleum products with a low boiling range, such as casinghead gasoline and some of the lighter motor gasolines, generate a higher pressure at a given temperature than water vapor. Petroleum products with a relatively high boiling range, such as kerosene and transformer oil, generate less pressure than water vapor at a given temperature. In general, the pressure generated by petroleum products when subjected to elevated temperatures varies inversely with the average boiling point of the product. The temperature-pressure curves however, are not parallel, due to the varying composition of the products. For the same reason, the distillation range curves are not parallel.

[1] Lionel S. Marks and Harvey Davis, "Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam," 1919.

[2] "Specifications Committee Methods for Testing Petroleum Products," Tech. Paper 298, Bureau of Mines, 1922, p. 13.

Manufacture of Fireclay Refractories

Outline of Plant Operations at the Evens & Howard Fire Brick Co., St. Louis—Forming Brick and Special Shapes—Drying—Burning—Manufacturing Operations Co-ordinated to Obtain Maximum Production Efficiency

By Alan G. Wikoff

ST. LOUIS has long been an important center of the fireclay refractory industry because of the exceptional quality of the plastic fireclay in the famous Cheltenham seam underlying the city and county of St. Louis. This clay is refractory enough for many industrial purposes, but the increasing use of very high temperatures has created a demand for more highly refractory products, which has been met by the addition of non-plastic flint clay. Fortunately deposits of excellent flint clay are abundant in the east-central portion of Missouri. But the present plants are no longer able to obtain their entire raw material supply right at their doors, as was the case in the earlier days. Manufacturing methods have also kept pace with the development in service requirements for refractories so that the modern plants make full use of such factors as scientific control and material-handling equipment in obtaining efficient production.

Plant Layout for Straight-Line Flow

Situated in the rolling country just west of St. Louis is the modern firebrick plant of the Evens & Howard Fire Brick Co. The straight line flow from storage pile to stock shed and loading platform is evident from the layout as shown in Fig. 1. The spur from the St. Louis Belt & Terminal R.R. which passes the boiler house, clay shed and calcine kiln is an elevated or high line so that hopper-bottom cars can be dumped directly from it. The clay products are formed and dried in the large 4-story brick building connecting with the clay shed, burned in the kilns which are numbered as shown and then transferred to the stock shed or directly to cars.

As a brick 9x4½x2½ in. is the standard size, plant capacities in this industry are often stated in terms of 9-in. brick, other sizes and shapes being calculated to their equivalents in 9-in. brick. On this basis the daily capacity of this plant is about 115,000 9-in. equivalents, or, roughly, 400 tons, since a 9-in. brick weighs 7 lb.

Raw Materials

As has been indicated, two types of clay form the primary raw materials—Cheltenham plastic fireclay and flint clay.

At the present time the Cheltenham clay is obtained from mines owned by the company, about 5 miles north of the plant. Here the clay occurs as a 10-ft. vein about 100 ft. under ground. A shaft is sunk to the proper level and galleries are run into the vein of clay. Fig. 2 is a general view of one of the galleries. At Mine No. 6, which has just been opened, the clay

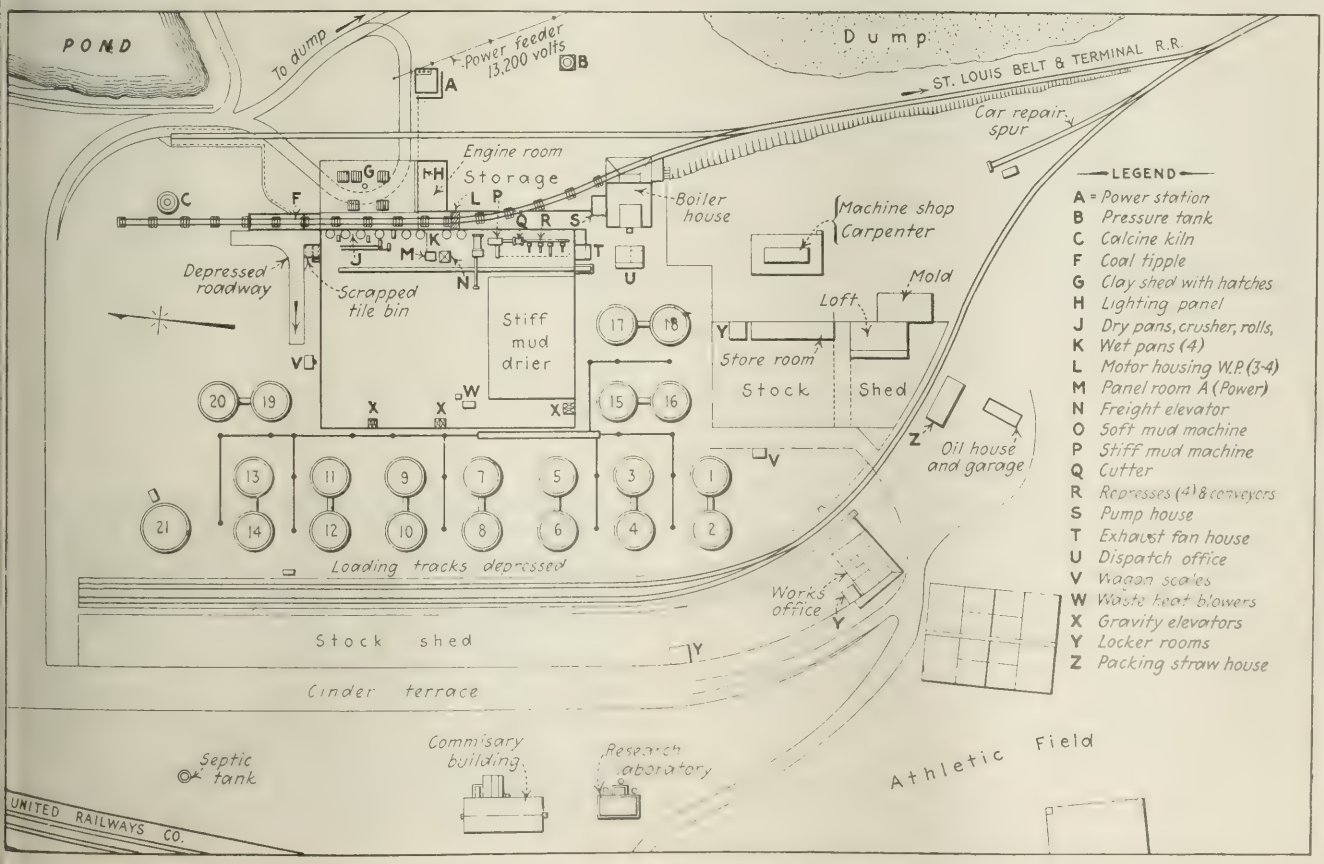


FIG. 1—LAYOUT OF FIREBRICK PLANT

FIG. 2—GALLERY IN A CLAY MINE

loosened by blasting and by pick is loaded upon cars which are hauled to the shaft by a mule, raised by an electric hoist and dumped into elevated storage bins. As yet this mine has not been placed upon a production basis, but it is expected to yield 250 tons a day. The clay from these mines fuses at about Seger cone 31, which is equivalent to 1,750 deg. C., or 3,182 deg. F.

For transporting clay, the company has its own standard-gage hopper-bottom cars.

Flint clay of a grade known as No. 1 white flint is brought from Owensville, Mo., and vicinity, about 100 miles west of St. Louis, where it occurs in pockets in sandstone varying from 100 to 250 ft. in diameter and from 20 to 75 ft. thick. Owing to the fact that the clay has to be hauled from 1 to 5 miles with teams, shipments depend upon fair weather and accordingly it is necessary to provide storage facilities at the plant. If the clay is not used as received it is transferred from cars on the high line to storage piles by an Ohio locomotive crane, which also serves to load hopper-bottom cars when material in storage is to be used.

Grinding Cheltenham and Flint Clays

When ready to be ground, the clay is dumped from hopper-bottom cars on the high line, as shown in Fig. 3, into hoppers which discharge by means of plate feeders into dry pans, *J*, Fig. 1. Each of the three Frost dry pans is provided with a bucket elevator to carry the ground material to the upper floor of the building, where it is screened over sloping screens into master storage bins. Flint clay and Cheltenham clay are ground and stored separately.

Grog and Calcine

In addition to the raw clays just described, there are three materials derived from them, but differing in physical properties, which may be termed secondary raw materials. These are plastic clay grog, flint clay grog and flint clay calcine. Grog is a general term applied to material which has been reground after having been burned. Thus broken or imperfect plastic clay brick taken from the kiln might be ground up to form plastic clay grog. Flint clay calcine is prepared by burning the clay in lump form without preliminary grinding in a vertical shaft kiln located alongside the outer end of the high line so that it can be charged directly from the cars.

Grogs and calcine are ground separately in an Austin gyratory crusher, screened and stored in master bins similar to those used for the raw clays.

There are thus five materials which may be used in a variety of combinations according to the properties desired in the finished product. About twenty-five standard mixes are regularly employed at this plant in the production of a wide range of refractories.

Having the five ground materials in separate bins makes the preparation of any desired mix an extremely simple matter. Freese feeders in the bottom of each master bin are so calibrated that a constant, predetermined flow of material can be delivered from any number of the bins onto a common belt conveyor which runs along one side of the bins. A bucket elevator and another belt conveyor serve to place the mixture thus formed in bins located directly over the machines which are to temper the clay with water. With this arrangement, the proportions of a mixture can be controlled automatically to within 1 per cent.

Methods of Forming Fireclay Refractories

Fireclay refractories may be formed in any one of several ways. Brick may be made on machines or in hand presses. According to the consistency of the mixture (which depends upon the amount of water present), the process is referred to as soft mud, stiff mud, or dry press. In the dry press process, water is added merely to dampen the clay, when the amount normally present in the clay is not sufficient. All three processes are used at this plant, the proportions being about 20,000 hand press, 20,000 dry press, 60,000 stiff mud and 15,000 hand molded.

Many of refractory shapes are so large or so complicated that they must be molded by hand. As the manufacturing operations in the hand-molding and machine departments differ to quite an extent, they will be treated separately.

Machine-Made Firebrick

Clay mixtures for use on the brick machines are mixed with water to the proper consistency in an American pug mill, which consists essentially of a number of blades mounted on a horizontal shaft rotating in a steel trough. The blades are set so that the clay gradually moves toward the discharge opening which feeds an American auger machine (*P*, Fig. 1). Here the clay is forced through a rectangular die emerging in the form of a dense, continuous column about 9 in. wide and 4½ in. thick. As it moves along on a small belt conveyor it is picked up by the Freese cutter, *Q*, where a number of tightly stretched wires pass vertically through the clay column forming about twenty-five brick at a cut. The movement of the clay is not interrupted during the cutting process. The brick pass on a belt conveyor in front of three Bonnot represses. (The fourth press shown at *R*, Fig. 1, is being installed.) At each of

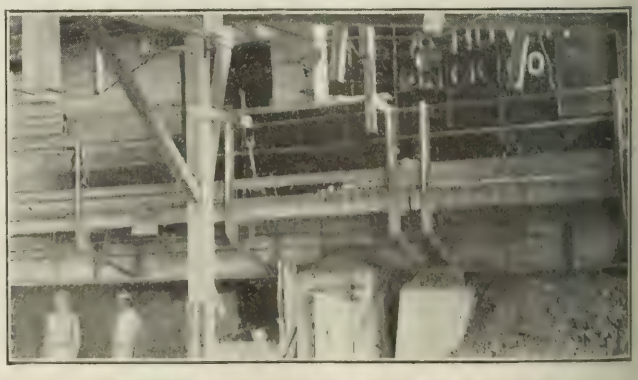


FIG. 3—FEEDING CLAY TO DRY PANS

these, an attendant removes two brick at a time from the conveyor and places them in the press. This operation assures smooth sides and sharp, straight edges so that the brick are easily laid up. Brick made in this way are known as wire side-cut, repressed. This machine has a capacity of 60,000 9-in. equivalents.

Waste Heat Driers

As they come from the presses, the brick are stacked on double deck cars with galvanized truck frames. They are spaced with some degree of regularity so that drying will be as uniform as possible. Waste heat from the kilns which are cooling is supplied to a parallel row of tunnel driers by means of a powerful blower. A transfer car running on a track along the front of the driers makes it possible to place the cars of green brick in any one of the driers. The cars are pulled through by a steel cable attached to an electric winch, three cars of dried brick being drawn at a time. The waste heat driers were installed by the L. E. Rodgers Engineering Co., Chicago.

Since there is always the possibility of not having sufficient kilns cooling at a given time to maintain the proper temperature in the driers, an auxiliary furnace is provided to take care of such emergencies, but this has never been required to date.

All products being burned in the same type of kiln, the general subject of burning will be considered after discussing briefly the production of hand-made ware.

Preparing Clay for Hand-Made Ware

Instead of being put through a pug mill, all clay for hand-made ware is tempered with water in a wet mill. There are four 9-ft. Frost wet pans, *K*, with 14-in. mullers, so arranged under the storage bins that each pan is served by two bins. The pans are elevated so that mud carts can be run underneath to receive the clay as discharged by a Wynn unloader. The mud carts distribute the clay to the molding gangs on the upper floors of the building.

Hand-Made Brick

Each hand-press for making brick is operated by a gang of four men. A wad of clay somewhat larger than the brick to be made is worked into a shape approximately that of the mold and is then thrown with considerable force and skill so as to fill the mold completely and uniformly. After the excess clay has been removed, the press is operated by hand and the brick removed ready for drying. This process is used for the more refractory grades of firebrick, and the five hand presses (made by George Carnell, Philadelphia) have a daily capacity of about 20,000 9-in. equivalents.

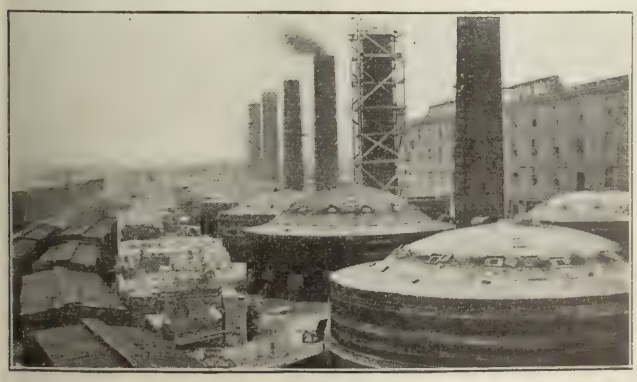


FIG. 4—GENERAL VIEW OF KILN YARD

FIG. 5—NORTH END OF KILN YARD

Although the standard brick with its modifications, such as key, wedge, neck, arch, skew and circle, is applicable in a wide range of refractory construction, there are many cases where more satisfactory results can be obtained by the use of special shapes. Many of these are very complicated and their successful manufacture calls for great ingenuity, skill and experience.

Wooden molds are used wherever possible, although some of the larger pieces are built up patiently by hand. Having dusted the mold with fine sand so that the clay will not stick, the molder throws in a lump of clay. After working this uniformly into all parts of the mold, the excess is removed by passing a tightly stretched wire across the free surface of the mold and the piece is carefully removed from the mold and placed upon the floor to dry. The time the ware must remain on the drying floor depends upon the size and shape of the pieces and is determined largely by experience.

By far the larger part of the floor space of the main building is required for the drying floors, as the nine tile gangs (two men each) produce about 15,000 9-in. equivalents per day.

Burning

All ware is burned in round, down-draft periodic kilns, there being twenty 36-ft. kilns each capable of holding 70,000 9-in. equivalents and one 40-ft. kiln with a capacity of 130,000 9-in. equivalents. Figs. 4 and 5 are general views of the kiln yard. A system of tracks makes it possible to bring the cars of brick directly from the driers to the kilns. A loaded car en route to the kiln may be seen in the lower part of Fig. 5. Hand ware is loaded onto two-wheel spring carts, lowered to the yard level by gravity elevators.

Setting the ware in the kiln is an operation which calls for a great deal of experience. Since practically all of the special shapes are incapable of supporting other brick and tile owing to their peculiar shape, the lower half of the kiln is set with brick, arranged according to a definite plan so that the heat will be distributed as uniformly as possible throughout the setting. The careful arrangement is evident in Fig. 6, which shows a kiln being drawn. The upper part of the kiln is filled with special shapes. Heat from the sixteen fireboxes set in the circumference of the kiln rises inside following the crown and then passes down through the ware and the flues in the kiln bottom to the stack.

The kilns are fired on a definite schedule according to the ware in them. Instruction sheets are prepared each day covering every kiln on fire that day. All kilns have pyrometers, and Seger cones and trial pieces are used to determine the finishing time. During the cooling period, the flue dampers are set so that the heat

goes to the driers instead of up the stack. Spring wheelbarrows holding about seventy brick are used to draw the kilns.

An accurate record is kept of the performance of each kiln, all ware being checked in and out and the results entered along with such data as the temperature schedule, hours burned, coal consumption, etc.

About 16 days are required for the complete cycle of setting, burning, cooling and drawing. The average burning time is 180 hours, while setting and drawing each require about 1½ days with a gang of twelve men.

Fuel and Power

Coal, ordered in hopper-bottom cars, is dumped directly from the high line into a tipple holding 150 tons, from which it is distributed around the yard to the kilns by means of an Autocar truck. Steam for heating the drying floors when necessary is supplied by the boiler house.

Power throughout the plant is electrical, machines being equipped with individual motor drive.

Research Laboratory

The laboratory is equipped to make all standard tests for refractory wares, having a muffle kiln, load furnace and high-temperature furnace in addition to the necessary chemical apparatus. Fig. 7 shows the furnace room, with a glimpse of the laboratory beyond. All clays and finished products are checked up at least once a month, but the most important part of the laboratory work is the development of new products in co-operation with the factory and sales department.

New clays are thoroughly tested before use. The fusion test is, of course, the most important guide to the refractory qualities of the clay, but chemical analysis and load tests are also of value. The regular supply of clay from deposits whose properties have already been determined is inspected at the mine, the flint clay as it is being loaded, and the soft clay by the top level boss.

Functions of Planning Department

Perfect co-ordination of all manufacturing operations is essential if waste of time and materials is to be eliminated in filling orders. Consider, for example, an order for several varieties of special shapes, some small and simple, others large and complicated, all to be delivered at the same time. In such a case, handling would be minimized if all pieces were burned in the same kiln and transferred directly to the freight car. But if the different shapes were manufactured simultaneously, it is obvious that the smaller pieces would be dry before the larger ones and that consequently valuable drying floor space would be wasted.

It is the function of the planning department so to schedule the operations that such wastes are eliminated. This requires an accurate knowledge of the capabilities and limitations of each department and the characteristics of each type of ware. Furthermore, with such data at hand, it becomes possible to promise delivery intelligently. Accordingly, it may be of interest to outline briefly the methods followed in this work.

Analysis of Orders

Orders naturally vary greatly in complexity, from those which call simply for material in stock to those covering a variety of special shapes. If the material is in stock in sufficient quantity the order goes directly to the shipping clerk. If special, it may be of a type which has been made before, in which case the molds will be in stock, or it may be necessary to make new molds. These points having been determined, it is possible to set a delivery date from a knowledge of the standard time required to make, dry and burn that particular type of ware and also of the amount of work already scheduled.

FIG. 6—DRAWING A KILN

Planning of Making

An order card is made out covering the whole order and separate route cards are made out for each class of ware on the order. This makes it possible to fix the dates for making the different kinds of ware so that all of the order will be ready for setting at the same time. The order card acts as a check to prevent any of the items being overlooked.

When the molds are ready, a molder's order is made out. This gives the making date, the exact amount (including a certain overage to cover possible losses) of war to be made, and the location on the drying floor which experience indicates as the best place for drying that type of ware. When the molding is completed the location on floor is noted on the route card, and an entry made on the order card showing ware made and number of making hours.

Setting

In planning the setting of ware, the kilns are considered as divided into four horizontal zones, the lowest zone being called the first. Experience has shown what zone is best adapted to each type of ware. Thus, some shapes can be set only in the top of the kiln or fourth zone.

All this is considered in preparing the setting schedule, which shows the ware to be set by zones and its location on the drying floor. A kiln near the ware and also convenient to the storage or shipping point should be available if the planning has been carefully done. In addition, the setting of the various kilns should be timed to give as uniform heat as possible to the driers and to prevent loss of time in kiln turnover.

Drawing and Shipping

On the date planned for drawing, the necessary cars are placed as near to the kiln as possible by the yard foreman. From the drawing report, an entry is made on the route cars showing amount drawn and lost. From the shipping ticket, a record of the amount shipped is made on the route cards and if the order is filled, the order card and route card are filed as completed.

FIG. 7—RESEARCH LABORATORY

Careful inspection at all stages is of vital importance. The thoroughness is indicated in the following brief summary.

All new molds are inspected when completed (and stock molds before using) by the mold inspector. First tile from new molds are examined by the floor inspector, who also makes a daily report of the condition of ware on the drying floor. Before being scheduled for setting, the chief inspector satisfies himself as to the dryness. At the kiln, ware damaged from floor to kiln is rejected by the kiln inspector, who also prepares the drawing report showing quality and loss. All special ware is again inspected by the chief yard inspector for dimensions and quality before being loaded.

While it has not been possible to go into any detail, it is hoped that this discussion will serve to indicate a few of the many factors which have to be considered in directing the manufacture of refractory materials.

In conclusion, the writer wishes to acknowledge the courtesies extended by the management, and to express his indebtedness to A. B. Christopher, ceramic engineer, and J. W. Alexander, of the planning department, for information which was used in the preparation of this article.

Aczol—An Interesting Wood Preservative

MINING engineers and railroad men in this country have expressed a good deal of interest in a new wood preservative—new at least in this country. It had been used in Belgium particularly and on the continent of Europe for a number of years, but has never before been manufactured here.

Its name Aczol is derived from its ingredients—ammonia, copper, zinc and phenol. All of these component parts have been used to a greater or less extent in wood-preserving work. Copper and zinc have been used for a long time and phenol is an essential principle of creosote, which is at the present time the most widely used wood preservative. The novelty of this compound lies in the fact that the inventor has succeeded in producing this mixture in soluble form. It is entirely soluble during impregnation and precipitates after this is completed while the wood is being permitted to dry in the air. The drying causes the evaporation of the ammonia, which in this case simply acts as a carrier of the other material. The phenolic salts of copper and zinc become firmly imbedded in the wood fiber—in fact the sap and ligneous material is soluble in the solution and this liquid is replaced by the precipitated salts.

The impregnation of wood with creosote is accomplished by placing the wood in a large air tight vat. The air is then pumped out to as high a vacuum as possible and the heated creosote is put in under pressure. With Aczol the process can be conducted without the use of vacuum at all. This is, of course, a distinct advantage. It is reported, however, as would be expected, that a better impregnation takes place when vacuum and pressure are used. One distinct point of vantage, however, is the fact that no heat need be used on the solution. This use of heat is thought by some engineers to weaken the wood structure in creosote impregnation. Whether this is the case or not, creosote-impregnated wood is not as strong either in tensile or compressive strength as raw wood and, on the other hand, wood which has been impregnated with Aczol is much stronger, due, in all probability, to the cementing action of the salt in and around the wood fiber.

As compared with creosote, it has a number of advantages. It leaves the wood clean, dry, odorless and fire resisting. This last point is a distinct advantage. Furthermore, the wood can be tooled and worked exactly as untreated wood.

The material is manufactured in rather concentrated form and is diluted—six parts of the product to ninety-four parts of water in the field.

Severe Tests on the Continent

The interesting thing about this product from the standpoint of the American manufacturers is that it has already been tried out. Records of the use of wood impregnated with this material have been kept in Belgium for the past decade. In many coal mines it has been found necessary to renew timber in the return air galleries every 3 or 4 months. This is becoming an increasing expense with the diminution of our forests. When wood was relatively cheap, it did not worry mining engineers much and they said, "Oh well, we would rather put in a new piece than bother with impregnation." Especially was this true when creosote was known to be the best material, for very few persons cared to handle creosote. In Belgium coal mine operators testify that "aczolated" timber has remained in its original sound condition for 8 years. The difference is extremely notable.

Successful as Wood Paving

It has also been used successfully on wood paving. In Brussels during the war, the main street was paved with wood blocks which had been "aczolated." During 1914 the entire German war machinery—millions of soldiers with hobnailed shoes and numberless cannons and supply wagons—passed over these wooden blocks. They are, even now, in perfect condition 10 years after they were placed in use.

In America this product is made by Zinsser & Co., Hastings-on-Hudson, N. Y. No tests, of course, have been made in this country which would compare with the Belgian test, because the material is so new. The company has sample blocks of wood impregnated with this material which have been in mines for 6 or 7 years. Another use of aczolated wood is in railroad ties, where the rotting is extremely rapid, especially in some climates. The development of the use of this product will be watched with a very great deal of interest and it is predicted by a number of competent men that its use will rapidly displace that of creosote or similar work, not only because of its greater durability, but because of its greater ease of handling.

Synopsis of Recent Chemical & Metallurgical Literature

Durability of Sole Leather

Technologic Paper 215 of the Bureau of Standards describes the preparation of four lots of leather used to determine the comparative durability of sole leather filled with sulphite cellulose extract, and sole leather filled with ordinary vegetable tanning materials, such as chestnut wood and quebracho extracts.

Several hides were used in the preparation of each lot, and alternate sides were filled with the sulphite cellulose extract. Each pair of soles contained one sole prepared by each method, both of which were cut from the same hide and from similar locations.

The results of actual service tests are presented, which show that the average wear of the leather filled with sulphite cellulose extract was 9.08 days per unit thickness and of the ordinary leather 9.06 days.

Complete chemical analyses of both the new and worn soles are also given. The general conclusions are that there is no difference in the two leathers as reflected by the chemical analyses, that sole leather filled with sulphite cellulose extract is as durable as leather filled with chestnut wood and quebracho extracts and that the former could well be used in place of the latter materials, thereby conserving them for the actual tanning of leather, for which they are more suitable than sulphite cellulose extract.

Decarburization of Steel by Hydrogen

Charles R. Austin, of University College, Swansea, presented a long memoir on "Hydrogen Decarburization of Carbon Steels With Considerations on Related Phenomena" before the May, 1922, meeting of the British Iron and Steel Institute. He worked with several very pure steels, and examined the metal after 12 hours' exposure to a stream of moist hydrogen at various temperatures. The end result is due to two main factors (*a*) removal of carbon as methane and (*b*) diffusion of carbon from the unaffected core. At low temperatures (*a*) seems to be more important, therefore the line of demarcation between ferrite case and substantially unaltered core is very clearly marked. At high temperatures—roughly above the upper critical—(*b*) is of greater importance, therefore the carbon content decreases gradually.

At temperatures just below A_1 the depth of decarburization was a linear function of the time of exposure. Its actual amount becomes unobservable at about 500 deg. C., but reaches a maximum at about 1,000 deg. C. Measurements and calculations indicate that the amount of carbon diffusing across 1 sq.cm. in one day under unit concentration gradient (i. e., the diffusion constant) is equal to 0.005 at 650 deg. C., and 0.05 at 850 deg. C.

Columnar ferrite crystals were noted in the muffs of steels heated within the transformation range; equiaxed ferrite resulted from higher or lower decarburizations. Tendency for columnarization appeared in hypereutectoid steels at temperatures somewhat above and below this range. No columnar crystals could be developed in Armco iron. Consequently the author concluded that the elongated crystals were caused by the disturbing influence of hydrogen gas diffusing into and out of the steel. There are reasons for believing that this occurs more readily along the grain boundaries.

Growth of Cast Iron

It has long been known that gray cast iron increases in volume after repeated heatings, and the many investigators who have studied the phenomenon have divided into two camps—one which believes it due to internal oxidation, and another which thinks the main influence is the expansion of occluded gases.

Tario Kikuta, in the fifty-ninth report of the Iron and Steel Research Institute (*Science Reports*, Tohoku Imperial University, Sendai, Japan, vol. 11, p. 1) has measured the leakage of gas through the walls of a gray cast-iron tube at various temperatures, and finds that at room temperatures the leakage increases for sixty repeated heatings to 960 deg. C. Furthermore the leakage at elevated temperature is only slightly less than when cold. Therefore the view is untenable that air penetrates the iron at low temperatures, but cannot escape at high temperatures, and hence causes expansion of the iron. Density of a gray cast iron was also observed during repeated heatings under various circumstances. The greatest expansion was noted after repeated heatings *in vacuo*, followed by quenchings. Next was after heatings in air, followed by furnace coolings; air heatings followed by quenchings caused slightly less. The least expansion resulted from heatings and furnace coolings *in vacuo*.

Most instructive data were had by recording temperature-elongation curves. When working *in vacuo*, a large and sudden expansion occurred in gray cast iron during the first heating at 700 to 800 deg. C., caused chiefly by decomposition of cementite (a phenomenon which causes an extension of 2.5 per cent in white cast iron passing through this range). A slight contraction occurs when passing Ac_1, representing the solution of a certain amount of free carbon. This contraction approaches zero at about the fifteenth heating. On cooling, a larger and irreversible expansion occurs at Ar_1, an expansion which recurs with but slightly decreasing intensity on each cooling.

Oxidation can have little to do with this phenomenon, since the work was done in a vacuum. The author thinks that carbon, which goes into solution readily at the eutectoid areas, passes very slowly from the graphite flakes to the surrounding ferrite. On cooling, the eutectoid decomposes readily, expanding and splitting the surrounding ferrite low in carbon. Growth of these fractures occurs by repeated stresses during cooling, and consequently growth continues. Slow cooling should permit these stresses to relieve themselves somewhat; therefore furnace coolings *in vacuo* show the least expansion. Slowing down the rate of reaction is due to coagulation of graphite particles, as observed under the microscope. White cast iron, not having the duplex structure, does not grow on repeated heatings, the changes at the transformation being reversible. About one-third the total expansion is due to decomposition of cementite, the remainder to minute fissures caused by differential expansion of various microportions.

Gray iron heated in air exhibits the same phenomena as *in vacuo*. The expansions at Ar_1 are more intense at first, but slow down more rapidly. The contraction at Ac_1 is almost absent, thought to be due to the oxidation of iron along the graphite flakes, thus preventing solution at these areas. Large expansions during Ar_1 are also due to filling the cavities with oxide, preventing them from adjusting their volume to the surrounding conditions. Very slow heatings and coolings in air cause greater volume changes at A_1, thus being opposite to the effect in vacuum, a discrepancy explained by the author as due to the more extensive diffusion of carbon and the continuous oxidation of the ferrite ground mass.

Studies on Aluminum Alloys Capable of Improvement by Aging

W. Fraenkel and E. Scheuer (*Z. Metallkunde*, vol. 14, pp. 49 and 111, 1922) have investigated with great care the electrical conductivity of alloys of the Duralumin type, including those containing zinc, in the annealed, as quenched, naturally aged and artificially aged condition. Elasticity, resistance to corrosion, electromotive force in aluminum sulphate solution, thermo-electric force and density were also studied, the purpose being to learn the true explanation of the improvement which takes place during aging.

The change in specific resistivity during the aging is most significant, especially since marked differences were found in the behavior of the naturally aged (at room temperature) and artificially aged (at 100 deg. C.) specimens.

Starting with the annealed metal, they found that heat-treating and quenching increased the resistivity, which indicates that this operation has caused the formation of a solid solution. If the aging consisted in the precipitation of the dissolved components, as believed by Merica and others, it should be accompanied by a decrease

n resistivity. Actually, aging at room emperature was accompanied by an ncrease in resistivity, indicating that here must be some other phenomenon nvolved. Aging at 100 deg. C. caused he resistivity to decrease about as nuch as it increased when the aging ook place at room temperature. Nevrtheless the physical properties obained by these two methods of aging re practically identical.

The authors conclude that the aging nenomenon at low temperatures consists in the formation or increase in oncentration of a solid solution, as a esult of a chemical reaction between he additions (particularly magnesium) nd aluminum. Accordingly the aging onsists of two simultaneous changes —the chemical reaction and the formaion of the solid solution.

It is conceivable that one of these henomena might take place without he other. This case seems to occur vhen the aging takes place at elevated emperatures, since we have here the ncreased strength, but a decreased reistance. The increased strength is upposed to be due to the formation of he chemical compound.

Instead of considering the aged state f the alloy as a metastable one lying etween the "as quenched" state and he stable annealed state, as previous vorkers have done, the authors conider it more probable that it is the tate which is really stable at ordinary emperatures. After annealing and low cooling, the constituents are so nuch separated that the stable comound cannot form at a measurable ate, on account of the extremely slow ate of diffusion. The reaction can ake place only when the separation is revented by the rapid cooling of the olid solution obtained at the heatreatment temperature.

This theory, based on the measureents of electrical conductivity, is ound to be in harmony with the exeriments on the other properties, so ar as they can be interpreted.

Book Reviews

PRACTICAL TANNING. By *Allen Rogers, Ph.D.* 699 pages, 124 illustrations. New York: Henry Carey Baird & Co., Inc., 1922. Price $10.

While based in part on the third dition of Flemming's "Practical Tanning," the present volume bears little esemblance to the earlier ones, which vere simply collections of miscellaneous ecipes and formulas. Dr. Rogers has rouped related topics under suitable eadings and presented these in logical equence so that the whole forms a onnected story of the leather industry. Material from the earlier edition has een supplemented by data from Dr. Rogers' experience and from many ther sources. While it is obviously mpossible to present a manufacturing manual for such an extensive and aried industry within the space of a ingle volume, the tanner will find a reat number of suggestions relating to practical details of tannery operations.

The policy followed intentionally throughout the book of emphasizing the practical side to the almost complete exclusion of theoretical considerations would seem to imply that success in the tannery depends more upon having a good formula than upon an understanding of the nature of the reactions involved. This is not in accordance with the experience of many other industries and advance in the leather industry will be slow as long as empirical methods predominate.

While, as indicated above, the book has been prepared primarily for the practical tanner, it will be of interest to students and others desiring information regarding modern practice in leather manufacture. A variety of modern illustrations serve to increase the attractiveness of the volume.

ALAN G. WIKOFF.

DUST EXPLOSIONS. By *David J. Price* and *Harold H. Brown.* Published by National Fire Protection Association, Boston, Mass. 320 pp., 87 illustrations. 1922. Price $3.

This discussion of the theory, nature of and causes of dust explosions is by two authors whose names are already well known in the literature of this subject. In this particular work they are assisted by two other able investigators whose co-operation is acknowledged on the title page—namely, Hylton R. Brown and Harry E. Roethe. The two principal authors and these men associated with them are all members of the technical staff of the Bureau of Chemistry, in which department they are directly responsible for the work on dust-explosion prevention.

As pointed out in the preface of this work, the general subject has not received anything like serious consideration until very recently. However, the tremendous importance of protection of industrial establishments against the hazard of dust explosions is now well recognized.

This work will be of immense value to the construction engineer as well as to those responsible for operating practice. It gives a clean-cut, simple discussion of why a suspension of dust in the air will explode and makes clear not only the possible consequences of such explosions but also the practical means at hand for prevention of the formation of dangerous air-dust mixtures. All the way through the work the reader will be impressed with the very practical nature of the proposals made. It is a great relief to find a safety engineer who writes on such a basis, for all too often the man who specializes in safety devices permits his enthusiasm to run away with his judgment.

The problem of dust prevention is by no means confined to the agricultural and cereal-milling industries, in which lines the disastrous consequences of dust explosions have been most conspicuous. Recent events well illustrate the hazard in fertilizer, metal-powder, rubber, soap, spice, sulphur and many other chemically controlled industries. It will pay every operating management to get a copy of this work and read it carefully. Such reading will be suggestive of many hazards of serious moment which occur throughout the industry. Moreover, the work will suggest readily available means for correcting these conditions at nominal cost. The price of the work will thus be about the cheapest form of explosion insurance which a management can possibly buy.

R. S. MCBRIDE.

METALLURGY OF ZINC AND CADMIUM. By *H. O. Hofman.* 341 pp., 261 illustrations. New York: McGraw-Hill Book Co., 1922. Price $4.

This is the fourth of a series of notable metallurgical treatises by Professor Hofman, of the Massachusetts Institute of Technology. The most pretentious was the "General Metallurgy," issued nearly 10 years ago. The interval is none too much for such comprehensive volumes as Hofman's "Metallurgy of Copper," "Metallurgy of Lead" and the subject of the present review. To round out the series, a "Metallurgy of Minor Metals" and a "Metallurgy of Gold and Silver" are now in preparation.

A reader or student who is acquainted with any of the other volumes will recognize the form and style immediately. I presume that a certain rule was laid down for these treatises: they must be comprehensive and yet be compressed in size. A mere statement of fact is all that is permitted. But it's all there, together with footnotes telling the exact source of information, to which the student can go for further discussion and detail. Unfortunately this gives the impression that the author is merely a compiler—often it appears that a series of index cards were set into type. Such a rule unfortunately submerges the personality of the author, and even masks the fact that he must be acquainted with operating details in order to appraise, as he has done, the relative importance of various publications, and fill the gaps left by periodical literature.

"Metallurgy," as comprised by this volume, is the art of extracting marketable metal from the ore. A number of auxiliary subjects are outlined, such as the ores and chemistry of various chemical compounds. Certain auxiliary operations are also discussed which are not metallurgy, but which have always been done at the zinc smelter (not smeltery), notably the manufacture of retorts—which is pottery—and the manufacture of zinc oxide—which is pigment. A chemical engineer might claim that the important chapter on electrolysis is something else than metallurgy. But even though the book contains preliminary chapters on properties of zinc and its alloys, these matters are discussed merely in order to show what is required of good marketable spelter and the effect of various metallic impurities. The physical metal-

lurgy, metallography, heat-treatment and mechanical working of pure zinc and its remarkably important alloys are not mentioned.

This doubtless is in keeping with the division of the industry in America, where zinc is smelted wherever there is a confluence of ore, fuel and labor, and the metal sent down East to rolling mills and brass works established long before the first pound of virgin metal was won in the States. In fact the book is almost entirely confined to American practice. Thus it supplies a gap in literature; Mr. Ingalls' "Metallurgy of Zinc and Cadmium" is 20 years old, and the quite recent "Zinc Industry," by E. A. Smith, is confined almost exclusively with British conditions.

E. E. THUM.

PUBLICITY METHODS FOR ENGINEERS. 187 pages, illustrated. Chicago: American Association of Engineers, 1922. Price $1.50.

In discussions regarding the lack of real public appreciation of the importance of chemistry and the closely related topic of the diligence with which the average chemist avoids participating in public activities, reference is frequently made to the accomplishments of other professions. While the lawyer is almost invariably set up as the shining example, the engineer has quite often been included in the favored group. Consequently it was with a great deal of interest that the reviewer noted the following paragraph in the book under consideration:

"Take one illustration, as a typical example. 'Creative Chemistry,' a book by Edwin E. Slosson, can teach many lessons about making interesting reading of engineering productions. It originated in a series of articles prepared for the *Independent* in 1917-18, 'for the purpose of interesting the general reader in the recent achievements of industrial chemistry.' The original article and the book itself have been read by thousands of people who were interested in the author's presentation of otherwise dry chemical facts, and without question there has been a tremendous amount of valuable publicity for the chemical profession as a result. The same can be done with engineering subjects."

Chemists who are interested in getting chemistry across to the public—and every chemist should be—will find this book full of valuable suggestions. It is based on papers and discussions presented at the First National Engineering Congress on Public Information, which was held under the auspices of the American Association of Engineers in Chicago, Feb. 25, 1921. The excellent educational material presented at this conference has been edited to eliminate duplication and make easy reading in a handbook. Some idea of the method of treatment can be gained from the chapter headings: Some Reasons for Publicity; The Right Conception of Publicity; Ways and Means That Bring Publicity; Getting News Into the Newspapers; The Publicity Man and What He Needs to Know; Typical Publicity Problems. Approximate estimating cost and an outline of a working plan for public information are included as appendices.

From the chemists' point of view it is also of interest to note that the book closes with an extract from the talk on research information service by Dr. Charles L. Reese which was presented at the Birmingham meeting of the American Chemical Society.

ALAN G. WIKOFF.

CATALYTIC ACTION. By *K. George Falk.* The Chemical Catalog Co., 1922. 72 pages. Price $2.50.

CATALYSIS, WITH SPECIAL REFERENCE TO NEWER THEORIES OF CHEMICAL ACTION. A general discussion held by the Faraday Society. Reprinted from the *Transactions* of the Faraday Society, vol. 17, 1922. 172 pages. Price $2.50.

Dr. Falk has taken the themes which would form the introductory and theoretical chapters of a larger textbook of Catalysis and has expanded them into a 170-page volume. He has profited by the intensified interest displayed in these last years in the mechanism of catalytic processes and has produced a brief volume which should be stimulating and provocative to all chemists, not alone those interested in catalytic processes. For, stripped of the romance which even the chemist sometimes clothes his science—and, in catalysis, hitherto, romanticism has been uppermost—catalysis in its essentials is seen to be a branch of ordinary everyday chemistry and chemical reactions.

Having essayed an earlier, if less successful, volume on chemical reactions, Dr. Falk inquires in the present work how far the theory of intermediate compounds is applicable alike to catalytic phenomena. His answer is given in Chapter III, which demonstrates the applicability of the theory to a number of examples. Many of the catalytic reactions of organic chemistry are the more understandable by reason of such a theory, more especially those occurring in homogeneous systems. The postulation of intermediate compounds in catalysis or the elucidation of the pathway of a simple chemical reaction is, however, no longer soul-satisfying. Energetics, sub-atomic phenomena and the activity of radiation are now all being probed, as Chapter IV and V show, for their contributions to the general theory of reactions.

Chapter VIII, on Contact Catalysis, should have preceded Chapters VI and VII, on Enzyme Actions and the Chemical Interpretations of Life Processes. The point of view now developing with respect to reactions at interfaces involving oriented adsorption (Hardy, Langmuir and others) or the association of catalysts with reactants to form temporary unstable complexes, specific in nature (Armstrong and Hilditch), will go far toward elucidating the more complex life processes. Only the fringes of the problem here have, as yet, been reached. An enormous amount of experimental work is needed, upon the basis of theories now outlined. In that work the problem of promoter action, for which Dr. Falk finds no theory as yet, will find its solution. Let us hope that the perusal of the volume will send yet more experimentalists into the field, that the outline here presented may be enlarged and developed.

The reprint of the general discussion on "Catalysis, With Special Reference to Newer Theories of Chemical Action," conducted by the Faraday Society in September, 1921, has an interest for a far wider chemical audience than that particularly engaged in catalytic work. It emphasizes anew the important influence which a numerically small society can exercise in the development of chemical science. It is a challenge to those who are at present busied with the problem of improving the service which the American Chemical Society renders to its members through its stated meetings. For here we have a record of a symposium admirably organized, with papers preprinted for the members desiring to attend so that useful discussion may be possible. The contributors to the symposium were acknowledged experts and from many lands, Perrin of France, Langmuir, Arrhenius, Lewis, Baly and others. The argument was concentrated on well-defined aspects of the particular problem, the radiation theory in the one hand and surface reactions on the other. The mind of the meeting was thereby directed to definite issues and vagueness and diffuse generalities were accordingly absent. The whole was carefully matured long months before the meeting took place, little being left to the hasty activities of last minute enterprise. The genius of the organizing secretary, F. S. Spiers, should be noted and his procedure emulated.

The volume extends the benefit of the discussion to a wider audience. Herein may be found complements to the outline discussion in Dr. Falk's book. The section on the radiation theory represents the most comprehensive statement of the theory yet put forward. Perrin's brilliant exposé of theoretical aspects of the problem is supplemented by Lewis' statements of attempted experimental verification. Baly summarizes the point of view which has led him to his recent work on photocatalytic processes such as the hydrogen-chlorine combination, the mechanism of carbohydrate and protein synthesis. The discussion contributed by Langmuir and Lindemann enables the reader to maintain a just perspective as to the merits and defects of the theory.

In the section devoted to Surface Reactions it was fitting that both contributions should be by Langmuir. Here will be found a general résumé of the subject and a detailed study of platinum catalysis of the oxidation of hydrogen and carbon monoxide. The point of view and the experimental method are both useful as models for much future work.

HUGH S. TAYLOR.

Recent Chemical & Metallurgical Patents

American Patents

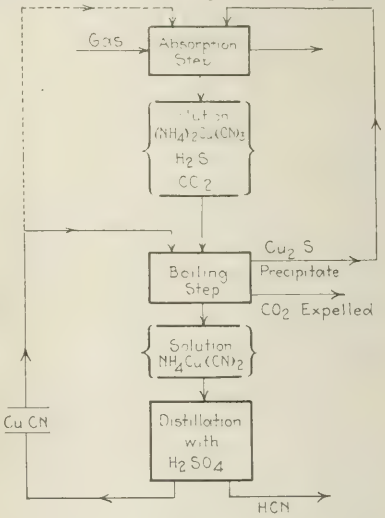
Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Oxidizing Olefines—A number of unusual products may be obtained by the oxidation of the hydrocarbons obtained in the cracking of petroleum distillates. Not long ago Professor James of the Carnegie Institute of Technology outlined a catalytic process for this oxidation which yielded, among other materials, a number of fatty acid products of very interesting properties. More recently Carleton Ellis, of Montclair, N. J., has been granted a patent for the oxidation of such or similar products by the use of nitric acid. As a raw material he uses the acid extract which may be obtained by dissolving the various olefine products in sulphuric acid, cooling and agitating to yield a solution of alkyl-hydrogen-sulphates or similar products. By treating this extract with nitric acid or with an oxygen-containing compound of nitrogen, various ketones and fatty acids are obtained. The process is not limited to the acid extracts, but is also applicable to the alcohols produced by the hydrolysis of such an acid extract. (1,418,368; assigned to Seth B. Hunt. June 6, 1922.)

Purifying Hydrogen — Hugh Scott Taylor and E. K. Rideal have developed a process for obtaining pure hydrogen by means of the well-known iron steam process. As used at present, the process produces hydrogen containing appreciable quantities of carbon monoxide and carbon dioxide, the latter of which impurities is easily removed. It is almost impossible, however, to remove the carbon monoxide by a simple process, and the authors showed in their researches that the proportion of steam increases in relation to the hydrogen present as the gases emerge from the iron retort during any single make period. (The make period is, of course, the period during which steam is allowed to flow through the hot iron.) During this same period the ratio of carbon monoxide to carbon dioxide decreases. Utilizing these two phenomena, the authors have developed what might be called a preferential combustion of the carbon monoxide to carbon dioxide by steaming the impure hydrogen. This changes the CO to CO_2. This process will have distinct advantage in industries where pure hydrogen is highly desirable, such as the hydrogenation of fats and oils. (1,411,760; April 4, 1922.)

Vulcanizing Caoutchouc—Clayton W. Bedford has patented the use of methylenediphenyldiamine as an accelerator in vulcanization. Combining this or another one of Schiff's bases with sulphur in the ratio of 198 to 64 gives a compound which he designates as the sulphur-nitrogen accelerator. This process is patented as well as the application to rubber. The producer also can be produced by using a solvent such as aniline with sulphur and methylene aniline. Still another form is being made by the use of methylene aniline (dipolymer) and sulphur alone. Vulcanization of a mix of 16 parts zinc oxide, 16 parts of rubber, 1 part of sulphur and 1 part of the accelerator takes about half the time required for vulcanization without the accelerator. In addition, a higher tensile strength, a higher modulus of elasticity and other properties are also claimed by the author. (1,418,772; June 6, 1922.)

Extraction of Cyanide From Gases—The object of these inventions is extraction of cyanides or hydrocyanic acid from gases in the form of alkaline cupro-cyanide and recovery as such or conversion to other cyanide compounds.



The scheme of operation for recovery of hydrocyanic acid is shown diagrammatically. The application of these reactions to the recovery of cyanides is obvious. (1,413,762 and -63; Max E. Mueller, of Youngstown, Ohio. April 25, 1922.)

Purification of Gases by Selective Oxidation—This process comprises the catalytic removal of catalyzer poisons from gases which are subsequently subjected to the action of catalysts. In this way the danger of poisoning or destroying the efficiency of catalysts is removed or substantially avoided.

The invention comprises the passing of the gases through a sorbent oxidizing catalyst at a low temperature, the gases being previously mixed with the necessary quantity of air or oxygen when the amount of impurities is large and when the amount is small, being without such admixture.

Among the objects of the invention is the removal of oxidizable gases such as carbon monoxide, from other oxidizable gases, such as hydrogen, in such gases as water gas or other gas mixtures and the removal of such impurities as arsine and phosphine from gases, such as acetylene, ammonia, or the like, to produce respectively pure hydrogen, acetylene, ammonia, etc., and to accomplish such removal at low temperatures. In other words, it might be said that one of the objects of the invention is to provide a process whereby combustible mixtures may be purified by selective oxidation of certain of the constituents.

It may be stated as a general rule that a mixture of metallic oxides consisting of two or more oxides, one being polyvalent and the other mono- or di-valent, will produce the desired oxidation, when properly prepared. The catalysts are active from the start even when operating at low temperatures. In other words, when the gases are brought in contact with the catalysts the oxidation begins at once.

The choice of the material to be used in any particular oxidation depends on the ease with which the oxidation takes place at the desired temperature, and the temperature at which the oxidation will take place will depend upon the quantity of the impurities in the gas and, to some extent, the humidity of the mixture.

The catalysts are prepared in the manner set out in the Patent 1,345,323, dated June 29, 1920, by J. C. W. Frazer and C. C. Scalione. These methods of preparation involve the initial preparation of the material in a very finely divided state, preferably by precipitation, substantially complete removal of the impurities, such as the excess of precipitant, collection of the material, thorough kneading in order to very intimately mix the constituents, formation into a more or less dense cake, and drying of the cake at low temperatures.

Specific examples of the preparation of a copper oxide catalyst and one composed of copper oxide or carbonate and manganese dioxide are given.

Other mixtures such as ferric oxide, manganese dioxide, bismuthic oxide and copper oxide may be used if properly prepared as indicated. (1,418,246; Joseph C. W. Frazer, Baltimore, Md., Arthur B. Lamb, Washington, D. C., and David R. Merrill, Newark, N. J. May 30, 1922.)

Coke-Oven Construction — The triangular flue oven which has been adopted in recent construction for the Koppers Co. installations is described by this patent. Claims for the improvement are increased flexibility in operation and adaptability of the oven for operation with either producer gas or coke-oven gas as the fuel. The invention also contemplates burning these fuel gases either with preheated air alone or with preheated air in an atmosphere containing large quantities of a neutral gaseous diluent which enables control of the combustion, even distribution of the heat over the entire heating wall area, and avoidance of the harmful effects of flame concentration. The structural advantages due to triangular instead of rectangular flues are also emphasized both from the standpoint of construction and operation of the oven. Features of con-

struction of the fuel gas, air and diluent-gas inlet and outlet valves are also covered in the description in some detail. (1,416,322; Joseph Becker, of Pittsburgh, Pa., assignor to the Koppers Co. of Pittsburgh, Pa.)

British Patents

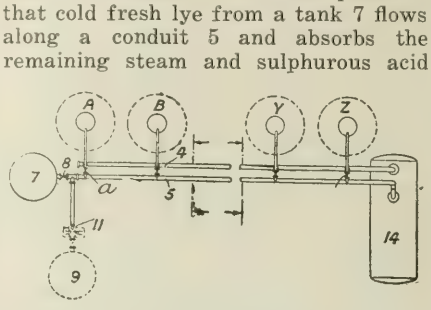
For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Vegetable Oil Extraction—The extraction of vegetable oils and fats by means of relatively low pressure is effected by humidifying the oleaginous matter before pressing so as to produce cellular exudation of the oil. The desired humidity may be obtained by exposing the material to steam or to atomized water until its weight has increased by 10 to 40 per cent. The pressing may be effected while the material is hot or cold, and one-tenth of the pressure employed in the usual process is sufficient. In the case of coconut oil and peanut oil pressures of 5 to 10 kg. per sq.cm. are suitable. (Br. Pat. 179,191; not yet accepted. Cellulose et Papiers Soc. de Richerches et d'Applications, Paris. June 28, 1922.)

Fertilizer From Waste Sulphite—A fertilizer is obtained by causing a reaction of waste sulphite lye from the manufacture of cellulose with matter adapted to bind the water of the lye. Quicklime or a mixture of quicklime and magnesia are suitable for the purpose. Hot concentrated lye is preferably used and peat dust may be added to the mixture. The product is ground for use, and fertilizing agents may be added either before or during grinding. (Br. Pat. 179,151; not yet accepted. Zellstoff-Fabrik Waldhof, Mannheim. June 28, 1922.)

Chromium Electrolysis—Alkali chromates are obtained by electrolysis of alkali carbonate solution with anodes of ferrochromium, and without a diaphragm. The chromate may be converted into bichromate by continued electrolysis after complete conversion of the carbonate. Concentrated solutions are preferably employed, so that the resulting chromate or bichromate solution is near the crystallizing point. To obtain neutral chromate, bichromate may first be formed and excess of alkali carbonate then added. Iron oxide is formed as a precipitate and is removed from time to time by agitation and filtration of the liquid or by centrifugal separation. The anodes may alternately consist of carbon chromite and tar heated below fusion to partially reduce the oxide of chromium. The cathodes may be of lead. Ferrochromium anodes should contain not less than 40 to 45 per cent of chromium. A high current density of some hundreds of amperes per square meter is employed so as to heat the electrolyte. Alternating current may be used. The electrolysis may be carried out in a series of baths between which the electrolyte circulates. (Br. Pat. 177,174; not yet accepted. A. J. B. Jouve and A. Helbronner, Paris. May 10, 1922.)

Sulphite Cellulose—In regenerating the waste heat and sulphurous acid from a system of sulphite cellulose boilers *A, B—Y, Z*, valves leading by conduit 4 to the tank 14 are opened and the pressure thus reduced to about 2 atmospheres. These valves are then closed and valves *a* and 8 are opened so that cold fresh lye from a tank 7 flows along a conduit 5 and absorbs the remaining steam and sulphurous acid



evolved by the boilers *A, B—Y, Z* and is collected in the tank 14, where it is finally saturated to the desired degree with sulphurous acid. The lye may run by gravity from the tank 7, or may be forced from a lower tank 9 by a pump 11. (Br. Pat. 179,150; not yet accepted. Zellstoff-Fabrik Waldhof, Mannheim. June 28, 1922.)

Magnesium Carbonate — Magnesium carbonate is prepared from dolomite by treating a suspension of the burnt dolomite in water or alkaline carbonate solution with carbon dioxide under ordinary, diminished or increased pressure, the proportion of burnt dolomite being so adjusted that "in the treatment the magnesia in the dolomite is always present as a deposit." In an example, 100 kg. of burnt dolomite are mixed with 1,500 liters of water, and treated with carbon dioxide under pressure. The mixture is filtered, and about 70 kg. of hydrated magnesium carbonate is obtained from the filtrate by heating. (Br. Pat. 176,785. T. Simon, Mark, Germany. May 3, 1922.)

Decomposing Leucite—Aluminum and potassium chlorides are separated from solutions of leucite in hydrochloric acid by the following cyclic process. A hot, highly saturated solution of leucite in hydrochloric acid is cooled to atmospheric temperature, when most of the potassium chloride crystallizes and is removed. The molten liquor is then treated with gaseous hydrochloric acid either by spraying the liquor into the gaseous hydrochloric acid or by passing the latter into the mother liquor. The aluminum chloride, which is thereby precipitated, is removed, and the mother liquor is used for treating fresh quantities of leucite. (Br. Pat. 176,770; not yet accepted. G. A. Blank, Rome. May 3, 1922.)

Treating Chromium Ores—Ores containing oxides of chromium are treated for the purification or concentration of the chromium constituent by submitting the ore to the action of a halogen or gaseous halogen acid, for example chlorine or hydrochloric acid, or a mixture thereof, with or without the addition of hydrogen, at such a temperature as to convert some of the constituents of the ore into volatile halogen derivatives. The temperature or the nature of the halogen atmosphere may be adjusted or varied so as to obtain selective distillation of the halogen derivatives; or two or more derivatives may be volatilized and collected together, or separately collected by fractional condensation or by absorption in a solvent for one or more of the constituents. For example, the iron may be volatilized from crushed and washed chromite by treatment at about 900 deg. C. with a mixture of hydrochloric acid and hydrogen, the chromium being afterward volatilized by raising the temperature to 1,200 deg. C. and passing chlorine over the residue; or the iron and chromium may be volatilized together by heating throughout at 1,200 deg. C. (Br. Pat. 176,729. W. H. Dyson, Ringwood, Normandy, and L. Aitchison, Birmingham. May 3, 1922.)

Loading Paper Pulp—The mineral salts, such as barium sulphate, used as filling for paper pulp, are maintained in suspension by the addition of water glass. Magnesium chloride solution or other salts, or acids, which precipitate the silica, may be used. Where mineral carbonates are used, their conversion into salts is preferred. (Br. Pat. 177,137; not yet accepted. F. Reichard, Berlin, May 10, 1922.)

Sulphur—Finely divided or colloidal sulphur is obtained by evaporation of ammonium polysulphide solution in presence of a protective colloid. Various protective colloids, or waste materials containing them, may be used, as for example saponines, gelatine, casein, sodium lysalbinate, waste sulphite liquor, naphthol pitch and glycerine foots. Evaporation of the solution may be accomplished in any convenient way; also, it may be continued until evolution of ammonia and hydrogen sulphide is complete, or the solution remaining after the removal of part of these gases may be neutralized with acid and then treated with an oxidizing agent, when the sulphur liberated from the hydrogen sulphide is also obtained in the colloidal state. In an example, a concentrated solution of ammonium polysulphide is run slowly into a boiling 0.5 per cent solution of soap. A white milk of sulphur is obtained. This may be removed from the solution, for example by the addition of an electrolyte, and the mass, after separating, may be reconverted into a stable sol by shaking with water. (Br. Pat. 117,103. Badische Anilin und Soda Fabrik, Ludwigshafen-on-Rhine. May 10, 1922.)

Litharge—Litharge is produced by the auto-oxidation of very finely divided lead. The lead is first powdered by putting lead balls into drums slowly revolving at, for example, 25 r.p.m. The oxidation is started by moisture or heat and then proceeds of itself; more lead power is added at a proper rate. The litharge can be converted into red lead according to known practice by heating in a furnace or pan at a temperature below 500 deg. C. (Br. Pat. 176,924. G. Shimadzu, Kyoto, Japan. May 10, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Montreal Program Promises Big Meeting for American Electrochemical Society

Many Attractions of Canadian City and Social Features Will Add to the Attraction of Strong Technical Program

FOLLOWING its customary agreeable practice of tempering a strong technical program with just the right amount of social and entertainment features, the American Electrochemical Society has completed plans for its Montreal meeting, Sept. 21 to 23. The Society headquarters will be at the Windsor Hotel, where registration will begin Wednesday evening, Sept. 20.

The Canadian city offers a number of attractions which aid in making it an ideal location for a convention of this kind. The drives about Montreal, in the Mountain Park, around Mount Royal and along the banks of the St. Lawrence and Ottawa rivers afford delightful views, unsurpassed in America. On Sherbrooke Street is one of the most beautiful buildings on the continent—the art gallery of the Art Association of Montreal. It has a splendid collection of paintings and sculptures. Within a stone's throw is also McGill University, with its magnificent buildings and campus. The Redpath Museum, one of the university buildings, is well worth a visit.

At Ste. Anne de Bellevue, 25 miles from Montreal and reached either by boat or train, is the Macdonald Agricultural College, built and equipped at a cost of over $5,000,000 and presented to McGill University.

The most interesting of all the old French buildings is the Chateau de Ramezay, named after Claude de Ramezay, the eleventh Governor of Montreal, who was born in France in 1657. The Chateau de Ramezay was built in 1705 as a mansion for the famous Baron de Longueuil.

There is one experience which no visitor should miss, and that is to "shoot" the famous Lachine rapids. These rapids are formed by the leaping of the St. Lawrence River over rocky ledges as the river descends swiftly to the level of the Montreal harbor.

Social Features

The Kanawaki and the Royal Montreal (Dixie) Golf clubs will afford golf enthusiasts an opportunity to compete for the Society championship. On Friday evening an old-fashioned smoker will be given by the local committee at the Windsor Hotel.

The visiting ladies will be entertained by sightseeing trips, theater parties and teas at the golf clubs. On Thursday evening the ladies will attend a lecture by Prof. A. S. Eve on "The New Philosophy of Physics" at McGill University.

Local members of the Society of Chemical Industry, Engineering Institute of Canada, Canadian Institute of Mining and Metallurgy, the faculty staff of McGill University and of Montreal University (Ecole Polytechnique) are cordially invited to attend the meetings and entertainments.

Excursions

There will be a special private train to Shawinigan Falls, leaving Windsor Station Friday at 11.30 at night, arriving at Shawinigan Falls at 7.30 a.m. The members will have a rare opportunity to inspect the following industrial plants: Belgian Industrial Co., Canada Carbide Co., Canadian Carborundum Co., Laurentide Power Co., Laurentide Pulp & Paper Co., and the Shawinigan Water & Power Co.

Opportunity will also be afforded for visitors to inspect the numerous industrial establishments in the vicinity of Montreal, including the St. Lawrence Sugar Refinery Co., Canada Cement Co., Imperial Oil Co., Dominion Engineering Works and the C. P. R. Angus shops.

The technical sessions on Thursday and Friday will be held in the Auditorium of the Windsor Hotel. The program follows in full:

Thursday, Sept. 21

10 a.m. Session for Reading and Discussion of Papers.

Norman B. Pilling: Effect of Heat-Treatment on the Hardness and Microstructure of Electrolytically Deposited Iron.

R. P. Neville and J. R. Cain: The Preparation and the Mechanical Properties of Vacuum-Fused Alloys of Electrolytic Iron With Carbon and Manganese.

Ralph B. Abrams: The De-zincification of Brass.

Walter G. Traub: Electroplated Zinc and the Diffusion of Electrodeposits Into Zinc.

John T. Ellsworth: The Effect of Single Impurities on the Deposition of Zinc From Sulphate Solutions.

M. R. Thompson and C. T. Thomas: The Effect of Impurities in Nickel Salts Used for Electrodeposition.

Ernest A. Vuilleumier: The Application of the Contractometer to the Study of Nickel Deposition.

12:45 p.m. Adjournment.

1 p.m. Meeting of board of directors at luncheon, Windsor Hotel.

2 p.m. Session devoted to papers and discussion on "Industrial Heating"; Bradley Stoughton, chairman, Electrothermic Division.

Charles P. Steinmetz: The Underlying Principles of the Industrial Heating Problem.

E. F. Collins: Electric Heat; Its Generation, Propagation and Application to Industrial Processes.

E. J. Smalley: Principles of High-Temperature Furnace Design.

Wirt S. Scott: Advantages of Industrial Electric Heating.

M. A. Hunter and A. Jones: Some Electrical Properties of Alloys at High Temperatures.

C. E. Williams: Resistivities of Some Granular Resistor Carbons.

J. C. Woodson: Heat-Insulating Materials for Electric Heating Apparatus.

Friday, Sept. 22.

9:30 a.m. Session on "Industrial Heating"; Part II.

Frank W. Brooke: Methods of Economically Handling Materials in Electric Furnaces.

Wirt S. Scott: The Development of Industrial Electric Heating for Low-Temperature Enameling.

E. T. Smalley: Treatment of Ceramics.

(Continued on page 519)

English Engineering Societies Form Joint Council

It is announced that proposals for closer co-operation among the leading English engineering institutions, which have recently been under consideration, have now received the approval of the institutions whose representatives met in conference—namely, the Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Naval Architects and Institution of Electrical Engineers—and that an Engineering Joint Council composed of representatives of these bodies has been formed.

The objects of the Joint Council will be, among others, to improve the status of engineers, to obtain the better utilization of their services in the country's interests and the appointment of properly qualified individuals to responsible engineering positions, and to prevent the unnecessary duplication of activities. At a later stage the number of bodies represented on the Joint Council may be increased.

Government Begins Chemical Foundation Suit

Equity Proceedings to Be Conducted in Delaware—List of Preferred Stockholders Numbers 158 Firms

ANNOUNCEMENT by Attorney-General Daugherty that the government's suit against the Chemical Foundation will be filed within the week was made Aug. 29. The original intention of bringing the suit in the District of Columbia has been abandoned and the equity proceedings will be started in Delaware, the state in which the Foundation was incorporated.

For the present, the American industry centers in the Chemical Foundation, which acts as trustee for American manufacturers whom it licenses. Its opponents charge that it obtained patents worth millions for $250,000. The Foundation asserts that this opposition comes from the former German owners of the patents who themselves wish to profit at the expense of the American industry, whose upbuilding is vital to national defense and whose development is resulting in cheaper prices for dyes and chemicals.

Finances of the Foundation

Capitalized at $500,000, the Chemical Foundation has 4,000 shares of preferred and 1,000 shares of common, par value $100 each. Both issues are restricted to 6 per cent dividends out of earnings which, in their option, the Foundation's trustees may distribute. Surplus must be used for educational work. To date no dividends have been paid. Preferred stock is retirable at the option of the trustees. It has no vote. It represents what thus amounts to a voluntary and practically complimentary advance to assure the early financing of the Foundation's activities, or cash-down ambition of American business to further develop a new industry in the experimental stages of which hundreds of millions have been invested.

Any qualified manufacturer may receive a license from the Chemical Foundation. Payment for the privilege is made in royalties ranging from 5 per cent down. Materials for the government may be manufactured without royalty. In the 3 years of its existence, the Foundation has shown a deficit of over $200,000, accounted for by expenditures of $260,000 in publicity and educational work. In the same period the United States Treasury has received $356,090 in royalties from thirty-five licensees of sixty licensed patents granted by the Federal Trade Commission. The Foundation has entered suit to recover this amount.

The Chemical Foundation holds 5,068 patents, 873 trademarks, 492 copyrights, 55 contracts and 22 applications, for which it paid $271,850.

List of Stockholders

The complete list of preferred stockholders of the Chemical Foundation follow, published now for the first time, follows:

Abbott Laboratories, Chicago, $800; Althouse Chemical Co., Reading, Pa., $400; Aluminum Co. of America, Pittsburgh, $800; American Aniline Products, Inc., New York, $800; American Cellulose & Chemical Manufacturing Co., Ltd., New York, $800; American Chemical Society, New York, $800; American Cotton Oil Co., New York, $800; American Platinum Works, Newark, N. J., $800; American Printing Co., New York, $800; Aniline Dye & Chemical Co., Inc., New York, $800; Arnold Print Works, North Adams, Mass., $800; Armour Fertilizer Works, Chicago, $800; Aspinook Co., Jewett City, Conn., $800; Atlantic Dyestuffs Co., Boston, $400; F. E. Atteaux, Boston, Mass., $800; Ault & Wilborg Co., Cincinnati, $3,100.

H. J. Baker & Bros., New York, $800; Baker & Co., Inc., Newark, N. J., $800; George A. Ball, Muncie, Ind., $800; Joseph Bancroft Sons Co., Wilmington, Del., $800; The Barrett Co., New York, $6,500; The Bayer & Co., Inc., New York, $800; Bethlehem Steel Co., Bethlehem, Pa., $800; C. Bischoff & Co., New York, $800; Borne, Scrymser & Co., New York, $800; H. Bowker Chemical Manufacturing Co., Philadelphia, $800; Bronx Co., New York, $800; Brown & Co., Portland, Me., $800; Butterworth Judson Corp., New York, $6,500.

John Campbell & Co., New York, $3,100; Capudini Chemical Company, Raleigh, N. C., $400; Chemical Dyestuffs & Chemical Co., Newark, N. J., $7,200; Antonin Chapel (Catskill Chemical Co.), Brooklyn, $800; Cheney Brothers, South Manchester, Conn., $800; Citro Chemical Co., Maywood, N. J., $400; B. P. Clapp Ammonia Co., New York, $400; R. H. Comey Co., Brooklyn, $800; Commercial Research Co., New York, $800; Commonwealth Chemical Corp., New York, $400; Consolidated Color & Chemical Co., New York, $6,500; Contact Process Co., Buffalo, $800; Crocker Burbank & Co., Fitchburg, Mass., $800; Samuel A. Crozer & Son, Upland, Pa., $800.

Davison Chemical Co., New York, $800; John C. Dehls, Newark, N. J., $800; Dermatological Research Laboratories, Philadelphia, $800; Detroit Chemical Works, Detroit, Mich., $400; Diamond Alkali Co., Pittsburgh, Pa., $800; Dicks-David Co., Inc., New York, $400; Digestive Fermints Co., Detroit, Mich., $400; John V. N. Dorr, New York, $800; Dow Chemical Co., Midland, Mich., $1,500; E. I. du Pont de Nemours & Co., Wilmington, Del., $84,100; Durex Chemical Co., New York, $400; Winthrop C. Durfee, Boston, $800; Dye Products & Chemical Co., Inc., New York, $400.

Eastern Drug Co., Boston, $800; Electric Boat Co., New York, $800; Electro Bleaching Gas Co., New York, $800; Charles Engelhard, New York, $800; The Essenkay Products Co., Chicago, Ill., $800; Essex Aniline Works, Inc., Boston, $500.

General Bakelite Co., New York, $800; General Ceramics Co., New York, $800; General Chemical Co., New York, $33,500; General Electric Co., Schenectady, N. Y., $800; Genesee Pure Food Co., Le Roy, N. Y., $800; George L. Gilmore, Lexington, Mass., $800; The Grasselli Chemical Co., Cleveland, $20,000.

Harovia Chemical & Manufacturing Co., Newark, N. J., $800; Hardwick & Magee Co., Philadelphia, $800; The Heller & Merz Co., Newark, N. J., $13,200; Hercules Powder Co., Wilmington, Del., $800; Herf & Frerichs Chemical Co., St. Louis, $800; Hess Goldsmith & Co., Inc., New York, $800; Heyden Chemical Works, Garfield, N. J., $800; Hooker Electro Chemical Co., New York, $6,500.

Irvington Smelting & Refining Works, New York, $800; Isco Chemical Co., New York, $800.

Johnson & Johnson, New Brunswick, N. J., $800.

Kelly-Springfield Tire Co., New York, $800; E. C. Klipstein & Sons Co., New York, $800; Walter E. Knipe & Sons, Philadelphia, $800.

La Belle Iron Works, Steubenville, Ohio, $800; Lackawanna Steel Co., Lackawanna, N. Y., $800; Lehn & Fink, Inc., New York, $800; Lewiston Bleachery & Dye Works, Boston, $800; Eli Lilly Co., Indianapolis, $800; Lindsay Light Co., Chicago, $800; Lonsdale Co., Providence, $800; Lowell Bleachery, Lowell, Mass., $800; John Lucas & Co., Inc., Philadelphia, $800.

Mallinckrodt Chemical Works, New York, $800; Marden, Orth & Hastings (Calco Chemical Co.), Bound Brook, N. J., $33,500; Francis T. Maxwell, Rockville, Conn., $800; McKesson & Robbins, New York, $400; Merck & Co., New York, $6,500; William S. Merrill Co., Cincinnati, $400; Merrimac Chemical Co., Boston, $11,900; Metals Disintegrating Co., Inc., New York, $400; H. A. Metz Laboratories, Inc., New York, $6,500; Millville Manufacturing Co., Philadelphia, $800; Monroe Drug Co., Quincy, Ill., $400; Monsanto Chemical Works, St. Louis, $800; George H. Morrill Co., Norwood, Mass., $400; Mt. Hope Finishing Co., North Dighton, Mass., $800; Mutual Chemical Co. of America, New York, $800.

National Ammonia Co., St. Louis, $800; National Aniline & Chemical Co., New York, $25,100; National Electrolytic Co., Niagara Falls, $800; National Silk Dyeing Co., Paterson, N. J., $800; The Naugatuck Chemical Co., Naugatuck, Conn., $800; New Bedford & Agawam Finishing Co., East Wareham, Mass., $400; The Newport Co., Milwaukee, $13,200; Niagara Alkali Co., Niagara Falls, $800; Niagara Electro Chemical Co., Niagara, $400.

Ohio Chemical & Manufacturing Co., Cleveland, $800.

Pacific Mills, Boston, $800; Parke, Davis & Co., Detroit, $800; Joseph E. Patchett, Keyser, W. Va., $800; Peerless Colors Co., Inc., Bound Brook, N. J., $800; Pennsylvania Salt Manufacturing Co., Philadelphia, $800; Permutit Co., New York, $800; Perth Amboy Chemical Works, Perth Amboy, N. J., $400; Charles Pfizer & Co., Inc., New York, $800; Philadelphia Textile Machine Co., Philadelphia, $800; Philadelphia Tapestry Mills, Philadelphia, $800; Powers, Weightman & Rosengarten Co., Philadelphia, $800.

The Rector Chemical Co., New York, $400; Republic Iron & Steel Co., Youngstown, Ohio, $800; Rhodia Chemical Co., New York, $800; The Roessler & Hasslacher Chemical Co., New York, $800.

Sayles Finishing Plants, Saylesville, R. I., $800; Schieffelin & Co., New York, $400; Solvay Process Co., Syracuse, $800; Semet Solvay Co., Syracuse, $6,500; Sherwin-Williams Co., Cleveland, $3,100; Frederick Stearns & Co., Detroit, $400; J. L. Stifel & Sons, Wheeling, W. Va., $800; E. R. Squibb & Sons, New York, $800.

Tartar Chemical Works (Royal Baking Powder Co.), New York, $400; Toch Brothers, New York, $400.

Union Carbide & Carbon Co., New York, $800; Union Bleaching & Finishing Co., Greenville, S. C., $800; United Drug Co., Boston, $800; United Piece Dye Works, Lodia, N. J., $800; United States Color & Chemical Co., Boston, $1,800; United States Finishing Co., New York, $800; United States Industrial Alcohol Co., New York, $800; The Upjohn Co., Kalamazoo, Mich., $800.

The Viscoloid Co., Leominster, Mass., $800.

George J. Wallau, New York, $800; The Wanskuck Co., Providence, $800; West Virginia Pulp & Paper Co., New York, $800; Western Electric Co., Inc., New York, $800; Jacques Wolfe Co., Passaic, N. J., $800.

Youngstown Sheet & Tube Co., Youngstown, Ohio, $800.

Zinsser & Co., Hastings, N. Y., $800.

Preferred Shares Have No Vote

Holders of preferred shares have no vote. The entire voting control is confined to the common stock, which is in trustees' hands.

These trustees are Otto T. Bannard, chairman of the New York Trust Co.; George L. Ingraham, former presiding justice of the Appellate Division of the Supreme Court of New York; Cleveland H. Dodge of New York; B. Howell Griswold, Jr., of Alexander Brown & Co., Baltimore, and Bradley W. Palmer of Boston. The trusteeship extends until 1936, by which time all patents will have expired.

Make Rapid Progress on Tariff

Conferees Postpone Controversial Points Until Last—Changes in Rates Not Announced but Expected in Chemical Schedule

DRIVING at top speed, Republican conferees on the tariff bill have considered and tentatively agreed upon more than half of the amendments to rates which were made by the Senate. Working 7 hours daily and with prospects of night sessions, the conferees have declared that their report will be submitted to Congress by the middle of September.

In making this record of speed, however, the conferees have passed over until the last all highly controversial points in the measure. The question of the basis of valuation to be used in determining ad valorem rates will not be taken up until the rest of the bill has been disposed of. The House used American valuation as its basis—the value of a comparable American article. The Senate used foreign valuation, which has been the basis of all previous tariff measures. In proceeding with discussion of rates, the conferees are using the Senate basis of foreign valuation, but with experts of the Tariff Commission keeping a parallel column translating such duties into terms of the American wholesale selling price of the imported article. This is the so-called Burgess plan, suggested by William Burgess, now a member of the Tarriff Commission, and which was considered and rejected by the Senate Finance Committee when the bill first came from the House more than a year ago. If this plan finally were adopted by the conferees, it would change every ad valorem rate in the bill—and ad valorem rates constitute about 22 per cent of all rates in the bill—and would destroy any accurate basis of comparison with previous tariff laws.

When the House of Representatives debated the rule under which the tariff bill was sent to conference on Aug. 22, an opportunity was given to the leaders on each side of the aisle to express their opinions as to the merits of the measure.

Political Situation

It was predicted freely on the Democratic side that it is the intention of the Republicans to keep the bill in conference until after the election. As long as the bill is in conference, it is contended, a candidate for office can go before the people and promise a favorable outcome in conference on questions where his constituents want to see higher rates and predict the modification in conference of rates which would be hard to defend.

Republican members did not deny that the bill would be held in conference until after the election and it was charged that Democratic campaign members have arranged for price advances on a large number of articles for which increased duties are being provided. If the bill is brought out just prior to the election it was charged that the Democrats have an understanding with importers to advance certain prices arbitrarily with the idea of influencing votes. This would be made possible, it was stated, by the relationship between importers and retailers.

On the other hand, it was contended that the Republicans were afraid to go before the country after having written ridiculously high rates in the law. Emphasis was placed upon assertions that Republicans are divided as never before on the matter of tariff rates. It was stated that many of the great manufacturing interests oppose high rates on the ground that they restrict their foreign market. In addition large loans have been made abroad and it was asserted that American financiers realize that repayment depends to some extent at least on sales made to the United States. One speaker urged the Republicans to bury their tariff bill. "There is already reaction against it," he said. "What we need is not new barriers, new obstacles, new difficulties, but the opening and broadening of the channels of communication between the peoples of the earth."

The Republican answer to that argument was that America's high place in the world as an economic power is the result of the application for over 100 years of the policy of taxing foreign producers for the privilege of selling their products in our markets.

Proceedings Secret

Nothing as to definite agreements on rates is being given out by the Republican conferees. The Democratic conferees are excluded from the sessions and no meetings are being held with reporters, as was done during conference on the tax bill.

Senator McCumber, however, has stated definitely that in the chemical schedule the conferees passed over coal-tar products, rates on which were increased heavily in the Senate by the Bursum amendment, raising the figures and placing them on the basis of American valuation. He also stated that white arsenic, on which the House placed a duty of 25 per cent and the Senate Finance Committee recommended 2 cents per pound but which was placed on the free list by vote of the Senate, had been passed over. It is expected that in the cotton schedule, the additional duty of 4 per cent imposed by the Senate upon yarns and cloths treated with vat dyes will be passed over until the dye rates in the chemical schedule are determined.

While no authoritative information has been given out by the conferees, it is the general understanding in the corridors of both houses of Congress that the conferees have made some reductions in the chemical schedule and in the metals schedule, the latter being in manufactured articles. The cutlery rates were passed over, it is understood.

Expect Fight on Dyes

When the conferees take up the coal-tar rates in the chemical schedule, a vigorous contest is expected. Senator Smoot is opposed to anything like the rates imposed by the Bursum amendment. Somewhat significant of the fight he proposes to wage in the conference was the fact that on the day the bill passed the Senate the Utah Senator obtained adoption of an amendment to the flexible tariff provision of the administrative section which would empower the President to make effective a change in rates of coal-tar products on 15 days' notice, whereas 60 days' notice is required before changes on any other products shall go into effect.

On the other hand, Senator McCumber heartily favors the high rates of the Bursum amendment, and Senator McLean, the third Senate conferee of the Republicans, voted for the high rates and is an ardent protectionist.

Of the House conferees, Representative Fordney, chairman of the Ways and Means Committee, while advocating high rates for dyes and chemicals, has indicated that he believes the Bursum rates "rather high." Mr. Fordney opposed the dye embargo, which was rejected by the House. Representative Longworth favored an embargo and it is believed that he will advocate very high rates of duty on dyes and chemicals. Representative Green of Iowa is rather an unknown quantity in this particular case and it is believed that his attitude largely will determine the issue.

Republican leaders in both House and Senate predict that the new tariff bill will be on the statute books by Oct. 1.

Alpha Chi Sigma Dinner

The dinner of Alpha Chi Sigma, the professional chemical fraternity, which is scheduled for Thursday evening, Sept. 14, at Keen's Chop House, New York City, will be mainly an informal get-together, and the main efforts will be directed toward giving everybody a pleasant evening. No formal talks have been arranged, and it is the arrangement committee's intention to allow the meeting to proceed spontaneously.

The one matter of importance that is to be considered at any length is the fraternity's plan for organizing the alumni members. At present, the strength and enthusiasm of the fraternity is centered in the undergraduate chapters, where there is little real necessity for it. The fraternity has already launched plans to extend the active organization to include graduates and active chemists all over the country, so that Alpha Chi Sigma will more truly rank as a professional fraternity.

Photographic Society Appoints Committees

Steps Taken to Assure Success of Exhibition and Meeting—Chamot Speaks

In connection with the activities of the Technical Photographic and Microscopical Society, which is planning an exhibit and meeting at the Chemical Exposition, a meeting of a number of the active members and officers was called for Aug. 30 at the Chemists' Club in New York. T. J. Keenan, secretary of the society, emphasized the fact that in view of vacancies on the executive committee, there was need of a temporary committee to carry out the details of the program. The following committee was appointed to conduct the affairs of the society in connection with the exposition and annual meeting, when the personnel of the executive committee will be completed: E. R. Morton, chairman, D. S. Mungillo, J. A. Lucas, D. G. Woolf, J. A. Scheick and J. Gibbs. This committee will work in co-operation with the society's exhibition committee, of which A. E. Buchanan is chairman.

A nominating committee was also appointed, consisting of M. W. Cohen, A. E. Buchanan and P. F. Wehmer. Names of the nominees will be presented to the annual meeting of the society at the Grand Central Palace on Sept. 14.

PROF. CHAMOT'S INTERESTING TALK

An interesting talk was delivered by Prof. E. M. Chamot of Cornell University at this meeting, in which the well-known microscopist pointed out some of the things that he hopes the society will accomplish. The speaker mentioned the need for specially designed instruments for industrial microscopical work. The needs of the biologist and bateriologist do not coincide with those of the industrial microscopist, he said, yet the design of standard equipment is entirely dominated by the demands of the former because it is a well-established demand. By the concerted efforts of industrial workers it may be possible to convince instrument makers that there is a field for special apparatus that is worth their attention and thus eliminate the necessity of giving this business to foreign instrument makers.

Dr. Chamot expressed the hope that the society will be able to combat the misguided secrecy that surrounds so many industrial establishments. The war, he said, did much to break down this traditional attitude of mysticism that some firms assume with the idea of keeping their professional secrets from competitors. The technical societies can do a great deal to show proponents of this obsolete idea what a short-sighted policy it really is and how much better work would be done by the employees if a company would encourage their mixing with their coworkers from other organizations and freely interchanging ideas.

Manufacturing Chemists' Association Will Aid DeLong

The executive committee of the Manufacturing Chemists' Association will serve as an advisory committee to the Chemical Commodity Division of the Department of Commerce. This committee will make a survey of the situation and will submit recommendations to Secretary of Commerce Hoover as to how the division can be most useful to the chemical industries. This arrangement was worked out at a conference in which the following participated: Secretary Hoover; Julius Klein, director Bureau of Foreign and Domestic Commerce; C. R. DeLong, chief of the Chemical Commodity Division; Henry Howard, chairman of the executive committee Manufacturing Chemists' Association; S. W. Wilder, Merrimac Chemical Co.; Robert T. Baldwin, National Aniline & Chemical Corporation; Gilbert Currie, Dow Chemical Co.; M. R. Kienle, Mathieson Alkali Co., and John Tierney, Washington representative of the Manufacturing Chemists' Association.

The executive committee of the Manufacturing Chemists' Association will meet Sept. 20 to formulate the recommendations that will be submitted to Secretary Hoover.

Prominent Speakers at Chemical Show

Government Representatives to Discuss Live Subjects During Exposition

Acting Secretary of War J. M. Wainwright has accepted an invitation to address the opening meeting of the National Exposition of Chemical Industries on Monday evening, Sept. 11, at 8 p.m. The title of his address will be "The Relation of the Chemical Industry to National Defense."

Another speaker that will attract many is Wayne B. Wheeler, counsel for the Anti-Saloon League, who speaks on Monday evening, Sept. 11, at 8 o'clock on "The Attitude of the Anti-Saloon League Toward Industrial Alcohol." One of the most vital subjects in the chemical industry today, a discussion of the alcohol question by so eminent an authority as Wheeler will undoubtedly bring out the local chemical, drug, flavoring extract, perfume and allied consuming industries en masse.

On the same evening C. P. Smith, Assistant Commissioner of U. S. Internal Revenue, will fully discuss the subject of industrial alcohol by reviewing the government's regulations upon this commodity.

The Chemical Division of the U. S. Department of Commerce will be represented, with the Bureau of Mines and the Bureau of Chemistry. C. R. DeLong of the Department of Commerce will speak on Sept. 12 at 8 p.m. on "How the Department of Commerce Can Serve the Chemical Industry."

Brigadier-General Amos A. Fries, Chief of the Chemical Warfare Service of the U. S. Army, will attend the exposition and speak on Tuesday evening, Sept. 12, taking for his topic the peace time application of chemical warfare gases in the extermination of forest and farm pests, with comment on other uses of these toxic gases.

Separate auditoriums for the motion picture program and for the speakers at the 1922 Chemical Exposition are to be built on the fourth floor of the Grand Central Palace. Owing to the big program this year, it has been deemed advisable to double the auditorium facilities, separating the motion pictures from the balance of the program.

The standardization program of the 1922 Chemical Exposition, composed of a number of addresses on standardization by well-known authorities, will be held on Friday, Sept. 15, under the direction of the New York Section of the American Chemical Society. Dr. Martin H. Ittner will act as chairman.

Excellent Program for Ceramic Meeting

American Ceramic Society Plans "Ceramic Day" at Chemical Exposition

The American Ceramic Society has provided the program for one of the days during exposition week known as Ceramic Day. This will be on Friday, Sept. 15. President Frank H. Riddle will appear on the opening program of the exposition with the presidents of other technical societies. E. P. Poste and Ross C. Purdy will appear on the special program on "Specifications." Mr. Poste will discuss specifications for enameled chemical ware and Mr. Purdy will describe the problems in writing specifications for refractories.

The partial program follows:

High-Temperature Cements, by W. H. Gaylord, Jr., Quigley Furnace Specialties Co.

Application of Magnetic Separator in Ceramic Industries, by E. S. Hirschberg, Dings Magnetic Separator Co.

Preparation of Clays and Minerals for Ceramic Purposes, by G. D. Dickey, chemist, Industrial Filtration Corporation.

Apparatus for Quickly Determining Fineness of Grind, by Eric Turner, Trenton Flint & Spar Co.

Feldspar Colloquium: W. H. Landers, George M. Darby, O. O. Bowman, 2nd, V. A. Staudt, C. R. Moore, C. M. Franzheim and others.

Manufacture of Gray Enameled Ware, by H. C. Arnold.

Whiting for Ceramic Uses, by A. E. Williams.

Gas Producers for Glass Works, by C. B. Chapman, Chapman Engineering Co.

Witchery of Glazes, by Paul E. Cox.

Architectural Faience and Its Artistic Possibilities, by Conrad Dressler.

Organization of a Decorative Ceramic Research Department; Financial and Manufacturing Considerations, by Frederick H. Rhead.

Electrochemical Society Program

(Continued from page 515)

C. B. Gibson: Electric Annealing of Malleable Iron.

P. S. Gregory: Electric Steam Generators and Their Application.

J. Murray Weed: A New Type of Induction Furnace.

A. Glynne Lobley: A Simple Electric Crucible Furnace for Melting Aluminum.

2 p.m. Reading and Discussion of Papers.

A. E. R. Westman: The Relation Between Current, Voltage and the Length of Carbon Arcs.

George A. Richter: Manufacture of Carbon Bisulphide.

O. C. Ralston: Electrosmosis and Electrophoresis. Two Definitions.

Alexander Lowy and Catherine M. Moore: Electrolytic Oxidation of Isoeugenol.

Alexander Lowy and Henry S. Frank: Electrolytic and Chemical Chlorination of Benzene.

C. W. Vinal and L. M. Ritchie: A New Method for Determining the Rate of Sulphation of Storage Battery Plates.

F. C. Mathers and Jacob W. H. Aldred: Preparation of Perchlorates by Heating Chlorates.

H. C. P. Weber: Changes in the Electrical Conductivity of Varnishes During Drying.

C. J. Rodman: Arc Action on Some Liquid Insulating Compounds.

S. F. Howard and T. A. Martin: The Difference Between the Half Sum and the Square Root of the Product When Weighing by the Method of Gauss.

The excursion train to Shawinigan Falls leaves Montreal at 11:30 p.m. and will return Saturday evening in ample time to permit members wishing to make connections for all through night trains home.

A.I.C.E. to Banquet During Exposition Week

The American Institute of Chemical Engineers will hold its usual banquet during exposition week on Thursday, Sept. 14, at the Hotel Pennsylvania at 6.30 p.m. This dinner has become quite a feature of exposition week and Institute members make plans to visit the exposition so as to be there at that time. Ladies are invited to attend the dinner.

Reservations may be made by writing to the secretary, Dr. J. C. Olsen, the Polytechnic Institute, Brooklyn. They may also be made at the desk of the Chemists' Club and at the *Chem. & Met.* booth (No. 42) at the Chemical Exposition, which will be used as the headquarters of the Institute. Those desiring to attend are urged to make reservation beforehand if possible.

Chemical Exposition Exhibitors Requested to File Catalogs

Under the direction of W. T. Read of the department of chemistry, Yale University, students in the industrial and engineering chemistry course will spend the week of Sept. 11 at the Chemical Exposition in Grand Central Palace, New York. This is the third successive year that Professor Read has brought his students to the exposition. As the supply of catalogs in his department is now out of date, he requests that exhibitors file with the exposition management ten copies of their catalogs and trade literature for the use of his students. The catalogs will not only be used at the exposition but will be filed in the library of the chemical department at Yale University.

Personal

C. C. Concannon, a Harvard chemist of the class of 1911, has been appointed assistant chief of the Chemical Division, Bureau of Foreign and Domestic Commerce. Mr. Concannon since 1916 has been connected with Takamine, Inc., and is thoroughly experienced in the details of chemical importing and exporting.

Prof. Robert T. Haslam has been appointed director of the research laboratory of applied chemistry, Massachusetts Institute of Technology, to succeed Robert E. Wilson, who has resigned. Professor Haslam has been for some time in charge of the Institute's school of chemical engineering practice.

Dr. Simon Klosky has accepted an appointment as instructor at the Martin Maloney Chemical Laboratory of the Catholic University of America. Dr. Klosky served overseas as First Lieutenant in the Air Service during the World War and is now with the research department of Edgewood Arsenal, Chemical Warfare Service.

Walter B. Land has been appointed geologic aid to take the place of H. W. Hoots in the work on Texas potash. Mr. Lang will be in the chemical laboratory of the U. S. Geological Survey for a short time prior to taking up the work in Texas.

George Walker, formerly of the Dorr Co., is now with the Grasselli Chemical Co., Cleveland, Ohio, in the research department.

Dr. George B. Waterhouse, for the past 16 years connected with the Lackawanna Steel Co., Buffalo, N. Y., has accepted the appointment as head of the department of metallurgy at the Massachusetts Institute of Technology, Boston, Mass. He will assume his new duties at the beginning of the college year this fall. Dr. Waterhouse succeeds Prof. H. O. Hofman, who resigned last June as head of the department at the Boston institution, after many years of service.

Thomas H. Wickenden and Charles McKnight, Jr., have recently joined the development and research department of the International Nickel Co., New York City, to undertake development work in connection with alloy steels. Mr. Wickenden was for many years associated with the Studebaker Corporation as engineer in charge at its South Bend plant, and more recently associated with the Zeder-Skelton-Breer Engineering Co. in a consulting capacity. Mr. McKnight was formerly works manager of the Carbon Steel Co. and engaged for many years in the production of alloy steels.

Robert E. Wilson has resigned as director of the research laboratory of applied chemistry, Massachusetts Institute of Technology, to accept a position on the research staff of the Standard Oil Co. of Indiana.

The American Society for Steel Treating has elected the following new officers: President, T. D. Lynch, research engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; second vice-president, W. S. Bidle, president, W. S. Bidle Co., Cleveland, Ohio; secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio; director, S. M. Havens, assistant treasurer and manager, Ingalls-Shepard Division, Wyman Gordon Co., Harvey, Ill. The board of directors of the American Society for Steel Treating will be composed of the newly elected officiers and the following: First vice-president, R. J. Allen, metallurgist, Rolls-Royce Co. of America, Springfield, Mass.; treasurer, J. V. Emmons, metallurgist, Cleveland Twist Drill Co., Cleveland, Ohio; director, J. J. Crowe, metallurgist, Philadelphia Navy Yard, Philadelphia, Pa.; director, A. E. White, past president, director engineering research, University of Michigan, Ann Arbor, Mich.; director, F. P. Gilligan, past president, secretary-treasurer, Henry Souther Engineering Co., Hartford, Conn. The new officers will begin their duties at the close of the annual convention of the society, which will be held at Detroit Oct. 2 to 7 at the same time as the International Steel Exposition.

Obituary

T. R. L. Loud, vice-president and general manager of the New York Quinine & Chemical Works, Inc., New York, died Aug. 19, as the result of an automobile accident near Trenton, N. J., while en route to Atlantic City. He was associated with the chemical and drug industries for the past 50 years, and at one time was connected with the Mallinckrodt Chemical Works, St. Louis, and later with the Herf & Frerichs Chemical Co. of the same city. He was 64 years of age at the time of his death.

Paul F. McGovern, New York manager for the General Alloys Co. and for years the representative of the Quigley Furnace Specialties Co., died almost instantly from an acute heart attack, Aug. 12, 1922.

Charles Scott, Jr., of Philadelphia, vice-president of the Giant Portland Cement Co. and a director of the Railway Steel Spring Co., died at Glouces-ter, Mass., Aug. 21.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

The Outlook for Better Business

A Survey of Fundamental Economic Conditions Indicates That Once Present Difficulties Are Surmounted, Substantial Business Revival Is Assured

ANY REVIEWER of bu iness conditions must be impressed by the fact that two well-defined, but distinctly opposing, forces are largely responsible for the present situation. His problem in properly evaluating these forces must necessarily involve a consideration of whether their effects are temporary and subject to change either for better or worse or are the result of some fundamental economic movement having a permanent bearing on business progress.

It must be admitted that the labor troubles in the coal fields and on the railroads are of grave significance to industry and at the present moment appear to exert far-reaching effects on industrial activity. Production has been seriously curtailed. Although many industries have suffered and probably will continue to suffer, business refuses to regard the strikes as a permanent blight on the progress toward general prosperity. The ground gained during the past year will not be given up easily. Confidence in the soundness of the underlying situation has not been materially disturbed and there is a widespread conviction that once the difficulties of transportation and fuel supplies are definitely settled, there will be no further obstacles to substantial business revival.

Higher Security Values

This very evidently is the sober judgment of the investing public. Security values have continued at high levels. New records have been set by representative stocks and bonds. The *Wall Street Journal's* average for twenty industrials was 100.75 on Aug. 30, as compared with 92.3 for July 1 and 78.59 for Jan. 10, 1922. The average for the twenty rails has risen from 73.48 for Jan. 3, 1922, to 92.68 for Aug. 30. The Dow-Jones monthly bond index for July reached 75.44, the highest point for several years.

Other fundamental business factors to show improvement in recent months include the decreasing volume of unemployment, the better adjustment of commodity prices, increasing outlook for farm products, increasing car loadings in spite of the shopmen's strike and finally the promise of an early settlement—whether to everybody's satisfaction or not—of the uncertainties of the new tariff bill.

Less Unemployment and Higher Wages

Encouraging news of employment comes from all sections of the country. Reports from sixty-five cities showed that on July 31 1,428 concerns were employing 1,729,085 workers—a gain of 7,434 over the payrolls of June 30. Of these industrial centers, forty-four (mostly in New England and along the Atlantic seaboard) reported increases and twenty-one reported decreases. The Department of Labor's monthly survey of labor conditions by industries shows that in twelve manufacturing industries there were seven increases in employment and five decreases during the month of July. The largest increase, 44.8 per cent, was in the iron and steel industries, while cotton manufacturing showed the largest decrease, 26.4 per cent. Furthermore there have been many significant wage advances, particularly the 20 per cent increase announced by the Steel Corporation and followed by other steel companies. The New York Federal Reserve Bank's index of wages for July was 66 per cent above the 1914 level. Wage increases at this time would seem to confirm the belief that the recent industrial progress has been of a substantial character.

Car loadings of revenue freight had fallen from a weekly average of 351,700 cars in June to 828,029 for July, but the first 3 weeks of August showed a striking recovery to 853,383 cars. In the week ended Aug. 19, 856,219 cars were loaded—an increase of 3,639 cars over the preceding week and of 41,072 over the corresponding week in 1921. The decreases noted in earlier months were due almost entirely to the lower coal loadings.

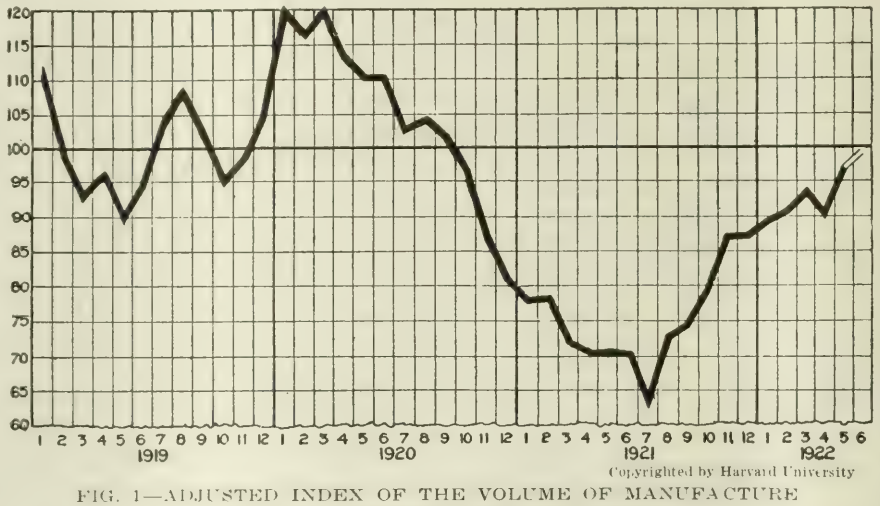


FIG. 1—ADJUSTED INDEX OF THE VOLUME OF MANUFACTURE FOR THE PRINCIPAL BASIC MATERIALS

(*Normal = 100*)

Progress in the Basic Industries

The Harvard Economic Service's index of the volume of manufacture is based on a combination of three minor indices: (1) Basic materials, (2) pig iron for equipment, vehicles, etc., and (3) consumption goods. The index of basic materials, whose trend since 1919 is shown in Fig. 1, includes iron and steel, lumber, cotton and woolen fabrics, leather and paper. This index stood in June at 99.0, the highest figure recorded since September, 1920. Except for a slight recession in April, this index has shown a consistent upward movement ever since July, 1921. Seasonal influences

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	150.60
Last week	149.80
September, 1921	147
September, 1920	267
April, 1918 (high)	286
April, 1921 (low)	140

Three of the twenty-five commodities included in this index were advanced during the past week and there were no reductions. Ammonium sulphate, bleaching powder and linseed oil were reported at slightly higher levels.

have been such, however, that July, 1922, will probably again show a slight recession.

The output of pig iron recorded a slight increase in July—from 2,361,000 long tons in June to 2,400,000 tons in July. Steel ingot production, however, fell from 3,012,000 tons to 2,843,000 tons during this same period. Unfilled orders on the books of the U. S. Steel Corporation showed a gain of 140,630 tons over the previous month.

Pulp and paper production continues at a better-than-average rate. The total output of all grades of newsprint during July, 1922, was 120,839 net tons, while only 94,247 tons was produced in July, 1921, and the 5-year average for the month is 110,000 tons. Wood-pulp production in July, 1922, was 279,308 net tons, a gain of 101,000 tons over July, 1921, and well above the average of 270,850 tons for July, 1919-1922.

Higher prices and a record volume of sales for both foreign and domestic consumption have stimulated the leather industry. Shoe manufacturers are laying in large stocks in anticipation of an unusually good fall trade. Production, especially of sole leather, increased considerably in both June and July. August figures are not yet available, but it is believed that the increased rate has been well maintained.

The American Petroleum Institute estimated the daily average production of crude oil at 1,504,150 bbl. for the week ended Aug. 13. This is a gain of 5,050 bbl. over the average for the preceding week, the largest for any month of 1922.

Heavy Chemical Situation

Manufacturers of heavy chemicals in Philadelphia and vicinity have reported to the Federal Reserve Bank of that district that they can accept no more orders on account of the impending shortage of fuel. At the present time these industries are running at about 80 per cent of capacity, but in most plants the stocks of coal are slight and there is every prospect for seriously curtailing production within the near future.

In the 12 months ended June 30, 1922, exports of all chemicals fell off about 50 per cent, but the foreign shipments of heavy chemicals recorded gains in both volume and value. Exports of acetate of lime and of glycerine doubled, while caustic soda, borax and sodium silicate showed heavy gains. Bleaching powder and soda ash declined.

In general credit conditions are reported as only fair. In proportion to the volume of sales, the accounts outstanding for July have increased from 130.4 per cent in June to 137.5 per cent for July.

Atlas Dividend

A special dividend of 3 per cent on the common stock of the Atlas Powder Co. has been declared, payable Sept. 11, 1922, to stockholders of record at the close of business on Aug. 31, 1922. The stock transfer books will not be closed for the payment of this dividend.

Credit Conditions in the Fertilizer Market

Accompanying the annual report of the American Agricultural Chemical Co. is a statement by the chairman of its board, Robert S. Bradley, which gives a very encouraging view on the fertilizer outlook. Although the demand has not yet returned to normal, there is every prospect for such a return within the near future. Mr. Bradley's statement in part is as follows:

> The sales of fertilizers in the United States for the past year are estimated to have been about 65 per cent of the tonnage of 1920; but while the demand has thus decreased, owing to the severe depression in all agricultural districts during the past 2 years, the productive capacity of the fertilizer industry had been considerably increased under the stimulus of the heavy demand in the spring of 1920. These conditions have naturally led to very severe competition and to a continuance of low prices.
>
> Although there still remains uncollected in the South a large amount of fertilizer notes and accounts from sales of 1920 and 1921, it is estimated, nevertheless, that one-half of all the fertilizer used in the cotton belt in the spring of 1922 was sold for cash, instead of on the usual fall credit terms, and it is confidently expected that the balance of these sales will be collected this fall at maturity, together with a large part of the receivables carried over from 1920 and 1921. Much more fertilizer could have been sold in the South last spring had it not been for the unsatisfactory credit conditions prevailing in that section. From June, 1921, to June, 1922, the price of cotton advanced from around 11 cents per pound to over 22 cents, which latter price should yield a very satisfactory profit on the present cost of production. If the price of cotton should remain around present figures there should be a considerable increase in the demand for fertilizers in the Southern States in the spring of 1923.
>
> In the Northern States credit conditions have been more favorable and a relatively larger tonnage of fertilizer has been sold, though far less than in 1920. Competition in these states has been very keen and prices have remained at a low level.

The annual statement of the American Agricultural Chemical Co. and its associated companies shows a net operating deficit for the year ended June 30, 1922, of $1,124,070.56.

Du Pont Earnings in 1922

For the 6 months ended June 30, 1922, E. I. du Pont de Nemours & Co. reports net earnings of $5,346,857 after deducting all expenses, taxes, depreciation, etc. When provision had been made for $1,403,653 of bond interest and discount, and $2,137,791 for debenture stock dividends, there remained $1,805,412 available for the common stock. This was equivalent to $2.85 a share for the six-month period.

Mathieson Alkali Turn Loss Into Profit

The Mathieson Alkali Works, Inc., operated during the second quarter of 1922 at a net profit of $233,898 as compared with a loss of $361,252 for the corresponding period of last year. The gross earnings were $369,489, from which $135,591 was set aside for depreciation reserves. Payment of preferred stock dividends has been resumed, and it is estimated that after allowances have been made for federal taxes, preferred dividends, sinking fund, etc., the earnings on the common stock will be at the rate of 9.7 per cent per annum.

The New York Market

New York, Sept. 3, 1922.

Activity in the chemical market during the past week has been along broader lines than at any other time for a considerable period. Consumers are showing lively interest in many of the basic commodities. Spot stocks have dwindled considerably and an eager desire to cover has been stimulated by the fear of delayed shipments resulting from the rail and coal strikes. Reports from abroad show that quotations on leading chemicals are much higher than at any time this year. The coal strike in many instances has restricted adequate production and has given the resale merchant an opportunity to get rid of any surplus stocks. Prices on many important items have already advanced and consumers are somewhat uneasy about the chances of obtaining additional supplies. Many are of the opinion that the market shows every sign of broadening materially on an upward basis.

One of the items that commanded the most interest was bleaching powder. Supplies have been taken so quickly that leading producers are unable at present to quote anything but October-November shipments. The alkali situation still remains in an extremely firm position both for home and export consumption. White powdered arsenic has again been advanced by importers and has given rise to keen speculation among resale merchants. Nitrite of soda, prussiate of soda, permanganate of potash, prussiate of potash and oxalic acid have shown considerable activity during the interval.

General and Special Chemicals

Acetate of Soda—Spot supplies are exceedingly low, with production limited to contract specifications. The recent strength in acetate of lime, as well as the higher labor costs, is directly the cause for the advance. Quotations ranged around 7¼c. per lb. for small quantities.

Alums—A moderate consuming business is reported for the lump ammonia alum at 3¼@3½c. per lb. Imported potash alum has been offered down to 3c. per lb.

Aluminum Sulphate—Domestic producers are experiencing a steady call for the commercial grade at 1½c. per lb. Sales of iron-free are reported at 2½c. per lb. The general tone is steady.

Amyl Acetate—Prices are recorded at higher levels and the market presents a steady position. Offerings are rather light, while consumers have shown a better interest for additional supplies. Prices range from $2.25 per gal. upward, depending upon the seller and quantity.

Arsenic—The market remains exceedingly firm, with quantity lots very difficult to obtain either on spot or for prompt shipment. During the later trading prices were advanced to 8½@9c. per pound.

Bleaching Powder—This item has been the feature of the week's trading. Supplies on spot and nearby shipments

have practically been exhausted. Leading factors quote odd lots at $1.90 per 100 lb. ex-store and $2 per 100 lb. for Oct.-Nov. shipment, f.o.b. works.

Fusel Oil—Crude material is moving on the basis of $1.55 per gal., which is somewhat higher than recently quoted. The refined material is also higher, with sellers asking $2.75 per gal. Business is running along regular lines and leading producers seem satisfied with the volume of passing business.

Nitrite of Soda—Large importers and traders have announced an advance on all available spot goods and material for shipment. Higher prices abroad and the scarcity of material for immediate consumption are responsible for the keen interest and renewed speculation. A few odd lots on spot were offered up to 8½c. per lb.

Oxalic Acid—Prices continue to follow an upward course. Buying interest has not ceased and the general tone is very satisfactory. Prices range from 16¾@18½c. per lb., depending upon the seller and quantity.

Prussiate of Potash—Yellow material has been materially advanced during the interval and prices were quoted very firm at 35c. per lb. for small lots. The red variety was quoted higher at 95c.@$1 per pound.

Prussiate of Soda—Activity has increased notably and the tendency of prices has been distinctly higher. Sales were reported for moderate quantities up to 23c. per lb., an advance of 3c. per lb., since our last report.

Coal-Tar Products

Crude coal-tar products have shown considerable strength. It is apparent that the coal and rail situation is directly responsible for the restricted production in some of the these basic commodities, and leading factors are of the opinion that this will eventually force up values of intermediates. The present condition of the market has permitted resale merchants to rid themselves of any surplus stocks. The shortage in phenol is very acute and prices are rising to extremely high levels. Salicylic acids have been affected by this and prices have been advanced.

Benzene—The restricted offerings have placed the spot market in a very strong position. Factors are having trouble in making shipments on old contracts. Future orders are the only transactions being considered. Quotations at the works are firm at 27@32c. per gal. for the 90 per cent and 30 @35c. per gal. for water white.

Cresylic Acid—The market is in a very firm state. The continued inquiries and scant offerings are keeping the market at its present high levels. Domestic offerings for shipment are quoted around 51@53c. per gal. for the 95 per cent and 56@58c. per gal. for the 97@99 per cent. Imported material is quoted at 64@65c. per gallon.

Phenol—There has been a pronounced scarcity of spot material and prices have been sharply advanced. Quotations for odd lots are heard around 23c. per pound.

The Chicago Market

CHICAGO, ILL., Aug. 29, 1922.

The tone of the industrial chemical market has been firmer during the past 2 weeks. A good volume of business was reported from nearly all quarters, particularly from first hands, for there appears to be a growing tendency on the part of the buyer to purchase his supplies from the manufacturer. There were but few price advances to be noted, although nearly all items were in a very firm position. Imported chemicals in particular were exceptionally firm, as holders had little or no idea of their replacement costs. It was to be noticed that most buyers were willing to pay a small premium for domestic goods.

General Chemicals

Caustic soda was very firm, with only moderate supplies available. Solid 76 per cent material was available in small or moderate lots at $3.85@$4 per 100 lb. and the ground or flake at $4.40 @$4.50. *Caustic potash* was unchanged as to price and was reported to be moving fairly well at 6½@7c. per lb. for the 88-92 per cent material. *Soda ash* continued to move in a good volume and was unchanged at $2.35 per 100 lb. for small lots of 58 per cent material in cooperage. *Sal soda* enjoyed a good inquiry and was available at $1.90 per 100 pounds.

The list of alums was rather quiet, with moderate supplies available. Lump *potash alum*, iron free, was offered at 4½@5c. per lb. in single-bbl. lots and the powdered at 6@6½c. *Sal ammoniac* was quite firm, with first hands in control of the situation. White granular material of domestic manufacture was quoted at 7¾c. per lb. in moderate quantities. *White arsenic* maintained its firm position and was offered at 8½@9c. per lb. *Barium carbonate* was in a firm position and small lots for spot delivery were held at 5c. per lb. The situation on *copper sulphate* was less acute and moderate lots were available at 6½c. per lb. *Carbon bisulphide* was quite firm, with only small quantities available at 7@7½c. per lb. *Carbon tetrachloride* was in about the same position as before and was quoted at 9½@10c. per lb. in large drums. *Glycerine* was in a very firm position with most of the refiners asking 17c. per lb. for the c.p. material in drums. *Formaldehyde* was unchanged both as to price and demand. Supplies were available at 9c. per lb. in single-bbl. lots. *Furfural* was unchanged at 35c. per lb. for 1,000-lb. lots. *Lead acetate* was in no better demand and barrels were offered at 11@12c. per lb. for the white crystals. *Red phosphorus* was very quiet, with imported material offered at 26c. per lb. and domestic at 48c. *Phosphorus pentoxide* was in better demand and was quoted by the one holder at 35c. per pound.

A better demand was to be noticed for bichromates, the coal situation forcing the price upward. *Potassium bichromate* was quoted at 11½@12c. per lb. and soda at 9@9½c. *Potassium chlorate* was very firm and scarce on spot, small lots of the crystals bringing 10c. per lb. *Potassium permanganate* was reported to be in a firm position with supplies getting scarce. Spot U.S.P. crystals were held at 16½c. per lb. and the movement was said to be very fair. *Hyposulphite* of soda was unchanged in price and moved in a routine way at $3.85 per 100 lb. for pea crystals in barrels.

Linseed Oil and Turpentine

Linseed oil was reported to be moving in a fair volume but the price was weak at 92c. per gal. for 5-drum lots of the boiled and 90c. for similar quantities of the raw.

Turpentine was also moving in a fair way, but factors differed on the condition of the market with some predicting a sharp decline, others an advance. Five-drum lots were quoted at the close of today's market at $1.23¾ per gallon.

The Iron and Steel Market

PITTSBURGH, Sept. 1, 1922.

A fundamental change has occurred in the past fortnight in the spirit that underlies the iron and steel market. Previously there had been a gradual but very moderate departure from the policy well outlined last June, of holding prices down so as to avoid discouraging buyers for deliveries in the late months of the year, as it grew clearer that on account of curtailed production there would be little to sell. The new thought is that the astonishing and complete success of the coal miners in their strike, with various other developments, makes inflation unavoidable and that in the circumstances no general benefit can accrue from efforts to hold prices down. Banking interests appear to have been the first to sense the situation and to have passed the word around that since labor forces inflation the best course is to let inflation have its way, producing its natural economic consequences, resulting eventually in people in general becoming less extravagant and more willing to work.

The result is that the influences that are usually exerted to prevent a runaway market are not operative. Prices are not going to be pushed up by design, but they are going to be permitted to go up if so disposed—as they are.

Predictions are already being made that "the inflation can't last long," April 1 being sometimes mentioned as an extreme date. The assigned period may easily prove too short. Business has momentum. Not all material still to be received by buyers is at high prices, for in practically all lines of commerce there are forward commitments. Costs of production do not instantly mount when the current market advances. Furthermore, it is being remarked that some bankers have said that "there is too much money" for prices and wages to be held to reasonable levels, in keeping with economic laws, but if that is the case the large amount of money cannot be spent in a short space of time.

The iron and steel industry appears to have assumed that since it has had

nearly 2 years of very lean times and in the past few months production costs quite out of keeping with prices at which the steel made had been sold, it should now make the most of the present opportunity.

Steel Prices Advancing

As reported under date of Aug. 18, the Steel Corporation advanced its sheet prices $2 a ton on blue annealed and $4 a ton on other descriptions, following advances previously made by independents. On Aug. 23 the corporation advanced prices on welded tubular goods three points on black and two points on galvanized, a point being equivalent to about $2 a net ton, 8 days after independents had made a similar advance, and 1 day after the corporation's wage advance had been announced.

The absolute minimum on bars, shapes and plates has advanced from 1.80c. to 1.90c. in the case of bars and to 2c. in the case of shapes and plates, this being for altogether indefinite delivery. The ordinary market is 2.25c., while prompt plates have been bringing 2.50c. for 2 or 3 weeks' delivery. While the Steel Corporation has made no formal announcement as to prices of wire products, it is selling at prices as recently advanced by independents, the advance being $2 a ton on plain wire to 2.35c. and 20c. on a keg of nails to $2.60.

The Steel Corporation on Aug. 22 announced that, effective Sept. 1, it would advance wages generally by 20 per cent. This would raise the common labor rate from 30 to 36 cents an hour. Some of the independents followed instantly, others later. Wages in the Connellsville region were dealt with separately, as will be indicated later. The general wage advance increases the cost of making the average net ton of finished steel by something like $4, the Connellsville wage advance adding something like a dollar more.

On Aug. 22, after the "Cleveland agreement" in the union bituminous coal industry, the H. C. Frick Coke Co. posted notices in the Connellsville region restoring the wage scale of Sept. 1, 1920, the highest scale ever paid in the region, an exception being the rate for outside day labor, which was made to conform to the labor rate at mills and furnaces. The advance was to be effective Aug. 23 and strikers were invited to return to work. Independent operators followed the Frick scale. While some men have returned, the expected stampede has not occurred. This week the Pittsburgh district operators signed the scale and it is a question whether this will affect the Connellsville labor situation favorably or otherwise. The Connellsville region has been non-union for at least 30 years and while the coal strike has presented many surprises, it is inconceivable that the Connellsville operators will sign any agreement.

Connellsville coal and coke prices have been declining, steam coal having reached a range of $4.50@$5, while furnace coke is $10@$11 and foundry coke $13@$14. Blast furnaces are beginning to take hold in a very limited way, the supply offered being very scant and the price still distinctly objectionable. One of the Shenango furnaces resumes this week, on purchases of odd lots of coke, but this is to make bessemer iron, supplied molten on a long term contract to an ingot mold foundry. There is practically no merchant pig iron production in western Pennsylvania and the valleys. The last foundry iron appears to have been sold some time ago, and recourse has been had to Buffalo, where a purchase has just been made of several hundred tons of prompt iron at $34 Buffalo for Pittsburgh delivery, the valley equivalent, considering freights, being $35.50. Bessemer is up to $32 valley on small-lot sales. Basic cannot be had at under $30 valley, and probably not at that figure. The only pig-iron market is a spot or prompt market, forward deliveries being out of the reckoning. When it becomes possible to offer forward deliveries, the expected readjustment in prices may not occur, the resumption being so gradual as to make forward prices in line with the spot market then existing.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0 38 – $0.40
Acetone	lb.	$0.13½– $0.13¾	.14 – .14¼
Acid, acetic, 28 per cent	100 lbs.	2.70 – 2.80	2 85 – 3 30
Acetic, 56 per cent	100 lbs.	5.25 – 5 35	5.40 – 5.75
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	12 00 – 12.50	12 75 – 13 50
Boric, crystals	lb.	.11 – .11½	.11½– .12
Boric, powder	lb.	.11 – .11½	.11½– .12½
Citric	lb.	..... –	.45 – .45½
Hydrochloric	100 lb.	1.10 – 1 20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09½– 10	.10½– .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½– .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06½	.06½– .07
Nitric, 42 deg.	lb.	.06½– .06¾	.07 – .07½
Oxalic, crystals	lb.	.16½– .17	.17½– .18½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08½– .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1 75
Sulphuric, 60 deg., tank cars	ton	10.00 – 10 50	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14 00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15.00 – 16 00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20 00	20 50 – 21 00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22 50	23 00 – 24 00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32 00	33.00 – 34 00
Tannic, U. S. P.	lb.	..... –	60 – 75
Tannic (tech.)	lb.	.40 – .45	46 – 50
Tartaric, imported crystals	lb.	..... –	.29½– .30
Tartaric acid, imported, powdered	lb.	..... –	.30 – .31
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1 00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4 75 – 4 95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.31 – .33
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.31 – .33
Alum, ammonia, lump	lb.	.03½– .03¾	.03½– .04
Alum, potash, lump	lb.	.03 – .03¼	.03½– .04
Alum, chrome lump	lb.	.05 – .05¼	.05½– .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1 65	1 70 – 2 25
Aluminum sulphate, iron free	lb.	.02½– .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾– .07¼	.07½– .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½– .31
Ammonium carbonate, powder	lb.	.08¼– .08½	.08¾– .09
Ammonium nitrate	lb.	.06 – .06½	.06¾– .07½
Amylacetate tech.	gal.	..... –	2.25 – 2.35
Arsenic, white, powdered	lb.	.08½– 09	.09¼– .09½
Arsenic, red, powdered	lb.	.12 – .12¼	.12½– .13
Barium carbonate	ton	61.00 – 62.00	63.00 – 66.00
Barium chloride	ton	85.00 – 88.00	89.00 – 95.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼– .22
Barium nitrate	lb.	.07½– .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½– .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	2.00 – 2 10	2.15 – 3 25
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05¼– .05¾	.06 – .06¼
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½– .35
Calcium acetate	100 lbs.	2.35 – 2 40	2.45 – 2 50
Calcium carbide	lb.	.04½– .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23 00	23 50 – 27.00
Calcium chloride, granulated	lb.	.01½– .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.82 – .84
Carbon bisulphide	lb.	.06 – .06½	.06¾– .07½
Carbon tetrachloride, drums	lb.	.09½– .10	.10½– .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½– .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½– .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½– .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½– .06
Chloroform	lb.	..... –	25 – 32
Cobalt oxide	lb.	..... –	2 00 – 2 10
Copperas	ton	20 00 – 22 00	23 00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – 20	.20½– .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.25 – 6 50	6 60 – 6.75
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.08 – .08½	.08½– .09
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00	..... – .....
Fullers earth–imported powdered–net	ton	30 00 – 32 00	..... – .....
Fusel oil, ref.	gal.	..... –	2.75 – 2 90
Fusel oil, crude	gal.	..... –	1.55 – 1 75
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.17 – .17½
Iodine, resublimed	lb.	..... –	4 20 – 4 25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.10½– .11½
Lead arsenate, powd.	lb.	.13 – .13½	.13½– .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½– .08	.08½– .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½– .07½
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2 25	2 30 – 2 50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95°	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Nickel salt, single	lb.	..... –	.12 – .12½
Phosgene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.10½ – .10¾	.11 – .11¼
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07½ – .08
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06¼ – .06½	.07 – .08
Potassium permanganate	lb.	.14½ – .15	.15½ – .16
Potassium prussiate, red	lb.	..... –	.95 – 1.00
Potassium prussiate, yellow	lb.	.35 – .35½	.35½ – .36
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .06½	.06¾ – .07
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	18.00 –21.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07¼ – .07½	.07¾ – .08
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07¼ – .07¾	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06¼ – .06¼	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21¼ – .25
Sodium fluoride	lb.	.09½ – .10	.10½ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.70 – 3.75	3.80 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .03	.03¼ – .03½
Sodium nitrite	lb.	.08½ – .08¾	.09 – .09¼
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03 – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.23 – .23½	.23½ – .24
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders ex wks.	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	..... – .....
Talc—domestic powdered	ton	18.00 –25.00	..... – .....
Tin bichloride	lb.	.09 – .09¼	.09½ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.5½ – .06	.06¼ – .06¾
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.30 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.65 — .67
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.22 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dop oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.85 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06¼ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	$0.15 — $0.17
N-W acid	lb.	1.15 — 1.30
Ortho-amidophenol	lb.	2.10 — 2.15
Ortho-dichlor-benzene	lb.	.17 — .20
Ortho-nitro-phenol	lb.	.75 — .77
Ortho-nitro-toluene	lb.	.10 — .13
Ortho-toluidine	lb.	.12 — .14
Para-amidophenol, base	lb.	1.20 — 1.25
Para-amidophenol, HCl	lb.	1.25 — 1.30
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .80
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.85 — .90
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.23 — .25
Pyridine	gal.	1.75 — 2.75
Resorcinol, technical	lb.	1.50 — 1.55
Resorcinol, pure	lb.	2.00 — 2.10
R-salt	lb.	.55 — .60
Salicylic acid, tech., in bbls.	lb.	.25 — .27
Salicylic acid, U. S. P.	lb.	.29 — .30
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.27 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.12 — .14
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — .....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — .....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.19½ — $0.20
Beeswax, refined, dark	lb.	.30 — .32
Beeswax, refined, light	lb.	.34 — .35
Beeswax, pure white	lb.	.38 — .42
Candellila, wax	lb.	.38 — .40
Carnauba, No. 1	lb.	.40 — .42
Carnauba No. 2, North Country	lb.	.25 — .26
Carnauba, No. 3, North Country	lb.	.18 — .18½
Japan	lb.	.16 — .16½
Montan, crude	lb.	.03½ — .04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04¼ — .....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ — .....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼ — .03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½ – .03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ — .04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05½
Stearic acid, single pressed	lb.	.09 — .09½
Stearic acid, double pressed	lb.	.09½ — .09¾
Stearic acid, triple pressed	lb.	.10½ — .10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$6.25	— $6.30
Rosin E-I.	280 lb.	6.35	— 6.40
Rosin K-N.	280 lb.	6.45	— 6.65
Rosin W. G.-W. W.	280 lb.	7.85	— 8.40
Wood rosin, bbl.	280 lb.	6.25	— .....
Spirits of turpentine	gal.	1.23	— 1.24
Wood turpentine, steam dist	gal.	.85	— .....
Wood turpentine, dest. dist.	gal.	.70	— .70
Pine tar pitch, bbl.	200 lb.	.....	— 6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	— 9.50
Retort tar, bbl.	500 lb.		— 9.00
Rosin oil, first run	gal.	.36	— .....
Rosin oil, second run	gal.	.38	— .....
Rosin oil, third run	gal.	.46	— .....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist.	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref.	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.70	— 3.75
Blood, dried, f.o.b., N. Y.	unit	4.75	— .....
Bone, 3 and 50, ground, raw	ton	37.00	— 39.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10	— 3.20
Nitrate of soda	100 lb.	2.50	— 2.55
Tankage, high grade, f.o.b. Chicago	unit	4.50	— 4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50	— 4.00
Tennessee, 78-80%	ton	7.00	— 8.00
Potassium muriate, 80%	ton	33.00	— 34.00
Potassium sulphate	unit	1.00	— .....

Crude Rubber

Para—Upriver fine	lb.	$0.18½	— .18¾
Upriver coarse	lb.	.13½	— .13¾
Upriver caucho ball	lb.	.13½	— .13¾
Plantation—First latex crepe	lb.	.14	— .14½
Ribbed smoked sheets	lb.	.14	— .14½
Brown crepe, thin, clean	lb.	.13½	— .....
Amber crepe No. 1	lb.	.14	— .....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12½ —	12½
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¾ —	.08½
Cocoanut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
Corn oil, crude, in bbls	lb.	.10½ —	.10¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.08 —	.08
Cottonseed oil, summer yellow	lb.	.10½ —	.11
Cottonseed oil, winter yellow	lb.	.11½ —	12
Linseed oil, raw, car lots (domestic)	gal.	.87 —	.88
Linseed oil, raw, tank cars (domestic)	gal.	.82 —	.83
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.89 —	.90
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.06½ —	.07
Palm, Niger	lb.	.06 —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09½ —	.09½
Peanut oil, refined, in bbls	lb.	.12 —	.12¼
Rapeseed oil, refined in bbls	gal.	.82 —	.83
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¾ —	....

FISH

Light pressed menhaden	gal.	$0.53 —	....
Yellow bleached menhaden	gal.	.54 —	.55
White bleached menhaden	gal.	.56 —	.57
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700 00	$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65 00 —	100.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24 00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	16.00 —	20.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, No. 1 pottery grade	long ton	6.50 —	6.75
Feldspar, No. 2 pottery grade	long ton	5.75 —	5.90
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00 —	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal.	per ton	40.00 —	....
Kieselguhr, f.o.b. N. Y.	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	8.00 —	12.00
Pumice stone, imported	lb.	.03 —	.05
Pumice stone, domestic, lump	lb.	.05 —	.05½
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.70 —	.71
Shellac, orange superfine	lb.	.72 —	.73
Shellac, A. C. garnet	lb.	.70 —	.71
Shellac, T. N.	lb.	.68 —	.69
Silica, glass sand, f.o.b. Indiana	per ton	1.50 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16 00 —	16.00
Silica, building Sand, f.o.b. Pa	per ton	2.00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16 00 —	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00	
Chrome brick, f.o.b. Eastern shipping points	net ton	40–42	
Chrome cement, 40-50% Cr_2O_3	net ton	23–27	
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00	
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	28–35	
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–28	
Magnesite brick, 9-in. straight (f.o.b. works)	net ton	56	
Magnesite brick, 9-in. arches, wedges and keys	net ton	70	
Magnesite brick, soaps and splits	net ton	90	
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	33–35	
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	35–40	
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	31–33	
Silicon carbide refractory brick, 9-in.	1,000	1100.00	

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225 00
Ferrochromium, per lb. of Cr contained, 6–8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	36 00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	1.85 —	2 00
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58 00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	21 00 —	22.00
Coke, foundry, f.o.b. ovens	net ton	13.00 —	14 00
Coke, furnace, f.o.b. ovens	net ton	10.00 —	11.00
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19 00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.29 —	....
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.45 —	.50
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.25 —	3.50
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent	19.10
Antimony, wholesale lots, Chinese and Japanese	5.375
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.625
Lead, New York, spot	5.90
Lead, E. St. Louis, spot	5.55
Zinc, spot, New York	6.55–6.60
Zinc, spot, E. St. Louis	6.20–6.25

OTHER METALS

Silver (commercial)	oz.	$0.69⅝	
Cadmium	lb.	1.20–1.25	
Bismuth (500 lb. lots)	lb.	2.00@2.10	
Cobalt	lb.	3.00@3.25	
Magnesium, ingots, 99 per cent	lb.	1.15@1.25	
Platinum	oz.	$108.00	
Iridium	oz.	Nominal	
Palladium	oz.	55.00@60.00	
Mercury	75 lb.	61.00	

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	19.50
Copper bottoms	29.50
Copper rods	19.50
High brass wire	18.25
High brass rods	16.25
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	23.75
Seamless high brass tubing	21.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	10.25@10.50
Copper, heavy and wire	10.00@10.25
Copper, light and bottoms	7.75@ 8.25
Lead, heavy	3.90@ 4.15
Lead, tea	2½–2
Brass, heavy	4.50@ 4.75
Brass, light	4.00@ 4.25
No. 1 yellow brass turnings	4.00@ 4.25
Zinc	2.00@ 2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.70	$2.70
Soft steel bars	2.60	2.60
Soft steel bar shapes	2.60	2.60
Soft steel bands	3.10	3.20
Plates, ¼ to 1 in. thick	2.70	2.70

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

PAPER—The Lititz Box Board & Paper Co., Eden, near Lancaster, Pa., has adopted a 24-hour daily working schedule at its plant, under a 7-day operating basis, giving employment to a large working force. It is said that orders on hand insure this capacity for some time to come.

The H. H. Bartin & Son Co., Philadelphia, Pa., manufacturer of sandpaper, is operating on a full-time schedule at its plant, giving employment to a regular working force. The company is now building a 2-story addition, and will place the structure in service at the earliest possible date.

The Tonawanda Board & Paper Co., Goose Island, Tonawanda, N. Y., heretofore operated by the Beaverboard Companies, Buffalo, and recently acquired by new interests, is planning for the immediate resumption of production at the mill, which has been closed down for about 2 years past. The new company is headed by Maurice W. Simon, Buffalo.

The Temiskaming Pulp & Paper Co., Haileyburg, Ont., will commence operations at once at its new local mill, recently completed at a cost of about $1,000,000, giving employment to a large working force. Initial production will be increased gradually until the plant capacity of 40 tons per day, ground-wood pulp, is reached.

The Jesperson Newsprint Co. has reopened the former Perseverance Paper Mill, South Union St., Lambertville, N. J., recently acquired, following considerable rebuilding and remodeling. The plant will manufacture newsprint paper under a new process, and will operate at a capacity basis. Henry Weeks is general manager.

LEATHER—The Benz Kid Co., Lynn, Mass., is increasing operations at its tannery and is now manufacturing at the rate of about 1,000 dozen skins daily.

The Graton & Knight Mfg. Co., Worcester, Mass., has advanced production at its tannery at St. Louis, Mo., to about 75 per cent of normal. At the local finished leather plant at Worcester, the working force has been increased from 700 to 1,200 persons.

IRON AND STEEL—The steel mill of the Driscoll-Reese Co., Hamburg, Pa., closed for a number of months past, has been acquired by new interests and will be placed in operation at once. The machinery will be repaired and additional equipment installed. A new company will be formed to run the mill.

The Eddystone Steel Co., Eddystone, Pa., has closed its plant temporarily owing to fuel shortage. The plant has been giving employment to about 200 men.

The Tacony Steel Co., Tacony, Philadelphia, Pa., is operating at full capacity at its rolling mills and at close to 50 per cent output in other departments of the works. The company has recently changed two of its four furnaces to utilize oil as fuel.

The Youngstown Sheet & Tube Co., Youngstown, O., is increasing production at its local bessemer plant, following a resumption of operations recently curtailed on account of fuel shortage. One of the bar mills at the works is in service, running at full capacity.

The Eastern Steel Co., Pottstown, Pa., will make immediate repairs in its No. 1 blast furnace, and will place the unit in operation as soon as sufficient fuel is available. The No. 2 blast furnace of the company has recently been blown out owing to a shortage of coke.

The National Enameling & Stamping Co. is increasing production at its sheet mills at Granite City, Ill., following a curtailment due to fuel shortage. Arrangements have been made to use oil as fuel in a number of departments. It is planned to develop maximum output at the earliest possible date. The plant is said to be about to open behind on orders.

The American Steel & Wire Co., Youngstown, O., has been forced to reduce operations to a point of about 25 per cent of normal, owing to coal and coke shortage.

The Republic Iron & Steel Co., Youngstown, O., has resumed operations at four of its bar mills, following a recent curtailment. Arrangements are being made to increase the finishing mill capacity at the works.

The Eastern Rolling Mills Co., Baltimore, Md., has adopted a 24-hour day working basis at its plant, for the production of steel sheets, and up to the present time the plant has not felt the effects of fuel shortage. Employment is being given to about 1,200 men, and it is said that this working force will be advanced at an early date.

Owing to coal and coke shortage, the Carnegie Steel Co. has suspended operations at five of its seventeen bar mills in the Youngstown, O., district.

The Kokomo Steel & Wire Co., Kokomo, Ind., is curtailing operations at its mills, owing to fuel shortage.

The Central Coal & Iron Co., Birmingham, Ala., has its blast furnace at Holt, Ala., ready to blow in, and will place the unit in service as soon as the fuel situation has improved.

METALS — The New Jersey Zinc Co., Palmerton, Pa., is increasing operations at its plant and practically all departments are now running on full time with full working force. New employees will be added gradually.

The Butte Copper & Zinc Co., Butte, Mont., has resumed operations at its local Emma properties, which have been closed down since early in 1921. It is expected to reach normal production within a few weeks.

MISCELLANEOUS — E. I. du Pont de Nemours & Co., Wilmington, Del., will reopen its Ashburn works at Hannibal, Mo., devoted to the manufacture of high explosives, early in September, following a shutdown for more than a year.

The Industrial Alcohol Co., Baltimore, Md., is increasing production at its Curtis Bay plant to 100 per cent capacity, for the first time in a number of months. Operations at all other plants of the company are being developed to maximum output.

The Lehigh Portland Cement Co. has curtailed operations in a number of departments at its three mills at New Castle, Pa., owing to a strike of laborers. The men have asked for a 25 per cent wage advance.

The American Tar Products Co., Woodward, Ala., is maintaining active production at its local plant with normal working force. The company has adopted a plan for using pulverized pitch as fuel instead of coal.

The L. Martin Co., Philadelphia, Pa., manufacturer of carbon and lampblack products, has advanced production to full capacity. At this time last year the works were running at about 50 per cent of normal. It is said that orders on hand insure maximum output for some time to come.

The Pure Oil Co., Columbus, O., operating refineries in Pennsylvania, West Virginia, Minnesota, Ohio and Oklahoma, has increased production at the plants to a basis of 30,000 bbl. a day, gross.

The United States Navy Department is arranging for the resumption of operations at its helium gas plant, Fort Worth, Tex., early in September, when an appropriation of $800,000, recently granted by Congress, will become available. It is expected to develop 8,000,000 cu.ft. of helium gas for government use during the coming year.

Capital Increases, Etc.

THE AMERICAN HARD WALL PLASTER CO., Utica, N. Y., has filed notice of increase in capital from $25,000 to $350,000, for proposed expansion.

THE KANAK CO., New York, N. Y., has been organized with a capital of $100,000, to form a consolidation of the Kanak Co., 708 6th Ave., New York, and the Deode Chemical Co. The new company will manufacture chemical specialties, with headquarters at the address noted. It is headed by H. J. Davenport, K. Burham and F. S. Metcalf.

THE MESABI IRON CO., 25 Broad St., New York, N. Y., operating iron ore properties and milling plant for the manufacture of iron ore concentrate, etc., is disposing of a stock issue of $600,000, a portion of the proceeds to be used for expansion.

THE OHIO REFINING CO., Louisville, Ky., a Delaware incorporation, manufacturer of refined petroleum products, has filed notice of increase in capital from $500,000 to $2,000,000, for proposed expansion.

THE ROCHESTER BRICK & TILE MFG. CO., Rochester, N. Y., has filed notice of reduction in capital from $84,000 to $24,000.

THE DOMESTIC COKE CORP., Fairmont, W. Va., has filed notice of increase in capital from $3,500,000 to $4,500,000, for proposed expansion.

THE ILLINOIS POWDER MFG. CO., 28 East Jackson Blvd., Chicago, Ill., has filed notice of increase in capital from $250,000 to $500,000.

THE ALBRECHT-HERD CO., Equitable Bldg., Baltimore, Md., manufacturer of salt products, has filed notice of increase in capital to $300,000.

THE ARMSTRONG CORK CO., 24th St., Pittsburgh, Pa., manufacturer of cork insulation products, etc., is arranging for an increase in capital from $17,000,000 to $30,000,000.

THE UNITED STATES GLASS CO., South 9th and Bingham Sts., Pittsburgh, Pa., has called a special meeting of stockholders on Oct. 4 to vote on a proposition to dispose of the plant and property of the company for a consideration of $1,920,000. Ernst Nickel is secretary.

THE WEST INDIA SUGAR FINANCE CORP., 129 Front St., New York, N. Y., is arranging for an increase of $835,000 in preferred stock, the proceeds to be used in connection with extensions in operations of its sugar properties in the West Indies and to provide for the merger of other sugar refineries in this district.

Construction and Operation

Arkansas

FORT SMITH—The Industrial Laboratories, North 1st St., manufacturers of floor-sweeping compounds, cleansers, etc., are planning for the immediate rebuilding of the portion of their plant, recently destroyed by fire, with loss estimated at about $18,000. W. V. Botright is head.

GRAVETTE—The Spees Vinegar Co., Kansas City, Mo., is arranging for the immediate installation of new equipment at its plant to increase the present capacity.

California

LONG BEACH — Alexander Hursh, 12 Locust St., Los Angeles, will commence the immediate erection of a new oil refinery at Cherry and Newport Aves., with initial output of about 1,500 bbl. per day. It will cost about $60,000.

RICHMOND—The Lunning Mineral Products Co., manufacturers of paint products, pigments, etc., has preliminary plans under consideration for the rebuilding of the portion of its plant, recently destroyed by fire, with loss estimated at about $30,000.

VENTURA—The Associated Oil Co., Los Angeles, plans for extensions and improvements in its local storage and distributing plant on Figueroa St., estimated to cost about $30,000.

Connecticut

BRIDGEPORT — The Sieman Hard Rubber Corp. has filed plans for the construction of a new 1-story plant addition, 60x168 ft., estimated to cost about $16,000, exclusive of equipment. Work will be commenced at once.

BRIDGEPORT—The Electrolytic Iron Co., recently organized by local interests, has leased a factory at Milford, Conn., formerly occupied by Page & Nettleton, located on New Haven Ave., for the establishment of a plant for the manufacture of pure iron by the electrolysis process. The building will be remodeled and improved, and equipment installed at an early date. The works will include a complete laboratory.

BRIDGEPORT—The Compressed Paper Box Co., 128 Thompson St., recently organized with a capital of $300,000, will take over and operate the local plant and property of the company of the same name. The reorganized company plans for extensions and improvements. J. C. Stanley is president; and E. E. Irving, treasurer.

WATERBURY—The Gulf Refining Co. has preliminary plans under way for the construction of a new storage and distributing plant on South 5th St., to include a number of 1-story buildings.

Florida

MIAMI—The Pennsylvania Sugar Co., 135 South 2nd St., Philadelphia, Pa., has construction under way on the initial units of its proposed local sugar mill. The plant will have a grinding and converting capacity of 1,000 tons of sugar cane per day. It is expected to install machinery late in the fall, and have the mill ready for service early in the coming year. The company has a 100,000-acre tract in this section. George H. Earle, Jr., is president.

Georgia

LUDOWICI—The McDonald Brick Co., recently organized, has acquired the local plant of the Ludowici-Cedalon Co., heretofore devoted to the manufacture of roofing tile products. The new owner is said to be planning for extensions, to include the production of brick and other burned clay products. It will operate with a capital of $50,000.

Indiana

FAIRMOUNT—The Graham Glass Co. will make extensions and improvements in its local plant, including the installation of a new tank and other operating equipment. The works have been closed down for this purpose, and will be reopened as soon as the installation has been completed.

FAIRMONT—The Standard Oil Co. will commence the immediate construction of a new storage and distributing plant on property in the western part of the city, recently acquired. The present works in another district will be removed to the new location.

Maine

HOWLAND—The Advance Bag & Paper Co. has construction under way on a new pulp and paper mill, and plans to have the plant equipped ready for service at an early date. The machinery will be electrically operated.

Maryland

BALTIMORE—The Solarine Co., Emerson Bldg., manufacturer of metal polishes, has plans under way for the construction of a new 1-story plant, 100x150 ft., at Eagle and Mallwood Sts., estimated to cost close to $50,000, of which amount approximately $30,000 will be expended for equipment. E. H. Glidden, American Bldg., is architect. C. A. Allen is president.

HAGERSTOWN—The Security Cement & Lime Co., Equitable Bldg., Baltimore, has plans under way for enlargements in its cement-manufacturing plant at Hagerstown, to increase the capacity approximately 50 per cent. Work will be commenced at an early date.

BALTIMORE—The James Robertson Lead Works, Inc., 827 South Howard St., will commence immediately the construction of its proposed new plant addition, to comprise a 2-story building, to cost approximately $60,000. It will be equipped for the manufacture of sheet lead and other lead products. A general contract for the work has awarded recently to the Consolidated Engineering Co., Calvert Bldg. The company is a subsidiary of the United Lead Co., New York.

BALTIMORE—The Baltimore Paper Box Co., West and Howard Sts., has acquired property on the Key Highway, heretofore used by the Key Manufacturing Co., comprising a number of buildings with aggregate floor space of about 100,000 sq.ft., for a consideration of approximately $225,000. The new owner will take immediate possession and will use the plant for general manufacture. It is planned to install new machinery to cost about $75,000.

BALTIMORE — The Republic Boiler & Radiator Co., Union Ave., Woodberry, has awarded a contract to the Claiborne-Johnson Co., Garrett Bldg., Baltimore, for the construction of a 1-story foundry, 60 x 150 ft. Work will be commenced at once. William C. Keown is engineer in charge.

FUNKSTOWN—The Tanners' Hide & Tallow Co. has tentative plans under consideration for rebuilding the portion of its plant, recently destroyed by fire with loss estimated at about $25,000, including equipment.

Michigan

GRAND RAPIDS—The Grand Rapids Tire & Rubber Corp. has plans nearing completion for the construction of a new plant for the manufacture of cord tires, estimated to cost close to $250,000, with machinery. L. A. Brown is president and general manager.

FILER CITY—The Filer Fibre Co., manufacturer of kraft papers and other paper products, has awarded a contract to J. O. Olsen, Muskegon, for the construction of a new 2- and 3-story mill, 72x420 ft., with extension 60x60 ft., estimated to cost about $150,000, exclusive of equipment. Work will be placed under way at once. The company has recently disposed of a bond issue of $500,000, for general plant expansion. Philip P. Schnorbach is general manager.

Massachusetts

DORCHESTER—The Tide Water Oil Co., 60 Cambridge St., Allston, Mass., will commence the immediate construction of a new storage and distributing plant on Dorchester Ave. near Locust St., Dorchester, comprising a 1- and 2-story building, with about 15,000 sq.ft. of area, estimated to cost close to $75,000.

Missouri

ST. LOUIS—The Ho-Ro-Co Mfg. Co., 110 Locust St., manufacturer of flavoring extracts, etc., has plans nearing completion for the construction of a 3-story and basement plant, 60x100 ft., at Leffingwell and Dodier Sts., to cost about $55,000. Edward Lantz, 603 Post-Dispatch Bldg., is architect. N. G. Roth is president.

ST. JOSEPH—Morris & Co., Union Stockyards, Chicago, has plans in progress for the construction of a 4-story and basement lard-refining plant at St. Joseph, to replace the factory recently destroyed by fire, with loss estimated at approximately $100,000, with machinery. The new plant, it is said, will cost in excess of this amount.

Nevada

ELY—The Nevada Consolidated Copper Co. will equip its new concentrating plant, to be constructed to replace the McGill concentrator recently destroyed by fire, for a capacity of about 4,000 tons of ore per day. The unit will form sections Nos. 3 and 4 at the main works. It is estimated to cost close to $1,000,000, with machinery.

New Jersey

MORRISTOWN—The Morristown Electric Steel Foundry, Inc., 106 Water St., recently organized with a capital of $125,000, has acquired the former plant of the Liberty Steel Co. in the Shelley Terminal district, for the establishment of a new works for the manufacture of steel castings by an electrical process. Immediate possession will be taken, and it is planned to commence production at an early date. The company is headed by J. Lovell Paulmier, Samuel B. Illingsworth and Richard B. Eurich.

TRENTON—A committee of trustees of the Empire Tire & Rubber Corp., East Clinton Ave. and Mulberry St., manufacturer of tires and mechanical rubber goods, now in receivership, is perfecting plans for a reorganization of the company. The property will be offered for sale on Sept. 13. The new organization will be headed by W. T. Baird, A. W. Pickford and former Governor E. C. Stokes.

NEWARK—The Pittsburgh Plate Glass Co., 290 Elizabeth Ave., will break ground at once for the construction of a new 1-story plant, 66x110 ft., at the foot of Chester Ave. at the Passaic River, to be equipped for the manufacture of linseed oil products. It will cost about $160,000. The company will also construct a 4-story elevator, 46x46 ft., to be used for the storage of raw material, estimated to cost about $40,000. The buildings will be used in connection with the paint division of the company.

New York

LONG ISLAND CITY—The Mathieson Alkali Works, 25 West 43rd St., New York, has leased a building on 14th St. near Van Alst Ave., Long Island City, from the Connelly Iron Sponge & Governor Co., and will equip the structure for a new experimental works.

NEW YORK — The Mesabi Iron Co., 25 Broad St., operating magnetite ore properties in Minnesota for the manufacture of iron ore concentrate, or sinter, has plans under way for extensions in the plant to handle about 30,000 tons of material per day for a finished production of approximately 10,000 tons daily. It is purposed to install new machinery at the crushing plant and other departments to more than treble the present capacity. To provide for the expansion the company is disposing of a stock issue of $600,000. D. C. Jackling is president, and W. G. Swart, vice-president and general manager.

BROOKLYN—The Norman Bronze Co., 100-12 Provost St., has filed plans for the construction of a 1-story foundry addition.

LONG ISLAND CITY—Joseph R. Greenwood is organizing a new company to operate an enameling works. The building at 66 Myrtle Ave. has been leased from the Commercial Research Corp. for the proposed plant, providing about 25,000 sq.ft. of floor space. Immediate possession will be taken, and equipment installed.

YONKERS—The Arlington Chemical Co., 100 Hamilton St., has awarded a contract to the Turner Construction Co., 244 Madison Ave., New York, for the construction of a new 4-story plant, 60x200 ft., with laboratory, to be located on Harriett St. Work will be commenced at once.

North Carolina

HIGH POINT—The Marietta Paint & Color Co., Marietta, O., has plans under way for the construction of a new 4-story plant at High Point, for the manufacture of a general line of paints and colors. It is planned to commence construction at an early date.

Ohio

AKRON—The International Lead Refining Co., East Chicago, Ind., a subsidiary of Anaconda Copper Mining Co., New York, has commenced the clearing of the site on East Talmadge Ave., North Akron, recently acquired, for the construction of its proposed new plant, for the manufacture of zinc oxide. The units to be constructed at the present time will cost about $500,000, with machinery. It is planned to build other units at a later date. E. T. Gillen, 212 Ohio Bldg., Akron, is engineer. The company is said to be planning for the construction of a new 1-story addition to its zinc oxide works at East Chicago, 50x100 ft., estimated to cost approximately $50,000, with machinery installation.

Pennsylvania

SPRING GROVE—The P. H. Glatfelter Co. will commence the immediate installation of new machinery and equipment at its local paper mill. The plant will be considerably enlarged for increased capacity.

CONSHOHOCKEN—A new 1-story foundry will be constructed at the plant of the Montgomery Foundry & Fittings Co., to be equipped for a daily production of approximately 100 tons of gray iron castings.

PITTSBURGH—The Stroh Steel-Hardening Process Co., Westinghouse Bldg., has plans nearing completion for the construction of a new addition to its steel foundry at Ridge Ave. and Chateau St., to cost about $250,000, with equipment. Work on clearing the site is under way. W. Y. Stroh is president.

Tennessee

MEMPHIS—The Indiana Board & Filler Co., Vincennes, Ind., lately organized with a capital of $750,000, has acquired the local plant of the Tennessee Fibre Co., located in the North Memphis district. The new owner will take immediate possession of the plant for the manufacture of strawboard and fiber products, with department for a complete chemical treatment of straw materials used. The present works will be enlarged and considerable new machinery installed.

Texas

FORT WORTH—The Armstrong Steel Co., recently organized with a capital of $2,500,000, to take over and operate the iron and steel plant of the George W. Armstrong Co., has plans in progress for remodeling and improving the local works, converting the plant from a present line of general iron products to the manufacture of steel specialties. New mills will be constructed and considerable machinery installed, estimated to cost approximatey $1,000,000. The company is disposing of a stock issue to provide for the expansion. George W. Armstrong is chairman of the board; R. L. Van Zandt, president; and David R. Knapp, consulting engineer, formerly connected with the Eastern Steel Co., Philadelphia, vice-president in charge of operations.

YOAKUM—In connection with the proposed expansion at the plant of the Texas Hide & Leather Co., a 1-story tanning plant will be built, 30x150 ft. Two other buildings will be erected, 50x100 ft. and 50x80 ft. respectively. J. B. Harris is general manager.

Virginia

LEXINGTON—The Board of Directors of the Washington & Lee University will install a complete chemical laboratory in a new 3-story building at the institution, for which plans are being prepared. The structure will cost about $150,000. Flournoy & Flournoy, 306 St. Paul St., Baltimore, Md., are architects.

New Companies

THE CHAPMAN PRODUCTS CO., Centerdale, North Providence, R. I., has been incorporated with a capital of $25,000, to manufacture chemical products, germicides, etc. The incorporators are M. L. Merithew, R. S. Thornton and E. B. Chapman, 131 Greenville Ave., Manton, R. I.

THE REICH-ASH CORP., New York, N. Y., care of N. D. Le'man, 291 Broadway, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are S. and L. R. Reich, and S. Ash.

THE NEW JERSEY BRICK CO., INC., Eatontown, N. J., has been incorporated with a capital of $20,000, to manufacture brick and other burned clay products. The incorporators are Eugene A. H. Watson, Walter T. Spalding and Theobald Mincer, all of Eatontown. The last noted represents the organization.

THE BURKE-GREIS OIL CO., Tulsa, Okla., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are John F. Burke, D. deLace Greis and Henry N. Greis, Tulsa. The last noted represents the company.

THE COLUMBIA LEATHER GOODS CORP., New London, Conn., has been incorporated with a capital of $500,000, to operate a tannery and manufacture leather goods. The incorporators are Inez C. Delgado, Samuel Friedman and M. P. Breen, 54 West 90th St., New York, N. Y.

THE FRAHER BRASS WORKS, INC., 14 South Jefferson St., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture brass, bronze and kindred metal products. The incorporators are L. L. Richmond, Lowell A. Lawson and Thomas T. Dudley, Jr.

THE CAROLINAS CHEMICAL CO., Columbia, S. C., has been incorporated with a capital of $100,000, to manufacture chemicals, fertilizers and kindred products. The incorporators are Iredell Jones, Jr., and W. D. Black, Columbia.

THE VENEZUELA OIL CORP., Boston, Mass., has been incorporated with a capital of $300,000, to manufacture petroleum products. Raymond D. Smith, 55 Congress St., Boston, is president and treasurer.

THE MASTER CHEMICAL CO., Rochester, N. Y., care of J. E. Whitley, attorney, Rochester, representative, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are L. and P. S. Burnherr, and S. R. Joffe.

THE SEWICKLEY SOAP WORKS, INC., Sewickley, Pa., has been incorporated under Delaware laws, with a capital of $50,000, to manufacture soaps and kindred products. The incorporators are Norman B. Abercombe, Paul and R. C. Wright, Sewickley. The last noted represents the company.

THE BENSON-THARPE PAINT CO., Birmingham, Ala., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. Y. K. Benson is president; and W. A. Tharpe, vice-president, both of Birmingham.

THE INTERSTATE CHEMICAL CO., Providence, R. I., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are Philip C. Joslin, R. A. McDonald and Thurston Seabury, Cranston, R. I. The last noted represents the company.

THE RELIABLE GAS & OILS, INC., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture lubricating oils, etc. The incorporators are Harry B. O'Connell, and William F. Haas, 1212 Broad st., Newark.

THE FOURLOCK TILE CORP., American Bldg., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture concrete tile blocks and kindred products. The incorporators are Harry W. Somers, William L. Breman and Frank E. Holt.

THE PHOSPHOGEN FERTILIZER CORP., Richmond, Va., has been incorporated with a capital of $10,000,000, to manufacture commercial fertilizer products. Horace S. Wright is president, and N. T. Cook, secretary, both of Richmond, Va.

ARTHUR J. CAHILL & CO., 96 Linden Ave., Jersey City, N. J., has filed notice of organization, to manufacture chemicals and chemical byproducts, dyes, etc. Arthur J. Cahill heads the company.

THE CHARLES BECK CO., Philadelphia, Pa., care of Archibald T. Johnson, 1617 Land Title Bldg., representative, is being organized to manufacture paper products. The company is headed by H. P. and L. Beck and Andrew Simon. Application has been made for a state charter.

THE INDUSTRIAL PRODUCERS' & REFINERS' CORP., Wilmington, Del., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, has been incorporated under state laws, with a capital of $12,000,000, to manufacture petroleum products.

MAXUDIN & CO., INC., New York, N. Y., care of Niles & Johnson, 54 Wall St., representatives, has been incorporated with a capital of $100,000, to manufacture oil products. The incorporators are W. R. Fuller, R. Q. Kelley and F. H. Medbury.

THE NEW YORK VITREOUS ENAMEL PRODUCTS CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., representative, has been incorporated under Delaware laws, with a capital of $300,000, to manufacture vitreous enamel ware and kindred burned clay products.

THE SEABOARD BRASS & COPPER CO., 805 Continental Bldg., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture brass, bronze, copper and kindred products. The incorporators are Harvey H. Wilson, Edwin M. Talbot and Herbert Langrall.

THE AMERICAN GLASS EXPERIMENTAL WORKS, 104 Point St., Providence, R. I., has filed notice of organization to manufacture glass specialties. William Cepek heads the company.

THE P. M. REFINING CO., New York, N. Y., care of I. H. Bookman, 799 Broadway, representative, has been incorporated with a capital of $10,000, to operate a metal refining plant. The incorporators are A. S. Bockman and E. H. Vogel.

THE INTERSTATE OXYGEN CO., Wheeling, W. Va., has been organized under state laws to manufacture commercial oxygen products. The incorporators are H. G. Beckett, F. C. Niebergall and G. H. Helfer, all of Wheeling.

THE BRIDGEPORT BRONZE CO., Bridgeport, Conn., has been incorporated with a capital of $200,000, to manufacture bronze, brass and other kindred metal products. The incorporators are H. M. Trainor, H. L. Shaff and Jonathan Grout, 886 Main St., Bridgeport.

THE STRAW CELLULOSE PRODUCTS CO., Portland, Me., has been incorporated with a capital of $1,000,000, to manufacture paper and pulp products under a special process. Charles M. Drummond is president; R. B. Buzzell, treasurer; and Wadleigh B. Drummond, clerk, all of Portland. The last noted represents the company.

THE INDIANA OIL & SULPHUR CO., Mooresville, Ind., has been incorporated with a capital of $500,000, to manufacture oil and sulphur products and affiliated specialties. The incorporators are M. H. and Alfred L. Thomas, and Pharoah H. Hill, all of Mooresville.

THE SOMERTON FOUNDRIES CORP., Philadelphia, Pa., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws with capital of $250,000, to manufacture iron, steel and other metal castings. The incorporators are M. F. Devine and S. R. Kerr, Philadelphia; and C. L. Hadgkiss, Camden, N. J.

THE WESTERN OIL & REFINING CO., 1828 Second Ave., Rock Island, Ill., has been incorporated with a capital of $25,000, to manufacture refined oil products. The incorporators are James McCrory, Carl J. Mueller and Patrick L. Welsh.

THE HARLEM CORK CO., New York, N. Y., care of L. A. Cuvillier, 154 East 121st St., representative, has been incorporated with a capital of $5,000, to manufacture cork products. The incorporators are S. Becker, A. H. and C. F. Stahl.

THE SMITH-WILKINSON GUANO CO., Spartanburg, S. C., has been incorporated with a capital of $25,000, to manufacture fertilizer products. The incorporators are Floyd T. Smith and J. C. Wilkinson, both of Spartanburg.

THE GOBLE RUBBER PRODUCTS CO., Cleveland, O., care of Homer J. Smith, Wyoming, Del., representative, has been incorporated under Delaware laws, with a capital of $50,000, to manufacture rubber specialties. The incorporators are H. L. Indal Smith, M. L. Merchant and J. M. Whitford, all of Cleveland.

THE PENNSYLVANIA PRODUCTS LABORATORIES, INC., Brooklyn, N. Y., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical by products. The company is represented by F. G. Milligan, 375 Fulton St., Brooklyn. The incorporators are C. Jacob, B. Miller and A. Devine.

THE MEXIA-FREESTONE OIL CORP., Mexia, Tex., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated with a capital of $5,000,000, under state laws, to manufacture petroleum products.

SCHWARTZ BROTHERS, INC., 309 East Center St., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture lubricating oils. The incorporators are Max L. and Louis A. Schwartz.

THE BAFFETTI VULCANIZER SYSTEM, INC., 917 West Washington Boulevard, Chicago, Ill., has been incorporated under state laws, to manufacture rubber specialties, rubber reclaiming fluids, etc. The incorporators are Louis A. Baffetti and Frank Fox.

THE LAKE SHORE OIL CO., 1125 West 79th St., Chicago, Ill., has been incorporated with a capital of $20,000, to manufacture refined oil products. The incorporators are George W. and Frank B. Busch, and Walter A. Johnston.

THE GRAPHO CRAYONS CO., St. Louis, Mo., has been incorporated with a capital of $50,000, to manufacture crayons, chalks and kindred products. The incorporators are W. L. Deist and R. H. Taylor, both of St. Louis.

THE AMERICAN CARBON ELIMINATOR CO., Brooklyn, N. Y., care of W. L. Morehouse, 50 Court St., representative, has been incorporated with a capital of $20,000, to manufacture special compounds for carbon elimination. The incorporators are N. Friedman and M. M. Rutchik.

THE BEAVER PETROLEUM CO., Buffalo, N. Y., care of Robert C. Palmer, Ellicott Square, representative, has been incorporated with a capital of $500,000, to manufacture petroleum products. The incorporators are F. L. Danforth, B. Rumsey and W. S. Jackson.

THE GLOBE STEEL TUBE CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with a capital of $10,500,000, to manufacture steel tubing and affiliated products.

THE PEERLESS OIL CO., Richmond, Va., has been incorporated with a capital of $500,000, to manufacture refined oil products. E. E. Pratt, Paola, Kan., is president; and Guy B. Hazelgrove, Richmond, secretary.

THE AMERICAN MICA MFG. CO., Wilmington, Del., has been incorporated with a capital of $100,000, to manufacture mica products. The incorporators are Charles S. Greelman, Waynesville, N. C.; Charles E. and Frank E. Slocumb, both of Wilmington. The last noted represents the company.

THE NYPROS STEEL CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., has been incorporated under Delaware laws with a capital of $5,250,000, to manufacture steel products.

Coming Meetings and Events

ALPHA CHI SIGMA dinner, during the Chemical Exposition, will be held Thursday Sept. 14, at 6:30 p.m. at Keen's Chop House, 107 West 44th St., New York City. Members are requested to register at *Chem. & Met.'s* booth at the Exposition.

AMERICAN CHEMICAL SOCIETY is holding its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS will hold its sixteenth annual convention Sept. 11 to 15 at Cleveland Public Hall, Cleveland, Ohio.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York, Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

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onferees Report On the Tariff

ANOTHER turn was given to the kaleidoscope of tariff legislation last week when the conferees greed upon the dye embargo and revised the ad alorem and specific duties on intermediates and dyes. n the face of it this is favorable to the chemical ndustry and gives a new lease of life to the embargo. is questionable, however, whether the action will be pproved by either the House or the Senate. The only ertainty is that the change will precipitate a fight in oth houses.

It will be recalled that the Fordney bill eliminated ne embargo altogether; that the Senate Committee on inance restored it, but that the Senate finally rejected after a spirited debate. The only way in which the nferees could revive the issue was by eliminating the ction in the Senate bill which authorized its repeal. here is a question whether this is permissible under nference rules, so that a fight will be waged not only n the embargo itself but also on the validity of the nference agreement. Meantime the Bursum amendent, carrying high ad valorem and specific duties, as been rejected, and it is impossible to foresee at his writing how the dye industry will come out of ne mêlée.

overnment Files Suit Against Chemical Foundation

CHARGING conspiracy to create a dye and chemical monopoly in the United States, with the Chemical oundation as a device for acquiring German patents, ne Attorney-General on Sept. 8 filed a suit in quity in the United States District Court at Wilmingon, Del., against the Chemical Foundation, Inc., emanding a return to the Alien Property Custodian of ll German patents and other rights held by this oranization. An analysis of the complaint, which covers nore than 500 printed pages, including exhibits of sevral hundred pages, reveals the line of attack on which he government will proceed. In the first place, it is lleged that the price paid for the patents by the hemical Foundation was grossly inadequate, so much o that if the sale is sustained it would constitute conscation and a violation of trust. Next, the government ttacks the authority under which the sale was made nd the validity of an executive order by President VILSON attempting to validate certain acts of the then ssistant Secretary of State. It is claimed that both f these officials were unaware of the facts in the case vhen taking their actions and that the Chemical oundation through its representatives "put something ver" on the government.

The conspiracy phase of the government's suit is a nost interesting one, because it brings into the controversy not only some leading chemical manufacturers but also certain trade associations and technical societies, naming them all as conspirators in the creation of the Chemical Foundation, which was to pull German chestnuts out of the fire for American chemical industry. No less interesting is the charge that these conspirators hoodwinked the government by misrepresentation or only partial representation of the facts. This is the government's side of the story, and it is evident that it calls for considerable light which the Chemical Foundation's answer undoubtedly will shed on the whole matter.

Public Appreciation of Chemical Warfare Service

EDUCATION of the public takes time. This is strikingly illustrated in the attitude of the people generally toward the Chemical Warfare Service, regarding which a large amount of information has been printed in the last 4 years. In 1918 the American public had no other idea than that the use of gas in warfare was barbarous in the extreme, with no redeeming feature. To dislodge that conception from the minds of 110,000,000 people has been a task of unusual difficulty, but General AMOS A. FRIES, Chief of the Chemical Warfare Service, believes that a majority of the people at last have been brought to estimate the value of the service more accurately.

Information reaching the Chemical Warfare Service directly and the opinion of Senators, Representatives and other officials who are in close touch with the people all lead to that conclusion. It is believed that this feeling will be strengthened as the public learns that the peace-time activities of the service carry with them great possibilities in the public interest. For instance, the Chemical Warfare Service, with the aid of representatives of the Public Health Service and of the Navy, has developed a substitute for hydrocyanic acid gas which removes all danger of accidental death from the use of that gas as a fumigant. The substitute is cyanogen chloride, which is a powerful tear gas when used in concentrations of only one-eighth the amount necessary to cause death. As soon as sufficient supplies of the new gas are available, it will be used exclusively by the government in the fumigation of ships.

Encouraged by the success of the experiment with cyanogen chloride, the chemists at Edgewood Arsenal are now getting encouraging results from experiments in mixing a sneezing gas with illuminating gas so that sleeping persons will be awakened in case unburned illuminating gas should escape in the room. The property of the gas which causes sneezing is destroyed when the gas is burned. Progress continues to be made in the use of poison gas against insect and rodent pests, notable work having been done recently in combating

locusts in the Philippines. Work is also continuing in the hope of finding a successful way of using gas in the eradication of the cotton boll weevil. All of which leads to the confident belief that gas will be found to be the most effective weapon that can be employed in the fight on insect and rodent pests. Thus are the means of war converted to the uses of peace; and meantime the knowledge gained will be a comforting asset in time of emergency.

The Universal Curse—Work

THE basis of the philosophy both of the men who exercise creative intelligence and of the great mass of the workmen, both skilled and unskilled, is the same: "Work is a curse." The practice growing out of the philosophy is different. The investigators and inventors are endeavoring to lessen the amount of work that has to be done to compass a given quantity of production, by improving methods, by finding short cuts. The workman is endeavoring simply to reduce the amount of work he must do individually without reducing the compensation received.

This is not a case of different reactions to environment, for the environments are different. One cannot assert that if men were to change places the reactions in the environments would be changed.

We appear to be, on the whole, sadly lacking in the application of psychology. There is much criticism of workmen for wanting to do less work and for wanting to get more pay for what they do. Great economic truths are hurled at them, with no results measurable by instruments of the present standard of sensitiveness. We poke fun at the remaining men who believe that breaking windows is good for business because it makes work for the glazier. Only the densely ignorant can have such a viewpoint, we opine. Yet we have a group of men, elected by men and women who must have thought the candidates possessed some intelligence, who have passed a tariff act plainly based on the philosophy that we want only so much work to be done, and that if we permit foreigners to do any of it we shall have so much less to do ourselves.

The captains of industry, the *entrepreneurs*, the employers—to name more specifically a class—should not expect employees and workmen to have a different philosophy than they themselves have. They all believe that work is something to be avoided, provided the results or rewards are still obtained, and that belief cannot be eliminated as a basis of conduct. It is a fact that must be recognized.

The burden of improvement rests not upon artisans or unskilled workmen, but upon those who invent and devise. Hitherto the activities of the men of creative intelligence have been directed chiefly to reduction in the total quantity of work to be done to achieve given results. They would like, to give an illustration, to replace a gang of four men by a gang of three men, each of the three men working as hard as each of the four men had to work. There is another field, little considered, that of making the work of the four men less irksome, whereby these four men become more contented than are four other men who are working the old way and who become ambitious for promotion to the less irksome work.

The general principle involved, that work should be made less irksome, is universally recognized. The most obvious proof of this recognition is the large part played in "welfare work" by the providing of [illegible]. Undoubtedly all such efforts, if intelligently directe are good, but it is plain that they represent an ope confession by the employer that the work of the em ployee is irksome. They improve conditions, no doub but at the same time they emphasize in the mind of th workman the point that improvement is confessed desirable. No competition among workmen is produce the benefits of welfare work being open to all. Whe however, some jobs are made less irksome than othe jobs, competition to possess the better jobs is stim ulated.

A Survey Of Business

"THEY are shipping niggers (*sic*) from Birmin ham by the trainload."

"California is prosperous. People must eat, and th West can always feed them."

In addition, there were a number of men who thanke whatever gods there are that they still hold their pos tions. All these, and many more, are the concomita joys of an editorial survey of general business cond tions that we have recently completed. We aske whether business was good, fair or poor. We aske whether unemployment was increasing or decreasin and we further inquired whether the addressee was em ployed. We addressed our inquiry to technical me distributed all over the country. Some of them a not technically trained, but all of them have a technic background. They are engaged largely in manufactu ing, and the products are in general connected wit chemical or metallurgical industries.

A gratifyingly small number of men reported tha they were unemployed. It is reasonable to assume tha a relatively large percentage of unemployed men woul answer a questionnaire of this kind, and it is probabl safe, therefore, to assume that 4 per cent is a hig figure for unemployment among technical men.

All sections reported unemployment decreasing. Th West was apparently surer of it than the East, for ove 75 per cent of the men from the Middle and Far Wes reported unemployment on the decrease. In the East 66 per cent believed that more men are at work now.

The accompanying table represents the opinions re ceived on business conditions. The similarity of th replies from the different sections of the country i striking, and a healthy note of optimism is apparen That business should be reported good in over 30 pe cent of the total replies is certainly encouraging. A slightly higher optimism, whether of temperament o of fact, is to be noted in the Middle and Far West, bu the similarity is rather more striking than the sligh difference.

Business Is	East, Per Cent	Middle West, Per Cent	Far West, Per Cent
Good.....	25	32	30
Fair.....	65	62	58
Poor.....	10	6	12

Those industries which were reported as "enjoying poor business were made a subject of special study It is quite reassuring, because no one industry wa mentioned frequently. Individual companies seem t have a continuation of lean years in dyewood extracts dyestuffs, copper, zinc, beet sugar, machinery, soap brass, etc. The striking thing, however, is not tha individual companies are having hard times but tha hard times are not general and that they are not con fined to any particular industry.

It is somewhat unwise to overemphasize the value o

ind yet the men have intimate contact with their indus-ries. Many of them are production heads, and all of hem are engaged in production work. It is perhaps air, then, to assume that the opinions have more weight han a casual opinion ordinarily would. The indication s that, disregarding enforced idleness through strikes, he country is on the road to business health.

Building With Foresight

RATIONAL, scientific plant design and layout are more often notable for their complete absence from the chemical plant than for their presence. This has been largely brought about by the circumstances under which chemical industry has developed—circumstances which preclude the use of any effective prevision.

Some of the points made by contributors to *Chem. & Met.'s* recent Exposition issue bring this situation clearly before the reader; and we feel that the course of conduct which would follow a complete realization of the present situation and the remedies for it is one that can be profitably considered by all those who can help to put it into effect.

Among other contributors, FRANK D. CHASE, in referring to this lack of forethought, said:

"The result has been in most plants a hodge-podge of buildings built one at a time without reference to co-ordination of manufacturing operations; without thought for future growth, either as a whole or for single units or departments; and without thought, in very many instances, of the physical comfort and welfare of employees."

A. E. MARSHALL, in his contribution on the design of chemical plants, expressed the need of this foresight in the following words: "In considering the design of a new plant, the chemical engineer has several important factors to take into account. One which has received least attention in the past and which has caused later on in the life of chemical plants either unnecessary cost of product or prevented possible reduction is the lack of provision for future expansion."

It seems axiomatic that each owner of a chemical plant desires his business to grow. A static condition is but little better than a reduction of business and a healthy growth is one of the requisites of real success. If the product which is manufactured is worthy and well marketed, the plant will inevitably be faced with a demand for increased output.

If the original plant was not built with this end in view, there seem to be only two ways open to meet this situation. Either a complete new plant can be built or additions can be crowded into the existing plant wherever an available corner can be found. Neither of these expedients has the effect of lowering the costs in the degree that could reasonably be expected to follow increased output.

How much better, then, to provide for a reasonable expansion at the time the plant is built. If this is done, capacity can be added as the need for the increase occurs. Such an expansion invariably results in more output per unit of labor; and there are certain features of the plant which will not have to be duplicated, but can serve the increased capacity as well as they did the original. The result of this is the reduced production cost that should always follow increased output.

One of the greatest of engineering firms has adopted as its slogan the words: "BUILDING WITH FORESIGHT." It may have the use of this phrase copyrighted for advertising purposes, but its application to industry is open to all. Let chemical industry adopt this as its watchword and by the use of an intelligent prevision escape the recurrence of the mistakes of the past.

Opportunities in The Leather Industry

AS MODERN chemical science has developed, workers in the different industrial fields have been quick to apply promising concepts to their own problems in the hope of obtaining a clearer understanding of the processes involved. Where it has been possible to determine the fundamentals, progress has been invariably rapid and often phenomenal. In some industries the required information became available at a fairly early period in the growth of the science, while others find even present knowledge inadequate.

Typical of this latter group is the manufacture of leather, which is still largely an art. Through practical experience, supplemented by knowledge which has accumulated as a result of centuries of experimentation by methods of elimination or trial and error, the tanner is able to manipulate successfully and profitably complex reactions, the mechanism of which still baffles the chemist. Progress in an art is often due to the application of methods quite similar in principle to those by which a science advances. Indeed, the progressive tanner has really employed scientific methods in attempting to trace cause and effect in the maze of variables confronting him, so that in this sense there may be said to be a science of leather manufacture.

Of necessity, development in this empirical way has been slow, and real progress will not result until the fundamentals have been established. At present, in spite of the excellent pioneer work which has been done, even a chemist whose training has included the latest developments of physical chemistry, the chemistry of proteins, tannins, colloids and of bacterial and enzyme action, will find difficulty in studying many of the reactions which take place. Attempts at process improvement by chemists with inadequate training have so often resulted in disaster that many tannery chemists find their efforts confined to laboratory control methods, where again the lack of fundamental data forces them to adopt empirical makeshifts. While control methods are necessary, there is so much work of more vital importance to be done that it would seem that there is a decided tendency among American leather chemists to place undue emphasis on analytical methods.

Fundamental work of the character discussed has been started within the last few years, but many of the results will require intelligent interpretation and application to plant conditions before the tanner will benefit. Herein lies an opportunity for chemists equipped with the thorough modern training which will enable them to qualify. As the industry is not sufficiently aware of its own needs to seek such men, they will be compelled to take the initiative. No small part of their task will be to convince the tanner that chemistry has something more to offer than analytical methods—that it can co-operate intelligently in the improvement of processes—but once this is accomplished both the industry and the status of the chemist within the industry will benefit. For the chemist will not receive proper recognition in the leather industry until he is able to stand shoulder to shoulder with the tanner in the development of the manufacturing processes to their highest efficiency. The field is open and the rewards are certain for those who have the ability and the determination to make good.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, Aug. 21, 1922.

THERE is little to report in regard to chemical markets, which are just recovering from the usual effects of the holiday season, but on the whole demand continues to improve and the outlook is promising. The export trade has been adversely affected by the collapse of the German exchange and a further depreciation is expected. This, it is thought, may have a beneficial effect upon exports to non-European countries. Although the price tendency is upward, the standard prices for soda products have recently been reduced, while the increase in price fixed for the current season by the Sulphate of Ammonia Association has been less than was expected under present circumstances. Coal-tar products are an uncertain market, but pitch is very firm and makers are holding back supplies. Arsenic compounds and particularly zinc oxide have been in good demand, depleted stocks and a rise in the price of spelter being mainly responsible in the latter case. The new trade index, "Where to Buy"—Everything Chemical, referred to in my notes for May, has now been published and was favorably received by the trade. This and other publications are symptomatic of a distinct tendency for better organization and effective propaganda in the chemical trade.

A Novel Design for Non-Rigid Filter Presses

Gavin A. Renton has worked out the details of a non-rigid type of chamber which enables the cake between the plates to be subjected to additional pressure by squeezing the whole press together after the completion of the normal filtering operation, like a concertina. Metal hoops forming a nearly complete circle in section and surrounding a rubber core are used as distance pieces between the filter press plates. Using vanadium spring steel with a high elastic limit, the relation between the dimensions and thickness of these hoops has been carefully worked out in order to give correct results. In a given case the normal thickness of the cake can be reduced from $1\frac{1}{4}$ in. to $\frac{3}{4}$ in., using metal filter cloth, and in certain cases a non-rigid press of this type should have distinct possibilities.

Yet Another Process for Cheap Hydrogen Manufacture

The synthetic ammonia industry is mainly responsible for the development of commercial methods of hydrogen manufacture, the two main sources being coal and water. Electrolytic hydrogen is dependent upon very cheap water power, and water gas made from coke has been the main source of hydrogen in this and other countries with adequate coal supplies. Claude has proposed to remove the hydrogen from coke-oven gas by fractional liquefaction, but in making coke-oven gas only about one-quarter of the hydrogen is liberated, whereas many coals contain about 5 per cent by weight of hydrogen, equivalent to about 20,000 cu.ft. per ton. Jaques & West are now developing a new process which is likely to give the maximum possible yield of hydrogen per ton of coal, this being attained by combining in a single apparatus the distillation of coal, the formation of water gas from the resulting coke and the conversion of all carbon monoxide into carbon dioxide and hydrogen by reaction with steam in the presence of a catalyst. The carbon dioxide is removed by absorption in water under pressure. An experimental plant, consisting of a modified form of Tully complete gasification plant, is now in operation in the north of England, the hydrogen present in the coal being very completely liberated by passing the crude coal gas through the hot zone in the producer, so that the tar, oils, methane and other hydrocarbons are "cracked" or split up into hydrogen and carbon, the carbon reacting with steam to form water gas. The catalyst used is stated to be cheap and reliable and a yield of about 45,000 cu.ft. of hydrogen per ton is stated to have been obtained at a cost of rather more than 1 shilling per thousand cubic feet. It is suggested that the mixture of hydrogen and nitrogen in the proportions required for synthetic ammonia manufacture may be obtained by adding a measured quantity of air to the hydrogen and passing the mixture over a catalyst so that combustion takes place quietly.

Stainless Steel for Chemical Plant

Independent investigations in this direction have been proceeding for some months, but Thomas Firth & Sons, Ltd., of Sheffield, has rendered a service by publishing a textbook on data from investigations carried out in its research laboratories. This book can be recommended for study by all who have the development of chemical plant at heart, and it is particularly interesting to notice occasional differences in the properties claimed for Firth's products as compared, for instance, with Krupp's V2A steel. The most striking of these is perhaps the non-magnetic properties of V2A and the claim that it can be autogenously as well as electrically welded. The most outstanding features are the complete resistance of the new material to caustic alkali, ammonia, copper sulphate and nitric acid of various strengths, its use for optical purposes and its capacity for withstanding high temperatures without excessive loss of strength. Curiously enough, acetic, citric, lactic and tannic acids will attack stainless steel, but natural products such as vinegar, lemon juice, sour milk and tanning extracts, although containing these acids, are without action. The material should be increasingly used in the chemical and other industries, particularly if further researches are generally published and if it should be possible to spray or deposit the metal. The question of price is of considerable importance and at present seems to be in the neighborhood of one dollar per pound. Firth & Sons and also other firms have, however, been developing another variety, which may be termed stainless iron and described as an iron-chromium alloy with a carbon content of under 0.1 per cent. It should be possible to market this and similar soft metals at about half the above price.

General Notes

In my contribution for March of this year I referred to the controversy regarding the presence of carbon monoxide in coal gas and meanwhile Prof. H. E. Armstrong has been investigating the carbon monoxide content in tobacco smoke. Experiments made at the South Metropolitan Gas Co. showed that cigar smoke contained 5 per cent and upward of carbon monoxide, while pipe and cigarette smoke averaged about 1 per cent. Rapid smoking considerably increased the carbonic oxide content.

Max Muspratt is the new chairman of the Association of British Chemical Manufacturers, succeeding Sir John Brunner.

The Artificial Silk Industry

A Concise Review of the Development of the Various Processes, With a Discussion of Their Relative Merits and a Summary of Patent Literature

By Hugo Schlatter

FROM time immemorial man has made use of a variety of animal and vegetable fibers for covering and adorning his body. By careful spinning, bleaching, dyeing, artful weaving and knitting, he has tried to improve and better adapt them to his uses; but it has been only in recent years that he has attempted and succeeded in imitating any of them. It is natural that these efforts of imitation should have been concentrated on silk, the most beautiful and costly textile material.

Natural silk is the product of the silk moth, *Bombyx mori*, and a few other insects closely allied to it. Its cultivation is an ancient industry in China and has spread from there to other countries, particularly Japan, Asia Minor and the southern countries of Europe, where the climate is favorable to the growth of the mulberry tree, whose leaves nourish the worms. In spite of a suitable climate in parts of the United States and repeated efforts aided by the government, the cultivation of the silkworm has never been a success in this country, as it depends on a plentiful supply of cheap labor. Chemically, silk fiber consists of a core of fibroin ($C_{15}H_{23}N_5O_6$), which constitutes 75 to 82 per cent of the entire mass, a covering of sericin or silk albumen ($C_{15}H_{25}N_5O_8$) and a little waxy and coloring matter. Fibroin is soluble in strong alkalis, concentrated sulphuric and nitric acids, concentrated zinc chloride solutions, ammoniacal solutions of copper oxide and nickel oxide. Its solubility in ammoniacal nickel oxide distinguishes it from cotton and artificial silk. Sericin is soluble in hot water and warm soap solutions. Silk is quite hygroscopic, containing under normal atmospheric conditions about 11 per cent of moisture.

Artificial silk is chemically quite different from the natural product. It is a derivative of cellulose and resembles silk only in certain physical characteristics, particularly the luster. At the most, it contains only traces of nitrogen.

At the present time there are four types of artificial silk manufactured commercially: Nitrocellulose silk (Chardonnet, Lehner or Tubize silk). Cuprammonia silk (Despaissis or Pauly silk, Glanzstoff). Viscose silk. Cellulose acetate silk. The first three are hydrated forms of cellulose, whereas the last named is, as its name implies, an ester of cellulose.

History of Artificial Silk

The first hint as to how silk might be imitated was given by Réaumur, the French scientist, who as early as 1734 suggested the drawing of threads from the gums and resins used in the manufacture of Chinese varnish[1]. It was more than 120 years later, however, before his suggestion bore fruit, when Andemars of Lausanne obtained a patent (Br. Pat. 283; 1855), according to which he made a collodion from the bast fibers of young mulberry twigs and mixed it with a solution of one part of rubber in ten parts of ether. Into this mixture he dipped a steel point and by means of it drew out a thread which was reeled in the usual way. Two years later Hughes (Br. Pat. 67; 1857) mentioned a viscous mass consisting of glue, starch, resins, etc., which he proposed to spin like glass. Ozanam was the first to suggest spinning through fine openings (spinnerets) in imitation of the silkworm[2]. In 1883 Joseph Wilson Swan of Bromley, England, produced filaments for use in incandescent lamps by extruding a nitrocellulose solution through fine openings into 70 to 80 per cent alcohol (Br. Pat. 5,978; 1883) and denitrating them by means of ammonium sulphide or other reducing agents[3]. It will be noted that Swan's method foreshadowed the essential steps of the process that first produced commercially successful artificial silk[4].

Outline of Process

In principle, the manufacture of artificial silk consists in dissolving cellulose, or one of its derivatives, in suitable solvents, and coagulating the solution, as it is extruded through fine openings, by removal or dilution of the solvent, or by decomposition of the soluble cellulose compound. This may be followed by further treatments to regenerate cellulose, as in nitrocellulose silk. The first method of coagulation is used in nitrocellulose and acetate, the second in cuprammonia and viscose silks.

The usual sources of cellulose are chemical woodpulp and cotton linters. The former is used only for the viscose process, and even there the cheapness of linters and the more uniform quality obtainable has caused manufacturers, in this country at least, to abandon woodpulp almost entirely. No matter what the source or the later process used, the first essential is a proper purification of the cellulose. It must be freed from impurities, such as grease, mineral matter, pectic substances, etc. Woodpulp in the form obtained from Norwegian spruce by the sulphide process answers these requirements sufficiently for the viscose process. Cotton linters (the short fibers remaining on the cotton seed after ginning) are boiled under a pressure of several atmospheres in a weak solution of caustic soda to which sometimes a little resin soap is added. After careful washing to remove and recover the caustic soda, the linters are lightly bleached with chloride of lime, washed again to remove all traces of chlorine and lime, and dried.

The spinning solutions must be of such character that they can be drawn out to a long fine thread which can easily be coagulated and which will have a certain elasticity and strength so that it will not break in spinning. They must necessarily be free from air, dust and other impurities that would cause uneven or defective threads. In general, the aim is to have a spinning solution that is practically on the point of precipitation

[1] "Mémoire pour servir à l'histoire des insectes," vol. 1, p. 154.

[2] *Compt. rend.*, vol. 55, p. 883 (1862).

[3] According to Lehner (*Chem. Zeit.*, p. 579, 1906) cloth made from Swan's filaments was shown at a London exhibition in 1884. A paragraph in *J. Soc. Chem. Ind.*, p. 34, 1885, mentions the product under the name of artificial silk.

[4] Similar methods, some depending on solutions of cellulose in zinc chloride, were patented in England in 1884 by Swinburne (Br. Pat. 4,121), Evans and Wynne (Br. Pat. 12,675), Watt (Br. Pat. 13,133), Wynne and Powell (Br. Pat. 16,805).

so that the thread will coagulate immediately on coming in contact with the precipitant. The viscosity is influenced by the preliminary treatment of the cellulose, the composition of the solvent and the temperature. Except in the case of nitrocellulose, the spinning liquids deteriorate on standing, especially at higher temperatures, and therefore it is usual to keep and "age" them in cold rooms that are maintained at temperatures of 4 deg. C. or lower.

The spinning apparatus consists essentially of a distributing pipe to which are attached branches carrying the individual spinnerets; a trough containing the precipitating bath into which dip the ends of the spinnerets, and a rotating receiver for the spun filaments. This receiver may be either a glass cylinder upon which the threads are wound crosswise, or a can in which the thread is deposited in skein form by centrifugal force. The spinnerets are usually made of glass connected individually to the distributing pipe, or combined in the form of a spray so that each spray furnishes the number of filaments required for one thread. The thickness of the filament is a function of the size of the spinning opening, the concentration and viscosity of the solution and the ratio of the spinning pressure to the speed with which the filament is drawn off.

Chardonnet Process

The first commercial process owes its development and practical application to the French Count Hilaire de Chardonnet, who was granted his first patent (French 165,349) in 1884. His first product was undenitrated nitrocellulose. This proved too flammable and it became necessary to remedy this defect by denitration. Chardonnet established a factory in Besançon, France, which in 1891 had a production of 100 lb. daily. By 1907 this rate had been increased to about 4,000 lb. per day. Other plants were started in Switzerland, Germany, Belgium, Hungary, Italy and England; but the last named was in existence only a short time.

Chardonnet worked with concentrated solutions of nitrocellulose (20 to 25 per cent) in a mixture of ether and alcohol which necessitated the use of relatively high pressures (40 atmospheres) and very fine spinning jets (0.08 mm.). Lehner modified this procedure by using thinner solutions (10 to 15 per cent), sometimes reducing the viscosity further by addition of acids. This made it possible for him to use much lower pressures. By drawing his filaments fine during their passage through the coagulating bath he was able to increase the size of his spinnerets still further to about 0.5 mm.

Another difference between the two methods existed in the manner of coagulation. Chardonnet's concentrated solutions made from nitrocellulose containing about 20 per cent of water harden sufficiently on exposure to moist air to be wound on bobbins without sticking and can therefore be spun "dry." Lehner spun his silk "wet"—that is, the ends of the spinnerets were immersed in water or weak alcohol, and the filaments coagulating slowly in this liquid were drawn out by winding them on cylinders at a greater speed than that with which the solution issued from the jets.

Nitrocellulose Silk

In the manufacture of the nitrocellulose itself, the properly purified cotton is dried to a moisture content of about 0.5 per cent, and nitrated at temperatures from 40 to 50 deg. C. in an acid mixture containing about 31 per cent of nitric and 54 per cent of sulphuric acid. Nitration is generally carried on in some form of mechanical dipping device[5]. After removal of the excess acid by centrifuging, the nitrocellulose is purified by boiling, pulping and washing in pure water. It is then freed from excess of water by centrifuging and sometimes further dried by displacing the water by alcohol. The solution of the nitrocellulose in the ether-alcohol mixture is carefully filtered under pressure to remove all undissolved particles and permitted to stand for several days to free it from air bubbles, which would cause weak spots or breaks in spinning. Storing the solutions in large tanks also has a blending effect and tends to make the product more uniform.

Generally sixteen to eighteen filaments are united to form one thread and given a slight twist on machines similar to those used in the twisting of natural silk in order to hold them together. From the twisting machines the threads are reeled in the form of skeins and then treated with sodium sulphhydrate to remove the nitric acid with which the cellulose had been combined. They are now washed with water, treated with hot dilute hydrochloric acid to remove iron sulphide, washed, bleached with sodium hypochlorite, washed again, sometimes passed through a soap solution to soften them, and dried.

The air from the spinning room is passed through scrubbing towers, where the alcohol is absorbed in water and the ether in sulphuric acid. The solvents are recovered from the absorption liquids, as well as from the precipitating bath, by distillation.

The advantages of the nitrocellulose process are primarily that the solution used is stable and may be kept for a long time without deterioration, and further that the mechanical processes of washing, twisting and reeling are carried on while the threads are in the thick and strong form of nitrocellulose. It has, however, many disadvantages. Nitrocellulose is highly flammable and care must be taken to keep it wet at all times. The solvents for it are expensive, volatile, flammable, and form explosive mixtures with air. Their recovery presents difficulties[6]. Expensive nitric acid is used to make nitrocellulose and must be removed without the possibility of recovering it. On denitration, the filament loses strength and weight, so in this respect it has no advantages over other forms of artificial silk.

Cuprammonia Process

The next process to find commercial application is based on the solubility of cellulose in an ammoniacal solution of copper hydroxide (Schweizer's reagent). This method is due to Louis Henri Despaissis, who was granted a patent in 1890 (French Pat. 203,741). Owing to a peculiarity of French law, the patent lapsed on the death of the inventor, which occurred a short time thereafter. In 1897 Hermann Pauly was granted German patent 98,642 (U. S. 617,009) which forms the basis of all subsequent methods. Manufacture was promptly undertaken by the Vereinigte Glanzstoffabriken A. G. in Elberfeld with factories at Oberbruch and Mulhouse, and further development is largely due to Bronnert, Fremery and Urban of this company.

The cellulose solvent may be prepared by precipitating copper hydroxide from copper sulphate solution with sodium hydroxide, washing the precipitate care-

[5] *Chem. & Met. Eng.*, vol. 26, p. 281 (1921).

[6] The alcohol consumption in the Chardonnet plant in 1907 is said to have been 4 to 5 liters per pound of artificial silk.

ully and dissolving it in aqueous ammonia. The nethod of the Glanzstoff A. G. consists, however, in the xidation of metallic copper in the presence of ammonia. A tower is filled with copper clippings and 14 per cent mmonia water. Air is blown in at the bottom of the ower, the whole system being maintained at a temperature of 0 to 5 deg. C. After about a day solution s complete and the liquid contains up to 5 per cent opper. It must be kept at a low temperature, as otherwise copper is precipitated. Purified cotton is dissolved n this solution. The spinning liquid contains 7 to 8 er cent cellulose, 2.5 to 3 per cent copper, and 7 to 8 er cent ammonia. A small quantity of cane sugar is lso added. Its viscosity should be such that the time equired for 150 c.c. to flow through a short orifice 5 nm. wide from a tube 32 mm. wide and 280 mm. long, rovided with two marks indicating a volume of 150 c.c., will be 5 to 6 minutes. The solution should also be apable of forming a continuous thread, 2 meters long, efore breaking up into drops. This solution is passed hrough three filter presses in succession, the first being quipped with metal cloth having 1,200 meshes per q.cm., the second 1,400 and the third 1,500 meshes. It s finally filtered through asbestos cloth.

The glass capillaries used for spinning have an internal diameter of 0.16 to 0.20 mm. and are 2.5 to 4 mm. ong. A spinning pressure of 1.5 to 2.5 atmospheres is sed. Originally the precipitating liquid was 50 per ent sulphuric acid and the filament was washed on glass cylinders with a weak solution of ammonium acetate, followed by treatment with ammonia-soap solution at 50 deg. C. This method has since been superseded by alkaline precipitation. The bath contains 25 to 33 grams of caustic soda and 8 grams of glucose per 100 c.c. and is maintained at 48 to 50 deg. C. The threads are wound on glass cylinders, washed in water, passed through a bath containing magnesium or aluminum sulphate to displace the alkali, washed again and dried. The filaments making up one thread are now twisted with three turns to the inch and reeled. They still contain copper, and this is removed by washing the skeins in weak acid. After washing to remove the acid, the skeins are soaped and finally dried. Alkaline spinning gives a stronger and better thread.

The Thiele-Bemberg method is a modification of the one just described in so far as the spinning process is concerned. Instead of a fine capillary, spinning jets having an internal diameter of 0.8 mm. and a weak alkaline precipitant (2 per cent NaOH) are used. The filaments drop through a 50-cm. column of this liquid, which has a slow coagulating action, and are drawn out to very fine diameters by their own weight. It is said that dry diameters of 0.015 mm. may be thus obtained[7].

Viscose Process

Viscose silk, at this time probably the most important of the artificial silks, owes its origin to the work of Cross, Bevan and Beadle, who obtained a patent (Br. Pat. 8,700; 1892) for the preparation of a water soluble derivative of cellulose which they called viscoid or viscose. Stearn made this product available for the manufacture of filaments by patenting various precipitating agents (U. S. Pats. 622,087; 716,778; 725,016). Müller (U. S. Pat. 836,452) protected the present method of using a bath containing sulphuric acid and a sulphate.

The cellulose, whether woodpulp or linters, is transformed into its sodium compound by grinding with three times its weight of 17 to 18 per cent caustic soda in a wheel mill, and storing it in boxes for 48 to 72 hours. The same effect is obtained by mixing it with ten times its weight of the same strength caustic in a Werner & Pfleiderer mixer, permitting it to stand for 24 hours, and then centrifuging until the liquid content has been reduced to the same weight as in the previous method. It is then permitted to stand 48 hours more. To 400 parts of this mass (containing 100 parts of cellulose) in a rotating cylindrical mixer are added 60 parts of carbon bisulphide, and the mixing is continued for 1 to 3 hours at 15 to 30 deg. C. The excess of carbon bisulphide is then evaporated. The viscous mass is now dissolved in 54 parts of caustic soda and 300 parts of water in a W. & P. mixer and diluted until it contains 9 to 10 per cent of cellulose. The viscosity of the solution depends on the treatment of the raw cellulose as well as on the length of the alkali treatment. The solution is now filtered through cotton batting held between cotton cloths and permitted to age or mature at a temperature below 10 deg. C. until a sample gives an insoluble thread in 5 per cent formic acid. Originally the thread was coagulated by means of acid or ammonium salts. In present practice the bath is made up of 40 parts sodium bisulphate, 7 parts sulphuric acid and 60 parts water. The thread, made up of a number of filaments, may be crosswound on bobbins and washed and dried in this form. More frequently it is collected in the rotating cans previously mentioned (U. S. Pat. 702,382), washed in the form of skeins and dried under tension on reels[8].

Cellulose Acetate

Cellulose acetate silks are of more recent development. Mork, Little and Walker were among the first to patent their production (U. S. Pats. 712,200 and 792,149). Dried cotton linters are treated for several hours, gradually increasing the temperature from 15 to 40 deg. C., with 25 per cent acetic anhydride, to which about 1 per cent of sulphuric acid has been added. At the end of this time the mixture is diluted with 50 per cent acetic acid containing some sulphuric acid, and hydrolyzed for 3 hours at temperatures ranging from 25 to 70 deg. C. Cold water is then added to precipitate cellulose acetate, which is filtered off and washed free from acid. For the production of filaments the acetate is dissolved in a suitable solvent, such as glacial acetic or formic acid, chloroform, acetylene tetrachloride, and spun in a manner similar to those described into a precipitating bath. This bath may be water, if the solvent is miscible with water; or alcohol, benzene, etc., if it is not. The solvent and precipitant must be chosen in such a way that one will easily mix with the other and that the solvent will readily diffuse through the thin filament walls of the precipitated cellulose acetate.

Acetate silks are decidedly stronger than the other silks when wet. They have a very low electric conductivity and may displace natural silk entirely for insulating wires, etc. They cannot be dyed in the same manner as the other silks, but methods have been found to overcome the dyeing difficulties.[9]

Other Processes

Various other processes of artificial silk manufacture have been proposed at one time or another, but have

[7]Ost. *Z. angew. Chem.*, vol. 31, p. 141 (1918).

[8]Wilson, *J. Soc. Chem. Ind.*, vol. 36, p. 817 (1917).

[9]*J. Soc. Dyers & Colour.*, vol. 38, p. 162 (1922).

not been successful, although some of them have found temporary use. We merely mention gelatine (Vanduara silk), albumin, casein, macerated silkworms, natural silk solutions, solutions of cellulose in caustic soda, various acids and zinc chloride (filaments for incandescent carbon lamps).

Brief mention may be made of the manufacture of allied products, such as artificial horsehair, imitation fabrics, etc. For horsehair the solution of cellulose is spun through large openings and dried under small tension to get away from the too brilliant luster of silk, or the hair may receive a later treatment with oils. Artificial lace and tulle are made by passing a very viscous solution through engraved rolls into a precipitating bath. Remarkable effects can be obtained in this way. During the war Germany produced considerable quantities of so-called *Stapelfaser*, which was used as a substitute or admixture for wool. This is made by twisting artificial silk in the usual way, then cutting it into short lengths and spinning the resulting fibers, either alone or mixed with wool, just as cotton or wool is spun.

Properties

The specific gravity of artificial silk is about 1.51 whereas that of natural silk is only 1.36. Its moisture content under normal air dry conditions is about the same as for silk—i. e., 11 per cent. Acetate silk, however, under the same conditions contains only 2 to 3.5 per cent moisture. The diameters, according to Massot, compare as follows[10]:

Natural silk	0.0150 mm.
Chardonnet silk	0.0288 mm.
Lehner silk	0.0354 mm.
Glanzstoff	0.0295 mm.
Viscose silk	0.0305 mm.

Artificial silks swell when moistened, and in this condition the diameters are from 50 to 60 per cent larger. Advances in the art since the time of Massot's publication have made it possible to obtain much finer threads, closely approaching natural silk, as in the Thiele process previously mentioned and in Bronnert's work on viscose (U. S. Pats. 1,374,718; 1,376,671-2; 1,393,197-8-9).[11]

According to Strehlenert[12], the strengths of various natural and artificial silks compare as in Table I.

S. J. Pentecost[13] gives the figures of Table II.

TABLE I—STRENGTH OF SILKS

Variety	Strength, Kg. per Sq.Mm. Dry	Wet
Natural silks		
Chinese	53.2	46.7
French	50.4	40.9
French boiled off	25.5	13.6
French dyed red and weighted	20.0	15.6
French blue black, 100 per cent weighting	12.1	8.0
French black, 140 per cent weighting	7.9	6.3
French black, 500 per cent weighting	2.2	....
Artificial silks		
Chardonnet nitrocellulose	14.7	1.7
Lehner nitrocellulose	17.1	4.3
Strehlenert nitrocellulose	15.9	3.6
Glanzstoff	19.1	3.2
Viscose, Cross and Bevan	11.4	3.5
Viscose, latest	21.5	....
Cotton yarn	11.5	18.6

TABLE II—STRENGTH BY DENIERS

Type	Size in Deniers[14]	—Strength, Kg. per Sq. Mm.— Dry	Wet	Redried
Chardonnet	120	42	0	95
Glanzstoff	130	40	35	41
Viscose	120	51	50	51.5
Viscose	200	91	86	88

[10] *Leipz. Mon. Text. Ind.*, 1902, pp. 760 and 832; 1905, p. 131.
[11] *J. Soc. Dyers & Colour*, vol. 38, p. 153 (1922).
[12] *Chem. Zeit.*, p. 297, 1900.
[13] *J. Soc. Chem. Ind.*, vol. 35, p. 587 (1916).
[14] In the trade, the fineness or "count" of silk is given in deniers, which is the weight, expressed in grams, of a thread 9,000 meters (Italian legal denier) or 10,000 meters (metric denier) long.

It will be noted that in Strehlenert's figures the artificial silks compare favorably with dyed silks, especially if the latter have been weighted to any extent. Here again, numerous advances have been made and the strengths of artificial silks have been improved.

Distinguishing Silks

Methods of distinguishing between the various kinds of artificial silks are given by Maschner[15]. About 0.2 gram of the sample in a test tube is covered with concentrated sulphuric acid. Copper silk turns yellow at once, changing in a few minutes to a yellowish red. Within half an hour it dissolves, coloring the acid a pale yellowish brown. Viscose silk turns to reddish brown in 1 or 2 minutes and dissolves to a brown liquid. Concentrated phosphoric acid of 1.7 sp.gr. turns copper silk that has been spun in alkali, brown, whereas it gives no coloration with copper silk spun in acid, nitrocellulose or viscose silks. Known samples should be subjected to these tests at the same time as the unknown to make sure of the colors. Nitrocellulose silk, owing to traces of undecomposed nitric acid esters which are always present, gives a dark blue coloration with a solution of diphenylamine in concentrated sulphuric acid.

Comparison of the cross-sections under the microscope is probably the best method for distinguishing between natural and artificial silks. A rough test that may, however, be masked by dyeing is to burn a thread of each. Silk will give the characteristic odor of burning nitrogenous matter. According to Formhals[16], the samples to be tested are dissolved in concentrated sulphuric acid, diluted with water and then made alkaline. A solution of diazotized paranitraniline is now added. Natural silk under these conditions will give a red, artificial silk a yellow color. It is claimed that this test may be used successfully even in the case of heavily weighted, dyed silks.

It would lead too far to go into the dyeing of artificial silk. Suffice it to say that in general it has a greater affinity for dyestuffs than cotton. This does not apply to acetate silk, where special methods have to be used to fix the dyestuffs on the fiber. Specific instructions for the different cases may be obtained from the dye manufacturers.

Uses of Artificial Silk and Its Consumption in the United States

Since artificial silk first came on the market its uses have rapidly increased. It has been improved to such an extent that it can be used in a great many cases in place of silk. Where there is considerable strain on the fabric, it is generally woven or knitted with a thread of silk or cotton. The largely increased production of artificial silk has apparently had no influence on the consumption of the natural product. Artificial silk must be considered as a new textile material rather than as a substitute for an old one; it has made a place for itself in many fields, and there is ample room for both. In 1899 the consumption of artificial silk in the textile mills of the United States amounted to 6,056 lb., of a value of $10,380. Table III shows how it has grown in importance since that time.

Wilson[17] estimates the present daily production of

[15] *Lehne's Färberztg.*, vol. 21, p. 352 (1910).
[16] *Lehne's Färberztg.*, p. 6, 1913.
[17] *J. Soc. Chem. Ind.*, vol. 39, p. 266 R (1920).

TABLE III—SILK CONSUMPTION IN UNITED STATES

Year	Raw Silk (a) Imports, Lb.	Artificial Silk Imports (b), Lb.	Artificial Silk U. S. Manufacture (b), Lb.	Artificial Silk Average Value Per Lb.
1899	11,250,383	.....	6,056 (c)	$1.72
1904	16,722,709	.....	466,151 (c)	3.52
1909	25,187,957	.....	914,494 (c)	2.13
1912	26,584,962	1,631,807	1,117,285	....
1913	32,101,555	1,395,599 (f)	1,565,583	....
1914	34,545,829	2,590,490	2,443,954	1.83
1915	31,052,674	3,044,316	4,107,385	2.46
1916	41,925,297	973,082	5,741,338	3.12
1917	40,351,423	543,446	6,696,861	3.52
1918	43,680,988	120,540	5,827,627	4.50
1919	44,816,918	1,072,040	8,173,824	5.50 (d)
1920	30,050,374	1,846,875 (e)	.....	....

(a) Statistical Abstract of the U. S.
(b) *Chem. Age* (N. Y.), vol. 28, p. 147 (1920).
(c) Consumption in textile mills of U. S. (Census of Manufactures, 1914).
(d) $4.25 low; $8 high.
(e) Foreign Commerce and Navigation of U. S., 1920.
(f) Up to 1912 artificial silk imports were included with silk figures.

artificial silk to be from 5 to 6 tons in Germany, 4 tons in France, 10 tons in England, with smaller quantities produced in Belgium, Switzerland and Italy. The estimate for Germany is believed to be low. The capacity in this country is probably about 45,000 lb. daily for viscose and 7,000 lb. for nitrocellulose silk.

Processes Used in Different Countries

It is interesting to note that nitrocellulose silk, which had its origin in France, has been most successful there and in Belgium. Cuprammonia silk, developed largely in Germany, has had its greatest success in that country, although the branches of the Glanzstoff A. G. have prospered in other countries. England and the United States have more or less confined themselves to viscose, which was discovered by Englishmen. The German viscose plants of Count Donnersmarck have never been successful and were sold to the Glanzstoff people a few years before the war. Owing to the scarcity of cotton, copper and ammonia during the war in Germany, the Germans turned to the manufacture of viscose silk in spite of the success they had previously had with cuprammonia. Of the nitrocellulose factories, the Belgian plant at Tubize has been signally successful, owing perhaps to a favorable and cheap supply of alcohol. Foltzer, in his book on "Artificial Silk and Its Manufacture," gives the following comparative cost figures for artificial silk:

Nitrocellulose	13.55 fr.	= $2.61 (at par of exchange)
Cuprammonia	8.85 fr.	= $1.71
Viscose	8.25 fr.	= $1.59

Solvents recovery has since been improved so that at this time the cost of nitrocellulose silks is relatively lower.

In the United States today three processes are in use—viscose, nitrocellulose and acetate. Of these viscose is the oldest, having been started in Lansdowne, Pa. (later Marcus Hook, Pa.), in the early years of this century. The nitrocellulose plant is the youngest, having been built in 1921. Cellulose acetate still seems to be in the experimental stage and but little of it is on the market. Cuprammonia has never established a foothold here, though a number of small plants have been started from time to time for its production. The failures seem to have been due to lack of capital or inexperience in the mechanical handling of the product. On the other hand, this type has been very successful in Germany and other places where the original manufacturers established branches and large quantities were imported and used here before the war. There seems to be no reason why it should not be made successfully in this country, as the raw materials—cotton, copper and ammonia—are available in large quantities and at prices as low as or lower than elsewhere. With an efficient recovery, it is decidedly cheaper to manufacture than nitrocellulose silk and should cost little if any more than viscose silk. It has a higher luster than either and has no tendency to yellow or deteriorate in storage.

The artificial silk industry is one of the few that have suffered little from the business depression prevailing during the past 2 years, and promises to maintain its status as an important branch of the textile and chemical industries.

U. S. Patents Relating to Artificial Silk

NITROCELLULOSE SILK

365,832	516,079	573,132	834,460	1,093,012
367,534	516,080	593,106	842,125	1,127,871
430,508	531,158	663,739	866,768	1,151,487
439,882	559,392	665,975	888,260	1,188,718
455,245	562,626	699,155	951,067	1,236,719
460,629	562,732	820,351	1,022,416	1,315,700
508,124	563,214	828,155	1,040,886	1,315,701

CUPRAMMONIA SILK

617,009	779,175	852,126	960,791	1,000,827
646,351	795,526	857,640	962,769	1,022,097
646,381	798,868	863,801	962,770	1,023,548
650,715	806,533	863,802	965,273	1,027,689
657,818	813,878	866,371	965,557	1,030,251
658,632	836,620	879,416	967,397	1,034,235
661,214	839,013	884,298	977,863	1,049,201
672,350	839,014	904,684	978,878	1,062,106
672,946	839,825	908,754	979,013	1,062,222
691,257	840,611	909,257	980,294	1,064,260
698,254	842,568	945,559	983,139	1,066,785
705,748	850,571	947,715	986,017	1,106,077
710,819	850,695	954,984	988,430	1,130,830
		957,460		

VISCOSE SILK

622,087	808,148	984,539	1,143,569	1,376,671
716,778	808,149	986,306	1,200,774	1,376,672
724,020	816,404	1,044,434	1,226,178	1,375,823
725,016	836,452	1,045,731	1,280,338	1,375,824
759,332	849,823	1,073,891	1,292,544	1,387,882
767,421	863,793	1,102,237	1,355,985	1,398,525
773,412	896,715	1,117,604	1,379,351	1,393,197
792,888	950,435	1,119,155	1,374,718	1,393,198
798,027	970,589	1,121,605	1,366,162	1,393,199
805,456	980,648	1,121,903	1,366,163	1,401,943

CELLULOSE ESTERS

712,200	838,350	955,082	988,965	1,107,222
733,729	902,093	972,464	1,028,748	1,109,512
792,149	912,637	981,574	1,055,513	1,156,969
	922,340		1,074,092	

ARTIFICIAL HORSEHAIR, ETC.

680,719	791,385	804,191	856,857	1,128,624
713,999	791,386	853,093	1,010,222	1,164,084

APPARATUS

702,163	750,502	846,879	923,777	1,155,777
702,382	796,740	849,822	979,434	1,184,206
716,138	823,009	849,870	988,424	1,202,766
732,784	827,434	858,648	1,093,146	1,366,166
745,276	838,758	876,533	1,119,155	1,371,113

MISCELLANEOUS PATENTS RELATING TO OTHER FORMS OF ARTIFICIAL SILK, SOLVENTS, DYEING, ETC.

571,530	646,799	961,241	1,082,490	1,315,393
594,888	697,580	979,966	1,087,700	1,366,023
611,814	712,756	995,652	1,141,510	1,378,443
625,033	729,749	1,002,408	1,169,267	1,398,357
625,345	836,788	1,041,587	1,218,954	1,394,270
	932,634		1,242,030	

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Thermal Conductivity of Refractories*

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IN CONNECTION with the work of A.S.T.M. committee C-8 on refractories, and particularly with that of the sub-committee on thermal conductivity, it seems worth while to consider, briefly, the relation of thermal conductivity to other properties of refractories and to attempt to find what place, if any, this property will have in specifications for refractories. It may also be worth while to try to determine what is most needed in the way of data and of methods of test.

Factors of Importance in Refractory Specifications

In practically all the uses to which refractories are put, the most essential requirement is that they shall resist destructive agencies, including heat, erosion, the chemical action of the constituents of furnace gases and the corrosive action of slags and glasses. No single type of material will resist all the destructive agencies successfully; neither are all the destructive agencies found in any one furnace. The primary purpose of a specification is to state, quantitatively, the properties which a refractory material must have in order to resist, for a reasonable length of time, the destructive agencies which will be encountered in a specific place in a particular type of furnace.

In general, only one type of refractory material is suitable for a given purpose. Most of the high-temperature furnace work calls for high-grade fireclay brick; for certain conditions, silica refractories are practically always used, and other conditions require still other types. It has been sufficiently well established that the difference in thermal conductivity between different brands or grades of brick within a given type or class are not important as compared with differences in refractoriness, in resistance to spalling, resistance to slag corrosion, etc. It seems probable, therefore, that in the great majority of cases those properties which are essential to resistance to destructive agencies and which vary to an important extent from one brand of brick to another will be made the matters of specification regardless of thermal conductivity.

There are cases, however, in which the selection of the *type* of refractory to be used for a given purpose is influenced by the relative conductivities of different types, and in cases of this sort, where more than one type is available and the conductivity is especially important, heat conductivity may eventually become a matter of specification.

Reliability of Available Thermal Conductivity Data

Since thermal conductivity may be a factor in the selection of the type of brick to be used for a given purpose, it is important to have reliable data as to the conductivity of the different refractory materials and it may be worth while to consider the completeness and the reliability of the figures now available.

Unfortunately, the figures given in many of the tables to be found in handbooks and elsewhere have been taken from unsatisfactory sources and are somewhat confusing. This applies particularly to the data obtained from the investigation by Wologdine,[1] which were for a number of years (1909-1915) the best data available on the heat conductivity of refractory materials and have, in consequence, been very extensively quoted. However, it is difficult, in going over Wologdine's results, to find record of a single group of specimens that appears to have been burned to the temperature to which the material would have been burned commercially; it appears to have been the purpose of the investigator to show the effect of the temperature of burning on the conductivity of the various materials rather than to provide data for the use of engineers and others who might have occasion to estimate heat losses in connection with the design of furnace installations.

In 1915 important work on thermal conductivity of refractories was reported by one American[2] and a group of British[3] investigators. The work of Dudley has much to recommend it. His determinations were made on large specimens built up from several full-size bricks and he used well-known American brands of firebrick, thereby establishing the identity of the materials on which his conductivity determinations were made. His description of his method indicates that his work was done with what may be termed good engineering accuracy.

The work done by Dougill, Hodsman and Cobb appears to have been well planned and skillfully executed. Their method permitted the use of commercial bricks, made and burned in the regular way. While their determinations were not made on the same brands of brick as Dudley's, they included approximately the same classes of refractories that he tested and a comparison of those results which are comparable, from

*Paper, slightly abridged, presented at the twenty-fifth annual meeting of the American Society for Testing Materials, Atlantic City, June 26 to 30, 1922.

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[1]Bull. Soc. d'Encour., p. 879 (1909); *J. Soc. Chem. Ind.* (1909).

[2]"The Thermal Conductivity of Refractories," by Boyd Dudley, Jr., *Trans., Am. Electrochem. Soc.*, vol. 27, p. 285 (1915).

[3]"The Thermal Conductivity of Refractory Materials," by C. Dougill, H. J. Hodsman and J. W. Cobb, *J. Soc. Chem., Ind.*, vol. 34 (1915).

TABLE I

Class of Refractory	Investigator	Brand or Make	Temperature Range, Deg. C. Inner Surface	Outer Surface	Mean Thermal Conductivity, k*	Remarks
Fireclay	A	Woodland	965	120	0.0026	
		Woodland	1,025	100	0.0026	
		Woodland	995	400	0.0027	
	B	Farnley	825	260	0.0029	
			970	300	0.0029	Hard fired—Seger cone 10-11 approximately
			1,080	330	0.0036	
			1,440	550	0.0040	
			1,100	420	0.0033	
			1,350	510	0.0039	Another specimen
Siliceous Brick with clay bond	A	Quartzite	935	100	0.0026	
			960	100	0.0026	
	B	Farnley	1,300	310	0.0025	Many quartz grains
Silica brick	A	Star	910	100	0.0031	
	B	Gregory	995	295	0.0030	
			1,210	370	0.0035	Coarse grained
			1,240	440	0.0039	
			1,395	440	0.0042	
Magnesite brick	A		830	445	0.0135	
	B	Mabor	875	525	0.0110	
			1,040	590	0.0098	
			1,370	690	0.0091	

* Cal. per sec. per sq.cm. for a temperature gradient of 1 deg. C. per cm.

A—"The Thermal Conductivity of Refractories," by Boyd Dudley, Jr., *Trans. Am. Electrochem. Soc.*, vol. 27, p 285 (1915)

B—"The Thermal Conductivity of Refractory Materials," by G. Dougill, H. J. Hodsman and J. W. Cobb—*J. Soc. Chem. Ind.*, vol. 34 (1915).

nese two investigations, given in Table I, shows as ose agreement as could be expected. While most of heir results are expressed as the mean k for the speci- hen under the temperature conditions existing in it at he time the determination was made, both Dudley and)ougill, Hodsman and Cobb computed, from their data, he coefficients of thermal conductivity of some of the naterials which they investigated, for different tem- eratures up to 1,000 deg. C. Dougill, Hodsman and Cobb deduced the following formulas:

1) For fireclay brick,

$$k_t = 0.00155 + 0.25 \times 10^{-5}t$$

2) For magnesia brick,

$$k_t = 0.0285 - 0.379 \times 10^{-4}t + 0.179 \times 10^{-7}t^2$$

n which k_t is the thermal conductivity at temperature t.

Application of the Data in Calculating Heat Transfer

All things considered, it seems entirely reasonable to ccept results of these investigations and to make use f the formulas of Dougill, Hodsman and Cobb in rdinary engineering computations, making allowance or the fact that the values will be lower in the case f porous, light-burned brick and higher with denser rick. It is true that only rough estimates can be btained in this way, but it must be taken into con- ideration that only rough estimates of the heat trans- er through the walls of a given installation could be btained by computation, in most cases, even though recise figures for the thermal conductivity of the fire- rick were available. In the first place the temperatures f the inner and outer surface must be known and if the wall is to be more than one brick thick, the effect of the joint, or joints, must also be known as well as the con- uctivity of the refractory material, before the heat flow through the wall can be computed. Unless the tempera- tures of the two surfaces can actually be measured, a rough approximation is introduced at this point. The effect of joints must not be overlooked and introduces another factor that is uncertain as to magnitude.

Effect of Other Factors—Surface Resistance

Furthermore, it must be taken into consideration that heat conductivity, or its reciprocal, resistance to heat flow, is but one of several factors, working in series and that the larger the other factors, such as surface resistance and the effects of joints, the smaller, relatively, is the effect of differences or errors in the values assumed for thermal conductivity. The effect of surface resistance is shown in the operation of re- torts, in a gas plant, by the fact that when the flame changes from transparent to luminous the rate of gas production increases, showing that heat is passing into the retorts more rapidly. When the flame is transparent a very large portion of the heat must be taken up by the retort by conduction; when the flame becomes lumi- nous, radiant energy is transferred rapidly from the myriad of minute particles of incandescent carbon float- ing in the gas to the surface of the retort, and the retort is heated by radiation, reducing to a large extent, the effect of the surface resistance at the outer surface. The fact that the difference in rate of production is con- siderable shows that the surface resistance is a large factor. This factor has been studied sufficiently to jus- tify the statement that the surface resistance of one surface of a retort may be as great as the internal re- sistance of the wall itself.

There is one other factor that should not be lost sight of in this connection. In the case of furnaces operating at high temperatures, there is a tendency for a portion of the brick to vitrify, in course of time, increasing the conductivity of that portion by possibly 40 to 50 per cent. Also, under certain conditions, re- fractories become impregnated with various substances taken up from the gases penetrating them and it is practically certain that the impregnated materials differ to an important extent in heat conductivity and in other properties from the original material.

It is not the purpose of the foregoing discussion to discourage the making of computations, but it is thought that some computers may believe, erroneously, that the lack of reliable figures for thermal conduc- tivity is the greatest obstacle in the way of obtaining reliable estimates of the heat transfer to be expected in a given case, whereas, as a matter of fact, the more one studies the problem the less concern is felt about the accuracy of the value ascribed to the conductivity of the material in question; other factors which neces- sarily enter into the computation have to be approxi- mated so roughly that the uncertainty involved in this one becomes relatively unimportant.

Need for Simple Standard Method

The fact remains, however, that in certain places, particularly in muffles and retorts, high conductivity is important because it is essential to efficiency, whereas in others, particularly in the insulating courses that are used in certain conditions, back of refractory lin- ings, low conductivity is important for the same reason. With the advent of carborundum and other high con- ductivity refractories, as well as the introduction of new insulating materials, an increasing interest is be- ing taken in the heat conductivity of refractories and it is important that a standard method for making conductivity determinations should be developed. The method should be simple so that routine tests can be made, with apparatus of moderate cost, with reasonable accuracy, by an operator of reasonable ability and ex- perience. It would be a waste of time to make conduc- tivity determinations with great precision on samples of firebrick, because the properties of different samples, even of brick of the same brand, would vary some- what. On the other hand, it is essential that any method adopted be capable of giving results that can be depended on for reasonable accuracy, say to about 5 per cent.

In answer to the question which naturally arises, in this connection, as to what the Bureau of Standards is prepared to contribute in the way of a suggested method, it may be said that the bureau has been work- ing for a number of years on the determination of thermal conductivity, the earlier work being done at low temperatures. Data obtained from this work are to be found in an article entitled "Thermal Conductiv- ity of Heat Insulators," by M. S. VanDusen, in the *Journal* of the American Society of Refrigerating En- gineers, November, 1920, and the *Journal* of the Society of Heating and Ventilating Engineers, October, 1920. Work is now nearing completion on a method for the ac- curate determination of the conductivity of refractory materials. While this method will not be adapted to the making of appropriate determinations in a rou- tine way, it is believed that the knowledge and experi- ence that have been gained in connection with the more

refined work that has been done will make it possible to develop a test method which will be suitable for such use.

SUMMARY

The situation in regard to heat conductivity may be summed up as follows: Differences in thermal conductivity between different brands or kinds of refractory materials within a given class, such as high-grade fireclay refractories, while they may be considerable, are comparatively unimportant so far as the efficiency of an installation is concerned, because the conductivity of the material constituting a wall is only one of several factors working in series, to affect rate of heat transmission. Thus a 10 per cent difference in conductivity may make only a 5 or a 2 per cent difference in the heat flow through a wall. On the other hand, the difference in conductivity between two types of materials such as fireclay refractories and carborundum refractories may be relatively important for such purposes as the walls of retorts and muffles. It is not unreasonable to expect that conductivity will become a matter of specification for refractory materials for certain purposes.

In regard to the question of obtaining satisfactory figures for use in computing heat flow through walls of various types in furnaces, attention is called to the fact that while the data of Wologdine, which have been copied extensively in physical tables, are likely to be misleading unless his work is discriminatingly studied, the data of Dudley and of Dougill, Hodsman and Cobb appear to be satisfactory for ordinary purposes. These investigators made determinations on well-known commercial materials and their results check as closely as should be expected, considering the fact that the materials studied were not identical. The data from these investigations should be satisfactory to the engineer, considering the fact that he must accept rough approximations for other factors involved in computations of heat transfer through walls.

The different investigators who have made heat conductivity measurements have developed a variety of methods, all of which are elaborate and laborious. There is a need for a standard method for making routine conductivity tests of commercial materials. It is not essential that it should be a precision method, but it is important that it be simple and reasonably convenient and at the same time accurate, within reasonable limits.

Hygroscopicity of Tetryl and Tetranitraniline

At the Pittsburgh, Pa., experiment station of the Bureau of Mines, a study is being made of the hygroscopicity of tetryl and tetranitraniline. The purpose of the investigation is to determine the physical constants of pure chemicals and the commercial products as used in the manufacture of explosives. The work is being done by L. G. Marsh, under the general supervision of C. A. Taylor, both assistant explosives chemists.

Chinese Pig Iron Production

Commercial Attaché Arnold, Peking, reports that, according to the estimate of K. Y. Kwong, Chinese engineer and mining authority, China's total production of pig iron annually is about 450,000 tons from Chinese furnaces and 250,000 tons from Japanese furnaces in China. The total output of iron ore in China is about 2,000,000 tons a year.

Industrial Ventilation as Applied To Dust and Fume Removal*

BY H. M. NICHOLS† AND F. R. ELLIS‡

TO QUOTE an official of one of the leading insurance companies: "Industrial or occupational diseases are becoming recognized more and more completely as being compensatable. That is to say, the insurance carriers (and therefore the employers, since they have to pay the insurance costs) now have to consider not only the obvious immediate injuries to employees from hazards such as burns from corrosive fumes or deaths from explosions of combustible dusts and vapors, but also the indirect and sometimes slow-acting internal injuries to employees, such as lead poisoning and other toxic actions in human organs and tissues."

It is, therefore, becoming a matter of economy as well as humanitarian to control these agencies so that they will not endanger the health of the workers, and mechanical ventilating systems play an important part in such control.

General Method of Arranging Mechanical Ventilation

The necessity for ameliorating the conditions created by machines producing irritating dust was recognized long before the days of liability insurance or of workmen's compensation legislation; in fact, the beginnings of the fan business were inspired by the necessity of finding some way to get rid of the irritating dust from buffing machines in the shoe industry. It was for this purpose that B. F. Sturtevant, the father of the industry, about 1860 conceived his first fan.

The treatment of this form of hazard—namely, all processes producing fine, irritating dusts from wheels or cutters—is today very much the same as the arrangement evolved in the application of this first fan. In this class come buffing, grinding and polishing wheel operation. Many classes of cutting operations may be treated in a similar manner.

Inclose Wheel of Cutter as Completely as Possible

In general, the wheel or cutter is as nearly wholly inclosed as possible by a metal hood which is attached to and becomes a part of the piping of the exhaust system; the hood should be designed to take advantage of any movement given the dust by the operation. Thus, if a cutter throws the dust in a horizontal direction, the hood should be so arranged that the dust will be thrown into it. Where the material is thrown vertically upward or downward, the hood should be placed above or below the wheel or cutter. It is obvious that by carrying away the dust in the direction in which it is thrown the trapping and removal of the material will be the most effective.

It was only a small step from the removal of dust-buffing operations to the removal of refuse from woodworking machinery, and while many woodworking operations do not produce refuse in a finely divided state, the handling of this class of machinery is very similar to the method of handling buffing machinery.

*Abstract of paper given at the convention of the National Safety Council, Detroit, Mich., Aug. 30 to Sept. 1, inclusive.

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Shrinkage and Expansion Of High-Speed Steel Due to Heat-Treatment

Volume and Hardness Changes, Thermal Analysis and Microstructure Indicate That Secondary Hardness in High-Speed Steel Is Due to Decomposition of a Stable Austenite Into Martensite II, Different From Martensite Formed During Quenching

By Marcus A. Grossmann
Metallurgist, Electric Alloy Steel Co., Charleroi, Pa.

TESTS described herein were recently undertaken primarily to obtain data on the amount which should be allowed in high-speed tools for shrinkge or expansion resulting from heat-treatment. The esults obtained seem to throw an interesting sidelight n the nature of the reactions taking place during the eat-treating of high-speed steel.

Method of Testing

Tests were carried out on a high-speed steel of the ollowing analysis: Carbon 0.65 per cent, tungsten 18.0, hromium 4.0, vanadium 1.0. Cylinders 1½ in. diameter nd about 2½ in. long were heat-treated and the changes n length noted. In all the earlier tests the pieces were laced in a semi-muffle gas furnace without protection n the ends. Therefore, due to the formation of scale, o direct comparison of the annealed to the hardened tate could be obtained. Instead, the scale was ground ff and a measurement taken in the hardened condition; he pieces were then drawn at successively higher temeratures and measured after each draw. Finally the amples were annealed, oxidation being kept as low as ossible. The final dimensions (after annealing) were ssumed to be the same as those of an annealed piece efore hardening. Later a method of clamping proecting pieces on the ends of the test-pieces was devised, vhich allowed the test-piece to be hardened at temperaures as high as 2,400 deg. F. without any visible xidation. Measurements could then be taken directly n both the annealed and the hardened condition. All neasurements were made with ordinary micrometers.

Heat-Treatment

In hardening, the test-pieces were preheated for about 15 minutes at about 1,550 deg. F. and were then heated o the temperature indicated on the graphs. In each ase they were heated just to the temperature for quenching and then quenched in oil. The samples were measured as quenched and were then measured after ach successive draw, each value shown in the table being an average of from four to six readings. Care was taken that the samples were measured always at the same temperature—about 70 deg. F. Drawings up to 600 deg. F. were done in oil; beyond that temperature the drawings were done in a lead bath covered with charcoal or in molten sodium-potassium nitrate. As soon as the specimen had been held the required time in the drawing bath it was immediately quenched in cold heavy oil in order to avoid excessive oxidation. It was not believed that this quenching had any effect on the dimensions inasmuch as the steel did not go through any transformations when being quenched from the drawing temperature, and the temperature gradient due to quenching could scarcely have been great enough to cause the steel at any point to exceed its elastic limit during the quenching. (For discussion of this point see Heyn, "Materialienkunde," Chap. VI, Section D.)

Observations

Examination of Fig. 1 shows that regardless of the quenching temperatures there is a certain regular trend of the contractions and expansions on reheating which in general vary in amplitude but not in direction. (It may be well to repeat here that all measurements were taken after the steel had cooled to room temperature, 70 deg. F. Therefore when, for example, a "contraction on heating" is mentioned, this refers to the comparative dimensions of the cold test-pieces after cooling from the heating temperature, and takes no account of the intervening normal thermal expansion in the heating process, which has no especial relation to the structural changes.) When the quenched steel was reheated slightly and then cooled, a contraction resulted; after further heating at higher temperature it showed a larger shrinkage until a drawing temperature of about 1,000 deg. F. was reached. Drawing to higher temperature (1,050 deg. F.) then caused an expansion which was only very moderate, but which became very marked after reheating to about 1,100 deg. Drawing beyond this temperature again caused a contraction, which continued until the steel was fully annealed.

Howard Scott[1] shows a figure giving practically the same shape curves as those shown in Fig. 1. After quenching at 1,940 deg. F. (1,060 deg. C.) his curve representing drawing temperature versus density shows uniform shrinkage after a draw up to 750 deg. F. and then a slight expansion after a draw at 1,100 deg. F.

It will be observed that as the quenching temperature

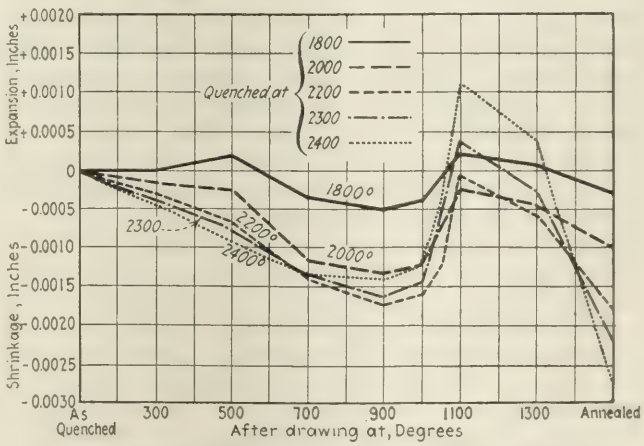


FIG. 1—MEAN VARIATIONS IN LENGTH OF 2.5-IN. SAMPLE OF HIGH-SPEED STEEL

[1]Bureau of Standards Scientific Paper 395, "Relation of the High-Temperature Treatment of High-Speed Steel to Secondary Hardening and Red-Hardness."

was raised, the amount by which the steel expanded on hardening increased (compare the location of the curves at the ordinates marked "As quenched" and "Annealed"). The amount by which the steel contracted after the low draws also increased. It will be observed that with this rise in quenching temperature, the amount by which the steel expanded after a draw in the neighborhood of 1,100 deg. F. also increased. Subsequent contraction, after the drawing temperature of 1,100 deg. was passed, was of course also greater as the quenching temperature was raised.

It appears that these shrinkage measurements throw further light on the reactions inferred from the hardness curves for drawn high-speed steel (Fig. 2) as well as the deductions from the microstructure and from the critical points shown in cooling and heating curves.

Hardness, Microscopic and Thermal Investigations

It is proposed to review rather briefly the evidence of other lines of investigation, and then to show how a series of shrinkage curves presents a general picture of all the reactions taking place in a high-speed steel. Shrinkage curves offer as yet no evidence as to the composition of the phases taking part in these reactions, but it is believed that with further refinement this, too, may be forthcoming.

Probably the earliest studies along these lines were in the field of hardness. Fig. 2 summarizes the results of numerous series of hardness measurements on steel of the composition under discussion. It will be seen that if we consider the steel as quenched but not drawn, there is an increase in the scleroscope hardness with rise in quenching temperature, up to a certain quenching range, beyond which no appreciable increase in hardness is produced. When these quenched pieces are drawn, there is a gradual decrease in the hardness, which decrease continues up to drawing temperatures of 900 to 1,000 deg. F. After the steel has been drawn in the neighborhood of 1,100 deg., there is an increase in hardness, which is very pronounced for steels previously quenched from the highest temperatures, but which is in evidence merely as a flattening of the curve at the low quenching temperatures. For still higher drawing temperatures the hardness finally decreases, approaching that of the annealed condition.

From these hardness curves it seems that as the quenching temperature is raised some hard constituent or constituents are formed, whose amount increases with this rise in quenching temperature. When the steels are drawn, some change takes place up to 1,000 deg. which is responsible for a decrease in hardness. After drawing at 1,100 deg., there is an increase in hardness which may be attributed most reasonably to the appearance of a new constituent. On heating at still higher temperatures, all the constituents are finally brought to the annealed condition.

Let us consider next the microscopic evidence. After quenching from the lowest temperatures the pieces show for the most part merely a gray mottled background, containing larger particles of what are considered to be carbides and tungstides. As the quenching temperature is raised, there gradually becomes distinguishable in the gray background of the cold samples a polyhedral structure of what appears to be a new constituent. As the quenching temperature is raised further, the new grains become more distinct and increase in size, and the comparatively large particles of carbide and tungstide decrease in size and number, being apparently dissolved to make up part of th new constituent. Now this new constituent has bee called austenite, from the fact that when a piece showin it is drawn at 1,100 deg., it develops the characteristi structure of martensite. Since martensite found in car bon steels is very hard, it is reasonable to suppose tha the martensite in high-speed steels is a very har constituent, even though it may be of different chemica composition from the martensite of carbon steels. Thi would account for the hardness developed by drawing a 1,100 deg., which is commonly called "secondary hard ness." On heating the hardened steel beyond 1,100 deg the martensite structure is broken up and the stee returns gradually to the obscure uncertain structur of the annealed condition.

Let us now consider the time-temperature curve found in thermal anaylsis, of which good examples ar those developed early by Yatsevich and reproduced b Sauveur in his "Metallography and Heat-Treatment o Iron and Steel," on p. 358. When the highest tem perature reached is but slightly above the critical range (say at 1,600 deg. F.) there is a pronounced jog in the

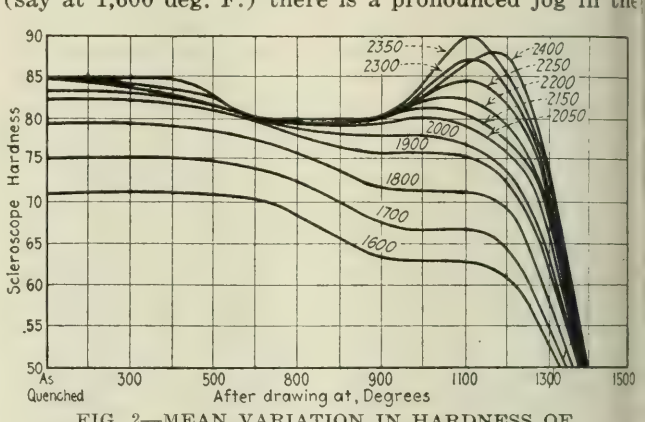


FIG. 2—MEAN VARIATION IN HARDNESS OF HIGH-SPEED STEEL

cooling curve at about 1,350 deg. F., which corresponds to the transformation from austenite through martensite to troostite. With rise in the temperature to which the steel is heated for taking the cooling curve this transformation at 1,300 deg. decreases in intensity, but there appears a second transformation at about 800 deg. F. This lower transformation, which the writer interprets as a transformation of austenite to martensite, increases in intensity as the initial temperature is raised. The increase in intensity of this martensite transformation naturally indicates an increase in the proportion of martensite in the cooled steel. (This would account partly for the increase in hardness with rise in quenching temperature, but involves the assumption that the microscopic appearance called austenite existing in these highly quenched steels is not really and entirely a solid solution of the various constituents.) If we now turn from the cooling curves to the heating curves, we find on reheating a piece which has been quenched from a high temperature and which is therefore apparently "austenitic" in the microstructure that there is a slight evolution of heat at 1,100 deg. F. This is thought to represent the transformation of some remaining austenite to a second kind of martensite, which also becomes evident in the hardness curves and finally appears in the microstructure.

Shrinkage Evidence

We come now to the evidence found in the shrinkage curves. These measurements, when considered in con-

lection with other lines of investigation, present a lear picture of the reactions taking place in heat-reatment.

It must be borne in mind that volume changes induced by heat-treatments may be the result of a combination of at least two factors: (1) The expansion which akes place during the transformation from austenite o martensite, and (2) the contraction which occurs after heating martensite, which is generally supposed o be connected with the formation of carbide molecules and crystals from elemental iron and carbon, but which the present author conceives as due in some measure also to grain growth. The contraction observed after drawing high-speed steel appears to be the same phenomenon as that observed by Andrew, Rippon, Miller and Wragg[2] which is discussed also by McAdam.[3]

We find first of all that as the quenching temperature is raised the difference in volume between the quenched and the annealed condition increases—that is, the expansion on quenching increases. This corresponds very satisfactorily to the increase in the amount of "primary" martensite, indicated in the cooling curves by the increasingly prominent discontinuity at about 800 deg. F., and in the hardness measurements by the increase in hardness as the quenching temperature is raised.

TABLE I—DIFFERENCE IN LENGTH BETWEEN DRAWN PIECES AND THE ORIGINALS QUENCHED AND NOT DRAWN.

	Drawing Temperatures, Deg. F.			
Steel	800	1,050	1,100	Subsequent 800
Annealed control piece...	—0.0001	—0.0001	0	+0.0003
	—0.0001	—0.0001	0	+0.0002
Quenched at 2,300 deg....	—0.0016	—0.0010	+0.0001	+0.0008
	—0.0016	—0.0012	+0.0003	+0.0007

When this quenched steel is now drawn to temperatures below 1,000 deg. F., the resulting contraction corresponds to the formation of carbide and grain growth in this "primary" martensite formed on quenching. The higher the quenching temperature the greater is this contraction on drawing; this was to be expected because of the presence of a greater amount of martensite which can be decomposed. This contraction, in being attributed to the decomposition of martensite with grain growth and formation of carbides, corresponds satisfactorily to the decrease in hardness of hardened high-speed steels after drawing at temperatures below 1,000 deg. F. This reasoning is based on the considerations presented in Jeffries' slip interference theory of hardening.[4]

After drawing hardened high-speed steels at 1,100 deg. F. there is then a second expansion which corresponds to the formation of a second martensite indicated by the hardness curve, the microstructure and the thermal curves. The expansion at 1,100 deg. acts in the manner which was to be expected. It also points out in a striking manner that the formation of a "secondary" or stable austenite begins soon after the critical point in heating has been passed, because quenching temperatures as low as 1,800 deg. F. induce a marked expansion after drawing at 1,100 deg. The amount of this expansion increases as the quenching temperature is raised until at quenching temperatures in the neighborhood of 2,300 to 2,400 deg. F. the expansion is very considerable.

It should be pointed out here, and the author wishes to lay emphasis on this point, that it seems inappropriate to refer to the two kinds of martensite formed in high-speed steel by the same name. The probability that they are not the same type of martensite and therefore probably not derived from the same type of austenite was indicated by a separate set of shrinkage measurements. If the martensite formed from the stable austenite by reheating at 1,100 deg. were of the same kind as the martensite formed in quenching, it would behave in the same way and would therefore decompose and show a shrinkage at the same temperatures. The values given in Table I show that the pieces hardened at 2,300 deg. and drawn at 1,100 deg. did not shrink on subsequent reheating up to temperatures of 850 deg. The new martensite is thus much more stable and holds its hardness better than does the "primary" martensite. It is therefore proposed to call the martensite formed on quenching "martensite I" and the martensite developed by subsequent tempering of the austenite "martensite II." It is this martensite II which can be seen readily under the microscope, for after the proper hardening and tempering procedure, martensite II is very coarse. Martensite I is a much less stable material than martensite II and corresponds more to martensites formed in carbon steels or low alloy steels, which are softened by comparatively low drawing temperatures. Martensite II, on the other hand, is the structural constituent which when developed gives to high-speed steel its most valuable high-speed cutting properties.

Constitution of High-Speed Steel

A general conception of the constitution of high-speed steels in the hardened condition is offered as follows:

It appears that there are present in the hardened steel before it is drawn the three structural constituents troostite, martensite and austenite. In addition there are certain tungstides and carbides, which are present as comparatively coarse granules if the quenching temperature was not high. With a very moderate quenching temperature—1,700 deg. F.—the amount of troostite is quite large, while the amounts of martensite and austenite are very small. As the quenching temperature is raised, the amounts of martensite and austenite increase with a corresponding decrease in the amount of troostite. At the same time it is evident that the absorption of tungstides and carbides increases, with the resultant formation of more austenite of a very stable character existing after quenching and changed only with difficulty to martensite—namely, by reheating to temperatures of 1,100 deg. F. and above.

Formation of martensite I is seen on the cooling curves of Yatsevich in the evolution of heat at about 800 deg. F. in cooling. Its presence is deduced from the shrinkage curves by the expansion on hardening and by the contraction of the steel after tempering up to temperatures of 1,000 deg. F. It makes its presence felt in the hardness by the increase in hardness of the quenched pieces as the quenching temperature is raised (see Fig. 2) and also by the decrease in hardness caused by the decomposition of this primary martensite after drawing the hardened steel at temperatures up to 1,000 deg. F. Formation of this martensite I increases at first rapidly with increase of quenching temperature,

[2] *Journal Iron and Steel Institute*, 1920—I, p. 527.

[3] *Chem. & Met. Eng.*, vol. 25, p. 613, Sept. 28, 1921.

[4] *Chem & Met. Eng.*, vol. 24, p. 1057, June 15, 1921. The slip interference theory fits observed facts so well that the present writer considers it to be completely established. It has served as the background of reasoning for the present paper.

but in the higher ranges of temperature above 2,100 to 2,200 deg. F. further increase in the quenching temperature does not seem to have proportionately as great an effect.

Existence of austenite in highly quenched samples is indicated in the time-temperature heating curves by the transformation (to martensite) when reheating quenched samples at 1,100 deg. F. The increase in the amount of stable austenite with quenching temperature is very evident both in the hardness curves and in the expansion curves, since its presence is deduced from the resultant formation of martensite. When the quenched samples are drawn at 1,100 deg. F., the increase in scleroscope hardness is very marked, especially after a quench in the neighborhood of 2,300 deg. F., as shown in Fig. 2. Expansion due to the appearance of this martensite also appears very plainly at 1,100 deg. F. (Fig. 1). This stable martensite II is decomposed only by subsequent heating at temperatures higher than 1,100 deg., which causes the final contraction of the steel and its return ultimately to the dimensions of the annealed condition.

Change of Properties of Substances on Drying

By Ellwood Hendrick

IN THE lively speech of Prof. H. E. Armstrong at the Glasgow meeting of the Society of Chemical Industry, he referred with great gusto to the work of Prof. H. B. Baker of the Imperial College of Science and Technology. We think his enthusiasm was warranted. A short record of Professor Baker's latest work has been published in the *Transactions* of the Chemical Society (London) for the current year (vol. 121) and for the benefit of our readers we shall review it adding few comments.

The title is "Change of Properties of Substances on Drying" and the significance of his findings will soon appear. Back in 1912 he observed that the boiling points of trioxide and tetroxide of nitrogen were raised respectively 44 and 47 deg. when they were permitted to stand for a long time in contact with phosphoric oxide. The following year he prepared a number of other liquids in a high state of purity, and sealed them up in vessels containing specially purified phosphorus pentoxide, with a view of getting them as dry as possible. Then came the war and the extraordinary duties involved in it, so that the substances Professor Baker had set aside for special drying in this way were left untouched for from 8 to 9 years. When the war was over and the opportunity for research returned, he proceeded to determine the boiling points of these very dry liquids, and he obtained surprising results, very similar to those noted in 1912. That is, the boiling points had gone up from 14 to 60 deg. above normal, although the boiling, when it did take place, was indicated by the formation of bubbles in the heated liquid in each case, and it proceeded quietly, with no sign of the violent ebullition which accompanies the breaking down of a superheated condition. Broken pieces of silica had been placed beforehand in each bulb to prevent superheating. In some cases two thermometers were inclosed in the bulb, one dipping in the liquid and the other suspended about 3 cm. above its surface. The temperatures read in the latter were at most 2 deg. above the normal boiling point of the liquid, and yet when the condensed liquid from the distillation was again heated it did not boil until the high temperature had been reached.

The following table shows the results of Professor Baker's tests:

	Period of Drying, Years	Original Boiling Point, Deg.	New Boiling Point, Deg.	Rise, Deg.
Bromine	8	63	118	55
Mercury	9	358	420–425	62
Hexane	8½	68.4	82	14
Benzene	8½	80	106	26
Carbon bisulphide	1 plus 27	49.5	80	30
Carbon tetrachloride	9	78	above 112	34
Ethyl ether	9	35	83	48
Methyl alcohol	9	66	above 120	54
Ethyl alcohol	9	78.5	138	60
Propyl alcohol	9	95	134	39

The apparatus used consisted in part of a glass distilling flask with two side tubes. To one of the side tubes was sealed the single side tube of another distilling flask, while the second side tube of the first was drawn out to a long, bent-down tube of about 2 mm. diameter. The necks of both flasks were lengthened by sealing on tubes of similar diameter, which were bent over at the top to form convenient receptacles for the phosphoric oxide. The apparatus was washed and dried thoroughly according to details given, and fragments of fused quartz previously heated were placed at the bottom of each flask. After the introduction of the liquids all openings were sealed and the drying process proceeded for the long period of time provided by the interim of the war and its more pressing duties. With liquids from which no chemical action on the phosphoric oxide was to be feared, such as benzene, hexane or bromine, a plug of the drying agent was placed with the liquid in the flask that contained it. In other cases the drying was performed only on the vapor.

To determine the boiling point the tip of the long tube was dipped under previously boiled mercury and then broken while the depth of the open tube was noted. The liquid was distilled by heating in an oil bath the flask containing it, while the other flask was cooled in water or ice. Then when enough of the liquid was collected in the previously empty flask which formed part of the apparatus, the second flask was heated and the first one cooled. The heating of the oil bath was conducted very slowly so as to allow the liquid to attain the full temperature of the oil. When this approached the boiling point, the heating was slowed down still more.

Experiments on Density and Melting Point

Details of the various experiments are given which we omit for lack of space. We should note, however, that with such a profound change as seemed to take place in these liquids on drying a marked change in density would also be observed. But benzene, carbon tetrachloride, carbon bisulphide, ether, bromine, sulphur dioxide and nitrogen trioxide were each left standing for a year and closed with phosphoric oxide, and the volumes remained the same, although a change of one part in ten thousand would have been easily detected.

Supplementary experiments were made in regard to melting points as follows: A tube containing sulphur which had been purified for atomic weight purposes was set up in 1913 and its melting point was 112.5 deg. The same reading was obtained in 1914, but by 1922 the melting point had become 117.5 deg. Professor Smits of Amsterdam points out that this is a confirmation of his recent theory of allotropy. A sample of iodine, also purified for atomic weight purposes, showed a change from 114 deg. in 1913 to 116 deg. in 1916 after similar

drying in the interval. Experiments are in progress for determining the specific heat of the dried liquids and the density of their vapors.

Professor Armstrong's enthusiasm will now become apparent. The amount of water removed by this long drying is so slight as to be apparently negligible; and yet the results support the hypothesis that at all events in the liquids tested we have aggregations of molecules probably held together by their external fields of force and that in the presence of the very slightest amount of water these aggregates separate or are loosened up. It seems to indicate the presence of colloidal phenomena clear outside the domain of colloid chemistry, to lend a shade of color to the contention that colloid chemistry is universal or, if we would follow Dr. Loeb or Professor Armstrong, that there isn't any such thing and that it is all just plain chemistry. It adds to our knowledge of the amazing qualities of water as a solvent and it carries us a step nearer toward the light in a direction where more light is sorely needed, and that is in the study of what a liquid really is. It is easy enough to visualize the molecules of a gas bumping around like so many balloons, but in a fluid the imagination of familiar things is less helpful. It begins to seem as though there were something like liquid crystals formed of aggregates of molecules and that the presence of water absorbed or took over the forces that hold them together. It may be that the alcohol molecules, for instance, have a definite geometric shape as suggested by the Lewis-Langmuir theory, and their external fields of force, being the same for each molecule of the same substance, cause them to interlock into the prescribed forms we know as crystals. Then when there is but one molecule of water with its own peculiar and different shape among many thousand molecules of alcohol, the interlocking of the alcohol molecules is prevented. It would be like inserting a block that "doesn't belong" into a picture puzzle. And why does the temperature of the vapor of the dry liquid prove to be only 2 deg. above normal, when taken at 3 cm. above the surface or at its dew point? This note has induced some eminent physicists to declare that for this reason there must be some mistake. But it may be right after all. There may be a time factor in this bunching or aggregation of the liquid molecules, although this is short, for as soon as the condensed liquid gets back to the mass it does not boil until the high degree of heat is reached. The precautions taken make it unlikely that the higher boiling points are due to the presence of any phosphorus compounds.

In fact the whole subject is causing a great deal of dispute in chemical circles in London.

Legal Notes

By Wellington Gustin

Tucker Decentralized Control System for Roasting Furnaces Not Invention

In a suit brought by the New Jersey Zinc Co. against the American Zinc, Lead & Smelting Co. in the United States District Court of Maine, the validity of patent 931,815, issued Aug. 24, 1909, to Allen Tucker of Mineral Point, Wis., was put in question.

The Tucker patent in suit involved certain improvements relating to an ore-roasting furnace generally known as the Hegeler furnace, invented by Edward C. Hegeler under patent 303,571, issued Aug. 12, 1884. In this furnace the ore is progressively moved forward on the hearths by rakes which are pulled through the hearths by the rake-moving machinery located at each end of the furnace. Now the Jersey Zinc Co., as plaintiff, says that prior to the invention of the Tucker patent, which it owned, two men were required at each end of the furnace for the raking operation. One man, called the "machine man" or "floor man," concentrated his attention wholly upon the operation of the mechanism or machinery for mechanically moving the rakes. Everything that had movement or which controlled selection or direction was in the hands of that man. He manipulated the control devices from the ground or floor adjacent to the head frame of the rake reciprocating mechanism. The other man, called the "hooker" or "platform man," attended to the hooking and unhooking of the rakes and the guiding of the rods and rakes into the hearths. Since his operating station was at various heights or levels, platforms were provided at each end of the furnace and on each side thereof, upon which the hooker stood in the performance of his duties.

Tucker decentralized the control by placing motor control devices upon each of the seven platforms so that the hooker could operate the mechanism in addition to his regular duties, thus eliminating the floor man.

The question the court asks is, Did Tucker make a patentable invention when he ran the control lines to the platforms instead of running them to the floor? The only substantial thing which he contributed or sought to contribute to the art was the convenience and economy obtained by reducing the number of men necessary to operate the kiln.

Simplicity Not Argument Against Invention

However, the court says, the simplicity of a device covered by the patent is not an argument against invention. When a thing has succeeded it is very likely to seem plain to any one. A classic quotation is here given.

"The very simplicity of an invention, which leads the inexperienced to infer little merit or application in the inventor, is most commonly the sequel of complications, which in succession have been contrived by him, and in succession been rejected. Indeed, who that ever cast a glance of intelligent observation upon our manufactures, or that has ever been struck with the combined simplicity and efficacy of the means employed, can do otherwise than infer that any one of the means that he admires must have been selected for superiority, when perhaps a thousand others have been rejected?"

Further, it is said that no test has been formulated by which a satisfactory line can be drawn between the products of the inventor's intuition and the results of the mechanic's skill, but that question must be left to a careful exercise of the judgment, guided by the established rules of the law.

Finally, however, the court held that the Tucker patent, for improvements in an ore-roasting furnace which consisted only in lengthening the handles of the controls for certain machinery so that they all could be operated by one man instead of requiring two as heretofore, did not disclose invention and was invalid.

Electrical Characteristics Of Dry Cells—I*

By G. W. Vinal and L. M. Ritchie

Showing the Effect of Temperature on Voltage, Amperage, Shelf-Life, and Tests of Dry Cells—Tables and Curves of Discharge at Constant Resistance and Constant Current Show Capacities to Different End Points at Different Rates

THE Bureau of Standards recently called a conference of leading manufacturers, various government departments and a few of the largest individual users of dry cells to consider the standardization of sizes of dry cells and flashlight batteries, and the revision of the specifications for them. This conference met on Dec. 5, 1921. An abstract of the work of the conference was published in this journal.[1] The sizes of dry cells and flashlight batteries which were adopted as standard are shown in Fig. 1. The data in this paper relate particularly to dry cells of the ordinary size, 2½x6 in.

Effects of Temperature on Dry Cells

Effect of Temperature on Voltage

The effect of temperature on the open circuit voltage of dry cells is small and for most purposes can be neglected entirely. The temperature coefficient is

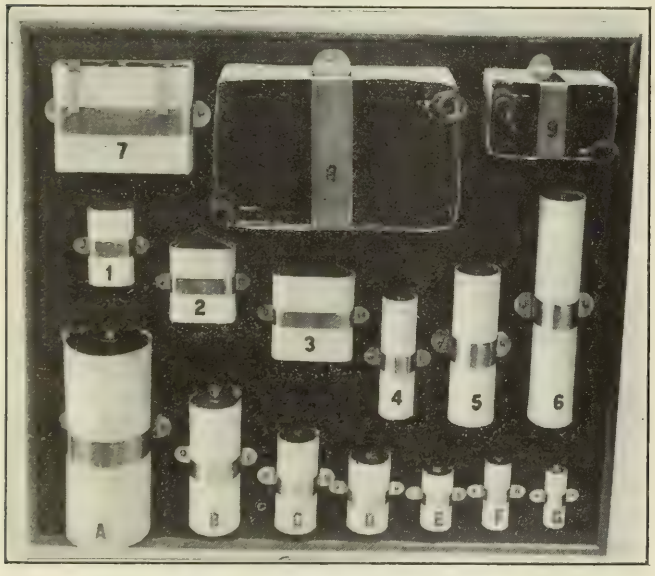


FIG. 1—SIZES OF DRY CELLS AND FLASHLIGHT BATTERIES ADOPTED AS STANDARDS

positive within the ordinary range of temperature—that is, an increase in temperature is accompanied by a rise in voltage. Measurements carefully made on a number of dry cells of various brands and even on different cells of the same brand are not very concordant. Differences are also found between measurements made by a potentiometer and by an ordinary voltmeter, the temperature coefficient appearing to be greater in the latter case. In Fig. 2 is given a curve that represents the average of sixteen different cells, including four different brands measured at the Bureau of Standards. These cells were all of the No. 6 size and of the paper-lined construction. They were kept at a fixed temperature for at least 24 hours before being measured by a voltmeter having 100 ohms per volt of its scale. The voltmeter measurements are given because they are of the greatest practical use. The effect of extreme low temperatures on the voltage of dry cells is given in Scientific Paper 434 of the Bureau of Standards.

Effect of Temperature on Short-Circuit Current

Between 0 and 25 deg. C. (32 and 77 deg. F.) the short-circuit current increases approximately 1 amp. for each 3 deg. C. (5.5 deg. F.) rise in temperature.

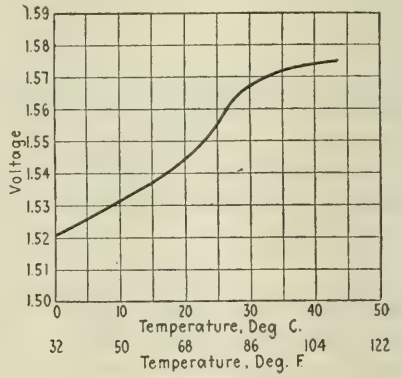


FIG. 2—EFFECT OF TEMPERATURE ON OPEN CIRCUIT VOLTAGE OF DRY CELLS

Mean of measurements on sixteen cells, No. 6 size, of the paper-lined construction, including four different brands. All cells kept at fixed temperatures 24 hours before being measured.

At higher temperatures the rate of increase is somewhat less. The curve of Fig. 3 shows the relation of the short-circuit current to temperature for a group of six cells of the paper-lined construction measured at the Bureau of Standards. Each point plotted is the

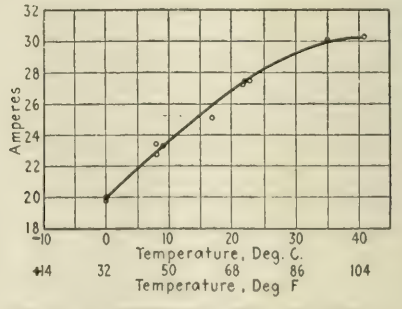


FIG. 3—EFFECT OF TEMPERATURE ON SHORT-CIRCUIT CURRENT

Mean values for a group of six cells maintained at each of the temperatures indicated for at least 24 hours prior to the measurement.

*This paper is taken from Chap. IV of the forthcoming circular 79 of the Bureau of Standards on Electrical Characteristics and Testing of Dry Cells. Published by permission of the Director of the Bureau.

[1]Vol. 26, p. 178, Jan. 25, 1922.

mean value of the six cells after they have been kept at the temperature indicated for at least 24 hours. The temperatures were taken in the following order, 22, 0, 22.5, 8, 0, 21.8, 35, 41, 8, 16.8 and 9 deg. C. This shows that the shape of the curve is well defined and that the short-circuit current reading at any temperature can be repeated with fair accuracy when the temperature of the cell is brought back to the same value.

Effects of Temperature on Storage

Heat produces deterioration of dry cells in two ways. First, it tends to produce leakage; this may be observed when the sticky electrolyte has oozed out around the seal of the cell. Second, it increases the rate of the chemical reactions taking place within the cell. The deterioration of the cells is usually measured by the decrease in the short-circuit current with time when the cells are stored on open circuit. This is not a true criterion of the decrease in service capacity of the cells, but is a convenient method of estimating the depreciation. In Table I is given the percentage decrease

TABLE I—EFFECT OF TEMPERATURE ON THE SHORT-CIRCUIT CURRENT OF DRY CELLS STORED ON OPEN CIRCUIT

Temperature of Storage	Percentage Decrease in Short-Circuit Current at End of 10 Weeks
5° C. (41° F.)	4
25° C. (77° F.)	10
35° C. (95° F.)	19
45° C. (113° F.)	25
55° C. (131° F.)	52
65° C. (149° F.)	71
75° C. (167° F.)	98

in short-circuit current at the end of 10 weeks for cells stored at various temperatures. The figures have been taken from an article by Pritz.[2] Recent experiments show that the measurements of Pritz for cells stored at 25 deg. C. are approximately correct for dry cells when new, but the rate of decrease of short-circuit current becomes less as the age of the cell increases, the total decrease during a year at room temperature being about 25 per cent. The table shows that it is necessary to keep the cells as cool as possible while they are in storage or being shipped. Temperatures of 55 deg. C. or above are not likely to be reached under any ordinary conditions of storage.

Effect of Temperature on Service Capacity

For heavy service a moderately high temperature is desirable, but for light service a low temperature is better. The data of Table II are taken from Pritz,[3] showing the hours of continuous service from cells of one manufacturer when discharged through various resistances until the closed-circuit voltage had fallen to 0.5 volt. The cells used for these measurements were the 6.5x15 cm. (2½x6 in.) size. Exactly the same figures for the 2-ohm test were also given by Ordway.[4]

Table II shows that 50 deg. C. (122 deg. F.) is the most favorable temperature when the external resistance is 8 ohms or less. However, a word of caution is necessary in applying this table to actual use. This is a continuous test, while cells are used ordinarily only part of the time. Hence the heat that may seem to make the cell more efficient in some cases may also cause so much deterioration during the idle periods as to be disadvantageous. For example, Table II shows 160 hours' service at 50 deg. C. when discharging

TABLE II—HOURS OF SERVICE OF DRY CELLS DISCHARGED TO 0.5 VOLT AT VARIOUS RATES AND TEMPERATURES

Temperature	Resistance of External Circuit in Ohms 2	4	8	16
0° C.(32° F.)	40	80	270	560
25° C.(77° F.)	60	94	260	700
50° C.(122° F.)	70	160	250	650
75° C.(167° F.)	65	158	315	615

TABLE III—HOURS OF SERVICE OF DRY CELLS, NO. 6 SIZE, DISCHARGED TO 0.6 VOLT AT FIXED RATES OF CURRENT AND AT VARIOUS TEMPERATURES

(Average of results of tests made on 3 standard makes of dry cells of paper-lined construction.)

Temperature	Service at Various Rates of Discharge in Amperes 0.1 Hours	0.25 Hours	0.50 Hours	0.75 Hours	1.00 Hours
0° C.(32° F.)	136	40	14	7	5
25° C.(77° F.)	220	64	24	13	9
30° C.(104° F.)	300	94	31	18	11

through 4 ohms; but this is less than 7 days. Table I shows that at this temperature the deterioration of the cell as measured by the short-circuit current is about 4 per cent per week on the average. If the cells were to be used over a period of several weeks, the hours of actual service obtainable would be much less than those shown in Table II. The obvious remedy is to keep the temperature lower.

The data given in Table II apply to cells discharging through a fixed resistance. It is also of importance to have data for cells discharging at a fixed rate of current. Results of tests recently made at the Bureau of Standards are given in Table III. The temperatures were kept constant by thermostatic control and the current in each case was maintained at the fixed value day and night throughout the test.

Capacity of Dry Cells

Since dry cells are mostly used on circuits of which the resistance is constant or nearly so, the capacity is usually expressed as the number of hours or days that the cell will continue to give service on such a circuit. This period is calculated to the time that the terminal voltage has fallen to some arbitrary value below which the service is not satisfactory. For example, the cut-off voltage of a group of three coils for telephone service is 2.8 volts. Such service is intermittent and extends over a number of months. The capacity of dry cells may also be expressed in terms of ampere-hours and watt-hours, but to obtain these data it is necessary to integrate carefully measured discharge curves. In any case the capacity, whether expressed as hours, ampere-hours or watt-hours, depends on the condition of the cells, the way they are made and the arbitrary choice of the cut-off voltage. In the pages that follow the most reliable data for the capacity of standard makes of No. 6 paper-lined cells discharging through fixed resistances and at constant current rates are given.

Table V shows clearly the gain in hours of service that is to be obtained by making the current drain light. For the cut-off voltage of 1.2 volts discharging through 2 ohms, 2.2 hours was obtained, but through 8 ohms the cell gave twenty times the service and through 64 ohms, 480 times the service.

Table V shows that when the voltage has fallen to one-half its initial value the cell is by no means one-half discharged. The true measure of discharge of the cell is the ratio of the energy delivered to the total energy contained, and this must be measured in watt-hours.

Just as the voltage is not a criterion of the service capacity remaining in the cell, so also the short-circuit current is not a true measure of the cell's capacity.

[2] *Trans. Am. Electrochem. Soc.*, vol. 19, p. 39, 1911.
[3] *Idem*, vol. 19, p. 39, 1911.
[4] *Idem*, vol. 17, p. 358, 1910.

TABLE IV—INITIAL WORKING VOLTAGE OF NO. 6 DRY CELL

Ohms Resistance of Circuit	Corresponding Amperes Drain	Initial Working Voltage
0.00	*42.9	*0.00
0.01	*32.0	*0.32
0.02	*26.5	*0.53
0.04	*18.5	*0.74
0.08	*12.0	*0.96
¼	8.8	1.10
½	5.1	1.28
¾	2.76	1.38
1	1.45	1.45
2	0.735	1.47
4	0.370	1.48
8	0.185	1.48
16	0.092	1.48
32	0.046	1.48
64	0.023	1.49
128	0.0117	1.50
256	0.0059	1.52
512	0.0030	1.52
Infinity	0.0000	1.53

* Estimated by exterpolation.

Excessively large short-circuit currents when the cell is new do not indicate that such cells will give more service than others yielding average currents. These excessive currents which are sometimes produced for advertising purposes may be the result of harmful additions to the usual ingredients of the cell. With any given brand of cell, a test that shows, for example, a decrease of 40 per cent in the short-circuit current does not mean that 60 per cent of its service capacity remains.

Discharge Through Constant Resistances[5]

Initial Working Voltage.—It is important to know what working voltage can be expected from the cell at the beginning of its service life under various discharge conditions. This of course is lower than the initial open circuit e.m.f. of the cell because of what is usually assumed to be the internal resistance of the cell. It varies with the current being drawn from the cell or with the resistance of the external circuit according to the figures in Table IV.

With circuits of greater than 1 ohm the initial working voltage is but slightly lower than the open circuit e.m.f. The difference between open and closed circuit voltage is not readily calculated from the value for the internal resistance of the cell because the latter is not a constant quantity since it varies with the current being drawn from the cell, from about 0.04 ohm at heavy drains up to several ohms at light drains.

Continuous Discharges.—In the first section of Table V will be found the life in hours to various cut-off voltages for cells discharged through various resistances.

A number of curves have been drawn based on the figures in Table V from which the characteristics of the cell can be studied more readily than from the table of figures.

If the cell discharged at the same efficiency through all resistances, a cell giving 100 hours through 10 ohms, at the same service efficiency should give 10 hours through 1 ohm and 1,000 hours through 100 ohms, etc. The efficiency, however, rises more rapidly for increasing resistances up to the region of 60 to 100 ohms, above which the rise is lower than for equal efficiency. It follows, therefore, that up to this region the efficiency is increasing, and above it decreasing. There-

[5]The subsections headed "Discharge Through Constant Resistances" and "Constant Current Discharge" are chiefly from a paper by C. A. Gillingham, *Trans. Am. Electrochem. Soc.*, vol. 34, p. 297 (1918), by permission.

TABLE V—HOURS OF SERVICE FOR NO. 6 DRY CELL

Cell Discharged	Cut-Off Voltage	Ohms Resistance of Circuit: ¼	½	¾	1	2	4	8	16	32	64	128	256	512	1,024	1,792
Continuously	1.2	....	0.02	0.13	0.70	2.2	9.1	47	115	390	1,050	2,780	2,220	6,350	7,850	9,120
(1)	1.0	0.01	0.21	0.95	3.7	11.1	32.5	89	233	650	1,560	3,200	4,800	6,850	9,720	10,740
	0.8	0.14	0.76	2.3	7.4	20.7	53.0	119	304	740	1,750	3,350	5,100	7,300	10,200	11,500
	0.6	0.50	1.9	5.1	12.5	36.3	75.0	184	383	805	2,470	3,500	5,220	7,550	10,570	11,800
	0.4	1.4	3.8	8.5	21.4	49.8	100.0	227	462	890	2,530	3,650	5,350	7,700	10,970	12,100
30 minutes	1.2	....	....	....	1.0	4.0	15.0	40	210	550	1,370	.....	.....	.....	.....	.....
every hour	1.0	....	....	(1.1)	5.5	13.0	37.0	120	320	810	1,570	.....	.....	.....	.....	.....
(2)	0.8	(0.2)	(0.8)	(3.0)	9.0	26.0	61.0	190	375	920	1,630	.....	.....	.....	.....	.....
	0.6	(0.7)	(2.0)	(5.6)	15.5	43.0	87.0	230	420	1,000	1,680	.....	.....	.....	.....	.....
	0.4	(1.5)	(4.0)	(9.7)	25.0	58.0	120.0	280	470	1,040	1,750	.....	.....	.....	.....	.....
15 minutes	1.2	....	....	....	1.0	5.0	13.0	90	240	580	1,225	.....	.....	.....	.....	.....
every hour	1.0	....	0.17	1.2	5.0	17.0	47.0	157	370	815	1,275	.....	.....	.....	.....	.....
(3)	0.8	0.31	1.0	3.0	10.5	40.0	80.0	195	445	875	1,325	.....	.....	.....	.....	.....
	0.6	0.91	2.3	5.1	16.5	74.0	100.0	223	500	920	1,370	.....	.....	.....	.....	.....
	0.4	2.0	4.3	11.0	29.0	89.0	122.0	264	560	965	1,420	.....	.....	.....	.....	.....
5 minutes	1.2	....	....	0.18	2.5	1.5	45.0	115	292	508	.....	.....	.....	.....	.....	.....
every hour	1.0	....	0.34	2.0	7.5	28.0	75.0	166	360	542	.....	.....	.....	.....	.....	.....
(4)	0.8	0.21	1.2	4.1	13.5	40.0	93.0	201	385	567	.....	.....	.....	.....	.....	.....
	0.6	0.75	2.3	6.4	20.0	50.0	114.0	224	403	602	.....	.....	.....	.....	.....	.....
	0.4	1.9	4.3	11.0	33.0	62.0	128.0	236	416	625	.....	.....	.....	.....	.....	.....
2 minutes	1.2	....	....	0.53	3.5	22.0	56.0	152	207	272	.....	.....	.....	.....	.....	.....
every hour	1.0	0.06	0.53	2.3	13.0	35.0	78.0	167	216	288	.....	.....	.....	.....	.....	.....
(5)	0.8	0.28	1.3	5.4	19.5	44.0	90.0	194	224	307	.....	.....	.....	.....	.....	.....
	0.6	0.72	3.0	10.0	28.0	59.0	103.0	209	231	333	.....	.....	.....	.....	.....	.....
	0.4	1.8	6.0	15.0	36.0	68.0	109.0	217	240	....	.....	.....	.....	.....	.....	.....
½ minute	1.2	....	....	2.0	8.7	22.0	42.0	70	....	....	.....	.....	.....	.....	.....	.....
every hour	1.0	....	1.6	6.0	15.7	29.0	46.0	76	....	....	.....	.....	.....	.....	.....	.....
(6)	0.8	0.80	3.7	8.5	17.7	31.0	48.0	80	....	....	.....	.....	.....	.....	.....	.....
	0.6	1.9	6.5	12.0	20.0	33.0	50.0	82	....	....	.....	.....	.....	.....	.....	.....
	0.4	5.2	10.3	16.0	23.0	36.0	52.0	85	....	....	.....	.....	.....	.....	.....	.....
5 minutes	1.2	....	....	0.14	1.5	5.0	20.0	40	220	530	1,280	2,550	.....	.....	.....	.....
every 10	1.0	....	0.42	1.3	6.0	14.5	45.0	115	340	795	1,580	2,800	.....	.....	.....	.....
minutes	0.8	0.45	1.5	3.3	9.5	28.0	70.0	170	410	930	1,670	2,850	.....	.....	.....	.....
(7)	0.6	1.3	3.0	6.0	16.5	45.0	105.0	220	460	1,010	1,730	2,875	.....	.....	.....	.....
	0.4	2.3	4.8	9.0	26.0	60.0	135.0	270	520	1,100	1,810	3,000	.....	.....	.....	.....
30 minutes	1.2	....	....	....	1.3	15.0	40.0	107	309	460	....	.....	.....	.....	.....	.....
every 6 hours	1.0	....	....	....	9.5	29.0	75.0	137	353	505	.....	.....	.....	.....	.....	.....
(8)	0.8	....	....	....	17.0	40.0	93.0	186	367	545	.....	.....	.....	.....	.....	.....
	0.6	....	....	....	24.0	48.0	102.0	216	381	590	.....	.....	.....	.....	.....	.....
	0.4	....	....	....	30.0	56.0	111.0	228	395	625	.....	.....	.....	.....	.....	.....
5 minutes	1.2	....	....	0.2	4.1	17.0	56.0	....	....	....	.....	.....	.....	.....	.....	.....
every 6 hours	1.0	....	0.24	2.9	11.2	32.0	61.0	....	....	....	.....	.....	.....	.....	.....	.....
(9)	0.8	0.34	1.7	6.7	16.3	37.0	63.0	....	....	....	.....	.....	.....	.....	.....	.....
	0.6	0.9	3.5	10.2	21.0	42.0	65.0	....	....	....	.....	.....	.....	.....	.....	.....
	0.4	2.8	6.5	14.0	26.0	47.0	82.0	....	....	....	.....	.....	.....	.....	.....	.....

Note.—Figures in parentheses are interpolated.

fre, the maximum efficiency lies in the vicinity of 60 t 100 ohms depending on the cut-off voltage.

Fig. 4 shows the continuous discharge results of the fst section of Table V plotted in terms of hours per ohm ordinate and a logarithmic scale to the base 2 of ohms for the abscissa. By this method it is possible put all of the results on the same plot without crowding the curves together in the region where there is e most occasion to use them. The actual hours of scharge are readily calculated from the hours per ohm the following relations:

ours of discharge = hours per ohm × ohms in discharge resistance.

his plot shows the following characteristics of continuous dry cell discharges:

(*a*) For any cut-off voltage the efficiency rises to a aximum as the resistance of the discharge circuit increases and then falls off rather abruptly.

(*b*) An increase in cut-off voltage causes this aximum point to move to the right.

The reason for the increasing efficiency as the resistance becomes greater (and hence the service lighter) no doubt due to the increasing completeness of the polarization. It becomes practically complete at 64 ms.

The falling off in efficiency for services lighter than at equivalent to a discharge through 64 ohms is cause of the local action within the cell, which is ten referred to as the shelf-life deterioration.

Local action consumes the zinc can and the other constituents as well as the useful service which the cell nders, so that as the period of discharge is increased ere is a relatively smaller amount of these available r service reactions.

It will be apparent also from examination of Fig. 4 at the shape of discharge curve for low resistances ust be quite different from that for high resistances. he relative distances between the various cut-off voltges show this.

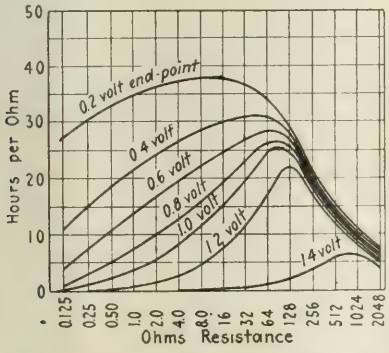


FIG. 4 — SERVICE EFFICIENCY CURVES FOR CONTINUOUS DISCHARGES THROUGH VARIOUS RESISTANCES

Intermittent Discharge.—The results of the various ntermittent tests are shown in Table V, from the econd division down. It will be noted that the first ve of these together with the continuous division form series of various length discharges in hourly cycles as ollows:

60 minutes per hour (continuous)
30 minutes per hour
15 minutes per hour
5 minutes per hour
2 minutes per hour
½ minute per hour

In Fig. 5 are shown the efficiency curves to the 0.8 volt end point for the various periods of hourly discharge. The maximum efficiency points move to the left toward the lower resistances as the period of discharge becomes lower, just as in Fig. 4 they move to the left as the cut-off voltage is lowered. The latter is true regarding the cut-off voltage for any given period of discharge less than 60 minutes, just as it is for the continuous tests.

This leads us to a consideration of what is called "severity of service." Severity of service decreases with increased resistance and decreased period of closure. In other words, severity of service is analogous to average rate of output. Two cells would be working at the same average rate of output if, for instance, one discharged at 1 amp. continuously and the other at 10

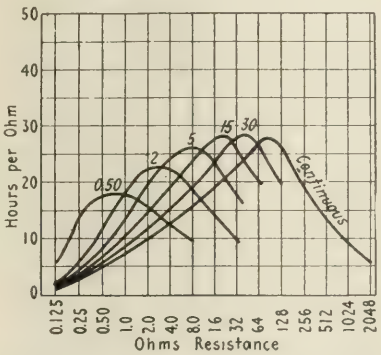


FIG. 5 — SERVICE EFFICIENCY CURVES TO THE 0.8 VOLT END POINT FOR VARIOUS PERIODS OF DISCHARGE
Numbers on curves refer to minutes of discharge per hour.

amp. for one-tenth of an hour each hour. Each would deliver 1 amp.-hr. per hour. "Severity of service" may be defined as equal to the percentage of the total time during which the cell is actually discharging, divided by the resistance of the circuit. When the severity of service is low, all the discharge curves for various rates coincide if the hours of service are plotted against the severity of the service to any given cut-off voltage. In other words, the efficiency and shape of the curve are approximately the same for the same severity of service whether the discharge is continuous or intermittent. This applies to service through a resistance of 16 ohms or more.

Thus far all conclusions regarding the intermittent characteristics are based upon the series in which one cycle occurs every hour, the period of discharge varying between ½ and 60 minutes. In order to ascertain the effect of cycles longer and shorter than 1 hour, tests were made as follows:

5 minutes every	10 minutes
30 minutes every	6 hours
5 minutes every	6 hours

The figures for these tests are shown in the 7th, 8th and 9th divisions of Table V.

Tests run 5 minutes every 10 minutes are discharging the same percentage of the total time as those run 30 minutes per hour. By comparing the results for these two tests (divisions 2 and 7 of Table V), it will be found that the two are identical (within the limit of error), except in the very low resistances, where a considerable difference is found, particularly at the higher cut-off voltages. The results are of course lower

for the longer 30-minute discharge period than for the shorter 5-minute period. The same will appear by a comparison of the 30 minutes every 6 hours with the 5 minute per hour tests (divisions 4 and 8, Table V). Appreciable discrepancies occur only when the resistance is below 1 ohm. In most cases, therefore, it may be assumed that any discharge cycle will give the same results as the 1-hr. cycle with the discharge covering

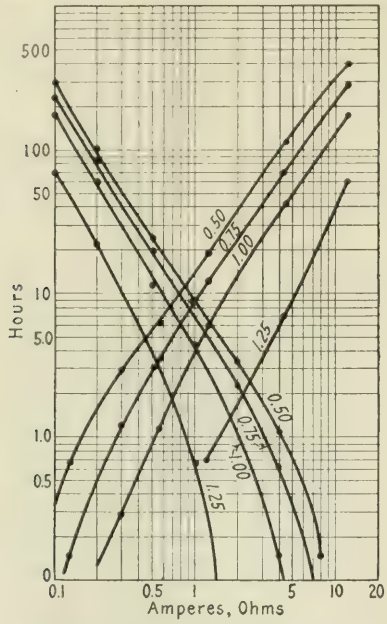


FIG. 6—CONSTANT CURRENT AND CONSTANT RESISTANCE DISCHARGE. 25 DEG. C.

the same proportion of the time. This statement, of course, must be applied with discretion especially in cases of discharge periods of considerable length and moderate resistances.

Constant Current Discharge

In Table VI are shown the results of a number of tests in which the resistance of the circuit was varied as the cell ran down so that the current drain remained constant in value throughout the test. In the constant resistance discharges, of course, the current drain decreases in direct proportion as the working voltage of

TABLE VI—HOURS OF CONTINUOUS CONSTANT CURRENT DISCHARGE

Cut-off Voltage	Amperes 8	4	2	1	0.5	0.2	0.1
1.2	.....	0.015	0.12	0.7	4.0	20	78
1.0	.....	0.24	0.82	3.6	13.5	49	140
0.8	0.047	0.43	1.9	6.3	21.0	66	183
0.6	0.137	0.82	3.1	9.2	27.5	80	220
0.4	0.240	1.29	4.3	12.0	36.0	92	237

the cell decreases. The cell, therefore, delivers current at a slower and slower rate as it becomes exhausted. In the constant current test, however, the cell is forced to deliver current at the same rate when nearly exhausted as at the beginning of the test. It is therefore to be expected that the discharge curve will drop less rapidly at the beginning and more rapidly at the end than for a constant resistance test of about the same average drain.

Comparison of Discharge Through Constant Resistances With Discharges at Constant Current

Dry cells have been commonly used on circuits of which the resistance is constant, such as telephone, ignition and bell circuits. There is now a growing tendency to use them also as a source of power for the operation of radio and other apparatus for which a constant current is necessary. The duration of the discharges of both kinds to various cut-off voltages are given in Tables V and VI (Gillingham's measurements) and also in Figs. 6 and 7, which are plotted from results obtained at the Bureau of Standards. Different brands of cells were used in making these experiments and the temperature also differed by several degrees. It is not surprising, therefore, that there are slight differences in the results, but the general agreement indicates that the performance of paper-lined cells of standard make is reasonably uniform and consistent. The curves which are given apply to continuous discharges at constant current and through constant resistances.

In order to determine the constant current at which a cell must discharge to give comparable service to that which it can give on a constant resistance circuit, Figs. 6 and 7 may be used. The former applies to the paper-lined cells and the latter to a bag-type cell of American manufacture. In either figure the curves sloping downward to the right are for the discharge at constant current for which the abscissas are amperes. The curves sloping downward to the left are for discharges through constant resistances. For these the abscissas are ohms. Example: To determine the constant current which will give the same service to 0.75 volt as for the cell discharging through 5 ohms. Starting at the 5 ohm point at bottom of diagram, follow the line vertically upward to its intersection with the curve marked 0.75 and then follow the ordinate horizontally to the left to it

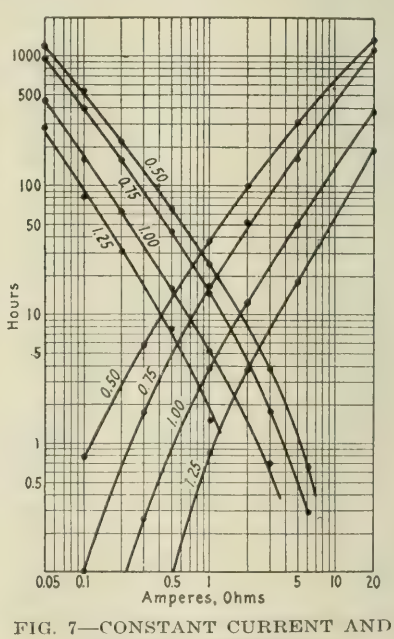


FIG. 7—CONSTANT CURRENT AND CONSTANT RESISTANCE DISCHARGE. 25 DEG. C.

intersection with the other curve marked 0.75. From this intersection follow line vertically downward to scale of amperes at the bottom of the diagram. On Fig. 6 this is found to be 0.19 amp.

Ampere-Hour Capacity

The ampere-hour capacity of dry cells does not possess the theoretical interest or practical value which the ampere-hour capacity has for storage cells, but it is occasionally necessary to determine it. This may be

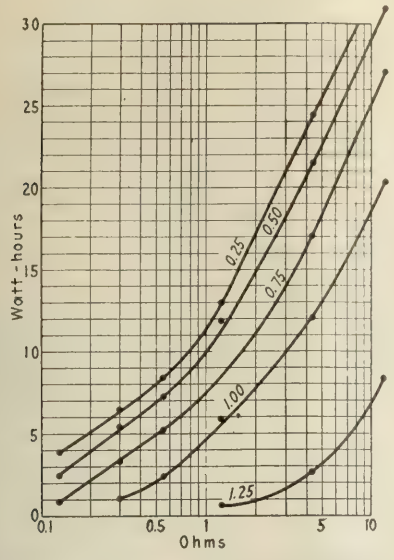


FIG. 8—WATT-HOUR CAPACITY. CONSTANT RESISTANCE DISCHARGE. 25 DEG. C.

ne for continuous discharges with the aid of Figs. 6 d 7.

When the cells are discharged at a constant current te, the capacity in ampere-hours to any specified cut- voltage can be calculated immediately. It is the oduct of the current by the duration of the discharge. us in Fig. 6 the ampere-hours for a cell discharging a fixed rate of 0.5 amp. to 0.75 volt is found to be

$$0.5 \times 19 = 9.5 \text{ amp.-hr.}$$

The more usual case, however, is for the cell to be scharged through a fixed resistance, the current deasing as the discharge progresses, because of the lling voltage of the cell. The equivalent constant curnt may be estimated for the discharge through any lue of resistance shown in either Fig. 6 or 7 as deribed in the preceding section and from this the apoximate equivalent in ampere-hours computed. An ample was given in which the constant current equivent to a discharge through 5 ohms to an end point 0.75 volt was found to be 0.19 amp. The time of the scharge was 85 hours. The ampere-hours were

$$0.19 \times 85 = 16 \text{ amp.-hr.}$$

The most exact way of computing the ampere-hours to determine the current flowing at a number of riods during the discharge of the cell by dividing the rminal voltage of the cell at such times by the fixed sistance of the circuit. From these values a plot can made and the average value of the current during e discharge obtained by integrating the curve with a animeter.

It should be remembered that the performance of fferent brands of cells differs considerably and that ie age and temperature conditions also have a marked fluence. The performance of typical brands of cells ven in Figs. 6 and 7 serve only as a rough indication the period of service and ampere-hour capacity that ay be expected under other conditions.

Watt-Hour Capacity

The watt-hour capacity is of greater interest than ie ampere-hour capacity, because it represents the tual energy that can be derived from the cell. It is ot computed as easily as the ampere-hour capacity, ecause of the necessity of determining the average voltage, which changes throughout the period of discharge.

If the discharge is made at constant current, the average voltage is most simply obtained by plotting the voltage readings and integrating the curve by a planimeter. In this case the watt-hour capacity is the product of the average voltage by the fixed value of current and by the period of discharge to any predetermined cut-off voltage.

If the discharge is made through a fixed resistance, both the current and the voltage vary throughout the discharge. It is then necessary to plot a curve of the voltage squared for integration. The watt-hour capacity is determined as the product of the average value

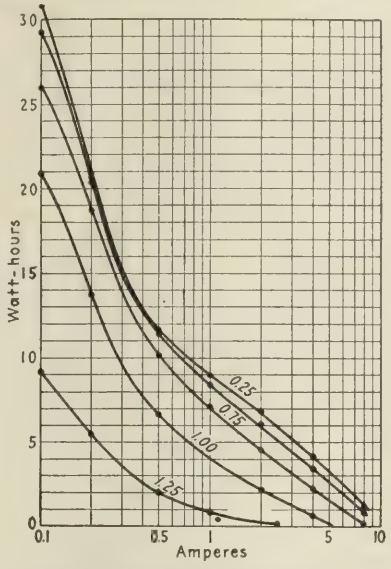


FIG. 9—WATT-HOUR CAPACITY. CONSTANT RESISTANCE DISCHARGE. 25 DEG. C.

of the voltage squared multiplied by the time of the discharge and divided by the fixed value of the resistance.

Since the watt-hour capacity of the cells cannot be computed from any of the preceding data, curves of Figs. 8 and 9 are given for continuous discharges of the ordinary paper-lined cells of No. 6 size discharging through fixed resistances and at constant current to the cut-off voltages indicated on the individual curves.

Part II will appear in a subsequent issue.

Failure of Paint and Varnish on Exposure to Weather

During the recent meeting of the American Society for Testing Materials at Atlantic City there was an extended informal discussion of the mechanism of failure of paint and varnish films on exposure to the weather. One party to the discussion claimed that a paint or varnish film should contain moisture in order to retain its elasticity. The known beneficial effect of baking a varnish film was then cited as being contradictory to this theory that moisture improved the durability of paint or varnish. The importance of the problem makes it appear advisable to study baked varnish films in order to obtain some definite data on the effect of baking. The Bureau of Standards has commenced an investigation in which a series of spar varnishes of varying strengths of oils will be baked on tin panels at different temperatures, and then tested for durability when exposed to the weather.

Application of Electric Service To the Chemical Industry

Power an Important Part of Manufacturing Cost—Electric Power Is Applied for Motor Drives, Illumination, Heating, Transportation, Electrolysis and Electrical Precipitation—Some Points to Be Observed

By William B. Todd
Engineering Department, E. I. du Pont de Nemours & Co.

POWER forms a large percentage of manufacturing cost in many chemical industries. But how many plant managers are familiar with the many applications of power? To the average manufacturer steam generation, transmission and use in chemical processes are more or less understood. Electricity, however, with its increasing uses, is little understood; and in many cases advantage is not taken of applications that would prove of value.

The applications of electrical service to the chemical industry may be roughly grouped under the following headings:

Motor drives	Electrolysis
Illumination	Electrical precipitation
Heating	Miscellaneous uses
Transportation	

Consideration of these headings will be briefly discussed. There are chemical plants now using all of these applications.

Motor Drives

Except in electrochemical plants, the largest percentage of a plant's electrical consumption is used in motor drives. Pumps, compressors, mixers, grinders, agitators, beaters, centrifuges, rotary driers, continuous filter presses, nitrators, etc., are all driven efficiently by electric motors if proper applications have been made. By proper motor application is meant the strict attention to correct type, correct size and correct installation.

Before selection of the correct type it will be necessary to consider the two classes of electric motors—direct current and alternating current. Except in older plants it will be found that alternating current is in general use on account of the advantages this system offers in the reduction of transmission losses and line costs, due to the ability to transform to higher voltages and consequent lower current and the use of smaller wire sizes.

Electrical service may be generated or purchased. The electric utility companies as a rule furnish only alternating-current service and the majority of chemical plants generating their own power use the alternating-current system. The problem of generation or purchase of electrical service will not be discussed here, as we are dealing with its application. The cycle of plant operations, however, must be so arranged that unusual peaks will not obtain, the penalty being increased costs due to the "demand charge" if power is purchased and investment in increased generating capacity if generated.

Use of Alternating-Current Motors

With alternating-current systems we are confronted with the power factor condition. The power factor in most industrial plants is "lagging" and represents the current doing real work in electrical machinery compared to that doing real work plus the amount doing "wattless" or unnecessary heating work in the coils of that machinery. The effect of lower power factor is the reduction of the output of generators, transformers and distributing feeders; and the impairing of voltage regulation. Low power factor is caused by underloaded induction motors and can be remedied by application of motors of correct rating or by the installation of synchronous motors on such large loads as continuously operated pumps or air compressors, or by the use of static condensers.

These last two items of electrical equipment cause "leading" current in the lines and will neutralize the lagging power factor caused by underloaded induction motors. Correction of power factor will save investment in added plant generating capacity.

It is generally conceded that alternating-current motors are more reliable and, in the case of the chemical industry, safer than direct-current motors, due to absence of commutators and their attending trouble. Direct-current motors are designed for 110-, 220-, 550-volt service, while alternating-current motors may be designed for various voltages, phases and frequencies, but the specifications in most general use are 110, 220, 440, 550 or 2,200 volts, two- or three-phase (single phase for fractional horsepower motors) and twenty-five or sixty cycles. The direct-current motors are divided into three types—series, shunt and compound. The alternating-current motors in industrial use are the squirrel-cage induction motor, the slip-ring induction motor and the synchronous motor.

Correct Application of Motors

For correct application to various loads the following table will roughly cover the type of motor to be used:

Nature of Load		Direct Current Motor	Alternating Current Motor
Speed	Starting Torque		
Constant...	Low.....	Shunt	Squirrel-cage or synchronous
Constant...	High.....	Compound or series.	Slip-ring
Variable...	Low.....	Shunt or compound.	Slip-ring
Variable...	High.....	Compound	Slip-ring

Synchronous motors, due to their higher cost and necessity of direct current for their fields, are seldom used in industrial plants except in large sizes to improve power factor conditions as has been explained before. Slip-ring motors are not efficient at speeds under synchronous speed rating, but afford the only practical method of obtaining variable speeds with alternating current motors. The nature of the load to be driven should thus be carefully considered before selecting the proper type of motor.

Choosing the Correct Size of Motor

One of the greatest faults in the application of motors has been that of "over-motoring" or installing motors of too large capacity. This fault has been caused by the desire to play safe; but, due to it, there are today many plants operating motors at greatly reduced efficiencies and power factor, and consequent higher power costs, as the maximum efficiency and

wer factor of a motor is at rated load. Whether dividual or group drive of machinery is used, careful sts should be made to obtain the average and maxi- um loads, and the proper size motor installed.

Motor ratings are based on the maximum continu- s temperature at which the heat caused by the passage current through the windings will be dissipated at e same rate as generated. Commercial motors are w manufactured with 40 deg. C. and 50 deg. C. rat- gs, expressing the permissible temperature rise above ambient temperature of 20 deg. C.—at rated capac- y. The 40 deg. motors permit of an overload of pproximately 25 per cent above normal rating, while) deg. motors permit of no overload. Naturally the) deg. motors are cheaper and in purchasing motors e difference in ratings should be taken into considera- on.

Correct Installation of Motors

Correct installation is particularly important in chem- al manufacturing buildings. It is well worth the gher installation cost to use 30 per cent para rubber sulation for conductors and to run the conductors in etal conduit, lead cable or in grooved timbers. This tter installation is fairly expensive; but, where metal nduit would be eaten through in a few weeks, the rooved timber and asphaltum-like compound will com- ine to give good service. The timbers are run through ie entire length of the building and the connections to ie circuits made on the exterior of the building. Lead able, while more satisfactory in withstanding acid imes than metal conduit, requires considerable lead urning; and, due to the mechanical injury that it is kely to receive, acid will leak into the wiring. Safety witches, overload relay and no-voltage release coils on arting apparatus and the installation of all electrical quipment from a safety standpoint are all-important.

In acid buildings it is often advisable to make up oil- witch boxes containing a lead reservoir filled with ransformer oil, so that the fuse blocks and all of the nife switch but the handle are submerged in oil. Iotors are frequently installed in motor houses outside f the manufacturing building and the power trans- itted to the machinery in the building either by a belt arried through a duct or by a shaft containing a pulley n the motor room. Remote control of motors from ush-button stations offers operators a convenient ethod of starting and stopping their machines and in uildings where there are dangerous operations the nstallation of these push-button stations at different oints is a step toward safety of operation. In the xplosives end of the chemical industry it is frequently dvisable to start and stop the operation of machinery t some distance from the building and the push-button tations are mounted on posts at a proper distance from ie operation.

Protection of Motors From Fumes

For protection of motor windings against acid and ther chemical fumes it has been found necessary to oat them with a solution of flexible black enamel and exible compound and bake from 40 to 60 hours at 75 eg. F. (36 deg. C.). The motor is then removed from ie oven and while still hot it is suspended by a sling o that the protruding windings can be lowered into a arge flat pan containing compound similar to asphalt, ut having a much higher melting temperature.

Motors receiving this treatment will withstand ex- osure to fumes that would put factory-impregnated motors out of business in a very short time. This protection, however, will gradually break down due to contraction, expansion and vibration of the stator laminations. A "dope" gang is therefore employed to prevent this breakdown. This gang neutralizes the acid deposits on the motors by swabbing with a solution of soda ash and alcohol, wirebrushing and sandpapering the metal parts and coating the winding with Harrison's quick-drying asphaltum paint applied with a paint "gun." The paint gun operates somewhat on the principle of a blow torch, the pressure being applied either by the plant air line or a tire pump. The "gun" is superior to a brush in applying the paint into every recess where fumes can enter.

The more important advantages of electric motor drives are:

1. Direct application of power where desired.
2. Minimizing of shafting and belting to give better illumination and handling of material.
3. Constant speed, causing increase of production.
4. Reliability, as breakdowns are usually confined to a single machine.

Illumination

Proper illumination has increased production in many industries, particularly in shops where hand and accurate machine work predominate. In the chemical industry the operations consist mainly of tending machines, and, as a general rule, the lighting system should consist of general direct lighting, an average of 1 to 1.25 watts per sq.ft., with local lighting at sight glasses, peep-holes, gages and places where greater intensity is desired.

The chief problem in interior illumination is to avoid fatigue and injury to the eyes of the operators by reduction or elimination of glare. This is accomplished by properly shaped reflectors and frosting of lamps. Indirect lighting does not, as a rule, lend itself to chemical operations due to the style of construction of chemical factory buildings. On account of fumes from most operations it is advisable to use vapor-proof globes. Where the explosive risk exists it is advisable to illuminate the interior by means of lamps inclosed in tilted glass front boxes mounted on the walls, the backs of the boxes permitting opening from the exterior of the building, and the circuits being run open on knobs on the exterior of the building to permit easy inspection. The outside type of reflector installed outside on posts opposite windows affords illumination for the interior of buildings with a high explosive risk.

It has been found advisable by safety authorities to restrict the use of nitrogen-filled Type "C" lamps in buildings of the chemical industry due to the high surface temperatures of these lamps. Lamp guards are advisable where there is a possibility of contact, particularly in the case of lamps at low heights. Drop-cord lighting should never be used where there is a vapor or dust risk. The installation of red lights over safety shower baths in acid buildings is very desirable. As many chemical operations are continuous, all passageways should be lighted and outside lighting carefully planned so that the operation of the plant on the night shift will be just as productive as on the day shift. In all places where possible the lamps and reflectors should be periodically cleaned to obtain maximum illumination from the energy that is being consumed.

Electric furnaces are used in the manufacture of certain chemical products, such as carbon bisulphide,

phosphorus, calcium carbide, calcium cyananide, etc., and in the fixation of atmospheric nitrogen.

Heating

A field of electric heating especially adaptable to the chemical industry is that to be obtained by the application of the electric resistance type of oven heaters such as are used by the automobile industry in enameling ovens. The application may be made directly, by the installation of the heaters in rotary driers, or below horizontal refining tanks; and indirectly, in oil heat transmission systems, by installing the heaters in a heating tank of high flash point oil which is circulated through the jacket of the still or autoclave. For operations requiring long heating periods this application does away with attendance of coal-, oil- or gas-fired furnaces to heat the oil. The advantage of electric heating is the automatic control of temperature by means of pyrometer-controlled magnetic switches. A kilowatt-hour of electrical energy is equal to 3,415 B.t.u.

Transportation

Due to the fact that the majority of chemical plants require numerous buildings, and in some cases safety spacing, transportation of raw, semi-finished and finished materials becomes an important consideration. Where roadways are adjacent to all manufacturing buildings, transportation may be taken care of by horses and wagons and gasoline or electric motor trucks. Where narrow-gage or tram tracks are installed, the motive power can again be furnished by horses and gasoline or electric locomotives. The following interesting data were secured from a chemical plant that has used all three forms of motive power.

1. Two electric locomotives did the same amount of work as fifteen horses. Including maintenance of horses and wage of drivers, the total cost of transportation per operating hour with the fifteen horses was $11.75. The total cost of transportation per operating hour with the two electric locomotives, including operators, repairs, charging and miscellaneous material, was $1.60. This latter charge did not include battery replacement, but assuming at least 2 years' life of battery, the cost would be increased to only $2.20 per hour.

2. Gasoline locomotives were out of running condition 50 per cent of the time and for the hours operated cost $1.50 per locomotive-hour. The electric locomotives had a "use factor" of practically 100 per cent and cost 74 cents per locomotive-hour. Neither of these figures includes operators' wages, which were the same in both cases and the available operating time per month averaged 200 hours.

Storage Batteries for Electric Locomotives

Special types of batteries are manufactured for electric locomotives. The battery should always be so mounted on the locomotive that the flat of the plate comes against the direction of motion. This assembly permits a cushioning effect of the electrolyte against the flat of the plates, and prevents displacement of plates or breakage of the rubber jars. The tray of discharged cells can be quickly lifted from the locomotive by a hand crane and replaced by a tray of charged cells.

When operating but one shift, and with only one battery charge per shift, the constant current method of battery charging can be used. But with three shifts, or several replacements per shift, it will reduce the time of charging and the consequent reduction in investment in batteries to use either the constant potential or modified constant potential methods. The two latter methods automatically control the charging rate and do away with the manual control of the charging current rate to prevent excess rise in temperature of electrolyte. Ampere-hour meters in conjunction with relays automatically cut out the battery when fully charged.

Electrolysis

Chemists as a rule are familiar with the application of direct current to electrolytic work. The electrolysis of saturated brine in concrete body cells containing graphite anodes, asbestos diaphragms and perforated sheet metal cathode plates produces chlorine gas in the anode compartment, and caustic soda liquor and hydrogen gas in the cathode compartment. Cells are connected in series and average from 3.2 volts to 4 volts per cell, depending upon the plugging of the diaphragm and the deterioration of the anodes. The energy efficiency of an electrolytic cell averages 55 to 60 per cent.

The decomposition of water to obtain oxygen and the byproduction of hydrogen is also accomplished by means of electrolytic cells. Except where water power is available the direct current is converted from alternating current by rotary converters of the booster type or by motor generator sets. Sufficient voltage range is necessary to handle the normal voltage variations of a series of cells.

Electrical Precipitation

The precipitation of dust, mist or fumes is accomplished in passing through vertical pipes by the ionization of the gases in the electrostatic field within the pipes. This electrostatic field is produced by means of wire or chain negative electrodes centered in the pipes, forming the positive electrode, the latter being grounded. A potential of 25,000 to 100,000 volts direct current is applied to the system. This high potential is secured by rectification of high potential alternating current with either mechanical disk-type commutator rectifiers or special two-electrode vacuum tubes. The ions travel with high velocity in a direction at right angles to the electrodes and impart a static charge to fume particles, causing them to be projected against the inner surface of the tubes, where they will either flow down the tubes or be rapped down. These installations have been successful in the recovery of nitric acid fumes, organic materials, potash from cement plants and the removal of sulphuric acid mist from gases from sulphur burners.

Miscellaneous Uses

Chemical laboratories have found many uses for electrical service in ovens, muffle furnaces, electrical settling, the starting of reactions by electrolysis and electrometric methods in chemical analysis. The mechanical department with an electric welding machine can cut down the cost of repairs, as equipment can be repaired without removal. With steel electrodes the bottoms of tanks can be repaired by welding while in place. The sterilization of water by ultra-violet rays has been accomplished.

Consideration of the applications of electrical service which have been shown in this article will give the chemical plant man a rough idea of the present field; but who can guess what will happen in the field of electrical application to the chemical industry in the next few years?

Wilmington, Del.

Molding Practice for Aluminum Alloys*

Aluminum Casting Alloys Are Light and Hot Short, Therefore It Is Necessary to Use Free Venting Molds and Cores Which Crush Easily — Low Gates and High Risers, Together With Free Use of Chills on Thick Sections, Necessary for Sound Casting

ALUMINUM can be cast by the same general methods used in the casting of brass and bronze, but with certain modifications dependent upon its various physical properties. The purpose of the following information is to point out where these changes in method should be made and to state in general what is considered the best practice.

Molding Sand

In the selection of molding sand for an aluminum foundry the texture or mechanical composition of the sand is much more important than its chemical composition. A good molding sand should be neither "close" nor "open." If it is too fine it will not be free-venting and will, therefore, prevent the escape of air, steam and gases. On the other hand, it should not be too coarse or it will fail to give a smooth and clean surface to the casting.

The sand most generally used in aluminum founding is Albany OO molding sand. The clay in this sand forms such a good natural bond that no artificial binder, such as flour, treacle, dextrin or sulphite-lees, is needed. All that is necessary is to riddle the sand through a No. 4 sieve to remove all large foreign substances, to moisten it and to mix it thoroughly; then it is ready for use. Just enough water should be added to the sand to give it the required bond; additional water only obstructs the escape of the steam generated and the gases given off by the molten metal.

No specially prepared facing sand is required. When riddled through a sieve ranging in size from No. 8 to No. 20, depending upon the casting in question, the regular molding sand makes a good facing for the pattern. Additions to the sand for the purpose of forming a smoother surface for the mold and increasing the bonding qualities of the sand are harmful, for they make the sand impervious to steam and gases. The practice of facing the pattern with good sand and using almost any kind of sand as a filler-up is a bad one. The saving realized in the cost of sand is more than offset by the loss in defective castings due to poor molds.

The usual method of putting the new sand into service is to add small quantities of it at frequent intervals to the old sand. With each additional use the molding sand loses some of its bond. The molten metal drives off the water and "kills" the clay which comes in immediate contact with it. Inasmuch as sand tempers best when it is steaming, water and new sand are usually added immediately after the castings have been shaken out.

Principles to Observe

Careful observation of the two following characteristics of the common aluminum alloys will obviate most of the troubles of the molder: Aluminum alloys are light, for iron or brass are two to three times as heavy; and they are brittle or "hot short" at temperatures slightly below the melting point. In casting aluminum practically every modification of the usual brass foundry practice is attributable to one or the other of these reasons, and any steps taken which provide for these peculiarities are in the right direction. A consideration of the first characteristic will explain why certain practices in ramming, venting, gating and feeding the mold employed in brass foundries cannot be used unmodified when casting aluminum. Aluminum is so light that it cannot rid itself of absorbed gases and drive off the steam as readily as brass. Observance of the second characteristic will prevent cracks in the castings due to hard cores or molds. If the cooling metal when in its "hot short" condition encounters very much resistance to further shrinkage it will almost invariably crack.

Because of the lightness of aluminum alloys the mold may be made in a snap flask which may be removed when the mold is completed. The sand should be rammed as lightly as is consistent with safe handling and pouring of the mold. Additional ramming serves only to create an impervious wall which will prevent the escape of the imprisoned air, steam and gas, forming blowholes, and producing a rough surface to the casting because the metal cannot lie close to the mold. Hard ramming is also objectionable, as it prevents the mold from giving when the metal shrinks, for it must be remembered that certain parts of the mold, as well as the cores, are called upon to give way to the metal in contraction. To help the mold to keep its shape after the flask has been removed, the outside of the mold may be rammed fairly hard, but the hard ramming should never extend to the sand immediately adjacent to the pattern. A close adherence to the principle of light ramming will probably obviate most of the aluminum molder's troubles.

The mold should be well vented for the same reason that the sand should be rammed lightly. In the case of large castings especially, the minute openings resulting from the porosity of the molding sand are an inadequate outlet for the steam and gases, and venting must be resorted to. For small castings vents are often unnecessary.

Low Gates and High Risers

No set rules can be laid down to govern the number, size and location of gates, for each particular casting presents a different problem. This must be left largely to the discretion of the molder, who should always bear in mind the two characteristics of aluminum alloys before mentioned. One or two general suggestions, however, may be given. A liberal fillet should always be employed where the gate connects with the casting in order to avoid drawing just beneath that point. If increasing the size of the fillet does not entirely eliminate trouble from drawing, the gate should be so

*From sales department condensed data prepared by the Technical Department, Aluminum Company of America.

located that the unsound part of the casting caused by the draw will do the least amount of harm. If possible, it is also good practice so to locate the gate that when the mold cavity is filled with metal, the length of the path traveled will have been such that the heavy sections will have filled first and will be colder than the light sections. It is also generally true that the gate should enter the casting at a low rather than high point, for less air is imprisoned in the mold by gradually rising metal than by falling metal. Due to mechanical difficulties, however, all these suggestions are subject to a limited application.

Risers are usually attached to those parts of the casting which solidify last. The parts which first solidify draw metal from the larger, slower-cooling sections, so the latter sections must find a source of supply sufficient to provide metal for both its own shrinkage and that of the smaller fast-cooling sections. Risers are constructed to create such a source of supply. They must be so located and of such a size that they will remain molten longer than the casting. Otherwise, they simply act in the same way the small sections of the castings do, and draw metal from the large section, making matters worse rather than better. If possible, the riser should enter the casting at its highest point so that the air and dross may be forced up into the riser instead of being trapped in the casting. By increasing the height of the riser, the pressure of metal may be increased, and consequently sounder and sharper castings will result. On small castings risers are seldom necessary.

Chills may also be used as a safeguard against injurious shrinkage, especially in large castings of irregular section. Where light sections of the casting join heavy sections, uneven cooling takes place. The light section cools first and, in cooling, is fed with metal from the still liquid heavy section. When the heavy section finally cools it draws from the light section, causing sponginess and sometimes cracks in the junction between the two. To correct this tendency some means of artificial cooling must be adopted which will make the heavy section set as fast as the light section. Chills are used for this purpose, and the pieces of metal are so placed in the surface of the mold that they will come in immediate contact with the heavy section of the casting.

It will thus be seen that chills serve much the same purpose as risers, the difference lying principally in the method employed. Risers prevent sponginess and cracks in the junction between two sections by supplying the larger section with molten metal as it shrinks, while chills accomplish the same result by making the two sections cool at an equal rate. Chills are also used for other purposes. They are often employed to give a hard, smooth surface to certain parts of the casting. A harder surface than is usually produced is often necessary if a part of the casting is to be subjected to unusual wear, while a smooth surface often eliminates machining.

Soft Cores Essential

Cores for aluminum castings should be made as soft as is consistent with safe manipulation. Because of the "hot short" condition of alloys at high temperatures, it is particularly important that they give way to the shrinkage of the cooling metal. A good core should be hard enough to be safely handled at ordinary temperatures, but should soften and crush when subjected to the intense heat of the molten metal, since the slightest resistance to the shrinkage of aluminum when it is in this fragile state will usually result disastrously.

A good core sand should consist of a mixture of sharp sand and molding sand in varying proportions held together by some such binder as rosin, flour or core oil. The sharp sand furnishes good venting qualities to the mixture. The molding sand adds strength to the cores before they are baked and produces a smooth surface to the casting. Rosin is probably the best binder to use, for on coming into contact with the molten aluminum it softens, permitting the core to give as the casting shrinks. In some core sands a small amount of flour is used in addition to the rosin to assist in binding the mixture together until the cores are baked. The rosin has no binding power until it has first been melted and then allowed to harden. Linseed oil and various patented core oils are also successfully used as binders by some foundrymen.

A sand mixture for cores that will crush and prevent cracking is composed of the following ingredients:

Sharp sand	45	parts
Molding sand	45	"
Powdered rosin	2	"
Flour	1	"

After this mixture has been moistened to the correct degree of dampness, it is ready for use. The core should be rammed lightly and should be freely vented. This precaution is more important in the construction of the cores than of the mold proper, for, unlike the mold, the core is almost completely surrounded by the metal. The completed core should be sprayed with molasses water, baked in an oven hot enough to melt the rosin thoroughly, and then given a soapstone wash to secure a smooth finish.

Green sand cores are molded from the regular sand which is used for the mold itself, and require no binder other than water. They are skin dried with a blow torch immediately before setting in the mold. At present green sand cores are used principally for large body cores in casting automobile crankcases and oil pans. With proper development there is no reason why their use cannot be greatly extended to such parts as manifolds, bearings, flywheel housings and gear cases. They cannot be used for small cores of intricate shape for ramming up, nor in places where the core print support is limited in size or position.

Green sand cores, since they are made of the same material as the mold, have an equivalent chilling effect which promotes uniform solidification of the metal. Baked sand cores, on the other hand, have but a fraction of the heat-absorbing power of green sand, therefore induce non-uniform solidification with the resultant shrinkage crack.

The crushing strength of green sand cores is from 1 to 3 lb. per square inch, or about 1/100 that of baked sand cores. This is an important consideration in connection with the very weak condition of the metal just below the solidification point when the solid shrinkage is taking place.

Die Casting

The art of die casting is not new. For many years zinc, lead and tin have been successfully cast in this manner. Aluminum die castings, however, are of comparatively recent development. A copper-aluminum alloy is most frequently used with copper content running from 8 per cent to 10 per cent.

It would naturally be supposed that castings made under pressure would be dense and homogeneous. On fracture, however, it is found that only the surface or skin of the casting is dense and close-grained, while the inner structure is porous. This applies particularly to the larger castings; smaller ones can usually be cast very satisfactorily. Another cause of trouble has been the cracking of the casting due to resistance to shrinkage offered by the metallic cores, but this trouble is largely removed by the use of collapsible cores.

Test Bars

It is important to standardize methods of testing aluminum castings in order that results obtained in one foundry may be comparable with those obtained in another, or that tests made one day may check up with those made at another time. The test specimen recommended by the Society of Automotive Engineers and the one most generally used is a cast-to-size bar $\frac{1}{2}$ in. in diameter at the breaking section and filleted to a $\frac{3}{4}$ in. diameter threaded end. The fillet should not be less than $\frac{5}{8}$ in. radius. The test bar should be cast in sand, the use of chills or artificial means of cooling is prohibited. The gage length for aluminum should be 2 in.

The American Society for Testing Materials recommends a similar bar, but machined to size rather than cast to size, in order that the diameter at the breaking section may be more accurately measured. In ordinary foundry practice the increased accuracy of the test due to machining the breaking section and threading the ends is not considered sufficient to pay for the cost of machining, and so the test bar is usually cast to size and pulled in wedge grips. Even the ideally designed and cast test specimen is not without its limitations, for it can be expected to give only approximate results for the metal in the casting which it is supposed to represent.

The test bar checks the history of the metal up to the time it goes into the mold. It gives no check whatever upon the molding variables, except when the bar is attached to the casting, when it reflects certain, but not all, of the variables, and in addition it gives no check on the design of the casting. The only way in which to secure such checks is to cut the casting up into parts and take test specimens from each part. Such an experiment will indicate considerable variations in the physical properties of the different parts, for unless molding practice and design are perfect the physical properties of a casting are bound to vary from point to point.

These variations are due to shrinkage, gating methods, the chilling effect, the personal element in foundry work and the design. When it is understood thoroughly to what an extent the physical properties of a casting are subject to control by variations in the melting conditions, the molding practice and the design, a long step will have been taken toward a better adaptation of castings to the purposes for which they are intended.

Heat-Temperature Curves of Metals

The adjoining diagrams, Figs. 1, 2 and 3, are taken from an article by J. F. Shadgen in *The Iron Age*, July 27, 1922, p. 218. In turn, that author is indebted to recent investigations by Wuest, Meuthen and Duerrer[1] for the data from which the diagrams are drawn, and the copious tables computed. "The investigators used the purest forms of metals commercially available, and an apparatus similar to the vacuum calorimeter of

[1] "Wärmeinhalts-Temperature Kurven der technisch wichtigen Metalle"; Mitteilungen über Forschungsarbeiten, No. 204; Vereines deutscher Ingenieurs.

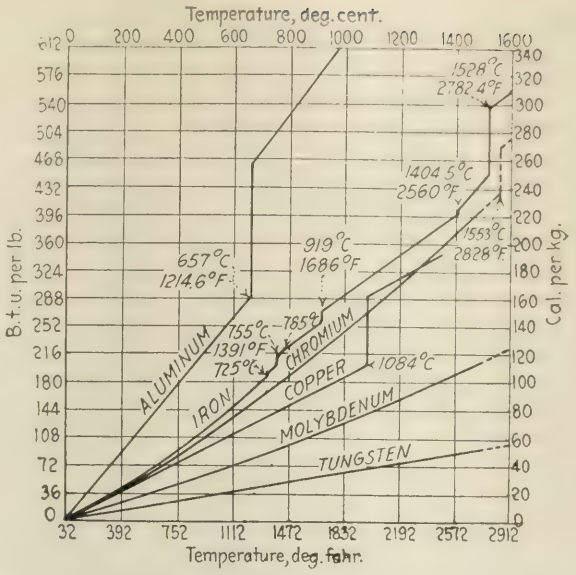


FIG. 1—HEAT CONTENT OF Al, Fe, Cr, Cu, Mo AND W

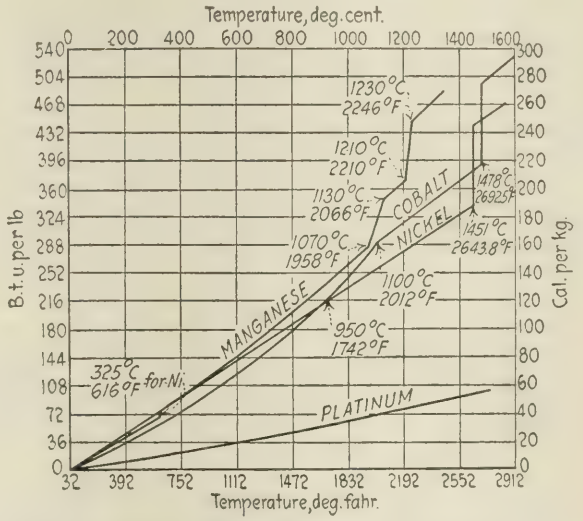


FIG. 2—HEAT CONTENT OF Mn, Co, Ni, AND Pt

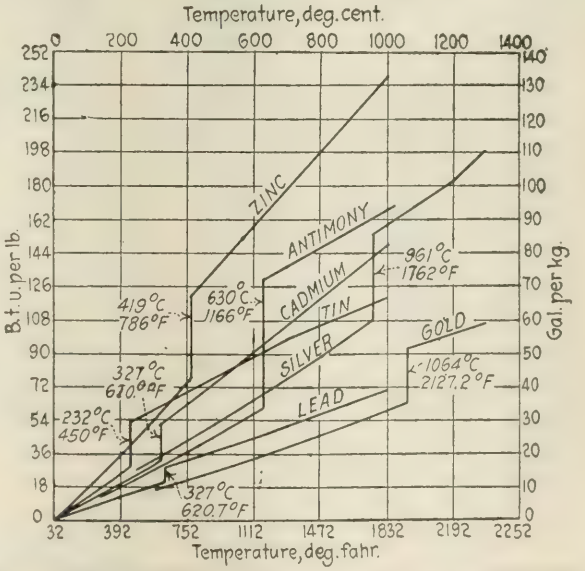


FIG. 3—HEAT CONTENT OF Zn, Sb, Cd, Sn, Ag, Pb AND Au

Synopsis of Recent Chemical & Metallurgical Literature

Determination of Modulus of Elasticity and Limit of Proportionality

R. Guillery[1] proposes a testing machine which will automatically register the modulus of elasticity of the specimen, and after this has been determined and checked, will then indicate the stress at which this modulus loses its constancy—i.e., the limit of proportionality.

Tension is put upon the test-piece *A* (Fig. 1) by a clutch attached to the piston of a hydraulic cylinder. Elongation is transferred by means of the link motion sketched at *B* to a proportional distention of the diaphragm at *C*, and is measured at a magnification of 2,000 by change in the elevation of the liquid in the attached level.

Liquid in the main cylinder is connected by a pipe to another cylinder actuating piston *F*, which works against a calibrated spring *G*, thus deflecting it an amount proportional to the stress on the test-piece *A*. This deflection, in turn, is transmitted by the lever system shown at *E* to a second diaphragm *D*, also connected to the level.

The arrangements are so made that an increase in elevation of the liquid in the measuring tube caused by contraction of *C* is counteracted by a simultaneous decrease in level caused by expansion of *D*. Exact balance may be had by adjusting the position of the little roller separating the upper and lower levers at *E*. When this is done, variation of the tension on the test-piece will cause no change in the water level, since within the elastic limit, stress and strain are proportional. Thus, the modulus of elasticity may be read from the position of the roller against a scale attached to one of the levers *E*.

Everything being in adjustment, as noted, the water level is unchanged as the load on the test-piece increases. The moment the proportional limit is reached, however, the water level shows a fluctuation, and the corresponding stress can be figured from the pressure existing in the main cylinder.

[1] "Nouvelle machine de traction donnant la limite élastique et le module d'élasticité," *Revue de Métallurgie*, February, 1922, p. 101.

Lowered Transformation in Quenched Steel

If carbon steels, containing from 0.4 to 0.9 per cent C, be cooled extremely slowly, A_1 occurs at 726 deg. C. Normal rates of cooling lower this to a narrow range at approximately 700.

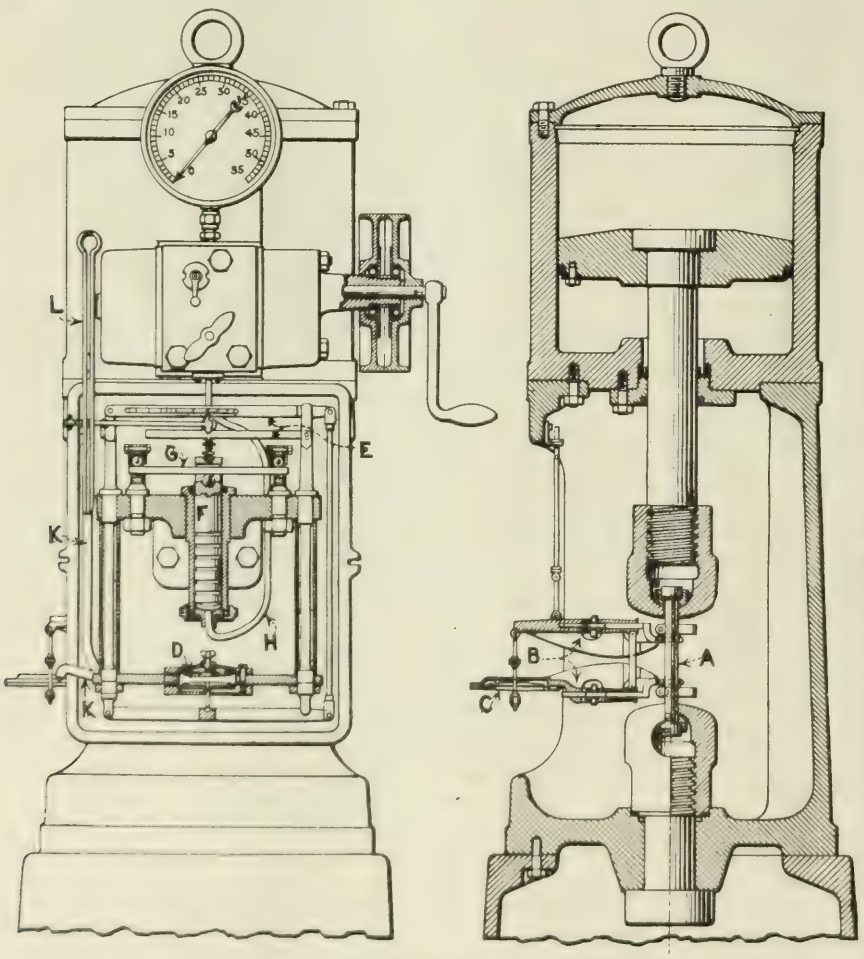


FIG. 1—DIAGRAM OF MODULUS INDICATOR

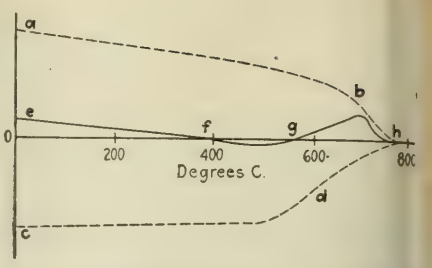


FIG. 2—TRANSFORMATION FORCES I CHROMIUM STEEL

More speedy cooling lowers it stil further and widens the range until i centers at about 550 deg. C., and th lowered transformation has been la beled Ar_1'. Quenching still more rap idly, as in jets of water at 70 deg., th lowered transformation splits, a secon portion called Ar_1'' occurring at a rang beginning at about 300 deg. C. or ever lower. Still more drastic quenching suppresses Ar_1' entirely and lowers Ar_1'' another 100 deg. The same kin of phenomena occur in steels containing 0.9 per cent carbon and 10 per cent chromium or nickel, except, due to sluggish rates of change, they may be observed at moderate cooling speeds.

Kôtarô Honda and Tario Kikuta* have studied these phenomena, and conclude that Ar_1'' and Ar_1' are both merely retarded A_1 transformations—i. e., the change of austenite through martensite to pearlite. They find that if the temperature is held constant at some temperature within Ar_1', the entire transformation completes itself and Ar_1'' does not appear. In the same manner if Ar_1' is passed fairly rapidly, and the temperature held constant somewhere within Ar_1'', this lowered transformation also continues to completion—a longer time is required as is consistent with molecular inertia at such low temperatures. However, in the chromium steel, Ar_1'' does not proceed if the temperature is held constant for hours between Ar_1' and Ar_1''.

Let us assume that the forces tending to produce a transformation vary with the degree of undercooling somewhat as sketched in *ab* (Fig. 2). The retarding influences, such as viscosity, increase the inertia with falling temperature, somewhat as *cd*. The arithmetical sum is plotted in *efgh*, and for such conditions it is evident that one transformation which initiates at *h* may occur in two steps, *h* to *g*, and *f* to *o*. Between *f* and *g* the net transforming force is negative, so that a stay in this region would not suppress Ar_1'' The illustrated case conforms to chromium steel. Curve *ab* for nickel and carbon steels has sufficiently larger ordinates than *cd* so that portion *fg* lies just above the horizontal axis. Therefore, while the transformation is stepped if the cooling speed is right, it will always complete itself at any temperature if sufficient time be given. Steels with 26 per cent nickel are non-mag-

*Fifty-ninth report of the Iron and Steel Research Institute; *Science Reports*, Imperial Tohoku University, vol. 11, p. 105. Also read before the May, 1922, meeting of the British Iron and Steel Institute.

tic at room temperature, but become agnetic in liquid air. Curves *cd* for ich steels have larger ordinates at gh temperatures but smaller at low, that curve *eh* is above the horizontal kis only at very low temperatures. xactly the opposite is true for Had-ld's manganese steel, which is non-agnetic in liquid air, but becomes agnetic after annealing at 550 deg. C.

Bureau of Mines Studies Economic Status of Carbon Black

Forty billion cubic feet of natural gas used annually in the United States the manufacture of carbon black, tates the Bureau of Mines, which has ompleted a study of the subject. Car-on black is used extensively in the ubber industry, something like 20,000,-00 lb. going annually into the manu-acture of automobile tires. From 0,000,000 to 12,000,000 lb. of carbon lack is used annually in the manufac-ure of printers' ink, and from 4,000,000 o 5,000,000 lb. in the making of stove olish. The product enters also into he composition of black and gray paint, honograph records, carbon paper, rayons, typewriter ribbons, glazed aper, tarpaulins, black leather, arti-icial stone and insulating materials. In ormal times the United States exports robably 10,000,000 lb. of carbon black n a year.

Confusion exists in the use of the erms lampblack and carbon black. Car-on black is the fluffy, velvety-black igment produced by burning natural as with a smoky flame against a netal surface. In its physical char-cteristics it is entirely different from ampblack, which is made by burning il or other carbonaceous material with nsufficient air and collecting the moke in settling chambers. The pro-ess of manufacture most widely used at present is the so-called channel sys-em, in which the black is deposited on he smooth undersurface of steel chan-nels by lava-tip burners. The mech-anism is inclosed in sheet-iron buildings in order that the amount of air may e regulated.

It is generally conceded that the most important use that can be made f natural gas is for domestic purposes. Whether gas is of greater economic alue for the manufacture of carbon lack than for other industrial purposes s a question that will depend on the onditions existing in each locality here a large supply of natural gas is vailable.

The policy of the Bureau of Mines is hat carbon black be made when gas is roduced in isolated sections with no resent or reasonably prospective mar-et for gas being produced, when gaso-ine has been extracted, and when prac-ical and modern and improved methods re used. At present there is consider-ble agitation for and against laws estricting the use of natural gas for he manufacture of carbon black. The natter has been the subject of consider-ble agitation and legislative considera-ion in Wyoming. The carbon-black in-lustry has been established in Pennsyl-vania for over 40 years, and in West Virginia for more than 20 years. The latter state still produces more than 50 per cent of the entire supply. Neither of these states has passed any laws restricting the use of natural gas for this purpose.

The carbon-black manufacturers claim that they use the best manufacturing processes that have been developed and that they produce a commodity of acknowledged utility. They have also provided a market for gas in isolated regions and in so doing have many times prevented conditions that would otherwise have resulted in waste. In certain isolated districts they have furnished small communities with natural gas whose consumption they assert was not sufficient to warrant the building of a pipe-line system.

The Bureau of Mines considers that the utilization in the manufacture of carbon black of low-pressure gas, of gas escaping into the air from natural-gas gasoline plants, gas in distinctly isolated districts, and gas in fields that have been abandoned by other gas companies on account of low pressure, is in reality often a conservation measure. It is preferable to the practice of letting the gas go to waste in the air or to plugging improperly the wells so that the gas sands can be damaged from flooding by water.

More efficient processes should be devised for the manufacture of carbon black. Thermal decomposition offers an interesting field for research as a possible means of increasing the relative efficiency of the industry. In the future it is probable that at some plants the waste heat will be utilized profitably.

The results of a study of the manufacture, properties and uses of carbon black, made by Roy O. Neal, consulting engineer, and G. St. J. Perrott, physical organic chemist, are given in Bulletin 192, just issued by the Bureau of Mines.

Vitamine Content of Canned Foods Compares Favorably With Cooked Food

A bulletin recently prepared by Dr. E. F. Kohman, of the Research Laboratory of the National Canners' Association, brings together all the research literature relative to the effect cooking has on vitamines. This research demonstrates that canned foods supply the vitamines as abundantly as the same foods cooked in the ordinary way. The vitamine content is the greatest when foods are at the proper stage of maturity for consumption and decreases when the foods are held for a period of time. Canned foods are processed in vacuum, while foods cooked on the stove are exposed to the air, which is the cause of a considerable loss of vitamine C. From the experimental evidence now available, canned foods are found to be practically as rich in vitamine A and B as the corresponding fresh raw products. In acid products, such as tomatoes and fruits, there is only a negligible destruction of vitamine C by ordinary cooking or in the canning process.

Book Reviews

THE CHEMISTRY OF THE NON-BENZENOID HYDROCARBONS. By *Benjamin T. Brooks, Ph.D.* New York: The Chemical Catalog Co., Inc. 1922. 612 pp. 23.5x26 cm. Price $7.

"The beautiful, interesting and often facile chemistry of the benzene hydrocarbons has somewhat overshadowed the chemistry of the aliphatic open chain and cyclic non-benzenoid hydrocarbons." Dr. Brooks, in the opening sentence of the preface, thus expresses his conviction that the chemistry of the hydrocarbons has in the past been too largely aromatic chemistry. To right the balance, the author presents us with a 600-page treatise which brings together a mass of detail concerning the properties and behavior of non-benzenoid hydrocarbons, both open chain and cyclic, saturated and unsaturated. It is no mere catalog of substances and processes; the author "has endeavored to show the close relationships which hold generally throughout the chemistry of the non-benzenoid hydrocarbons and, on the other hand, to point out that the chemical behavior of the more complex hydrocarbons of the paraffin series and the alicylic hydrocarbons cannot be assumed from the chemical behavior of a few of the simpler hydrocarbons," and he has done his task well. It is a large and varied field—paraffins, olefines, hydroaromatics and the multitudinous terpenes; petroleum refining, synthetic rubber and camphor—but each portion is ably handled with particular reference to the most modern developments.

The book should be of great value to those who are in any way dealing with non-aromatic hydrocarbons, whether from the industrial or the purely scientific standpoint. No attempt is made to consider all the complexities of such a subject as petroleum refining, but nevertheless there are several pages devoted to the pyrolysis of the paraffins and a very interesting discussion (9 pages) of the chemical aspects of certain steps in the refining, particularly the sulphuric acid treatment. The several processes for synthesizing camphor from turpentine are critically considered and clearly presented. A special chapter is devoted to the physical properties of the hydrocarbons, while another deals with their physiological action.

The organic chemist whose chief work lies in other directions will probably find the book almost as valuable as will the specialist. There are very few books or general articles which deal with the aliphatic hydrocarbons and none which can so conveniently serve as a reference book for this subject. The alicylic compounds and terpenes have been exhaustively reviewed before, particularly by Aschan, but a great mass of difficult and complicated work has appeared since the most recent

of these special books was published. Dr. Brooks has made a special effort to include the modern work in terpene chemistry and, for example, has brought the discussion of the Wagner rearrangement up to date by including Meerwein and Lipp's work (1920). For this reason and because of the general way in which the subject has been treated, the five chapters on terpenes make an excellent textbook for a student of this difficult field. The chapter on rearrangements is of considerable theoretical interest. It is to be regretted that it does not in some way contain cross-references to other cases of rearrangements which are dealt with elsewhere in the book. In fact, a greater number of cross-references throughout the monograph would have helped in correlating the various branches of the subject which necessarily overlap.

The typography is not as good as it should be. Some of the structural formulas are very carelessly printed, the carbon "bonds" in some instances being so irregular that the meaning of the formula is almost obscured. This is, however, a relatively small point and is perhaps counterbalanced by the large number of equations and structural formulas which are given, and which, as always, are of great assistance to the reader. JAMES B. CONANT.

ENGINEERING STEELS. By *Leslie Aitchinson*, Consulting Metallurgist of the Air Ministry of Great Britain. 397 pp. London: MacDonald & Evans. New York: D. Van Nostrand Co., 1921. Price $6.

"Engineering Steels" is written from the point of view of a mechanical engineer and designer rather than from the point of view of a metallurgist and is a valuable addition to the literature on this subject. It is clear and concise and points out the need for and importance of co-ordinating the wants of the engineer in his design with the problems of the metallurgical engineer, the heat-treating expert and the physicist. Dr. Aitchinson reviews the important factors to be met by the metallurgist in determining the proper composition for standard and special steels the heat-treatment necessary to produce the best microstructure, and the general subject of testing the steel for chemical and physical properties before applying it to the service for which it is intended.

A brief review is also given of the steel-melting processes in common use, and some of the advantages and disadvantages of each are pointed out. The author discusses the casting of the ingot, the flow of the metal under the roll, hammer or forging press and the effects of slag in the metal while being worked and its influence on steel when under stress.

The chapter on heat-treatment describes, in a concise manner, just what happens in plain carbon and alloy steels and causes them to respond to heat-treatment. The data include time-temperature cooling curves and curves showing the physical properties resulting from different drawing temperatures for different carbons in plain steel and for different alloys in alloy steels.

Photographs of special testing apparatus, macrostructures and microstructures of different classes of steel under varying conditions of manufacture and treatment are arranged in the appendix at the end of the book. This feature gives added usefulness in having much detailed data available, yet removed from the text proper.

In general, this book is a concise compilation of data on steel arranged in good order for students of steel metallurgy as well as the busy engineer who must decide quickly what material he will use and what tests he will require. T. D. LYNCH.

THE JOURNAL OF THE INSTITUTE OF METALS. Edited by *G. Shaw Scott*, secretary. Vol. 27. The Institute, 36 Victoria St., London, S. W. I. 630 pp. Price, 31s. 6d. net.

Despite the fact that the present volume corresponds with the inauguration of Leonard Sumner, a manufacturer, as president, the most of the original papers presented are what might be called "theoretical treatises on such impractical things" as recrystallization (85 pages) equilibrium of the aluminum-zinc system, or rate of combination of copper and phosphorus. On the other hand, some manufacturers would not be altogether disappointed, since they have doubtless found that recrystallization has much to do with the permanence of their product and its immunity from season cracking. This very subject is discussed at length in the same volume by Messrs. Moore and Beckinsale, while Dr. Guy D. Bengough's recent pamphlet (designed entirely for "practical" men) on "Corrosion and Protection of Condenser Tubes" was discussed at length by many members.

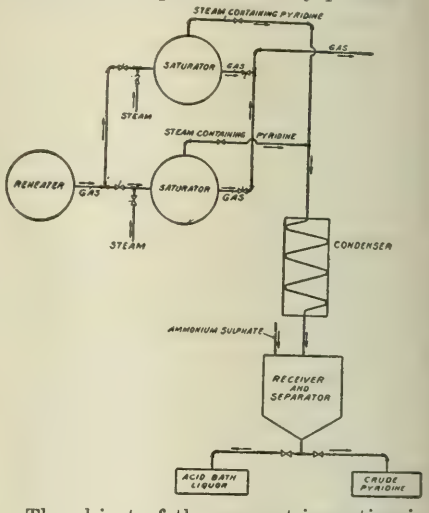
An important paper on "Mechanical Properties of Nickel-Silvers," by Prof. F. C. Thompson, is also included. Abstracts from current literature taking up 220 pages complete the remainder, a balance between theory and practice or between manufacturer and user which has been the aim of the Institute since the first. How well this aim has been fulfilled was commented upon by the new president, citing the fact that during 1921, a year of greatest trade depression, the membership increased from 1,298 to 1,410. He ascribed the fact that the cessation of the war brought no drop in the widespread interest in the Institute to the "open-door" policy inaugurated during the war, when every manufacturer was driven by the press for munitions to open his plant and discuss his trade secrets with his former competitors. The value of the Institute of Metals as a common meeting ground was very apparent then, and apparently has not yet been forgotten. E. E. THUM.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Recovery of Pyridine—In the manufacture of byproduct coke and illuminating gas, pyridine bases are present in the crude gas and are finally found in the tar, ammonia liquors, ammonium sulphate, light oils, etc. Some of the higher boiling pyridine bases are separated in the tar, but the gas after the removal of the tar contains a considerable proportion of them. A large proportion of these pyridine bases are absorbed in the sulphuric acid bath along with the ammonia in the saturators as employed in the direct or semi-direct ammonium sulphate recovery process.



The object of the present invention is to recover more economically the pyridine bases from the ammonium sulphate solution and particularly to accomplish such recovery with but little interference in the regular operation of the byproduct plant. In the process they dispense with the treatment of the acid liquor bath with ammonia and recover the pyridine directly from its acid solution. While the recovery of the pyridine from a strong acid solution is difficult, it is found that pyridine can be steam distilled readily from an acid bath of low acidity. This can be accomplished readily with solutions of not more than 2 per cent acidity. The distillation of the pyridine from such solutions can be more advantageously accomplished by having the solution substantially saturated with the ammonium sulphate at its boiling point.

In the drawing is illustrated schematically the application of the present invention to the pyridine recovery in a byproduct plant employing the direct or semi-direct ammonium sulphate process. (1,414,441; Frederick W. Sperr, Jr., and Ralph L. Brown, of Pittsburgh, Pa., assignors to the Koppers Co. of Pittsburgh, Pa., a corporation of Pennsylvania. May 2, 1922.)

Nitrocellulose Stabilizer — A novel method of controlling the diphenylamine content of smokeless powder has been patented by George Rocker for E. I. du Pont de Nemours & Co. The stabilizer is introduced in the process of washing the surplus ether from the nitrocellulose colloid. A 60 per cent ethyl alcohol solution is used and is made up to contain a certain percentage of diphenylamine which is calculated according to the formula $y = \frac{X-B}{4.5}$, where y equals the necessary percentage of diphenylamine in the solution, X equals the percentage of diphenylamine desired in the finished powder, and B equals the percentage of diphenylamine already in the powder. The diphenylamine-alcohol solution is calculated so that the proper amount of the stabilizer will be introduced into the powder, but no more. The excess solution is washed out by water. (1,424,212. Aug. 1, 1922.)

Gas Scrubber.—In the passage of gas or vapor through a scrubber, the back pressure created against the passage of the gas is in some cases of considerable importance. Such a case would be, for example, where a small amount of ammonia was to be absorbed in water from a large amount of gas; or again, where it is required to cool a large amount of water and the loss of water head becomes of importance.

This invention has for an object the production of a thorough contact between vapor or gas and a liquid or liquids. It is considered that by means of this apparatus, this contact can be obtained without the necessity for a high head on the liquid.

Th essential point of difference between this scrubber and other scrubbers made for a similar purpose is in the design of the diaphragm. The shell of the scrubber is composed of cylindrical sections united at flanged joints. At the bottom of each section is an inlet for gas and an outlet for scrubbing liquids. At the top of each section is an outlet for gas and an inlet for scrubbing liquids. On the inner periphery these sections are flanged to provide trough-like elements. In the interior of the section is a perforated diaphragm with its edges sealed by liquids in these trough-like elements. The perforations in the diaphragm are small and are adapted for the passage of gas without much, if any, passage of liquid.

These diaphragms are arranged so they may be set level or at an angle and means are provided for varying this angle. Liquid coming from the top is received on the diaphragm and covers it in film form. The thickness of this film depends on the angle at which the diaphragm is set and the amount of liquid supplied. The gas passes upward through the perforation and through this liquid film, producing thorough contact between the liquid and the gas. With the small perforations provided in the diaphragm, practically all the liquid on this diaphragm flows to the liquid seal at the discharge end and thence to the section below.

It is found in practice that the passage of gas through uniform perforations, such as occur in the diaphragms described above, is substantially equal at all points. For this reason it is claimed that maximum contact of liquid and gas is obtained with the minimum amount of back pressure. (1,419,867; Wilbur G. Laird, New York, assignor to Henry L. Doherty. June 13, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Ceramics—Grains of natural or artificial corundum, or composite artificial aluminates melted in the electric furnace, are incorporated in ceramic compositions, particularly those used in the manufacture of electric apparatus such as insulators, sparking plugs, pulleys, switchboad plates, tubes, boxes and resistances. (Br. Pat. 177,160; not yet accepted. L. A. Cordenot, Rosny-Sous-Bois, France. May 10, 1922.)

Metallic Chlorides—Inorganic chlorides are obtained by passing chlorine containing sulphur chloride over a heated mixture of an oxide and carbon, the production of silicon and aluminum chlorides being particularly described. When aluminum chloride is prepared, the first product is a sublimate containing an addition product of sulphur chloride with aluminum chloride from which the two chlorides are separated by distillation, preferably under reduced pressure. The mixture of chlorine and sulphur chloride may be made by passing chlorine through an evaporator containing sulphur chloride. Alternatively, the sulphur chloride may be formed *in situ*, for example by adding sulphur compounds such as pyrites or a sulphate to the mixture of carbon and oxide. (Br. Pat. 176,811. Consortium für Elektrochemische Industrie-Ges. Munich. May 10, 1922.)

Dialkyl Sulphates—Dialkyl sulphates are obtained by heating the corresponding alcohols or ethers with alkali pyrosulphates or chlorsulphonates or mixtures thereof, and distilling *in vacuo;* or the alcohol vapor may be passed over the heated pyrosulphate. Examples of both methods are given as applied to the production of diethyl sulphate from ethyl alcohol and sodium pyrosulphate. Methyl, propyl and butyl alcohols and ethers are also specified as initial materials. (Br. Pat. 177,189; H. Dreyfus, London. May. 17, 1922.)

Phosphates—A modification of the process in which a mixture of crude phosphate, alkaline sulphate and a loosening substance is treated with hydrochloric acid gas consists in treating the mixture of phosphate and loosening substance with hydrochloric acid gas without previous admixture of alkaline sulphate. The latter is added afterward to convert the calcium chloride formed into gypsum. In this case the addition of an indifferent substance such as sand, gypsum, infusorial earth or dry brown coal to the mixture of phosphate and loosening substance prevents caking during the course of the reaction. In an example, 100 kg. of Florida phosphate mixed with 40 kg. of crude lignite and 50 kg. of sand are submitted to the action of hydrochloric acid gas, and the product is mixed with 80 kg. of ammonium sulphate. (Br. Pat. 177,496, not yet accepted; F. Risberg, Mannheim. May 17, 1922.)

Ethylene Derivatives — These are manufactured from a gaseous mixture containing ethylene and a halogen or an acid chloride using a porous charcoal as a catalyst either with or without a halogen carrier such as chlorides of antimony, sulphur, phosphorus, etc. According to examples, the ethylene content of coal gas is caused to react with chlorine with and without antimony pentachloride, with bromine and with phosgene, forming respectively ethylene dichloride, ethylene dibromide and beta-chlorpropionyl chloride. (Br. Pat. 177,362; Bayer & Co., Leverkusen, Germany. May 17, 1922.)

Viscose—In the preparation of viscose, the caustic alkali solution is cooled to a temperature not exceeding 5 deg. C., for example, to —2 deg. C., before addition to the cellulose material. To assist the penetration of the caustic alkali solution into the cellulose, the air in the vessel in which the treatment is carried out may be evacuated or may be replaced by a gas that is soluble in or reacts chemically with the alkali solution, such as ammonia gas or sulphur dioxide. (Br. Pat. 178,152. W. P. Dreaper, London. June 8, 1922.)

Cellulose Acetate—Artificial filaments or films are prepared from cellulose acetate solutions, in particular the solutions in acetone, by coagulating the formed filament or film in a bath containing a thiocyanate such as ammonium, potassium, sodium or calcium thiocyanate. By this process the filament is of improved strength and elasticity and granulation is obviated, and in the case of filaments it is possible to employ large spinning orifices and to draw out the filaments to the fineness of natural silk. Plastifying agents such as benzyl alcohol and other additions may be made to the cellulose acetate solution. (Br. Pat. 177,868. British Cellulose & Chemical Manufacturing Co., London. May 31, 1922.)

Imitation Milk—An imitation milk, which may be concentrated or dried like cows' milk, is prepared from coconuts by extracting the endosperm with the water of the coconut. For this purpose the endosperm of fresh coconuts, preferably at the stage of ripeness at which the liquid is barely perceptible on shaking, or clean copra, is ground up with the water of the coconut, or it may be comminuted and the water afterward added. The water, with the material it has taken up, is then expressed in any known way, and the resulting liquid concentrated at a temperature not exceeding 80 deg. C. To

increase the protein and sugar content a portion of the coconut milk from which oil has been removed by decantation may be added to the liquid before concentration. (Br. Pat. 177,927. L. M. Smith, Hawaii. May 31, 1922.)

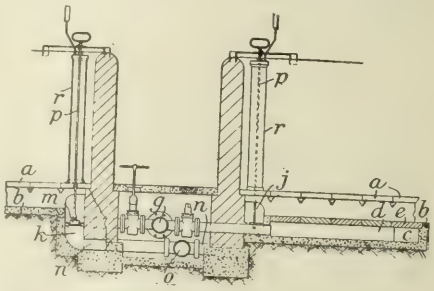
Lithopone — In making lightproof lithopone, the zinc salt solution, the baryta lye and the water used in the process are purified and clarified by producing small quantities of a purifying medium in the liquids. For example, a small quantity of an iron or aluminum salt is added, and precipitation is effected by adding a slight excess of a carbonate, phosphate or hydrate, the liquids being then boiled and filtered. The barium sulphide solution is obtained by treatment of a baryta lye, purified as described above, with sulphuretted hydrogen. (Br. Pat. 176,377. Cordes & Co. Ges., Berlin. May 3, 1922.)

Cellulose—In the preparation of cellulose capable of forming highly viscous solutions, the lignin substances are converted by treatment with chlorine into a form soluble in cold dilute soda lye, while the cellulose remains unaltered. Straw is first boiled with dilute hydrochloric acid such as is obtained from the chlorination process. Wood is first boiled with caustic soda or milk of lime, and may be treated as shavings with chlorine diluted with an indifferent gas or applied alternately with such gas. In treating wood as chips, chlorine under pressure is used. The hydrochloric acid produced by the chlorination reaction may be reconverted into an impure chlorine and used again. (Br. Pat. 178,196. H. P. Waentig and J. O. W. Gierisch. Dresden. June 8, 1922.)

Motor Fuel—A motor fuel is produced by agitating, say, 3 to 5 lb. of calcium carbide in a pressure-resisting vessel with 9 gal. of commercial alcohol and, say, 1 gal. of acetone, and permitting the mixture to stand with occasional shaking until the acetylene is absorbed. The liquid is cleared from the bulk of the lime by carbon, manganese dioxide or other insoluble flocculating agent. A fuel of the composition specified contains over 12.5 times the volume of acetylene and 0.025 to 0.05 per cent of lime. (Br. Pat. 178,498. S. W. Blake. South Africa. June 14, 1922.)

Continuous Crystallizer—In crystallizing and separating the salts contained in a mixed solution, the solution is evaporated by being run down a sloping table, and the salts separate on the table in order of their solubilities, the least soluble being deposited first. The table, which may be cambered, has projecting edges, transverse inclined baffles and intermediate spreading baffles. The table may be mounted on trunnions so as to be turned to discharge the salts, and may be combined with other tables in triangular or other form so that, on being turned, another table surface is brought into position. The table may be heated by electric resistances extending along it or by other means, and may be covered and the water vapor evolved be drawn off and condensed. Glass covers may be used and the heat of the sun used to effect evaporation. (Br. Pat. 178,263. T. G. Tulloch, London. June 8, 1922.)

Paper Making—In the manufacture of paper, the under side of a mass of stuff from which bleaching liquid has been partly drained is subjected to a vacuum to render the bleaching uniform throughout the mass. As shown,



the spaces between the false floors *a* and true floors *b* of a series of bins are connected to a sump by drainage channels *j*, valves *m*, ducts *k* and branches *n* of a pipe *o*. Transverse and longitudinal channels *c*, *d* in the floor *b* are connected by valve-controlled pipes with a main pipe *g* of air-exhausting apparatus. The stem *p* of each valve *m* is inclosed in a tubular pillar *r* provided with a vacuum-gage to indicate the exhaustion at the bottom of the mass of stuff in the bin. The channels *c*, *d* are covered with perforated tiles *e* preferably having upstanding branches to prevent ingress of liquor into the channel system. The channels may be omitted, pipes connected with exhausting-means then being disposed in the spaces between the floors *a*, *b*. (Br. Pat. 178,209. W. H. Salmon, Gravesend. June 8, 1922.)

Cholesterol — Crude cholesterol materials such as woolfat are purified by treating them with nitric acid, preferably with agitation and heating, for example, to 60 to 120 deg. C. The product is stated to vary from a hard wax-like substance to a highly viscous and elastic body and to be suitable for such technical applications as leather dressing, waterproofing, water- and acid-proof packing and joints, or as media in the preparations of decorative or anti-corrosion solutions. (Br. Pat. 179,241. F. G. Conyers and O. Reynard, Bradford, Yorkshire. June 28, 1922.)

Purifying Hydrocarbons—Hydrocarbons are purified by treatment with acid under conditions of concentration, temperature, pressure and duration such that sulphonation is avoided and the liquid polymerization products are insoluble in the acid and remain dissolved in the hydrocarbon, from which they are recovered by distillation. In the case of sulphuric acid, the concentration is always less than 60 deg. Bé., acid of 46 to 48 deg. Bé. being preferably used with heat. Phosphoric acid may also be used. For example, heavy solvent naphtha is treated with 10 per cent of phosphoric acid of density 1.70 or of sulphuric acid of 46 to 48 deg. Bé. at a temperature of 110 deg. C. for several hours. The acid is then drawn off, the solution neutralized and distilled in steam, yielding a viscous oil and a substance which may be used as a varnish. The treatment of xylene, benzene, toluene and light tar oil is also described. The process is also applicable to aliphatic hydrocarbons if these do not contain large quantities of aromatic derivatives. (Br. Pat. 179,610. J. Demant, Paris. July 5, 1922.)

Distilling Hydrocarbons—In distilling and cracking hydrocarbon oils by vaporizing the oil at about atmospheric pressure and compressing and condensing the vapors under pressure, the pressure is increased during the course of the distillation so that the heavier vapors coming off at the later stages are cracked by the heat generated by the compression and a uniform distillate is obtained. The still is supplied with oil from a vessel in which it is mixed with steam by a rotary stirrer to heat the oil to about 40 deg. C. The vapors generated in the still are withdrawn by a compressor and are passed through a condenser and receiver still under pressure. Uncondensed gases pass to the burners. When the evolution of vapor in the still ceases and the pressure falls below atmospheric, the temperature of the still is raised step by step and is maintained after each rise until evolution of vapor ceases. When the oil has reached a cracking temperature (about 300 deg. C.) superheated steam is passed into the still. The compressor is operated so as to maintain a pressure of about 125 lb. per sq.in. in the receiver until a temperature in the still reaches 300 deg. C., and the pressure in the receiving tank is raised about 25 lb. per sq.in. for each subsequent increase of 100 deg. C. in the still. (Br. Pat. 179,644. S. L. Gartlan and A. E. Gooderham, Toronto. July 5, 1922.)

Soya Bean Oil—To prepare inodorous and colorless oil and flour from soya beans, the beans, coarsely broken and freed from husk, are treated with an aqueous solution of organic acid, such as acetic acid or table vinegar, washed and dried. The oil is then expressed in known fashion, the temperature being kept too low to coagulate the albumen. The residue is ground to flour, which may be used either as food or in the manufacture of soap, washing powder, etc. (Br. Pat. 179,776. Y. Yamamoto and I. Mizusawa, Japan. July 5, 1922.)

Hydrogen and CO—In the process for producing hydrogen, carbon monoxide or a mixture of these gases by permitting steam or carbon dioxide or a mixture of the two to pass through an electric arc with sulphur vapor, as described in the parent specification, the metal sulphides are utilized directly in the electric furnace. By this means the metal formed also reacts, giving further quantities of hydrogen or carbon monoxide. (Br. Pat. 181,326; not yet accepted. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiana. Aug. 2, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Suit Against Chemical Foundation Filed

Government Asks Return of German Patents and Charges Conspiracy to Form Dye Monopoly

THE Department of Justice filed a suit in equity on Sept. 8 in the United States District Court at Wilmington, Del., against the Chemical Foundation, Inc., charging a monopoly in dyestuffs and seeking the return to the Alien Property Custodian of all former German patents, trademarks and other rights held by this organization, of which Francis P. Garvan, former Alien Property Custodian, is president.

The government in its bill of complaint makes broad and general allegations of the existence of a dye and chemical monopoly in the United States, which was stimulated by the shutting off of these products from Germany during the war. It states that control of the industry was effected between a number of chemical corporations and chemists' societies. It names the National Aniline & Chemical Co., the General Chemical Co., the Solvay Process Co., the Semet-Solvay Process Co. and The Barrett Co., all of which in 1920 were combined into the Allied Chemical & Dye Corporation, and E. I. du Pont de Nemours & Co. Trade organizations given were the American Dyes Institute, the American Chemical Society, the Chemical Manufacturers' Association of the United States and the Textile Alliance.

Including exhibits of several hundred pages, the complaint covers more than five hundred printed pages, and it is attested to by Thomas W. Miller, Alien Property Custodian. The United States of America, by Attorney-General Daugherty, is listed as complainant. The solicitors for the government are Henry W. Anderson and Herman J. Galloway, special assistants to the Attorney-General, and William W. Wilson, general counsel for the Alien Property Custodian.

Lists the Rights Transferred

The complaint states that included among the patents acquired by the Chemical Foundation were substantially all of the enemy-owned patents of any value which had not been previously disposed of, regardless of whether they related to the objects of the Foundation, such as machines for making fringes, airplane parts, telescopes, field and spectacle glasses and turbine engines. The bill charges that some of the patents acquired by the Chemical Foundation already had been granted by the Federal Trade Commission. It states that the Alien Property Custodian at the end of the Wilson Administration had transferred to the Chemical Foundation 4,813 patents, 281 applications for patents, 876 trademarks, 492 copyrights and rights under 56 contracts relating to patents for a gross consideration of about $271,000. The complaint declares that royalties amounting to $1,152,048 had accrued to the Foundation up to June 30, 1922, and that the average income from these licenses was approximately $300,000 a year.

The government declares that the records relating to these transactions were in the possession of Alien Property Custodian Garvan and his agents, who were also officers of or connected with the Chemical Foundation until the change in Administration; that many of the records were removed to the offices of the Chemical Foundation and that many of the facts stated in the bill only recently have come to the knowledge of the present Administration.

What the Government Demands

It declares that the Foundation has now pending many suits against the government resulting from patent licenses previously issued by the Federal Trade Commission. It asks that these suits be enjoined.

A return of all properties, the removal of any cloud upon the titles caused by their sale, and an accounting and repayment of all income and profits realized by the Chemical Foundation are demanded.

Believe Soviet Activities Boost Caustic Shipments to Germany

Heavy Russian purchases of caustic soda in Germany are believed to explain, in part at least, the large movement of this commodity to Germany. Since the bulk of the movement is to Hamburg it would seem that much of the American product is being reconsigned to Russian points. If the shipments were intended for the German chemical plants, the natural destination would be Bremen, it is declared. There is reason to believe that the Russians are using this material in the manufacture of picric acid. Some anxiety is being caused by this and other evidences that the Soviet authorities are launching heavily into the manufacture of explosives.

Dye Embargo Back in the Tariff Bill

The dye and chemical control act, the so-called embargo, will be extended one year and even a second year if the President deems this necessary to protect the development of the domestic industry, according to the terms of the conference report on the Fordney-McCumber tariff bill. The conferees also agreed upon rates for coal-tar products of 50 per cent ad valorem and 7 cents per pound on intermediates and 60 per cent ad valorem and 7 cents per pound on finished dyes and chemicals, the ad valorem rates being based on American valuation.

The ad valorem rates represent an increase from 30 to 50 on intermediates and from 35 to 60 on the finished product over the House rates and are practically double the rates recommended by the Senate Finance Committee, for, while the same figures are used, the valuation basis has been changed from foreign to American. The rates are lower than those adopted by the Senate in the Bursum amendment, which carried 75 per cent plus 10½ cents per pound on intermediates and 90 per cent plus 10½ cents per pound on the finished product, the ad valorem being on American valuation.

Peril for U. S. Tariff Commission Seen in Senate Tariff Bill

Probable impairment of the usefulness of the United States Tariff Commission is seen by the Chamber of Commerce of the United States in the event of enactment of the tariff bill as passed by the Senate authorizing the commission to adjust flexible customs rates. This view was expressed in a letter sent to members of Congress by Julius H. Barnes, president of the chamber, in which it is urged that a separate governmental body be created to adjust rates.

Urges Creation of Another Commission

In the opinion of Mr. Barnes, "the field of work to be covered in applying adjustable rates is broad enough and sufficiently varied to warrant two separate bodies—the present Tariff Commission with its statisticians, research workers and field agents to continue the highly important work of investigating and advising, a new Tariff Adjustment Board to hear evidence and to render decisions within limits set by Congress.

"If Congress adds new duties and quasi-judicial functions to the present duties of the Tariff Commission," he writes, "it will endanger the usefulness of that body."

New Bauxite Development in Tennessee

It is reported in Birmingham, Ala., that a syndicate of Chattanooga business men have organized a company for the purpose of developing large holdings of bauxite ores on Missionary Ridge. It is stated that this concern proposes building a smelter, in addition to mining the ores, for the purpose of turning the ores into billets.

The company is said to have acquired at least 1,000 acres of these ore lands; and engineering reports on the land acquired are to the effect that they are very rich in the ore from which aluminum is made.

The initial capital of the syndicate is to be $1,000,000, and a large percentage of the funds have been pledged; in fact sufficient to assure the opening of the mines and the erection of the first unit of the smelter, according to reports.

The developers of this new bauxite ore property point with enthusiasm to the fact that the electric power available is sufficient for any operations they may contemplate; and will make an effort to get their operations going in time to be with the vanguard in the new rumored developments in the automobile motor field.

Oil Consumption in July Sets Record

Consumption of crude petroleum in July was the highest on record for any month, having increased more than 51,000 bbl. as compared with June, while the daily average production decreased 15,633 bbl., the Geological Survey announces in its monthly report.

Domestic production in July aggregated 46,593,000 bbl., an average of 1,503,000 daily, compared with 45,559,000 bbl., an average of 1,518,633, in June.

Imports were estimated at 11,308,000 bbl., an average of 364,773 daily, compared with 12,182,000, an average of 406,062 bbl. daily.

Stocks held July 31 aggregated 261,478,000 bbl., or a supply of 158 days, compared with 255,817,000, or 159 days' supply so held on June 30.

Estimated consumption of domestic and imported petroleum was 51,387,000 bbl., an average of 1,657,645 daily, compared with 48,192,000, an average of 1,606,400 daily, in June.

Imperial Oil Will Build Refinery at Calgary, Canada

The Imperial Oil Co. has decided to build a large refinery at Calgary. C. O. Stillman, president, and A. M. McQueen, vice-president of the company, were in Calgary recently, looking over sites and making negotiations with the Mayor and City Commissioners for certain concessions in the event of a refinery being erected. At a meeting of the directors, held Aug. 18, the building of the refinery was approved, and the Mayor of Calgary was notified.

The refinery will be built on waste land in southeast Calgary.

Industrial Engineers to Meet in New York

Ninth National Convention of the Society to Discuss Economics of Industry

A number of subjects of general interest are included in the final program of the meeting of the Society of Industrial Engineers, which is scheduled for Oct. 18 to 20 at the Hotel McAlpin in New York. The general scheme of the discussion will be "Economics of Industry," and a number of well-known engineers and executives will contribute their ideas to the discussions of various phases of this topic. Sectional meetings for managing executives, production managers, sales managers, industrial relations directors, accountants and educators are included in the program. The international committee for the elimination of unnecessary fatigue will hold an open meeting.

A special feature will be an exhibition of factory and office equipment designed to save labor and reduce fatigue. The exhibition will be held in the winter garden adjoining the ball room in which the principal meetings will be held.

Wednesday's Program

The opening session on Wednesday afternoon, Oct. 18, will be addressed by Joseph W. Roe, president of the society, on the subject "The Relation of Economics to Industry." A. J. Lutterbach of the Palmolive Co., Milwaukee, Wis., will address the society the same evening on "The Budget and the Financial Forecast." Another paper of general interest at this session will be presented by L. W. Wallace, secretary of the Federated American Engineering Societies, on "The Importance of the Elimination of Waste to the Economic Structure."

Thursday Afternoon Meeting

Two important economic factors will be considered at the Thursday afternoon meeting, when symposiums are scheduled on the following topics: "How Can We Reduce Production Costs?" and "How Can We Keep the Worker Contented?" The annual banquet of the society is scheduled for Thursday evening, at which D. R. Dewey of the Massachusetts Institute of Technology will address the gathering on "The Relation of the Economist to Business" and Francis H. Sisson of the Guaranty Trust Company of New York will speak on "Finance and Industrial Economics."

Meetings on Friday

Friday morning will be given over to the sectional meetings enumerated above, at which a number of well-known speakers will discuss pertinent topics. The closing sessions on Friday afternoon will include talks by Ernest F. Dubrul, general manager of the National Machine Tool Builders' Association, on the "Economic Aspect of Production" and by A. J. Todd, director of labor, B. Kuppenheimer & Co., on "The Industrial Age."

Dye Investigation to Be Resumed Next Winter

A partial report from the special dye investigation committee of the Senate will be submitted before the present session ends, according to Senator Shortridge of California, chairman of the special committee.

Senator Shortridge declined to indicate the nature of the report. His personal attitude, however, was indicated to some extent by his statement on the floor of the Senate in July, when the dye embargo of the tariff bill was defeated, at which time, in defending the proposed embargo, he stated that not only had the investigation failed to disclose a monopoly of the dye and chemical industry of the country but that it had established the fact of "active competition."

The special committee held hearings for several weeks last spring before adjourning indefinitely. It is expected the committee will resume hearings next winter and conclude its work by clearing up a few points which were not touched in the testimony last spring.

Delay in drafting the partial report is due to absence of some members of the committee, according to Senator Shortridge. He stated that he expects to submit the report after the Dyer anti-lynching bill has been disposed of. This bill has been set as the last of the outstanding measures to be taken up at this session of Congress, according to the program announced by the Republican steering committee.

Evening Chemistry Courses Offered by City College of N. Y.

A series of evening courses in chemistry is announced by the College of the City of New York. The project has been arranged by the Evening Session Chemical Society as an opportunity for those engaged during the day to take up special subjects or to lay the foundation for a degree in chemistry. Besides the B. S. and Ch. E. degrees, a special departmental certificate is given to students who desire chemical knowledge only. To receive this certificate the student must complete the courses with an average of 80 and make a satisfactory report on some research problem. Thus the certificate indicates that the holder has a knowledge of the main branches of chemistry, a very good scholarship rating and some practice in research.

In addition to the various branches of chemistry usual in college courses the night sessions this fall will include two courses of interest to graduate and special students. Both will be under the direction of F. E. Breithut. Chemistry 159 concerns food inspection and analysis and Dr. Breithut plans to include lectures and excursions in cooperation with the Department of Health of New York.

Registration for the fall term starts Sept. 18. Further information may be obtained by writing to the Evening Session Office, College of the City of New York, Convent Ave. and 140th St.

Manufacturers' Attorney Attacks Dyestuff Duties

George Demming of Philadelphia Says Excessive Duties Prohibit Competition and Tend to Form Monopoly

"EXTORTIONATE" is the term applied to the present dye tariff rates by George Demming, attorney for a large group of Philadelphia, eastern Pennsylvania, New Jersey, Delaware and Maryland manufacturers, who will shortly appear before the House and Senate conferees in Washington to wage a vigorous fight for the reduction of the present duties.

The manufacturers who were opposed to the dye embargo are even more strongly opposed to the present tariff schedule, according to Mr. Demming, who declared that the duties were worse than the former embargo. Mr. Demming stated that Senator Smoot, who is leading the fight on the floor of the Senate for a lower dye tariff, made the following statement, which many manufacturers do not understand:

"For any foreign manufacturers of dyes to get by these rates, he would have to bring dyes to this country, give them away free of charge to the consumer and then pay the consumer money for the privilege of receiving the gift." How these words of Senator Smoot work out on a practical basis is explained by Mr. Demming as follows:

How It Works Out

"We will assume that a domestic dye, similar in quality to a foreign dye selling at 20c. a lb. abroad, is quoted in the American market for 80c. The American manufacturer, finding out that the domestic dye will not do exactly what the foreign dye does, desires to get the foreign product. He pays 20c. a lb. for the foreign product, approximately 10c. a lb. for transportation, insurance and overhead, and the dye is delivered here at a cost of 30c. Then the costs begin to mount. First the importer has to pay an ad valorem duty of 90 per cent base on the American valuation plan, which would be 90 per cent of 80c., the value of the similar American product, or a charge of 72c. per lb. Then, in addition, he pays 10½c. specific duty, or a total of 82½c. duty. Adding to this the original cost of the dye, plus transportation expenses, etc., we find that it will cost the American importer $1.12½ to get the article he wants. At this price the foreign article is naturally unable to compete with the domestic product. Thus Senator Smoot's contention is correct, and should the foreign manufacturer wish to compete with the American product, he would not only have to donate the dye, transportation and other expenses but would also have to give the importer 2½c. a lb. for taking the material."

More Than 100 Per Cent Protection

"In other words," said Mr. Demming, "the ad valorem and specific duties amount to more than 100 per cent of the value of the article under the American valuation plan, and when you protect articles to the extent of more than 100 per cent you are entering the field of extortion."

Mr. Demming asserted that in Pennsylvania manufacturers have found that the dyes, which are an absolute essential as one of their raw materials, are protected at a higher figure than that afforded their own finished products. The ordinary business man is said to want to know why the raw materials are offered this higher degree of protection than the finished manufactured product, as dyed articles made abroad, such as are manufactured in this district, are not protected by any such duties.

International Exposition and Congress on Liquid Fuel

French Government Departments Cooperating With Société de Chimie Industrielle

Final announcement of the International Exposition and Congress on liquid fuel is made by the Société de Chimie Industrielle and a cordial invitation to American representatives to attend is extended by Ambassador Jusserand. The congress will be held in Paris Oct. 4 to 15 and will be divided into two parts. During the first part of the congress discussion will be centered on the terminology of petroleum products and methods of analysis. These topics will be examined from three points of view—scientific, industrial and legislative—by three groups of specialists competent in the respective branches. The purpose of this study will be to furnish for each term the exact definition corresponding to each country and the exact description of the method of analysis employed. The congress has no intention of attempting to set international standards, but rather clearly and precisely to establish comparative tabulations, so that the present usages in all countries regarding terminology and methods may be perfectly understood by all concerned.

Following this part of the program the congress will divide into six sections in which will be brought together all the important developments and new researches in the fields of various liquid fuels. The subjects to be considered in these discussions include petroleum, shales, lignite and peat, tars and benzene, alcohol, and vegetable oils.

Arrangements for the congress have been made in co-operation with the Ministers of Commerce, Agriculture, Colonies, Public Works and Aëronautics of the French Government. Representatives of these departments will be present and participate in the discussion.

Arthur W. Thomas, 50 E. 41st St., New York City, is the secretary of the Société and is prepared to furnish further particulars to all who may be interested.

Extension of Control Act Asked by Equipment Manufacturers

Petition Sent to Senate Finance Committee Signed by One Hundred Manufacturers of Chemical Equipment

The Chemical Equipment Association through J. George Lehman, its chairman, has submitted to Senator McCumber, chairman of the Finance Committee, a petition urging favorable action on the amendment extending the dye and chemical control act, in accordance with the report and vote of the Finance Committee. In his letter of transmittal, Mr. Lehman pointed out that the Chemical Equipment Association represents the manufacturers of chemical equipment in the United States and that during the war every member of the association rendered every possible aid to the government. This resulted in expanded or relocated plants and personnel, both of which are now largely unemployed due to the uncertainty as to whether the industry will be accorded adequate protection. It is maintained that adequate protection for the chemical industry will not only assist that vital branch of our productive interests but will simultaneously assist some hundreds of co-ordinate lines to continue the advancement made in recent years, to maintain reasonable financial stability and to give wider employment to men now seeking work. The petition as submitted to Senator McCumber follows:

> The undersigned, whose business is specifically that of supplying equipment necessary to the American chemical manufacturer and industry, and believing that their close contact with the latter provides an intimate knowledge of their needs, respectfully submit for your consideration:
>
> 1. That the chemical manufacturer requires an endless variety and enormous volume of special equipment, the production of which in this country has progressed in step with the developing needs of the chemical manufacturer;
> 2. That the chemical equipment industry before the war was very small as compared with today;
> 3. That this equipment field represents millions of capital and thousands of employees, both now unemployed to a great extent, and, in our judgment, certain to remain so unemployed unless the American chemical industry is properly safeguarded and maintained in a flourishing condition;
> 4. Therefore, we respectfully urge that you not only support personally all just provisions for the welfare of our chemical and co-ordinate fields, but that you use your good judgment and effort in bringing your colleagues to do likewise, by voting for the amendment extending the dye and chemical control act, in accordance with the report and vote of the Finance Committee.

The petition was signed by over ninety manufacturers of all types of chemical equipment in every section of the country.

Headquarters for Chemical Engineers at Exposition

Members of the American Institute of Chemical Engineers are cordially invited to make use of *Chem. & Met.'s* booth as headquarters at the Chemical Exposition. A register will be provided and every facility afforded for bringing members of the Institute together.

Standard Oil of N. J. Says Mexican Oil Fields Are Near Exhaustion

Nation-Wide Search Must Be Made for New Fields—Future of Mexico's Oil Industry Largely Dependent on Government's Attitude

THE first era of the Mexican oil industry is drawing to a close, according to *The Lamp*, the house organ of the Standard Oil Co. of New Jersey, which gives a comprehensive survey of the past and present situation in the second largest producing country.

The production of petroleum in Mexico dates from about the year 1901, but it was not until 1911 that yield assumed such proportions that a surplus over domestic consumption was available for export. Only during the past few years has Mexican oil become a real factor in the world's markets and an important source of revenue to the government and people of Mexico.

Producing operations up to the present time have been largely confined to lands owned in fee or leased from individuals in two districts lying within the area bounded on the north by the Tamesi River; the Tuxpam River on the south; the Gulf of Mexico on the east; and on the west by an irregular line extending from the mouth of the Vinasco River through the Otontepec Mountains to the Panuco River, thence to the Tamesi. Although this area contains something like 2,470,000 acres, production has been found concentrated only in two producing districts—the Panuco field, producing very heavy, viscous oil, and the southern field, producing a somewhat lighter gravity oil.

Situation Critical

In both the producing fields above mentioned, exhaustion of oil resources has reached such a point that the exploitation of at least two-thirds of the estimated 25,000 acres of the producing area have been abandoned. In the Panuco, or heavy oil fields, where once 125,000 bbl. per day were produced, the average is now only about 100,000. In the southern field Mexico at one time produced as much as 500,000 bbl. of light crude oil in a day. Within the last few weeks this has been reduced to less than 300,000 and is still declining rapidly.

Explorations of the past 20 years within this vast area have developed only the two producing districts named, which together contain approximately 25,000 acres, or about 1 per cent of the area explored. It is estimated that the investment in the exploration and exploitation of Mexican oil has been not less than one billion pesos, or $500,000,000 United States currency. These figures do not take into consideration the cost of tanker fleets and foreign storage, manufacturing plants and other facilities created for the handling of Mexican oil.

The present situation is critical because the progressive exhaustion of the production has not been compensated by the exploration of new territory and the discovery and opening up of new fields. The oil industry will have no future in Mexico unless an intensive effort to find new fields of production be undertaken and successfully prosecuted. The areas to be explored are more remote from the ports of shipment than those now producing, and the necessary development work can be carried through only by expenditure of a vast amount of new capital.

It is essential to the permanency of the petroleum industry, as known fields begin to be exhausted, that reserves for the future be discovered by the extension of operations to other prospective areas.

The conditions and circumstances which have interfered with the carrying out of this established practice in Mexico, including those conditions which have prevailed to deprive capital of the fundamental and essential insurance which it must have as to its investments and the conduct of its operations, have largely grown out of the unsettled political situation that has prevailed in Mexico for the greater part of the last 12 years.

Unfortunately both for the welfare of Mexico and of the petroleum industry, the consequences of this situation must be suffered now and in the months near at hand. The future of the oil industry in Mexico rests primarily in the hands of the government.

Paint Company Must Stop Rebate Sales Scheme

The De Soto Paint Manufacturing Co., manufacturer and distributor of paints and similar products at Memphis, Tenn., is required by recent order of the Federal Trade Commission to discontinue certain competitive methods which the commission found upon inquiry to have been followed by the company.

The commission's order is directed to respondent's practice of making an arbitrary selection from among purchasers of certain of its products, to whom rebates or bonuses are paid. Under the terms of the order, the De Soto company is required to refrain from discriminating in net selling prices by any method between purchasers of the same grade, quality and quantity of commodities, upon the basis of a classification of its customers as "professional or contracting painters" or other similar classification.

The trial of the case developed that the De Soto company gave to professional or contracting painters a certificate for each gallon of paint purchased, such certificate being redeemable at the rate of 20 cents for each gallon of colored paint and 10 cents for each gallon of white paint purchased. These certificates were not given to purchasers other than professional painters.

Societies Would Aid Power Commission

Federated American Engineering Societies Move to Improve Personnel

The work of the Federal Power Commission cannot be organized on an effective basis until the commission is given the right to employ its own personnel. The Federated American Engineering Societies is trying to obtain the necessary legislation. The Secretary of War has written to the Federated Societies pointing out the difficulties of the existing situation. An extract from Secretary Weeks' letter is as follows:

> The commission is seriously handicapped in the administration of the act on account of inability to employ its own personnel. It has had placed upon it the greatest task with respect to water powers the government has ever had, at a time when the utilization of water power is more necessary than ever before. The act made a definite pronouncement of a national policy in water-power development. It created a commission to carry out that policy, but it gave it no means to do so. The commission has been obliged to depend exclusively upon such assignments from the several departments as these departments were willing to spare. The departments have had their own forces cut to a point where they are unable to perform either in Washington or in the field the work required of the commission under the act; and even if they had the numbers and the funds to pay them they do not have employees with a training or an experience required for the performance of certain of the duties of the commission. As a necessary consequence the commission has been forced to omit altogether action upon important matters which the act requires of it. Furthermore, with no personnel of its own and with no control over the personnel of the departments engaged upon its work (except for the small number directly assigned to its Washington office) it is not possible to organize the work on an effective basis, or to make the most economical use of the personnel actually engaged on the commission's work or of the funds actually expended for such purposes.

In its first annual report the commission said:

"What is seriously needed in the interest of adequate administration of the act is a small organization of trained and experienced men capable of meeting intelligently the important and perplexing engineering and economic problems which are constantly arising and upon the correct solution of which will depend the value of the legislation and, in no small degree, the future of the electric power industry."

Nothing has happened since to alter the situation.

Vanderbilt University Robbed of Platinum Laboratory Apparatus

Over two thousand dollars' worth of platinum laboratory apparatus was stolen from Vanderbilt University, at Nashville, Tenn., some time between Aug. 1 and 8. The missing apparatus included six crucibles, a milk dish, two combustion boats, two evaporating dishes and a new platinum combustion tube. The university authorities are making determined efforts to prevent the thief from disposing of the booty and have broadcasted a request for information that might lead to its recovery.

The Airplane and the Boll Weevil

Calcium Arsenate to Be Spread Over Cotton Fields From the Air

The use of much larger quantities of calcium arsenate in the control of the cotton boll weevil is expected to result from the very successful experiments in dusting cotton fields by airplane. The experiments have been conducted under the direction of B. R. Coad, in charge of the laboratory of the Department of Agriculture at Tallulah, La. In a special report made by Mr. Coad and read on the floor of the House of Representatives, it was shown that with crude apparatus it was possible to poison 20 acres of cotton per hour in a much more thorough manner than ever had been attained by the equipment operated on the ground.

The air blast from the propeller of the plane disseminates the particles of the material in such a way that they filter down through the air and settle regularly over the entire plant. The amount of material needed per acre is reduced one-half.

The success of these experiments has been so decided that community poisoning is to be undertaken at once in many districts. As a result there will be much wider application of the poison and much more effectual control. In addition to the better distribution of the material when applied from the air, the whole region will be covered, thereby preventing migrations of the weevil from unpoisoned tracts, as is the case at present.

Mr. Coad in his report points out that these experiments have an important bearing on the control of insect pests which attack any field crop. Airplane dusting can be done so rapidly and save so much labor that its cost will be a very small percentage of the present cost of poisoning, particularly when the hopper and fan equipment being used on the airplane have been perfected and enlarged.

Prof. Roe of New York University to Aid Eyesight Conservationists

Election of several engineers and educators to the board of councilors of the Eyesight Conservation Council of America is announced from the headquarters of the council in New York by Guy A. Henry, general director. Engineers chosen include Prof. Joseph E. Roe, head of the department of industrial engineering in New York University, and Dr. F. C. Caldwell, professor of electrical engineering in Ohio State University.

Professor Roe is a member of the executive board of the American Engineering Council of the Federated American Engineering Societies and president of the Society of Industrial Engineers. Professor Caldwell is chairman of the committee on education of the Illuminating Engineering Society. L. W. Wallace, executive secretary of the Federated American Engineering Societies, is president of the Eyesight Conservation Council, which plans further to enlist the co-operation of the engineering profession.

Professor Roe described eye conservation, which is to be intensively carried on in the classrooms and workshops of the nation, as an important public service made possible largely through the disclosures by the Hoover Committee on the Elimination of Waste in Industry. Enormous losses, Professor Roe said, were being sustained by the nation through defective eyesight. Surveys in industrial centers and in city and rural schools are showing that economic and physical damage is being caused simply through failure of parents, teachers and factory managers to correct faults which can be remedied.

Additional Plans for Detroit Convention of Steel Treaters

In addition to the plans announced in *Chem. & Met.* for the convention of the American Society for Steel Treating and the American Drop Forging Institute, to be held in the General Motors Building at Detroit from Oct. 2 to 7, other happenings of interest have been arranged for the same period.

H. N. Taylor, president of the N. & G. Taylor Co. and president for the past 8 years of the Drop Forge Supply Association, has made arrangements for holding a meeting of the members of his association at 12:30 p.m. on Tuesday, Oct. 3, in the General Motors Building.

F. M. Waring of the Pennsylvania R.R., chairman of Committee A-1 on Steel of the American Society for Testing Materials, has called a meeting of his full committee to be held at Detroit on Oct. 5 and 6, in the Hotel Statler.

On Thursday, Oct. 5, a bronze tablet will be unveiled on the walls of the Wyandotte Public Library to the memory of those pioneers who in 1864 erected the first commercially successful bessemer steel converter on that site. This tablet is the gift of the Detroit Chapter of the American Society for Steel Treating and marks the first public recognition of the achievements of William Kelly, who made his first bessemer steel in 1847 and patented his process in 1856.

Announcement will be made during the convention of the American Society for Steel Treating of the rules governing the award of the Henry Marion Howe Medal, a gold medal to be given annually to the author of the paper considered of highest merit on any subject within the field covered by the society and commemorative of the distinguished services rendered by the late Dr. Howe.

A.C.S. Council Announces Prize for American Chemists

Announcement of a $25,000 prize, to be awarded annually to the American who makes the most notable contribution to chemical science, was one of the outstanding features of the first meeting of the council of the American Chemical Society on Sept. 4 at Pittsburgh.

American Mining Congress to Organize Southern Division

Active Support to Be Given to Plans to Push the Muscle Shoals Power Project to Completion

Active support for the completion of the Muscle Shoals, Ala., power project is being given by the American Mining Congress, which will hold a convention at Chattanooga, Tenn., on Sept. 29, for the purpose of organizing a Southern division of the organization. The Governors of the Southern States, mining operators and others have been invited to assist in the movement, which, it is claimed, will result in the creation of a great Southern mineral empire.

Development of Cheap Power and Transportation Essential

"The most important thing in the South today is the development of cheap power and transportation," said James F. Callbreath of Washington, D. C., secretary of the American Mining Congress. "With this in view, the American Mining Congress proposes to consolidate its existing state chapters in the South into a Southern division, thus placing the entire organization of the American Mining Congress behind the completion of the Muscle Shoals project. The development of the Muscle Shoals project is essential, first, for transportation; second, for cheap power; and third, because its completion combined with the proximity of the great mineral resources of the South to the natural markets and superior supply of labor creates the possibilities of a great Southern mineral empire, which can compete with the products of any other region.

Opportunities of the South

"Many mining operators in the South have never awakened to the possibility of utilizing the efficiency of large operations analogous to the development of the porphyry coppers of the West," continued Mr. Callbreath. "The widely diversified and disseminated deposits of graphite, phosphate, manganese, barytes, pyrites and other minerals in the Southern States and their successful marketing call for collective thought and co-operative action. Cheap power is a prerequisite to successful mining operations. Without highly developed transportation, successful marketing cannot be attained. The mining industry is an essential factor to national prosperity. The constructive work of the American Mining Congress in behalf of the mining industry during the past 25 years entitles it to the heartiest support, complete indorsement and active co-operation of every man interested in the industrial development of the South."

Mr. Callbreath will outline the scope and purpose of the new organization in an address before the Chattanooga meeting, which will be held at the Hotel Patten and for which preliminary arrangements are being made by Dr. Henry Mace Payne, consulting engineer of the American Mining Congress.

Water Pollution Bill Passed

Quick Action on Frelinghuysen Bill to Prohibit Discharge of Oil

The Senate on Aug. 31 passed, without debate, a bill to prevent pollution of navigable waters by the discharge of oil. The measure was introduced only the preceding day by Senator Frelinghuysen of New Jersey to replace in more simple form the several pending bills on the same subject. It was reported favorably by Senator Willis, for the Committee on Commerce, with a brief report calling attention to the indorsement of the general plan by Secretary of War Weeks and Major-General Lansing H. Beach, chief of engineers, and was adopted with only a perfecting amendment offered by Senator Lenroot of Wisconsin, being disposed of quickly between the vote on the bill for adjusted compensation for former service men and debate on one of the administration coal bills.

The measure makes it unlawful to discharge oil—including fuel oil, smudge or refuse—upon, into or under navigable waters of the United States from any vessel, excepting for the purpose of smoothing the sea in case of emergency or under such regulations as may be prescribed by the Secretary of War in such quantities as shall not be deleterious to health or fish or dangerous to property. A fine of $2,500 for violation is provided and clearance papers may be denied until the fine is paid. The act does not become fully effective until 3 months after its passage and may be suspended in time of war.

The brief report accompanying the bill set forth a letter from General Beach calling attention to the lack of legislation to control oil pollution and its need, together with excerpts of hearings on previous bills calling attention to the fire hazard and destruction of fish and vegetable life by oil on waters.

Tons of Picric Acid to Be Distributed to Farmers

The Bureau of Public Roads, United States Department of Agriculture, is making plans to release, for shipment to farmers this fall, millions of pounds of picric acid for agricultural explosive purposes, such as clearing lands of stumps, etc.

This distribution of high-grade agricultural explosives to farmers by the government is to be without cost except 7 cents per pound for drying and cartridging expense plus the cost of the freight. Originally about 12,000,000 lb. of the picric acid was available as war surplus. A considerable amount was distributed to the states for road-building purpises by the government and there now remains approximately 5,000,000 lb. to be distributed this fall. The Bureau of Public Roads urges farmers in all sections of the country who can use this explosive to apply now for it, so that the fall shipping schedules may be made up for the states. Some of it is located at Fort Wingate, New Mexico, and an additional supply, for shipment to Eastern points, is located at Edgewood Arsenal, Maryland.

Picric acid is classed among the safest of explosives while at the same time being powerful, and for these reasons, if for no other, is ideal for blasting purposes. It also has advantages over commercial explosives, among them being that it keeps indefinitely and is not affected by heat or cold. Because of its greater cost of manufacture, it is not a competitor with commercial dynamite. It is being distributed for the purpose of increasing interest and activity in land clearing.

The Minnesota State Agricultural College reports: "We feel that picric acid has been a great benefit to the state and has done a great deal to stimulate land clearing. All reports are to the effect that its use has been highly satisfactory. The 744,000 lb. allotted to Minnesota last year was distributed to 3,511 farmers, averaging 222 lb. to the farmer. We estimate this will clear 35,000 acres of land and has made a saving of over $70,000 for the farmers of the state."

House Sidetracks Muscle Shoals

The President has authorized the transfer of certain river and harbor funds which makes available an additional $600,000 to apply on the work at Muscle Shoals. This amount insures the maximum amount of work which can be done on the project at this time and adequately bridges the period prior to Oct. 1, when the $7,500,000 appropriation becomes available.

The struggle in the House to obtain consideration of the Ford offer continues. Representative Garrett of Tennessee, the acting minority leader, forced the majority to abandon its plan for 3-day recesses. He is forcing roll calls on adjournment and resorting to all parliamentary tactics to speed the disposition of other business before the House with the idea that the majority then will be compelled to proceed to the consideration of the Ford offer.

Representative Mondell of Wyoming, the majority leader, states that he has no disposition to block the consideration of the matter, but contends that the legislative situation is such that it would be perfectly idle to call up the matter at this time.

It is possible that the House may take up Ford offer at this session, but the probabilities strongly favor the deferring of such action until the December session.

I.C.C. Rules on Shipment of Linseed-Oil Meal

The Interstate Commerce Commission has ruled that rates charged on carload shipments of linseed-oil meal from Undercliff, N. J., to Chicago, Ill., and North Hammond, Ind., are not unreasonable except as to shipments moved over the New York Central.

Personal

ARTHUR W. AMBROSE has been selected to succeed E. A. Holbrook as assistant director of the U. S. Bureau of Mines. Mr. Ambrose has been in the service of the bureau since 1917, during which time he has risen through the various grades from petroleum technologist to chief of the petroleum division of the bureau. His appointment as assistant director is an indication of the increasing importance of the bureau's petoleum work. F. B. TOUGH, who has been serving the bureau as chief supervisor of oil and gas leases, will succeed Mr. Ambrose as chief petroleum technologist. F. J. BAILEY, the assistant to the director, under a rearrangement of the work will take over a portion of the duties formerly assigned to the assistant director so as to permit Mr. Ambrose to give a portion of his time to the petroleum work. Mr. Ambrose comes originally from Lodi, Calif. His technical education was obtained at Stanford University, where he received his mining engineer's degree. Prior to his employment by the Bureau of Mines in 1917 he was in the service of the Dutch Shell and other petroleum companies. Just prior to his appointment as chief petroleum technologist, 2 years ago, he was superintendent of the petroleum experiment station at Bartelsville, Okla. Mr. Bailey is a graduate of Middlebury College, Vermont, and a graduate in law from George Washington University. He has been with the Bureau of Mines since its organization in 1910. As assistant to the director he has already had charge of a large part of the work including the Mine Safety Service.

ARDEN E. HARDGROVE, city chemist at the Akron Municipal University, Akron, Ohio, in charge of city tests, has been appointed permanent superintendent of the Akron City Hospital, succeeding Prof. Charles Bulger. He assumed his duties on Sept. 1.

Dr. KUNO B. HEBERLEIN has returned to New York after a 6 months' business trip through Europe.

GUY C. HOWARD, chemical engineer, has opened an office at 767 Stuart Building, Seattle, Wash., for consultation, investigations for industrial and financial purposes, plant design and technical supervision.

ERIC R. JETTE, who recently completed his work for the Ph.D. in Columbia University, has sailed for a year of study in Stockholm. He has an American-Scandinavian Fellowship for the year 1922-23.

J. F. SMITH has been appointed head of the research and information service of the Commercial Solvents Corporation, Terre Haute, Ind. He was formerly connected with the research department at the Buffalo, N. Y., plant of the American Aniline & Chemical Co.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Marketing Chemical Apparatus and Supplies

Reputable Manufacturers Are Facing a Serious Situation Growing Out of the Competition of Inferior, Low-Priced Goods of Both Foreign and Domestic Origin

By S. L. Redman
Central Scientific Co.

THE PAST 7 years has seen a marked change in the marketing of laboratory supplies. Prior to that time, materials were largely imported, sources were not well known and the sale of supplies was largely limited to a few firms of established reputation which held themselves strictly responsible for the quality of the products handled by them. The publicity given to chemical industry during the war, together with the ease of locating American sources of supply, led to the entrance of a number of new firms into this field, many with limited capital, limited knowledge of the business and a desire to reap quick rewards rather than to build up an institution for permanence. Having no reputation to hazard, no technical knowledge of apparatus manufacture and being desirous of obtaining goods at low costs in order to compete with established firms, some of these new dealers began to seek new sources for their supplies. The resumption of importations in 1920 favored this desire and has led to a flood of foreign apparatus being thrown on the market at low prices but of questionable quality.

This situation would have been impossible in the days when the laboratory man selected his own supplies or specified known brands or sources. The growth of the purchasing agent system, however, spreading like wildfire throughout both educational and commercial institutions, has helped to foster this condition. The purchasing agent is not always a technical man and is sometimes engaged for the purpose of making his concern's dollars stretch as far as possible. To this sort of man a burette is a burette, to be bought from the lowest bidder, and he does not care to restrict the number of bidders.

Is a Burette Just a Burette?

As a result of this situation the dealer with a reputation based on quality and service is seriously facing this dilemma: Is it necessary for him to lower his quality and skimp his service in order to secure his share of the competitive business, or can he find enough discriminating buyers to supply him with a sufficient volume of business to maintain his organization?

As an illustration of the possibility for a large difference in the price of what—to the purchasing agent—is a standard article to be bought from the lowest bidder, take the manufacture of a burette. The steps in the manufacture of a cheap and a good burette may be summarized as follows:

Cheap	Good
1. Use any stock tubing.	1. Select tubing free from striations and air bubbles.
2. Caliper only at one place for approximate diameter.	2. Caliper from end to end for uniformity of diameter.
3. Omit.	3. Check internal diameter to see that the length for the rated capacity is sufficient to bring the tenth c.c. marks at least 1 mm. apart.
4. Draw down one end and make tip or attach cheap stopcock.	4. Draw down one end and make tip or build stopcock on end or attach high-grade stopcock.
5. Put lip on other end.	5. Put lip on other end.
6. Anneal joint over flame.	6. Bake in annealing oven with pyrometer to indicate maximum temperature for 24 hours with gradual heating and cooling.
7. Select arbitrary 50-c.c. mark and point off 0 mark by rapidly running in 50-c.c. measured with another burette used as standard.	7. Carefully clean burette. Select arbitary 50-c.c. mark and point off every 5-c.c. by carefully running in portions from a certified burette, allowing full time for draining.
8. Graduate space from 0 to 50 in 500 equal linear divisions.	8. Graduate space between each two 5-c.c. marks in 50 equal linear divisions, resetting machine for each interval.
9. Wax and etch.	9. Wax and etch.
10. Melt off wax and dry.	10. Melt off wax, fill etched marks, dry and polish.
11. Omit.	11. Inspect for defective etching.
12. Wrap in paper and put in stock.	12. Wrap in paper and pack in separate carton to go in stock.

Is a burette just a burette?

How to meet this situation, which is bringing disrepute upon the entire apparatus business, is a serious problem. No reputable dealer desires to lower the quality of his merchandise, and yet his chief reward for furnishing better goods and rendering a more complete service to the laboratory man is the accusation of "profiteering." It is unfortunate that those institutions which "gambled" on the chance of securing a bargain from some "bootlegging" apparatus dealer and have been unmercifully cheated as a result do not make public their experience for the benefit of laboratory men in general. There are enough new "gamblers" each year to maintain a large number of such concerns on a very profitable basis, especially so since they are not put to the expense of developing new apparatus, or even issuing a catalog.

The best remedy in sight is apparently a long persistent campaign of education with a view to conveying to the laboratory man as much detailed information as possible about the manufacture of apparatus so that he may be able readily to detect by a brief inspection or examination fundamental

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	146.67
Last week	150.60
September, 1921	147
September, 1920	267
April, 1918 (high)	286
April, 1921 (low)	140

Not since January, 1922, has this index number reached the low level of the present report. This decline is due almost entirely to the low price of cottonseed oil, one of the most important, statistically, of the 25 commodities included in the compilation.

differences in quality of material, workmanship, finish and performance. This is a painfully slow process and the results may not justify the expense. In the long run it is believed that the situation will cure itself, and that after several sad experiences the laboratory worker may not only convince himself, but also his purchasing agent, that it is an axiom in competitive merchandising that you generally get what you pay for.

Chicago, Ill.

Production, Consumption and Prices in the Naval Stores Industry

Turpentine

More than 97 per cent of the spirits of turpentine produced in this country is from gum turpentine, the remainder from wood. Production in 1914 amounted to 27,648,939 gal., valued at $10,740,327. In 1919 the Census reported that 1,214 establishments produced 19,271,000 gal. of spirits of turpentine, valued at $21,918,100. Imports have rarely exceeded 1 per cent of the domestic output. Exports, on the other hand, formerly ranged between 15,000,000 and 20,000,000 gal., equivalent to approximately three-fifths of the domestic production. Since the war, exports have decreased to about 10,000,000 gal. The bulk of the exports go to the United Kingdom, the Netherlands, Germany and Belgium. Prices of gum turpentine were fairly stable until 1918, when a rise started that brought the price up to $2.50 per gal. in July, 1920. After a marked decline in 1921 prices are again rising and for the first quarter of 1922 have reached about $1.25 per gal.

PRODUCTION, IMPORTS AND EXPORTS OF TURPENTINE, 1914–1921

Year	Production (Gal.)	Imports (Gal.)	Exports (Gal.)
1914	27,648,939	72,679	18,900,704
1915	23,500,000	13,680	9,464,120
1916	26,750,000	20,675	9,310,268
1917	23,650,000	18,286	8,841,875
1918	17,000,000	302	3,717,093
1919	19,271,000	1,662	10,672,102
1920	. .	43,785	9,438,423
1921	.....	32,210	9,267,959

PRICES OF SPIRITS OF TURPENTINE, NEW YORK, 1914–1922
(Cents per Gal.)

	1914	1915	1916	1918
Jan.	46½	45½	56½	47½–48½
April	49½–50	47½	55	42 –42½
July	49 –49½	43	42	75
Oct.	48	41 –41½	47	64
	1919	1920	1921	1922
Jan.	70 –71	169	76	81½
April	75	247–250	59	86½
July	97	157½	58½	125–126
Oct.	151	139	75	

Rosin

The other member of the naval stores family has followed practically the same trend of production as that of turpentine. In 1914, 1,408 establishments produced 4,018,000 bbl. (280 lb. each) valued at $10,572,300. In 1919, 1,214 establishments produced 2,272,100 bbl. of rosin valued at $34,695,000. The naval stores industry is located in the south Atlantic and gulf states adjacent to the pine forests. Florida is the principal producing state, contributing about 45 per cent of the total output. Georgia follows with 22 per cent. A very large proportion of the domestic output is for export. Prior to 1914 exports amounted to considerably over 2,000,000 bbl. Germany at that time was one of the principal consumers.

PRODUCTION, IMPORTS AND EXPORTS OF ROSIN, 1914–1921

Year	Production (Bbl.)	Imports (Lb.)	Exports (Bbl.)
1914	4,018,000	2,742,083	2,417,950
1915	3,452,000	1,505,790	1,372,316
1916	3,155,000	5,571,325	1,571,279
1917	3,630,000	129,848	1,638,590
1918	3,214,000	210,443	779,027
1919	2,272,000	96,044	1,209,627
1920	.....	141,635	1,164,328
1921	.....	7,115	1,001,542

PRICES OF ROSIN, WATER WHITE, 1914-1922
(Dollars per Barrel, 280 Lb.)

	1914	1915	1916	1918
Jan.	7.25–7.50	6.40	7.85	8.50
April.	6.75	6.50–6.55	6.40	8.15
July.	6.92½	6.95	7.00	12.00
Oct.	6.75	6.50	7.25	16.25
	1919	1920	1921	1922
Jan.	18.00	22.25	9.00	7.25
April.	14.50	21.75	6.00	7.25
July.	19.75	16.85	6.60	8.25
Oct.	24.00	13.25	7.40	....

Dealers in rosin seem well satisfied with the general volume of present business. Domestic consumers have shown a keener interest in the market situation and the export demand has been along moderately steady lines. Rosin B-D grades range from $6.25@$6.30 per barrel; E-I, $6.35@$6.40; K-N, $6.45@$6.65, and WG-WW, $7.80@$8.25 per barrel.

The New York Market

New York, Sept. 10, 1922.

The general tone of the chemical market during the past week was decidedly firm. Advances were recorded in several instances due to the higher cost of production resulting from the coal strike. Inquiries for home consumption were more numerous, especially for the basic commodities. A much brighter outlook has been noted in caustic soda and soda ash, with the demand for home consumption materially stronger. The previously reported firm position has been sustained in all quarters for bleaching powder. Recent buying has reduced available supplies of yellow prussiate of soda and prices reached a new high level for the year. Oxalic acid is finding a ready outlet, with prices firm. Arsenic prices remain unchanged, although demand has slackened to some extent. Bichromates have been well maintained throughout the interval and inquiries for medium-sized lots were reported in several directions. Formaldehyde prices were advanced earlier in the week, but no change in the regular routine demand has been noted.

General and Special Chemicals

Acetic Acid—First-hand sales of the 28 per cent grade are heard at $2.70 per 100 lb. The 56 per cent is moving around $5.35@$5.75 per 100 lb.

Acetate of Soda—This product has been one of the features of the market. Production is greatly limited and surplus stocks have entirely disappeared. Small quantities are reported at 7¼@7½c. per lb. Round lots are almost impossible to obtain.

Bleaching Powder—Prices are quoted firm at the recent advance. Sales were reported at $1.80@$1.90 per 100 lb. in large drums, f.o.b. works. Small drums for export have brought $2.25 per 100 lb. General offerings are very limited, with the demand quite strong.

Caustic Soda—The inquiry for home consumption has been very active during the week. Small lots of standard brands are quoted at 3¾@4c. per lb. ex-store. Producers report a steady demand for contract deliveries. Export business has been somewhat dormant.

Chlorate of Soda—Leading dealers are very firm in their views for immediate shipment material and quote 6½c. per lb. as the low figure. The demand is moderately active for consuming requirements.

Formaldehyde—Large producers announced an advance in prices to 9c. per lb. in barrels for less carload quantities. Round lots are practically non-existent on the spot market.

Oxalic Acid—This market has been exceedingly strong of late and prices were again advanced to the highest level of the year. Sales at the works were reported at 17¼@17½c. per lb. Demand has been quite active and consumers showed more interest. The spot market held at the same level as works material.

Prussiate of Soda—Higher prices have been established for this material on spot. Most sellers held 24c. per lb. as an inside figure. Demand is quite active, with spot goods limited in most quarters. Shipments were quoted around 23¾@23½c. per lb. c.i.f. New York.

Soda Ash—The general tone of this market is very strong, with bag material held at $1.75 per 100 lb. and barrels at $1.90. Smaller quantities command a small premium. Producers report an active call for contract requirements.

Coal-Tar Products

Restricted production combined with increased inquiries are chief factors in bringing about firm markets for several coal-tar products. Factors in benzol state that normal conditions are still somewhat remote, although a slight improvement in production was apparent. Spot goods are entirely nominal. The phenol market seems to be following the same strong course. No relief is in sight and while producers are not inclined to quote above 20c. per lb., they admit that future shipments are the only offerings. Spot supplies are entirely controlled by second hands and these interests are getting all they can for their holdings. Solvent naphtha has been noticeably diminished and the same condition is also true of cresylic acid. Benzoate of soda and benzoic acid are both maintained at sharp advances. Beta naphthol has been offered at 23c. per lb., with some odd lots still heard as low as 22c. The demand has improved slightly. Makers report lower prices at 20c. per lb. for aniline salts.

The St. Louis Market

ST. LOUIS, MO., Sept. 7, 1922.

This market has been very active for some time and in general displayed a very steady tone with some of the more important items notably strong. A rising tendency in prices was to be noted.

ALKALIS

The volume of *caustic soda* business has increased somewhat, but no change in price has as yet been reported. There are considerable stocks in the St. Louis market, for as yet the strike has caused no shortage. *Solid caustic* in 5- and 10-drum lots was quoted at $3.90 per 100 lb. delivered, with *flake* at $4.25. Very little carload business is being transacted. *Soda ash* is quoted at $2.20 in bags and $2.40 in barrels for 5- to 10-bbl. or bag quantities. *Bicarbonate of soda* has weakened slightly and is now quoted at $2.25 per 100 lb. in 1 to 5 bbl., a drop of 10c. per 100 lb. *Sal soda* is moving very slowly, but has not weakened in price; $1.65 per 100 lb. is being generally quoted on 1- to 5-bbl. lots with plenty of spot goods on hand.

GENERAL AND SPECIAL CHEMICALS

Producers in this section report a very extensive movement of *heavy mineral acids*, and prices are strong. *Carbolic acid crystals* have been moving very extensively during the past few weeks, and it is reported that the government surplus stocks are about depleted. The demand for *citric acid* is practically nil. *Oxalic acid* is still one of the prominent features of the market, with a very heavy demand and prices still on the upward flight. The demand for *ammonia water 26 deg.* has been very good and prices are firm. *White arsenic, powdered*, is reported strong with a heavy demand and supplies light, prices ruling at 8¼@9c. depending upon quantity and delivery. The *blue vitriol* market has quieted down considerably, with a freer movement. *Carbon bisulphide*, while still active, is not in as great a demand today as it was several weeks ago. *Copperas* is still on the scarcity list, and while prices remain unchanged at this time, an advance would not prove surprising. *Glycerine* has taken another advance and is now firm at 17c. in drums, with a further advance looked for. An 18c. glycerine market is to be expected before any further decline need be looked for. *Sulphur* is declining slightly and is quoted at $1.95 per 100 lb. in bags for the commercial grade. This is a decline of from 5 to 15c. per 100 lb. since our last report. *Zinc sulphate* is still very strong and going higher, with the market today at 3c. St. Louis, in carload lots; 3¼@3½c., St. Louis, in less carload lots.

VEGETABLE OILS AND NAVAL STORES

Castor oil remains firm at 14c. in drums, with quite a volume of business being transacted. *Turpentine* has advanced quite sharply and today's market is $1.26 per gal. in 5-bbl. lots or $1.32 in single barrels. *Linseed oil* is again moving in good sized quantities and is being quoted at 92c. in 5-bbl. lots, basis raw oil, and $1.02 in single barrels with the usual 2c. differential for boiled oil.

Nothing of note has happened in the market for other paint materials except that a duly expected rise in prices of *zinc oxide* has not arrived as yet, the market remaining as it was when last we reported.

The Iron and Steel Market

PITTSBURGH, Sept. 8, 1922.

The low point in production of pig iron and steel fell at the end of August, when the rate of pig-iron production was about 20,000,000 tons a year and steel mill operations were estimated at approximately 50 per cent of capacity, against a rate of close to 75 per cent late in June, when there was the heaviest operation since late in 1920.

Quite promptly upon the signing of the Cleveland agreement whereby mining of bituminous coal could be resumed under union auspices, production of pig iron and steel began to increase, the important channel to be opened involving coal to byproduct ovens and the coke to the adjoining blast furnaces. Up to date nearly if not quite a dozen blast furnaces, chiefly banked furnaces, have resumed, chiefly at Pittsburgh, in the Mahoning and Shenango valleys and in the Chicago district. With these furnaces operating in regular form, production of pig iron would be increased already by nearly 10 per cent, promising a corresponding increase in steel ingot production a very few days later.

It is a notable fact that there is not corresponding resumption of idle merchant furnaces. The merchant furnaces of the North depend chiefly upon Connellsville and West Virginia beehive coke, production of which has not materially increased, and upon surplus coke from the byproduct ovens of steel works when there is no surplus coke. The outlook for the merchant furnaces is distinctly unpromising at the moment.

NO SOFTENING IN STEEL MARKET

The increase that has occurred in operation of blast furnaces and steelmaking departments at steel plants is not a criterion that increases will continue indefinitely. Since the Cleveland agreement of Aug. 15 there has been rather rapid resumption of coal mining at union mines, but it is not certain that coal production will continue to increase to the limit of requirements. It is regarded as practically certain, indeed, that it will not, for railroad capacity will naturally, as usual, furnish the bottle neck.

In the retrospect, a notable feature of the situation at the moment is that there is no softening in the steel market position as a result of the ending of the coal strike. Such a softening was expected in most quarters. It is true the volume of steel buying has been relatively light in the past week, but this is not traceable plainly to indifference on the part of buyers. On the other hand it is clear that producers are reluctant to sell. Some are already sold far ahead, while those that are not have a feeling that they may be able to obtain better prices later. Presumably there are stocks of steel in the hands of some buyers, perhaps of many buyers, and it was thought in most quarters that the ending of the coal strike would be a signal to such buyers to liquidate. No such disposition is observable, thus far at least. The disposition of the average buyer, whether jobber or manufacturing consumer, is to build up stocks against the expected railroad congestion.

HIGHER PRICES FOR A NUMBER OF STEEL PRODUCTS

While no important steel price changes have occurred in the past week, the market has plainly stiffened in its general undertone. The minimum price on bars is 1.90c. and on plates and shapes 2c., these being understood to be the Carnegie Steel prices, although no official information is vouchsafed. The deliveries involved are indefinitely far ahead. The regular market, for reasonable deliveries, has been 2.25c. on all three of these products, and it is notable that some mills upon re-entering the market now are quoting this price as minimum. Plates for shipment in 2 or 3 weeks continue to bring 2.50c.

Sheets are selling at a variety of prices, depending on delivery time and the relation between mill and buyer. The leading interest is on the basis, as recently advanced, of 3.35c. for common black. Among independents there are various prices according to circumstances, 3.35c., 3.40c., 3.45c., 3.50c. and perhaps even 3.75c. Galvanized is quite uniformly 1c. above common black. Automobile sheets range from 4.70c. to 5c.

PIG IRON AND COKE

Pig iron continues to present practically a spot or prompt market. There is no selling beyond current stocks or production, as there is nothing definite as to when any merchant furnace will be able to resume. Foundry iron for Pittsburgh delivery continues to be controlled by Buffalo, the nearest point of supply, with a Buffalo price of $34, equivalent in the case of Pittsburgh delivery to an f.o.b. valley price of about $35.50. On small sales bessemer has brought $34 valley, a $2 advance in the week. Basic remains quotable at the conjectural figure of $30 valley, there being no bids or offers or any recent sales. It is related that $32 was quoted to one inquirer, who thereupon promptly withdrew the inquiry.

Connellsville coke is quotable at $11@$12 for furnace. While the furnace coke price would be quite objectionable to a furnace that has low-priced pig iron orders remaining to be filled, and would not be particularly attractive to a furnace with a clear order book, a fundamental objection to the situation is that there is not enough coke offered, all told, to enable a single furnace to build up an operation.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0.13½ – $0.13¾	.14 – .14½
Acid, acetic, 28 per cent	100 lbs.	2.70 – 2.80	2.85 – 3.30
Acetic, 56 per cent	100 lbs.	5.35 – 5.40	5.45 – 5.75
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	12.00 – 12.50	12.75 – 13.50
Boric, crystals	lb.	.11 – .11½	.11¾ – .12
Boric, powder	lb.	.11 – .11½	.11¼ – .12½
Citric	lb.	..... –	.45 – .45½
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04¼	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)	....	..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06¼	.06¾ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07¼
Oxalic, crystals	lb.	.17½ – .17½	.17½ – .18½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	10.00 – 10.50	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.29½ – .30
Tartaric acid, imported, powdered	lb.	..... –	.30 – .31
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)	.....	..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.34 – .35
Alcohol, denatured, 188 proof No. 5	gal	..... –	.34 – .35
Alum, ammonia, lump	lb.	.03¼ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03½ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07¼
Amylacetate tech	gal.	..... –	2.25 – 2.35
Arsenic, white, powdered	lb.	.08¾ – .09	.09¼ – .09½
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	61.00 – 62.00	63.00 – 66.00
Barium chloride	ton	85.00 – 88.00	89.00 – 95.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)	.....	..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)	.....	..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2.40	2.45 – 2.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.83 – .85
Carbon bisulphide	lb.	.06 – .06½	.06½ – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)	.....	..... –	..... – .....
Caustic soda (see sodium hydroxide)	.....	..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.25 – 6.50	6.60 – 6.75
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)	.....	..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.09 – .09¼	.09½ – .10
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth—imported powdered—net	ton	30.00 – 32.00	..... – .....
Fusel oil, ref	gal.	..... –	2.75 – 2.90
Fusel oil, crude	gal.	..... –	1.55 – 1.75
Glauber's salt (see sodium sulphate)	.....	..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.17 – .17½
Iodine, resublimed	lb.	..... –	4.20 – 4.25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.10½ – .11½
Lead arsenate, powd	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.12 – .12½
Phogene (see carbonyl chloride)	.....	..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.10½ – .10½	.11 – .11¼
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06½ – .06½	.07 – .08
Potassium permanganate	lb.	.14½ – .15	.15½ – .16
Potassium prussiate, red	lb.	..... –	.95 – 1.00
Potassium prussiate, yellow	lb.	.35 – .35½	.35¾ – .36
Rochelle salts (see sodium potas. tartrate)	.....	..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .06½	.06¾ – .07
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	18.00 – 21.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07¼ – .07½	.07¾ – .08
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05½
Sodium chlorate	lb.	.06½ – .06½	.07 – .07½
Sodium chloride	long ton	12.00 – 13.00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09½ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.70 – 3.75	3.80 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02¾ – .03	.03¼ – .03¾
Sodium nitrite	lb.	.08½ – .08¾	.09 – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.23½ – .23¾	.24 – .24½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04¼	.04½ – .05
Sodium sulphite, crystals	lb.	.03¼ – .03⅜	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 – 20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 – 40.00	..... – .....
Talc—domestic powdered	ton	18.00 – 25.00	..... – .....
Tin bichloride	lb.	.09 – .09½	.09¼ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran	lb.	.5¾ – .06	.06¼ – .06¾
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.20 — .22
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.30 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.70 — .75
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15 —	$0.10
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.10 —	2.15
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.75 —	.77
Ortho-nitro-toluene	lb.	.10 —	.13
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.23 —	.25
Pyridine	gal.	1.75 —	2.75
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.25 —	.27
Salicylic acid, U. S. P	lb.	.29 —	.30
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12 —	.14
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

All quotations same as previous report.

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.25 —	$6.30
Rosin E-I	280 lb.	6.35 —	6.40
Rosin K-N	280 lb.	6.45 —	6.65
Rosin W. G.-W. W	280 lb.	7.85 —	8.40
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.23 —	1.24
Wood turpentine, steam dist	gal.	1.15 —	....
Wood turpentine, dest. dist	gal.	1.12 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.38 —	....
Rosin oil, second run	gal.	.41 —	....
Rosin oil, third run	gal.	.48 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr.1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.80 —	3.85
Blood, dried, f.o.b., N. Y	unit	4.60 —	....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.40 —	2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Prices remain unchanged.

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12½ —	.12½
Coconut oil, Ceylon grade, in bbls	lb.	.08¼ —	.08½
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09¾
Corn oil, crude, in bbls	lb.	.10½ —	.10¼
Cottonseed oil, crude (f. o. b. mill)	lb.	.06½ —	.07
Cottonseed oil, summer yellow	lb.	.09 —	.09¼
Cottonseed oil, winter yellow	lb.	.10 —	.10¼
Linseed oil, raw, car lots (domestic)	gal.	.88 —	.88½
Linseed oil, raw, tank cars (domestic)	gal.	.83 —	.84
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.91
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.06¾ —	.07
Palm, Niger	lb.	.06 —	.06⅛
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09¼ —	.09½
Peanut oil, refined, in bbls	lb.	.12 —	.12¼
Rapeseed oil, refined in bbls	gal.	.81 —	.82
Rapeseed oil, blown, in bbls	gal.	.87 —	.88
Soya bean oil (Manchurian), in bbls. N. Y	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09⅝ —	....

FISH

Light pressed menhaden	gal.	$0.53 —	....
Yellow bleached menhaden	gal.	.54 —	.55
White bleached menhaden	gal.	.56 —	.57
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Quotations same as previous report.

Refractories

Prices remain unchanged.

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	1.85 —	2.00
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58.00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V	lb.	3.50 —	4.00

Ores and Semi-finished Products

Prices remain quotably unchanged.

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent	18.00–18.50
Antimony, wholesale lots, Chinese and Japanese	5.20–5.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.625
Lead, New York, spot	5.90
Lead, E. St. Louis, spot	5.55
Zinc, spot, New York	6.55–6.60
Zinc, spot, E. St. Louis	6.20–6.25

OTHER METALS

Silver (commercial)	oz.	$0.69⅝
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.15@1.25
Platinum	oz.	$118.00
Iridium	oz.	Nominal
Palladium	oz.	55.00@60.00
Mercury	75 lb.	65.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	16.75
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	24.75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@ 8.75
Lead, heavy	4.50@ 4.75
Lead, tea	3.25@ 3.50
Brass, heavy	5.50@ 5.75
Brass, light	5.00@ 5.25
No. 1 yellow brass turnings	5.50@ 5.75
Zinc	2.25@ 2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.04	$2.70
Soft steel bars	2.94	2.60
Soft steel bar shapes	2.94	2.60
Soft steel bands	3.74	3.20
Plates, ¼ to 1 in. thick	3.04	2.70

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The Lehigh Portland Cement Co., Allentown, Pa., has preliminary plans in progress for the construction of a new cement mill on a tract of land at East Birmingham, comprising about 250 acres, acquired a number of months ago. The plant will consist of a number of buildings to provide for a capacity of approximately 1,000,000 bbl. per annum, and is estimated to cost in excess of $600,000.

BIRMINGHAM—The McWane Cast Iron Pipe Co., Birmingham, has plans nearing completion for the construction of a new foundry at East Birmingham, on site recently acquired. The works will comprise a number of buildings, to be equipped for the production of about 8,000 ft. of small-sized pipe per day, and will give employment to about 150 men. It is expected to commence work within the next 30 days, and to have the plant ready for service early in the coming year. It will cost in excess of $85,000.

California

NATIONAL CITY—The Jet Oil Refining Co. has commenced the construction of a new refinery on local site, and plans to have the plant ready for machinery installation at an early date. It will be equipped for the production of lubricating oils.

ANAHEIM—The Anaheim Sugar Co. has awarded a general contract to G. E. Fickette, 638 South Western Ave., Los Angeles, for the construction of a new 5-story reinforced-concrete building at its plant, 45x260 ft., estimated to cost about $160,000.

ALHAMBA—The C. F. Braun Co., 604 Mission St., San Francisco, manufacturer of heating equipment, will commence the immediate construction of a 1-story foundry, at Shorb near Alhambra, in connection with a new works at this location, to cost about $65,000.

NATIONAL CITY—The California Gypsum Co. has plans nearing completion for the construction of a new plant on ocean front property, recently acquired, for the manufacture of gypsum blocks and other kindred products. It is estimated to cost in excess of $50,000.

Florida

BRADENTOWN—The Manatee County Fertilizer Co. has awarded a contract to J. C. Walden, Bradentown, for the construction of a new plant on local site. The main building will be 60x108 ft. The plant will have an initial output of approximately 100 tons of commercial fertilizer. J. H. Humphries is president.

Georgia

ROME—The B. Mifflin Hood Brick Co., Atlanta, has plans in progress for extensions and improvements in the plant of the Rome Fireproofing Co., recently acquired. The work will cost about $75,000, including new equipment. The company has also purchased a large tract of clay deposits in the vicinity of the Rome plant, and proposes extensive development.

CAIRO—The Farmers' Co-operative Cane Syrup Association is having plans prepared for the construction of a local plant with initial daily capacity of about 10,000 bbl.; an extensive storage works will also be built.

CAMILLA—The J. P. McRee Turpentine Co., recently organized with a capital of $75,000, has preliminary plans under consideration for the establishment of a local plant for the manufacture of turpentine, rosin and kindred products. J. P. McRee heads the company.

Idaho

MACKAY—The Republic Consolidated Mining & Refining Co., recently organized with a capital of $3,000,000, has plans in progress for the construction of a new concentrating mill and cyanide plant at its properties in this section. A hydro-electric power plant will also be constructed. W. P. Barton is in charge. The project will cost about $150,000.

Illinois

CHICAGO—The National Paint & Wall Paper Co., care of Clarence Hatzfield, 7 South Dearborn St., architect, is completing plans for the construction of a new 1-story and basement plant, 50x105 ft., at 4317 Grand Ave. Bids will be asked at once.

PULLMAN—The Pullman Foundry Co. will soon commence the construction of a new 1-story foundry, 300x500 ft., to cost about $40,000, exclusive of equipment. Plans have been completed by Frank D. Chase, 645 North Michigan Ave., Chicago, architect and engineer.

Indiana

SPEED—The Louisville Cement Co., Louisville, Ky., has work under way on the rebuilding of its local cement-manufacturing plant, destroyed by fire early in July. It is proposed to increase the capacity at the new plant from 1,800 bbl. per day, the output of the former mill, to 2,500 bbl. per day. All equipment will be electrically operated. The new mill will cost close to $300,000, and is expected to be ready for service at an early date.

Louisiana

KENTWOOD—The Chamber of Commerce is perfecting plans for the establishment of a local mill for the manufacture of paper and pulp products. It is purposed to organize a company to operate the plant. H. A. Addison, secretary, is in charge.

BOSSIER CITY—The Louisiana Oil Refining Corp., Shreveport, is arranging for the early operation of its new plant here, now nearing completion, for the production of grease and lubricating oils. The works will have an initial capacity of about 9,000 lb. of grease and 250 bbl. of lubricating oil per day. It is proposed at a later date to extend the works, which now represents an investment of about $30,000.

Maryland

BALTIMORE—The city water department will commence preliminary work at once for an addition to the municipal water-filtration plant at Montebello, estimated to cost about $1,500,000. It is planned to award contracts for different features of the project, including machinery, by the close of the year.

Massachusetts

WATERTOWN—The Hodd Rubber Co., Nichols Ave., has awarded a general contract to William H. Illiffo, Bailey Rd., for the construction of a 2-story addition to its plant, 96x200 ft., to cost about $75,000.

WORCESTER—The Norton Co., manufacturer of abrasive products, will commence the immediate construction of a new 4-story building at its plant, 50x125 ft. Steel storage tanks and other operating equipment will be installed.

HAVERHILL—Fire, Aug. 19, destroyed one of the buildings at the plant of the Haverhill Box Board Co., manufacturer of paper products, with loss approximating $100,000.

CAMBRIDGE—The Cambridge Rubber Co., 748 Main St., will commence the immediate construction of a new 4-story plant, 83x104 ft. A general contract for the work has been let to the Scully Co., Cambridge.

Michigan

BAY CITY — The Laetz Foundry Co. is planning for the early occupancy of its new local plant, now nearing completion. It will be used for the production of a general line of metal castings.

MONROE—The new plant of the Republic Glass Co., now in course of construction, will be equipped to give employment to about 150 persons, and this working force will be increased at a later date. It is expected to have the works ready for service late in October. The company has established general offices at 207 South Macomb St. Manuel Llera is president; and J. H. Williams, secretary and treasurer.

Missouri

COLUMBIA—The City Council is arranging for the purchase of the artificial gas plant of the Columbia Gas Co., to be operated in the future as municipal property. It is planned to make extensions and improvements. Bonds for $100,000 are being arranged.

Montana

GREAT FALLS—The Silver Dyke Mining Co., operating at Hiehart, near Great Falls, is planning for the erection of a new concentrating plant, with daily capacity of about 250 tons.

New Jersey

NEWARK—The Alcohol Products Co. Blanchard St. and the Passaic River, has awarded a contract to Fred Kilgus, Inc., 13 South 6th St., for the erection of a 1-story plant addition, 40x145 ft. Work will be commenced at once.

OLD BRIDGE — The local plant of the Brookfield Glass Co., has been acquired by new interests, represented by William J. Burke, 99 Nassau St., New York, attorney, which plan to operate the works. The new owners are said to be organizing a company to manufacture a line of glass specialties, and will take immediate possession of the property.

CEDAR GROVE—The Department of Streets and Public Improvements, City Hall, Newark, is planning for the construction of a 1-story chemical laboratory, 26x48 ft., to cost about $20,000, for testing work in connection with the city waterworks at Cedar Grove. The Bureau of Water, John A. Foulks, engineer, is in charge.

New York

LONG ISLAND CITY—The A. C. Horn Co., Bodine and Hancock Sts., manufacturer of waterproofing products, will commence the immediate erection of a 3-story addition to its plant. Plans have been prepared by William Schoen, 507 5th Ave., New York. A. C. Horn is president.

ROCHESTER—Fire, Aug. 22, destroyed a portion of the tankage department of the Monroe County Oil Co., with loss estimated at about $15,000. It will be rebuilt.

ELMIRA—The Elmira Water, Light & Railroad Co., Heulett Bldg., will commence the immediate erection of a new artificial gas-manufacturing plant, estimated to cost about $300,000, including equipment. It will be located at Madison Ave. and East 5th St.

BROOKLYN—The Aetna Varnish Co., Maspeth and Vandervoort Aves., has plans under way for the erection of a new 1-story plant 80x100 ft., to cost about $20,000. Louis Allmendinger, 20 Palmetto St., is architect.

SPARKILL—The Standard Oil Co., 26 Broadway, New York, has preliminary plans under consideration for the erection of a new oil refinery on local tract of property recently acquired, comprising about 1,500 acres of land. The new works will consist of a number of buildings and is said to be estimated to cost in excess of $500,000.

YONKERS—The Kober Chemical Co., 24 Grey Oakes Ave., is completing plans and will soon call for bids for the erection of a 2-story chemical laboratory, 40x70 ft., on Grey Oakes Ave., estimated to cost about $42,000.

Ohio

EAST AKRON—The Trump Rubber Co., operating at the former local plant of the Denmead Rubber Co., manufacturer of mechanical rubber products, has plans nearing completion for the erection of a new local plant for the manufacture of automobile tires, to be equipped for an initial output of about 100 tires per day.

NILES—The Electric Alloy Steel Co., Youngstown, O., is perfecting plans for the erection of a new plant at Niles, to comprise open-hearth alloy steel furnaces, rolling mills, etc., for the production of high-speed steel products.

Oklahoma

OKLAHOMA CITY—The Kenyon Brick & Tile Co., 2700 West 10th St., is planning for the installation of new equipment at its plant, including mixing machinery, press, etc. A. W. Kenyon is president.

PONCA CITY — Miller Brothers, operating the 101 Ranch, will commence the immedi-

e rebuilding of the tanning plant on their operty, recently destroyed by fire. It will ve a capacity of 200 hides per day, and th power plant and other works buildings, ill cost about $100,000.

ARDMORE—The Indiahoma Refining Co. ederal Reserve Bank Bldg., St. Louis, Mo., negotiating for the purchase of the local l refinery of the Chickasaw Refining Co., hich has been inactive for about a year ast. Upon acquisition, it is purposed to ake extensions and improvements, includ- g machinery repairs, and place the plant service at the earliest possible date. E. . Schock is head of the Indiahoma com- any.

Pennsylvania

JEANETTE—The American Window Glass o., Farmers' Bank Bldg., Pittsburgh, will ake bids at once for the erection of an ddition to its local glass plant, to duplicate, pproximately, the present 12-tank building t the works. The installation will com- rise twelve cylinder blowing machines, anks, glass conveyors and other machinery. n appropriation of about $1,500,000 has een made for the expansion. Willian L. lonro is president and general manager.

WHITE HAVEN—The Peerless Explosive o. will make extensions and improvements n the plant of the Miller Powder Works, ce Lake, near White Haven, recently ac- uired, and plans to commence operations at n early date. Employment will be given o about 100 men.

ALLENTOWN—The Ford-Rennie Leather o., recently organized under Delaware laws as leased the former plant of the Victor eather Co., Auburn St., near the East Penn unction, and will operate a tannery for the manufacture of glazed kid products. John D. G. Rennie is president; and James I. Ford, treasurer.

PHILADELPHIA — The M. L. Shoemaker Fertilizer Co., Venango St. and the Dela- ware River, is planning for the rebuilding of the portion of its plant, recently destroyed by fire, with loss reported in excess of $400,000, including buildings and equipment.

South Carolina

LAURENS—The Laurens Glass Works, Inc., has plans in progress for the rebuilding of the portion of the main building at its plant, recently destroyed by fire. Albert Dial is president.

Tennessee

KNOXVILLE—The Knoxville Porcelain Co., recently organized with a capital of $370,000, has acquired property at Lonsdale, near Knoxville, comprising about 5 acres of land, as a site for the erection of a new plant for the manufacture of porcelain products for electrical service. The initial works will consist of a 3-unit plant, estimated to cost about $100,000. J. N. Houser is pres- ident, and O. C. Duryea, vice-president.

MEMPHIS—The Commercial Chemical Co., 394 South Front St., is reported to be plan- ning for the rebuilding for the portion of its works, destroyed by fire, Aug. 19, with loss approximating $40,000.

Texas

BEAUMONT—The White Eagle Oil & Refin- ing Co., Kansas City, Mo., has tentative plans under consideration for the construc- tion of a new oil storage and terminal plant here to cost about $250,000, including equipment, for export service. It is expected to commence work at an early date.

West Virginia

WIERTON—The Wierton Steel Co. will soon commence the installation of a new byprod- ucts coke plant, to comprise a battery of 37 ovens and auxiliary equipment, with capacity of about 600 tons of coke per day.

Industrial Developments

LEATHER — The Charles S. Walton Co., Philadelphia, Pa., is increasing production at its tanneries. The currying plant has been placed on a full capacity basis.

The Griess-Pfleger Tanning Co., Cincin- nati, O., is running full in its different plant departments, giving employment to a reg- ular working force. A new hide and skin storage plant has been completed and will be placed in service at once.

CERAMIC — All refractory plants in the vicinity of Mount Union, Pa., are operating at capacity, giving employment to normal working forces, including the Harbison- Walker Refractories Co., the General Re- fractories Co. and the United States Refrac- tories Co. Wages have been advanced at the plants for all classes of employees, averaging from 60 to 80 cents a day; the schedule for laborers has been increased from $2.70 to $3.50 per day.

The Vitrified Brick & Tile Co., Collins- ville, Okla., has adopted a night shift at its plant, in addition to a regular day force, and will operate on a basis of 5 carloads of material per day for an indefinite period. The company is said to have orders on hand for over 200 carloads of vitrified brick.

Owing to fuel shortage, a number of brick-manufacturing plants in the Akron, O., district have been forced to shut down or curtail production. Two plants are still running full. Operations will be resumed as soon as the situation improves.

Potteries at Trenton, N. J., are arranging for a full resumption of production as soon as a supply of anthracite coal is available. Fuel shortage has caused a number of the plants to curtail operations during the past few weeks. The present local supply of anthracite for this branch of industrial work is low.

A number of brick plants in Nansemond County, Va., and other parts of the state are refusing orders, owing to inability to make shipments and deliveries on account of the rail strike. The Virginia-Carolina Brick Manufacturers' Association has ap- plied to the state fuel distributor, Rich- mond, to grant priority shipments to the industry.

IRON AND STEEL—The Trumbull Steel Co., Youngstown, O., has resumed operations at its plant at Warren at close to normal capacity, on a basis of about 40,000 tons per month.

The American Sheet & Tin Plate Co., Elwood, Ind., is maintaining active produc- tion at its local mills, giving employment to more than 500 men.

The Monterey Iron & Steel Co., Monterey, Mexico, is increasing production at its mills, and is now operating at practically full capacity. The steel output has been ad- vanced from 400 to 500 tons per day, and will be further increased to a maximum of 600 tons at an early date. With three open-hearth furnaces in service, arrange- ments are being made to place the fourth unit at the plant in operation, at which time the working force will be increased by about 1,500 men. A recent increase in employees has been made from 2,000 to 3,500.

The Iron Products Corp., Bessemer and Anniston, Ala., has adopted a capacity basis of operation at all of its local plants, includ- ing coke works.

The Crucible Steel Co. of America is maintaining production at its Syracuse, N. Y., plant at close to normal, with employ- ment of regular working force.

The Midvale Steel & Ordnance Co., Phila- delphia, Pa., has adopted a present basis of operation of about 50 per cent of normal at its plants.

The American Sheet & Tin Plate Co. is increasing operations at its Shenango works, near New Castle, Pa., and has recently added about 100 ment to the working force.

Owing to coke and coal shortage, blast- furnace operation in the Buffalo, N. Y., has been curtailed to 5 active stacks out of a total force of about 25,000 men.

METALS—The American Smelting & Refin- ing Co. is planning for the resumption of operations at its plant at Monterey, Mexico, which has been idle for a number of years past. The company is operating its smelt- ing and refining plant at Tacoma at full capacity, giving employment to the regular working force.

The Utah Zinc Co., Salt Lake City, Utah, is running under heavy output at its local plant. The mill has orders on hand for some time to come for zinc oxide for the rubber and paint industries.

MISCELLANEOUS—The Darco Corp., Mar- shall, Tex., is running at full capacity at its local plant unit, recently completed, for the production of Darco, or coloring material for food products, and other service. The first full-car shipment has left the plant, and others will follow on a regular working schedule. Additional plant units will be constructed in the future.

The American Window Glass Co. is oper- ating with a working force of more than 700 men at its plant at Jeannette, Pa., at close to normal output. A wage increase of from 15 to 22 per cent has been made.

The Lehigh Portland Cement Co., New Castle, Pa., has resumed operations at its local mills, following a recent curtailment due to a strike of operatives. The men have been granted a 20 per cent wage advance. About 700 employees are affected.

The International Cement Co., New York, has been forced to curtail operations at its Knickerbocker cement plant, owing to the coal and rail strike. It is expected to re- sume as soon as the situation improves.

The Solvay Process Co., Solvay, near Syracuse, N. Y., is maintaining operations at its local plant at close to normal, with employment of regular working force.

Glass plants at Millville, N. J., are ar- ranging for an immediate resumption of operations, following the regular seasonal shut down in July and August. A large force of men is busy in placing the plants in readiness for full blast. A number of plants have accumulated orders to insure capacity production for some time.

The Smithville Oil Mill Co., Smithville, Tex., has resumed operations at its local cottonseed oil mill, closed for a number of months past. Production will be in- creased gradually until a day and night force is engaged. It is expected to keep the plant running full well into the winter.

The J. R. H. Products Co., Willoughby, O., specializing in the production of barium dioxide, has closed its plant for an indefinite period, owing, it is said, to foreign competi- tion. The plant has been giving employ- ment to close to 100 men.

The McMurray Asphaltum & Oil Co., Waterways, near Edmonton, Alta., is ar- ranging for immediate increased operations for the production of lubricating oils from tar sands. Machinery will be installed for this purpose.

New Companies

THE THOMAS ENGINEERING LABORATORIES, INC., Newark, N. J., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture paints, varnishes, etc. The incorporators are John H. Thomas, Milton A. Smith and Edward T. Moore.

THE BREWER MFG. CO., Grand Rapids, Mich., has been incorporated with a capital of $200,000, to manufacture spark plug por- celain products and kindred specialties. The incorporators are Ray E., John A. and C. G. Brewer, 1103 Front Ave., N. W., Grand Rapids.

THE HENDERSON OIL & REFINING CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representa- tive, has been incorporated under state laws with a capital of $1,000,000, to manufacture petroleum products.

THE NATIONAL PAINT WORKS, INC., Bos- ton, Mass., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. Philip Shurdut is president; and Frank V. Jordan, 237 Redlands Road, West Roxbury, Mass., treasurer.

J. C. SEITZ & CO., INC., Buffalo, N. Y., care of Dirnberger & Moore, attorneys, Buf- falo, representative, has been incorporated with a capital of $200,000, to manufacture tires, tubes and other rubber products. The incorporators are J. C. and E. W. Seitz, and H. F. Robinson.

A. BELL & SON, INC., Providence, R. I., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are Hiram G. Hall, Clive D. Waite and John M. Clifford, all of Providence.

THE SULFEX CO., Newark, N. J., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical by- products. The incorporators are Louis C. Owens, Jr., Charles P. Stewart and Ber- tram W. Saunders, 264 Jelliff Ave., Newark.

THE MACINNES MFG. CO., 10925 South Michigan Ave., Chicago, Ill., has been in- corporated with a capital of $24,000, to manufacture paper, fiber and kindred prod- ucts. The incorporators are Neil and M. V. MacInnes, and Harold L. Hart.

H. A. DEFRIES, INC., New York, care of N. F. Schmidt, 220 Broadway, representa- tive, has been incorporated with a capital of $20,000, to conduct metallurgical opera- tions. The incorporators are R. Chaplin, E. Goldberg and J. V. Ecker.

THE ACME PRODUCTION CO., New York, care of the Registrar & Transfer Co., 900 Market St., Wilmington, Del., representa- tive, has been incorporated under Delaware laws with capital of $2,500,000, to manu- facture petroleum products.

THE CHLORIDINE CO., Memphis, Tenn., has been incorporated with a capital of $10,000, to manufacture chemical products. The in- corporators are H. R. Bynum, P. C. Schalz and A. C. Grube, all of Memphis.

THE NEW PROCESSES CO., Indianapolis, Ind., has been incorporated with a capital

of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are George P. Shippey and Raymond L. Walker, both of Indianapolis.

MORRIS B. READE, INC., Nutley, N. J., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are Jacob Muller and Morris B. Reade, 72 High St., Nutley.

THE PROCESS CHEMICALS, INC., New York, care of M. P. Schaffer, 1463 Broadway, representative, has been incorporated with a capital of $1,250,000, to manufacture chemicals and chemical byproducts. The incorporators are A. P. Burch, E. Stempel and A. E. Wolz.

THE COLUTH CHEMICAL CO., Indianapolis, Ind., has been chartered under state laws to manufacture chemical specialties. The incorporators are Howard C. Baker, William M. Love and Thomas M. O'Connor, all of Indianapolis.

THE METAL PENETRATING COLOR CORP., New Haven, Conn., has been incorporated with a capital of $25,000, to manufacture a special metal process known as penetrating color. The incorporators are George R. Doolittle and William H. Unmack, 152 Whalley Ave., New Haven.

THE CLARK CHEMICAL CO., INC., Boston, Mass., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. Nelson B. Clark, 166 Lawrence St., Malden, Mass., is president and treasurer.

THE NORTH AMERICAN OIL & MFG. CO., 2319 North Seeley Ave., Chicago, Ill., has been organized to manufacture refined oil products. The company is headed by C. J. Christie and E. A. Schillinger.

THE DAVID HASSETT CORP., New York, N. Y., care of Burnett, Sorg, Murray & Duncan, 810 Broad St., Newark, N. J., representatives, has been incorporated with a capital of $100,000, to manufacture fiber products. The incorporators are D. H. Hassett, G. B. Bailey and F. E. Stults.

THE WAXENE MFG. CORP., Bloomington, Ind., has been incorporated with a capital of $60,000, to manufacture waxes, polishes, varnishes, etc. The incorporators are Halbert M. Wood, Oscar H. Cravens and J. E. P. Holland, all of Bloomington.

THE CHICKASAW REFINING CORP., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under state laws with a capital of $10,000,000, to manufacture refined petroleum products.

THE MERCHANTVILLE ALUMINUM & BRASS WORKS, INC., Merchantville, N. J., has been incorporated with a capital of $100,000, to manufacture aluminum, brass and other metal products. The incorporators are Peter Bernacki, Andrew Raroha and Dean S. Renwick, 511 Market St., Camden, N. J. The last noted represents the company.

THE KRISGOLD LEATHER CO., Chelsea, Mass., has been incorporated with a capital of $10,000, to manufacture leather products. George L. Goldman is president; and Jacob Kristal, 29 Franklin Ave., Chelsea, treasurer.

THE GULF STATES CHEMICAL & REFINING CO., Birmingham, Ala., has been organized to manufacture chemicals and chemical byproducts, and affiliated specialties. J. A. Moore, Jr., is president; and J. M. Gilby, Jr., vice-president, both of Birmingham.

L. HANERFELD, INC., New York, N. Y., care of Holley & Oxenberg, 50 East 42nd St., New York, representatives, has been incorporated with a capital of $15,000, to manufacture glass products. The incorporators are L. Hanerfeld, B. Finkelstein, and J. A. Sheridan.

THE ALLYNDALE LIME CO., Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture lime and kindred products. The incorporators are Samuel Gilbert, Benjamin Gaberman, both of Hartford; and M. S. Tracy, Glastonbury, Conn.

THE UNIVERSAL SODA & POTASH MINES, INC., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under state laws, with capital of $60,000, to manufacture soda, potash and kindred products.

THE OGDEN PRODUCTS CO., 3258 Ogden Ave., Chicago, Ill., has been incorporated with a nominal capital of $5,000, to manufacture chemicals and affiliated products. The incorporators are Charles Martin Sals, William Greenberg and Daniel D. Lichtenstein.

THE MORGANTOWN MANTEL & TILE CO., Morgantown, W. Va., has been incorporated with a nominal capital of $5,000, to manufacture tile and other ceramic products. The incorporators are H. L. Winter, James Fancey and O. M. Herod, all of Morgantown.

THE BOLTA CO. OF AMERICA, care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $1,000,000, to manufacture chemicals and chemical byproducts.

THE MARYLAND-VIRGINIA OIL CORP., 1010 Keyser Bldg., Baltimore, Md., has been incorporated with a capital of $500,000, to manufacture petroleum products. The incorporators are E. E. Hoch and L. R. Athey.

THE FRENCH MFG. CO., Seymour, Conn., has been incorporated with a capital of $50,000, to manufacture rubber specialties and affiliated products. The incorporators are C. M. and E. D. French, and C. J. Atwater, all of Seymour.

THE AETNA ALUMINUM & BRASS CASTINGS CO., 834-36 West 49th Place, Chicago, Ill., has been incorporated with a capital of $6,000, to manufacture aluminum, brass, bronze and other metal castings. The incorporators are F. A. B. Smith, William F. Bodong and Joseph A. Koehler.

THE TREMONT OIL CO., Chicago, Ill., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $500,000, to manufacture petroleum products. The incorporators are R. W. Taylor, J. N. Fulton and T. Goodrich.

THE CROTON CHEMICAL CORP., New York, N. Y., care of N. L. North, Jr., 32 Court St., Brooklyn, N. Y., representative, has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are H. H. Walker and N. P. Hicks, Jr.

THE BURKHART-SCHAIR CHEMICAL CO., Chattanooga, Tenn., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. A. C. Brukhart, Chattanooga, is president.

THE IDEAL MFG. CO., care of the Delaware Charter Co., 904 Market St., Wilmington, Del., has been incorporated under state laws with a capital of $80,000, to manufacture iron, brass, bronze and other metal castings.

THE MARION PRODUCTION CO., Marion, Ind., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are Omar F. Brown, Edgar S. Lane and Charles W. Beach, all of Marion.

THE OLD COLONY-RYNAK LEATHER CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture leather products. Walter Reinstein is president; and Henry Yozell, 40 County Road, Chelsea, Mass., treasurer.

Capital Increases, Etc.

THE COMMERCIAL CHEMICAL CO. OF TENNESSEE, Memphis, has filed notice of increase in capital from $2,500,000 to $2,750,000.

THE NEWPORT CO., Carrollville, Wis., manufacturer of heavy industrial and other chemicals, has disposed of a bond issue of $3,000,000, for general expansion, operations, etc. J. W. Shaeffer is president.

THE GLEN FALLS PORTLAND CEMENT CO., Glen Falls, N. Y., has filed notice of increase in capital from $600,000 to $1,200,000, for general expansion.

A petition in bankruptcy has been filed against the BROWN LEATHER CO., 1153 West Roosevelt Rd., Chicago, Ill. The liabilities are said to total $35,000, with assets close to a like amount.

THE UNITED STATES RUBBER CO., Akron, O., has arranged for a bond issue of $7,000,000, the proceeds to be used for general financing, expansions, etc. C. B. Seger is chairman of the board.

THE CENTURY CUT GLASS CO., Saugerties, N. Y., has filed notice of dissolution under state laws.

THE CLINTON TIRE & RUBBER CO., Toledo, O., has filed notice of change of name to the Wildman Tire & Rubber Co., at the same time increasing its capital from $100,000 to $2,200,000, for proposed expansion.

THE CUBA CANE SUGAR CORP., 112 Wall St., New York, operating sugar refineries in Cuba, has approved a bond issue of $10,000,000, to be used for general financing in connection with its subsidiary, the Eastern Sugar Corp.

THE NEW YORK VITREOUS ENAMEL PRODUCTS CORP., a Delaware corporation, has filed notice of organization to operate in New York for the manufacture enamelware products, with capital of $100,000. J. R. Greenwood, 66 Myrtle Ave., Brooklyn, represents the company.

Industrial Notes

THE CONVEYORS CORPORATION OF AMERICA, Chicago, Ill., announces that the Florandin Equipment Co. has been organized by C. H. Florandin, with offices at 110 West 40th St., to act as its New York representative. The new organization will also do a general contracting business in and around boiler rooms and industrial plants located in New York City and its vicinity, erecting and installing the lines of equipment which the organization handles. The Conveyors Corporation of America has also appointed the Mid-West Engineering Sales Co., Masonic Temple, Cedar Rapids, Iowa, representative in eastern Iowa, for the sale of the American trolley carriers, which are coal-handling equipment of the monorail type. J. W. Holden, who is manager of the Mid-West Engineering Sales Co., is well known in Cedar Rapids and vicinity.

THE MORSE CHAIN CO., Ithaca, N. Y., announces that due to increasing business it was necessary to move the Philadelphia office to larger quarters. It is now located at 612 Franklin Trust Bldg., 18-22 South 15th St. J. A. Meaney is district manager for that office.

W. A. JONES FOUNDRY & MACHINE CO., Chicago, Ill., announces the opening of another branch sales and engineering office at 2482 University Ave., St. Paul, Minn. C. F. Ford, who is in charge of this new branch, is an experienced transmission engineer and qualified to assist in elevating, conveying and power transmitting problems.

CELITE PRODUCTS, LTD., has been established in Canada to market Sil-O-Cel and Filter-Cel, as produced by the Celite Co. in the United States. Stock of these materials will be maintained in the New Kirks Bldg., Montreal. Lawrence Russel has been appointed manager.

THE J. R. ALSING ENGINEERING CO., 50 Church St., New York City, established in 1869 to develop pebble mills in this country under patents issued to J. R. Alsing in the early '70s, has recently undergone a reorganization. It has been taken over by W. W. Searle and Edward W. Lawler, the latter acting as general manager of the company. Mr. Lawler was previously manager of the Hardinge Co. of New York, which position he left 2 years ago.

THE BUCKEYE DRYER CO. has removed its main office from 243 North High St., Columbus, O., to 29 South LaSalle St., Chicago, Ill.

LESLIE H. WEBB, vice-president of the Wedge Mechanical Furnace Co. of Philadelphia, has recently assumed the management of the Pittsburgh offices of the Pennsylvania Salt Mfg. Co., the parent company of the Wedge Mechanical Furnace Co.

Coming Meetings and Events

ALPHA CHI SIGMA dinner, during the Chemical Exposition, will be held Thursday, Sept. 14, at 6:30 p.m. at Keen's Chop House, 107 West 44th St., New York City. Members are requested to register at *Chem. & Met.'s* booth at the Exposition.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS is holding its sixteenth annual convention Sept. 11 to 15 at Cleveland Public Hall, Cleveland, Ohio.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) is being held in New York, Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

CHEMICAL & METALLURGICAL ENGINEERING

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Looking a Gift Horse in the Mouth

OF THE important announcements made at the Pittsburgh meeting of the American Chemical Society none received more popular approval or wider publicity than that of the gift of an annual prize of $25,000 by the Allied Chemical & Dye Corporation. It is to be awarded to that American chemist who, in the opinion of a proper committee, has done most for the advancement of chemistry. The applause that greeted the announcement in Council meeting found an echo in the daily press throughout the length and breadth of the land. But during the remainder of the week the prize was a topic of frank discussion that belied the sincerity of the enthusiasm with which its announcement apparently was received. The general tenor of the conversation was, "The prize is a great thing for American chemistry, but——."

It is proverbially bad taste to look a gift horse in the mouth, but in this particular instance we think that comment is fairly invited. The organization of the Allied Chemical & Dye Corporation was a fine industrial conception. But events would seem to indicate that under the leadership and control of EUGENE MEYER, ORLANDO WEBER and their fellow syndicate members there has been a more abiding interest in finance than in chemical industry. The lack of chemical understanding and chemical sympathy at the top have found expression in the wrecking of research organizations and the emasculation of companies as far as chemists are concerned. Wholesale reorganization involving the discharge of employees from office boys to presidents has extended even to the removal from the list of aged pensioners who have given their lives to their employers. The policy pursued has, moreover, disturbed the morale of the remaining technical employees to a point where they have neither respect for their employers nor pride in their jobs. That they continue to do their work to the best of their ability is only a matter of self-respect.

It is conceivable that after pursuing this policy to a point where it has alienated the interest and friendship of the chemist, the corporation should now seek to gain his favor. But it will require atonement in other ways than by the gift of a cash prize to wipe out this blot on the 'scutcheon of American chemical industry. Of course the offer will be accepted and the prize awarded through the medium of the American Chemical Society, and undoubtedly the money will be joyfully accepted by the fortunate recipient, despite the fact that some have said they would scorn it, while others would devote it to the support of cast-off pensioners. The prize is a fine gesture, but it is not a convincing argument that the financial leadership of American chemical industry has been converted.

The Coal Industry On the Carpet

"I DO NOT believe great solutions are to be found out of emotional denunciations, but out of sober scientific examination," said HERBERT HOOVER to the chemical salesmen last week in discussing the coal industry in the United States. In his opinion, a sober, scientific examination of the coal industry by a national coal commission fully empowered to get at the bottom of the trouble is the plan that offers the greatest opportunity for constructive work since the war. Three times in recent years the coal industry has reduced the country to a point of industrial collapse because of a shortage of elementary and vital raw material. When an industry cannot so regulate itself as to avoid such impasses it is time for the public to step in and protect its interests through Congressional legislation.

The trouble with the coal industry is patent. It has a capacity of about 800,000,000 tons per year, whereas the maximum consumption is only 500,000,000 tons. Even in years of boom there are 200,000 surplus miners in the industry, and the average employment time is roughly 60 per cent, not counting strikes. Thus the public has to pay for 40 per cent idleness. The nation is forced to permit miners to live according to a standard out of proportion to their services, and that on only 60 per cent of productive work. In other words, the problem of the coal commission will be to develop some method whereby properties can be liquidated and miners turned into other industries, in order that the cost of the commodity may not be exorbitant. The overhead of the industry must be cut down. All this must be accomplished with an adjustment that shall be fair to employer and employee, but it should not be an impossible task.

Pittsburgh Entertains American Chemical Society

JUST as Milwaukee undoubtedly has claims to fame that were not wiped out by the adoption of the Eighteenth Amendment, so Pittsburgh would be perpetuated in the minds of chemists even if the reformer succeeded in placing a ban on the familiar stogey. Certainly the 1,300 chemists who registered at the Pittsburgh meeting of the American Chemical Society would be the last to forget the scientific excellence as well as the lively hospitality of the Pittsburgh Section.

One finds a peculiar spirit of co-operation and emulation among these chemists of the Smoky City. Due to the large number of industries centering in Pittsburgh there are groups of chemists, each of which is at once a competitive but co-operative unit in advancing the chemical industry. We are told that this spirit not only finds its expression in the annual outing and field day of the section, but that it is also a large factor in de-

veloping that quality of humanity that takes the curse off the cold scientific character of the profession.

Those who were responsible for the program of the Pittsburgh meeting showed rare judgment in one or two respects. In the first place, the formal dinner was abandoned for the more delightful sociability of a garden party and outdoor theatrical performance. Second, the smoker was enlivened by the fact that the various numbers on the program were performed by members of the local section. Evidently when it comes to making fun, the Pittsburgh Section "rolls its own." Without showing partiality, we think the skit prepared by the chemists of the Aluminum Co. of America deserves special mention, and we hope to publish it later as a contribution to the lighter vein in which chemists sometimes indulge.

The general and technical sessions had the customary interest for those in attendance. As usual the programs were entirely too long and many of the 457 papers were unworthy of a place in the list. Among the divisions and sections reporting good programs and good attendance were those devoted to rubber, cellulose, leather, petroleum, and industrial and engineering chemistry. For some reason or other the division of fertilizer chemistry was poorly attended—a delinquency that should be remedied if the division is to satisfy what is admittedly a large field of industrial chemistry. Perhaps less attention to methods of analysis and more to the broad problems of the industry will develop a strong division.

On the whole, the Pittsburgh meeting was one of the best that has been held and the Pittsburgh Section is entitled to the thanks of the visitors for the excellence of the arrangements.

Two Shifts and Three Shifts in Steel

A LARGE amount of information and opinion is accumulating on the question of the iron and steel industry eliminating the two-shift system of operation, where employed, in favor of a universal three-shift system. To the various studies made in past years there have now been added two long reports presented respectively by BRADLEY STOUGHTON and HORACE B. DRURY at a meeting September 8 of the executive board of the American Engineering Council of the Federated American Engineering Societies. Further, pursuant to the recent suggestion of President HARDING, a committee of the American Iron and Steel Institute is also at work on the subject.

The investigators find it necessary to consider the matter from many viewpoints. Even the barest outline of the subject cannot be given in this column. The momentary mental attitude of labor is a matter of importance. There is the question how many of the foreign born might become restless with an 8-hour day and seek 12-hour employment. Then there is the question of attracting classes of men who do not now gravitate toward blast furnace or steel mill employment. A point brought out in one of the reports now available is that with the introduction of more machinery the peak loads of activity, involving necessary rest periods, are reduced.

The literature thus far has been prepared chiefly by engineers and men who may in a sense be called social workers. The views of strictly business men will no doubt be incorporated in the report to be made by the American Iron and Steel Institute. From the business viewpoint, there seems to be good reason for making an effort to change from the two-shift to a three-shift system as soon as possible. Obviously the change must be made some time. Costs, wage rates and selling prices are in a particularly unstable condition now, hence less disturbance is promised than might prove to be the case later. Wage rates were declining sharply in 1921, while on the first of this month a 20 per cent advance went into effect in the industry. The price of one finished steel product or another sometimes changes several dollars a ton almost over night. There was much unemployment last year, while of late there has been a decided labor shortage at many plants. Nothing being at all fixed, changes can now be made better than at other times.

One suggestion has been made that deserves particularly careful consideration. It is that the man might be given the same hourly rate as formerly, whereby he would receive two-thirds as much per day, but with a bonus attached according to performance of the unit at which he is employed, whereby his weekly earnings might prove as large as formerly if not larger. This is a very attractive subject. A veteran in the iron and steel industry who recently retired from an important position after many years of service, a man noted for initiative, has often expressed the opinion that "payment by results" could be made to work in the iron and steel industry. He has insisted that some plan could be devised that would eventually prove practicable. Here is an opportunity to try the principle. Two changes would disturb conditions no more than one, so that there would be a chance to kill two birds with one stone.

Why Chemists Leave The University Laboratory

NOT long ago we commented editorially on the inequality in remuneration which exists between professional and industrial work. We were glad to sponsor the plan suggested by a good friend that there be established fellowships with unusually high remuneration—"to save the exceptional man for educational work." That is, however, only half of the story. A single incident from many will illustrate the other side.

A young professor of analytical chemistry was doing unique and recognized research. His apparatus, such as he had, was begged and borrowed from friends and foundations. His department supplied him with almost nothing. In addition for his analytical course he had sixty platinum crucibles for over a hundred men. These crucibles were loaned to students by the day and had to be returned to him personally each night to be locked in the safe (by order of the department head). Not only did his department give him no funds for research but it filled his time with meaningless routine that was irksome and useless.

This same man subsequently accepted an industrial offer which, incidentally, paid him more than double the salary; but, more pertinent to the immediate question, it gave him unlimited funds for equipment, almost unlimited assistance and complete freedom from the mechanical routine of even ordering apparatus.

The moral back of the tale is this: Industry has a much better appreciation of the intrinsic value of the research man's time and energy than is found in the university. It relieves him of elementary routine, pays him for the quality of his service and gets value received. The job is attractive not only because it pays better, but also because it is free from onerous red tape.

A chemist of parts is not apt to enthuse over a position, in a university or elsewhere, which consumes a part of his time in work that a high school boy would scorn. It is evident that universities may well look toward a housecleaning that will remove the millstones of routine and red tape from the necks of able chemists. Perhaps then the lure of industry and even the shaking of the moneybags will fall upon the deaf ears of the man whose creative impulse is being satisfied

Mass Production of Fundamental Data

SO RAPID has been the advance in the science of metallography that it now embraces far more than is indicated by the derivation of the word. It now embraces the science and art of metals and metal working. Its present importance is only another instance of how modern industrial life has eagerly adapted to its uses the principles discovered by precise physical and chemical experimentation.

Despite the fact that its practitioners devote much of their time to determining the strength, hardness or electrical characteristics of metallic samples, it is unquestioned that rational generalizations are often possible only if proper consideration be given to the constitutional or equilibrium diagram of the alloy system in question. Conversely, a correct diagram is an indispensable guide for a systematic investigation of the possibilities of any alloy series thought to contain members of commercial importance.

As yet we know surprisingly little about these possibilities—due in part to the comparative youth of the science. Excluding those rare metals which are only laboratory curiosities, there are about 600 possible binary systems of the thirty-five or forty fairly common metals. Of these not more than a dozen have been exhaustively studied, and perhaps a hundred are mapped out with fair accuracy. The general outlines of many more have been sketched, but at least 150 have not been touched! Many thousands of ternary systems are possible, and virtually all this field is untrod by the systematic researcher. Quaternary systems—but why continue?

It would be interesting to inquire into the origin of such work as has been done on equilibrium systems. French scientists proposed the principal investigative apparatus, but the Germans have done most, perhaps 80 per cent, of the detailed work. Russian effort has been confined to simple systems. PARRAVANO and his Italian followers have done some splendid work on ternary systems, chiefly of theoretical importance. It has remained for the English to explore a number of binary and ternary systems of great commercial importance, bringing to bear various methods of research in a penetrating examination—in great contrast to the very sketchy, almost hasty, work which characterizes the German publications.

Nearly all of these nations have done more than America. Disregard a large number of careful researches on commercial alloys of narrow composition, and there is little left of a sytematic nature. Perhaps we should not be unduly criticised for thus "skimming the cream." The rewards attending commercial work have been so great that in the past the Americans could afford to let others spend years of patient labor on theoretical problems, while we could apply their conclusions to shop practice.

Bear in mind, however, that practice rapidly adapts theory, and continuous and advanced investigation is essential for technical progress. Hence the importance of intensive work on equilibrium diagrams. We venture to state, though, that if Americans will ever take up the work which perforce has been dropped by Germans and Russians; if Englishmen of ability can be persuaded to continue their searches with the same minute care as before, it appears that some of the principles of mass production must be introduced into the laboratory. Certainly it is of no advantage to stop a tension machine every few seconds to read extensometers, when a movie film can automatically record the entire history of a continuous test, for study at leisure. Like statements are true of thermal analysis, magnetic studies and determinations of a wide variety of physical properties.

A revival in interest in the fundamental diagrams of physical metallurgy therefore seems to await the successful design or combination of instruments of fair precision which work almost automatically. Such a "machine" should contain a furnace chamber approaching black body characteristics, capable of being heated and cooled at definite rates. Its gaseous atmosphere should be under control, and the metallic samples contained therein so connected with auxiliary apparatus that autographic records of various kinds may be drawn simultaneously. All that would be necessary would be to insert the sample, fix the films or charts, and close the switch!

Many of the elements of such a machine are already known. It certainly would be well worth while for some of our institutions possessing good instrument shops to assemble such of them as are available, and to design and construct the necessary auxiliaries.

A New Viewpoint For Labor and Capital

THE typical cartoonist loves to depict a struggle between two huge and ferocious wrestlers—one labeled Capital and the other Labor—while off at one side stands a timorous little figure, afraid to interfere lest he be hurt yet obviously apprenhensive as to his fate should either win—the General Public.

Now the cartoonist may be trite in showing things in this way; but, unfortunately, he is almost always correct. It is almost the universal practice for both sides of an industrial controversy to act as though they alone were concerned. This attitude continues as long as the public at large will stand for it, and it is only when the force of opinion drives our administrators to the verge of drastic action that the rights of the great (or is it little?) third party receive the consideration which they justly should receive.

It is then with feelings of more than relief that we note the recent message of W. G. LEE, president of the Brotherhood of Railway Conductors, to his followers. Mr. LEE points out that there is an amount of damage to the public beyond which capital and labor must not go in their controversies; for, if they do, then the government must, to protect the very life of the nation, conscript their services and force them to fulfill their so necessary functions.

This fact has often been pointed out before. But coming at the time they do and backed by the force of his position, Mr. LEE'S words cannot fail to help drive home to both parties to industrial strife that their wishes alone cannot be the only guide to their actions, and that they must, if they would retain their present independence, consider the effect of these actions on the whole nation.

Report of Sixty-fourth Meeting, Sept. 4-8, 1922 — Council Meeting — Addresses at General Sessions— Abstracts of Technical Papers Presented at the Industrial, Physical and Inorganic, Fertilizer, Rubber, Sugar, Dye and Petroleum Divisions, and Educational, Historical, Cellulose and Leather Sections

EDITORIAL STAFF REPORT

THE Pittsburgh meeting was a good one. It was well attended, the registration running just over thirteen hundred. The provisions made by the Carnegie Institute of Technology were convenient and agreeable, and, as has been the case with every meeting held under the presidency of Dr. Smith, things have gone forward with a certain *cachet* of style, of grace, of dignity, that invariably reflected the captain-general of the hosts.

There were not many startling discoveries noted among the 457 papers presented. That of greatest general interest was probably Thomas Midgley's demonstration of his observations on accelerating and retarding catalysts in the combustion of petroleum hydrocarbons. The rest was, generally speaking, good average, with some peaks.

$25,000 Prize Announced at Council Meeting

The Council of the Society met on Monday afternoon at 3 o'clock in the ballroom of the William Penn Hotel, with President Edgar F. Smith in the chair. In opening the meeting he announced with great pleasure an annual prize of $25,000 donated by the Allied Chemical & Dye Corporation, to be given as a reward to the chemist in the United States who, in the opinion of a proper committee, shall have done most to advance the science of chemistry in the world. It is to be initiated in 1923, and to continue perpetually. The donors desired that a committee should be formed to consist of Dr. Smith and four others to be chosen by him. and this committee is to formulate rules and to organize the first jury of award. This jury is to consist of seven members, of whom five shall be appointed by Dr. Smith's committee and two shall be appointed by the donors; these two, however, are not of necessity to be men connected or associated with the corporation. The prize is available to workers in all fields of chemistry, and to include teaching as well as research.

It was resolved that a special committee draw an appropriate minute of the Society's acceptance and appreciation of this great gift.

Invitations were presented from the San Francisco and Milwaukee Sections to hold the fall meeting of 1923 respectively at San Francisco and Milwaukee, and on vote it was decided to accept the invitation of Milwaukee. It was resolved at the Birmingham meeting in April to hold the spring convention of April, 1923, at New Haven.

Approval was given to a plan for international editorial supervision and control of the *Journal of Physical Chemistry,* hitherto published by W. D. Bancroft, whereby the magazine will be published jointly by the Chemical Society (London) and the American Chemical Society. Neither organization is to be financially responsible for the publication of the magazine, the necessary expense being defrayed by an annual gift of $10,000 by the Chemical Foundation.

The editors of the Society's various journals and the secretary were re-elected. Prof. W. A. Noyes was re-elected editor of the scientific monographs, but Prof. John Johnston wrote that his other pressing duties compelled him to resign from the editorship of the technological monographs. A vote of thanks to Professor Johnston for his admirable work already done was passed and the advisory committee of the Society was delegated to appoint his successor.

The treasurer reported that, owing to reduced costs of paper and printing, he hoped, for the current year, to keep the expenditures of the Society within its income.

Research by Corporations

At the spring meeting in Birmingham action was taken on a motion of Dr. Harold Hibbert to make public the names of those firms and corporations that are supporting research or scholarships at various universities and colleges. Accordingly it was noted that the Grasselli Co., Fleischmann & Co., R. G. Carr of Chicago, the Monsanto Chemical Co., Antoine Chiris & Co., the General Bakelite Co., the Corning Glass Co., the Public Health Institute of Chicago, the du Pont company, the National Lime Association and many others were so engaged. Arrangements were made to obtain and publish a more complete list.

The subject of student members was discussed at some length without any definite action, except that it was recorded as the sense of the Council that the student rate be not increased. These pay $10 a year instead of $15. There are about 1,300 such members of the Society now, and the number of student applicants from Germany and Japan has materially increased of late.

After the meeting the members of the Council re-

paired to the Duquesne Club, where on invitation of the Pittsburgh Section they were guests at dinner. A number of prominent men of Pittsburgh who were not members of the Council were also present. At the close of the dinner short speeches were made by the toastmaster, James O. Handy, who is chairman of the Pittsburgh Section, and the following on whom he called: E. M. Herr, president of the Westinghouse Co., Charles H. Herty, E. R. Weidlein, E. E. Slosson, H. E. Howe, J. E. Teeple, Wilder D. Bancroft, Ellwood Hendrick, and finally as a kind of a cordial and friendly doxology, the president, Dr. Smith.

The General Meetings

The general meeting was called to order by J. O. Handy, chairman of the Pittsburgh Section. After a few introductory remarks, the customary felicitous addresses of welcome were made by S. H. Church, president of the Carnegie Institute, Dr. John G. Bowman, chancelor of the University of Pittsburgh, and Dr. Thomas S. Baker, acting president of the Carnegie Institute of Technology.

Mr. Handy then handed over the meeting to Dr. Edgar F. Smith, who with historical reminiscences and delightful allusions to ancient days, to protons and electrons and to Pittsburgh, the Imperial Daughter of the West (the speaker being first, last and always a Pennsylvanian) he introduced Dr. Charles L. Parsons, who told informally of his tour abroad this summer. He spoke of the International Conference at Lyons, which was its third annual meeting, of the seventy-five delegates present, and of the usefulness of the work carried on by the conference. There is full co-operation among the representatives of various nations. The hospitality dispensed was supreme. Of course the barrier of mixed languages sometimes brought out strange suggestions. Thus, at the formal banquet at the close of the sessions, the official interpreter translated from French into English, and had printed on the invitations, the memorandum as to evening dress in the following words: "Come in your night clothes."

Dr. Slosson's Speech

Following Dr. Parsons came Dr. E. E. Slosson of Washington. We are informed that Dr. Slosson's speech will be printed in full in the *Journal of Industrial and Engineering Chemistry*, and we commend it to our readers as an illuminating discourse on the status of the chemist today. Space forbids us to give more than a few disconnected quotations from his talk that are indicative of the whole.

For instance: "One hundred years ago chemistry was a poem. Today it is a tool." "All sciences earn their own living when they get old enough." "Some want to keep science as a sport, and many fear that the chemist may lose his amateur standing if he makes any money." "The chemist is the greatest coiner of words in the world. Nobody has had such a job since Adam named the animals." "The law of Malthus has been often refuted but never repealed." "Whenever any process is thoroughly understood it is found to belong within the field of physics or chemistry." "The new atom is composed mostly of vacuum with a few algebraic symbols." "The great problem of chemistry is that of combustion. Every tiny grass blade points the finger of scorn at the chemists and says: 'See how we do it!'" Apropos of the solemn dictum of the conferees at Washington to the effect that chemical warfare shall not be, it seemed to spring from the resolution by the home government that "the American Army shall never be sneezed at." "Mind is supposed to be immaterial; and yet it possesses inertia."

So much for his flashes. He concluded with an earnest plea for works on chemistry and chemical phenomena told in non-technical language.

Eliminating the "Knock" in the Automobile Engine

The paper of Thomas Midgley, Jr., and T. A. Boyd on "The Chemical Control of Gaseous Detonation, With Particular Reference to the Internal Combustion Engine," was one of broad appeal to the layman as well as to the chemist. It was sufficiently novel to interest the scientist and yet its utility and commercial significance were such as to attract the industrialist.

The work of the General Motors Research Corporation has had for its purpose the conservation and economic utilization of motor fuel and this particular study is an outgrowth of the problem of developing a more efficient type of internal combustion engine. Were it not for the phenomenon of "knocking," which is well known to every motorist, the simple change from a low- to a high-compression motor would offer a very effective economy in fuel consumption, for by increasing the compression ratio there is a more efficient utilization of the energy content of the fuel. What is but a commonplace annoyance in the ordinary automobile engine becomes so intensified in the high-compression motor that there is not only a serious loss of power but often an actual damage to the engine parts.

The Anti-Knock Compounds

Midgley's investigations have definitely shown that the chemical composition of the fuel is a controlling factor in causing and preventing knocking. An accidental discovery indicated that the addition of a small quantity of iodine to a gasoline fuel greatly lessened the tendency for a higher-pressure engine to knock. It took 2 years of research to discover a second compound having similar properties and about a year more to discover a third. These researches, however, served as a basis to indicate the general nature of the compounds that would accomplish the desired purpose. They also indicated compounds that have the opposite effect—namely, to increase the knocking.

Most of the compounds that affect detonation are derived from about fifteen elements, of which some of the more important are I, Br, O, N, Se, Te, Sn and Pb. Some typical compounds which have been used are iodine, bromine, oxygen, isopropyl nitrite, aniline, diethyl selenide, diethyl telluride, tetra-ethyl tin and tetra-ethyl lead. Bromine, oxygen and isopropyl nitrite are accelerators and the others are anti-knocking compounds. Tetra-ethyl lead, the best of the compounds now known for this purpose, has about 1,500 times the power of benzene in preventing detonation. Recent investigation has shown nickel carbonyl to be an excellent anti-knock and the indications are that the corresponding compound of platinum will probably be even better.

A splendid demonstration of the efficiency of one of these compounds was effected by the experimental explosion of a small quantity of acetylene in a glass apparatus at atmospheric pressure. The addition of but one part of diethyl selenide to 800 of acetylene was sufficient to reduce the loud crack of the acetylene-air explosion to an almost inaudible puff.

But what was perhaps the most striking exhibit was a high-pressure gas engine, completely installed on the lecture platform. By means of a special apparatus[1] connected to the engine cylinder it was possible to measure the detonating characteristics of the fuel. An electric light was so arranged in the circuit that as the knocking increased or decreased the lamp would burn brightly or dimly. When the engine was started and operated with ordinary gasoline a decided knock was distinctly audible throughout the hall. But true to predictions, a benzene fuel mixture did not cause knocking when used under exactly the same conditions. A gasoline fuel that knocked badly ceased immediately after very small amounts of the vapors of iodine or diethyl selenide were permitted to enter the breather of the motor. Similar demonstrations were made to show the efficiency of the other compounds, particularly of the tetra-ethyl lead mixture, which has already attained some commercial significance through its use in airplane and motor-boat engines.

These compounds, however, have not as yet been placed on the market, according to Mr. Midgley, for their full benefit cannot be derived until gas engines have been redesigned to operate at higher compression. The anti-knock compounds give little or no additional energy to a given volume of fuel, so that with the ordinary motor their use will not increase the mileage per gallon of fuel.

The most important aspect of these discoveries from the scientific viewpoint is the increased knowledge and new insight into the theory of catalysis.

Chemical Journalism

E. J. Crane, the editor of *Chemical Abstracts*, had chosen for the subject of his paper "The Journal Literature of Chemistry." He contrasted the exactness with which the scientist accumulates his data with the loose, indefinite and often careless language sometimes used for its presentation. Prof. Wilder D. Bancroft followed Mr. Crane's address with an informal but cleverly illustrated talk on structural colors in feathers. Those who will recall his paper at the Rochester meeting on "Blue Eyes and Blue Feathers" will appreciate the intensely interesting nature of the latest of the good doctor's hobbies.

[1] This is the so-called "bouncing-pin" method described by Midgley at the Birmingham meeting of the A.C.S. See *Chem. & Met. Eng.*, vol. 26, No. 16, p. 735, April 19, 1922, and *J. Ind. Eng. Chem.*, vol. 24, No. 7, pp. 587-93, July, 1922

Dr. Teeple on the Potash Industry

Dr. John E. Teeple was introduced as the man who made an industry, and this he promptly denied. Industries are never created by individuals but by co-operation of a group, each carrying out his function. Potash from Searles Lake was an industry moving slowly about 3 years ago, badly crippled by empirical work badly carried out. The process was sent back to the laboratory for repairs and a set of solubility curves and precipitation diagrams was developed by which it has been possible to increase yields and obtain consistent yields. An intelligent comprehensive investigation includes economic and sales study as well as chemical investigation. This latter should proceed in five steps: Research laboratory work, large-scale laboratory work, small-scale plant (experimental), single unit plant, full-size equipment, large-scale production. Dr. Teeple traced the potash industry through some of these steps and ended by discussing personnel—the difficulty of obtaining a chemically trained man with executive balance.

President's Address

The people of Pittsburgh were the specially invited guests at the session in Carnegie Music Hall on Wednesday evening, when President Smith delivered his address on "Our Science." In a way which is distinctly his own, Dr. Smith held the interest of a large and appreciative audience, who were treated with a brilliant review of the subject nearest our leader's heart—chemistry in America, its history and development.

Cellulose Section

Perhaps it was the stimulus due to the permanent establishment of the division as such that aroused the unusually enthusiastic discussions before the Cellulose Section. The attendance was large and representative, and the technical program was well balanced, including papers of interest to the pulp and paper, viscose and wood-distillation industries and a number of lively discussions on the all-important question of the structure of cellulose.

This latter debate took the form of a symposium on Wednesday afternoon. Dr. Louis Wise presented the views on the subject developed by the work of W. C. Russell and himself at Syracuse University, contending that the structure of cellulose from wood and cotton is the same and offering a hypothesis to explain the prop-

erties and products of cellulose which are generally construed as contrary to this view. E. C. Sherrard expressed opposing views based on the experience of the Forest Products Laboratory. The symposium was conducted by Harold Hibbert, chairman of the division, to whom must go much credit for the lively sessions which have characterized it.

Pulp and Paper Problems

One of the most interesting papers presented was a summary of the research problems in the pulp and paper industry by Edwin Sutermeister, which was read by Dr. Hibbert. The author emphasized the need of the closest co-operation between the research men and the industry if the most value is to be obtained from research. He named as the outstanding research problem the determination of the chemical constitution of cellulose, so that processes may be based on sound principles instead of guesses and empiricism. The nature of hydrocellulose and oxycellulose also needs more attention. More accurate methods of determination and separation should be devised and the extent of their harmful effect on the paper determined. Mr. Sutermeister then took up the problems of each step in paper manufacture by the sulphite and soda and sulphate processes, in bleaching, sizing, bating and coating special papers.

Another talk of interest to paper men was given by Harold S. Davis and described a new apparatus in which the humidity and temperature are easily controlled and in which the changes in dimensions of different samples of paper may be measured under varying conditions. This device is of practical importance in the manufacture of printing papers where the expansion or contraction between imprints may cause blurring.

The rosin sizing of paper was discussed by Alfred Tingle in two papers read by Dr. Hibbert. The reaction between aluminum sulphate and sodium resinate has been studied, and it has been found that when solutions of these compounds are mixed in stoichiometrical proportions, precipitation of alumina and rosin is complete. When a considerable excess of aluminum sulphate is used, the precipitate contains no resinate, but consists of free rosin acids with less than their equivalent of free alumina. At certain concentrations all the alumina remains in solution, rosin acids only being precipitated. Rosin acids precipitated in this way—Rosin B—are not in the same physical condition as when precipitated by mineral acids. Addition of mineral acids to this modification of rosin changes it to the more common form—Rosin A. Rosin B is probably spongy rosin very thoroughly interpenetrated with water. As commonly carried out, the reaction in the beater results in the deposition of rosin in the form of Rosin B on the fiber with less than its equivalent of alumina. Most or all of the remaining free alumina is precipitated as the result of subsequent dilution. That alumina plays no essential part in the sizing is shown by the fact that paper can be sized successfully under conditions such that no alumina can be deposited.

Adsorption of Salts by Cellulose

A most animated discussion was aroused by the symposium on the adsorption of salts by cellulose, which was opened by Wilder D. Bancroft. The significant phenomena in this connection were grouped by Dr. Bancroft under four classes of salts—miscellaneous salts, acids and bases, mordants and substantive dyes. H. B. Williams discussed the action of neutral salts on cellulose, particularly the peptization of cellulose by certain thiocyanates. H. N. Holmes expressed the opinion that the salts present in wood ash are absorbed in the plant and so retain their identity when the wood is ignited. An example of this is the presence of iodine in seaweed. Considerable discussion was aroused on the nature of the action of caustic soda on cotton and the general opinion of those present crystallized into the opinion that this action is one of adsorption rather than chemical combination.

No reports were ready from the committees on analytical methods and on standard cellulose. G. J. Esselen, Jr., reported for the viscosity committee, which submitted specifications for a standard falling sphere viscosimeter which were tentatively adopted and are to be tried out for a year in actual operation and if satisfactory, permanently adopted.

G. J. Esselen, Jr., was elected chairman of the division, with L. E. Wise vice-chairman and L. F. Hawley secretary.

Chemical Education Section

The Section of Chemical Education, of which President Smith is chairman and Prof. Neil E. Gordon is secretary, convened Wednesday morning in one of the largest lecture rooms of the Fine Arts Building, and there was standing room only. It is a very earnest group and those in attendance included eminent teachers who are the true links in the great chain of chemical advancement, old professors with a genius for teaching

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whose pupils fill outstanding chairs and occupy outstanding posts in science the world over, young professors with minds quick to sense ideas and to put them to use, and occasionally there are teachers who indicate their vain search for an easy formula for the practice of this most difficult of all the arts.

Pandemic Chemistry

"Pandemic Chemistry" was the first subject, presented by Prof. Wilder D. Bancroft, and it impressed us as the most important paper. He outlined a full course of lectures designed for students who are not majoring in this subject, and also for the general public. It is a course *about* rather than *of* chemistry. The first half-dozen lectures have to do with general principles and important processes and with illuminating experiments, after which he takes up various occupations and industries, and demonstrates the chemical basis of each. It might also serve as a school for the directors of corporations engaged in chemical industry, for goodness knows they need it! We are informed that Professor Johnston plans to establish a course along somewhat similar lines for the benefit of Yale students, while Professor Bancroft is hoping to be in a position to inaugurate such a course at Ithaca.

High School Chemistry in Correlation With College Chemistry

The second paper, by L. W. Mattern, had to do with high school chemistry and its correlation with college chemistry. It is desired that they shall not overlap and that they should be co-ordinated so as to provide for continuous advancement. Right here is where Professor Bancroft's pandemic chemistry is also indicated. The old question what to do with high school chemistry in college will not down. Some colleges require it; others don't. Most of them don't. Then, for freshman chemistry some divide the students into groups of "elementary" and "advanced," which is seldom satisfactory because many of the "advanced" students who have had high school training are not equipped for the advanced course. The discussion ran on for considerable time, and finally a committee of seven was resolved upon to present a report at the New Haven meeting in April. But it stands to reason that a boy who has been taught *about* chemistry in a secondary school will have a better sense of the subject and its scope and meaning than if he has had an inadequate course in the beginnings of chemistry without the vision.

In the afternoon of Wednesday a symposium was held on premedical, dental, pharmaceutical and agricultural chemistry teaching. Prof. J. C. Krantz, Jr., of Maryland State College gave a clear outline of the difficulties of teaching chemistry to pharmacists, and the way to meet them. If pure chemistry is taught, the students are likely to lose interest and study only in order to pass, whereas if the teaching is applied too closely to pharmacy they are disposed to bone up on business and to neglect the underlying theory. He finds that, by setting beacon lights along the way, indicating occasionally the applications of general principles to their prospective work, their interest may be retained and proper study encouraged. Prof. Charles W. Cuno concluded with a paper on "Qualitative Analysis for Engineering Students," and the question was raised whether it was worth while or not. The speaker proposed a course in the chemistry of materials as a substitute.

The Intelligence Test and Freshman Chemistry

Thursday morning Professors Jacob Cornog and Edward Bartow of the State University of Iowa gave a paper on "An Experience With the General Intelligence Test in Teaching Freshman Chemistry." There's no getting away from the correlation between high standing in these tests and high standing in chemistry courses. But in order to bring out the widest possible experience in the subject of mental and general intelligence tests in connection with teaching, it is to be made the subject of a symposium at the April meeting. Someone suggested that these tests helped to determine the competence of teachers, for if students of high standing in intelligence generally fail in their studies, the indication is that the teaching is defective.

Professor Silverman of the University of Pittsburgh reported a remarkable agreement between mental tests and the classification of students. The faculty is not informed of these records until the students have demonstrated themselves. He expressed the hope that some kind of examination along these lines might help to weed out the incompetents at the end of the first semester.

History of Chemistry Section

The Section on the History of Chemistry met in the Fine Arts Building on Thursday. This is Dr. Smith's ewe lamb, and Dr. C. A. Browne of New York and Prof. Lyman C. Newell of Boston University are his fellow shepherds. They are far from being alone in their enthusiasm for this distinguished and cultural side of chemistry, but they are the leaders. Being also active collectors, they have the goods. President Smith left the Educational Section to present two monographs here—viz., on James Curtiss Booth, Chemist, and the Bishop of Llandaff, with a handsome copperplate portrait, his works in four volumes, and an autograph letter.

Dr. C. A. Browne of New York told of John Winthrop, Jr., the first Governor of Connecticut, who was a close friend of Robert Boyle and a fellow member of the Royal Society. He was a chemist of parts, and practiced healing; although not as a physician. Professor McKee of Columbia showed some Dutch cartoons of Van't Hoff. Professor Newell showed letters of Sir Humphry Davy and diplomas signed by John Dalton, and Anton R. Rose showed an unpublished letter of Berzelius to the worthy burgomaster of his town in regard to silk culture.

Division of Fertilizer Chemistry

The Division of Fertilizer Chemistry met on Wednesday, with F. B. Carpenter as chairman and H. C. Moore as secretary.

Fertilizer Analysis Discussed

Many analytical methods for fertilizer testing were discussed. Special emphasis was laid upon the discussion of the Lindo-Gladding method for potash determination in mixed fertilizers as reported by F. B. Carpenter. This method is reported to give results from 0.25 to 0.4 per cent below correct under many conditions, with corresponding injustice to the manufacturer, who naturally desires credit for all of the available potash present. The recommendation of the author that acid be used in solution of the fertilizer to make free all of the available potash was by vote of the division referred to the referee of the Association of Official Agricultural Chemists. It is the hope of this division that the referee on potash may give further attention to this matter and recommend to the A.O.A.C. appropriate action on this erroneous procedure which has been continued for some years despite the fact that attention previously was called to it.

Variation in determination of insoluble phosphoric acid in acid phosphates was discussed by W. R. Austin, who emphasized the discrepancy caused in results from different laboratories by the failure to wash the precipitate thoroughly on the filter with water. In order that variation of commercial significance may not be incurred, it is recommended that a standard sample be included with every lot of tests run so that discrepancies resulting from variations in procedure or unsuspected changes in reagents may not go unnoticed.

E. W. Magruder reviewed methods for determining nitrogen in fertilizer and the discussion resulting made clear the wide variation in practice in commercial laboratories which doubtless is the cause of much of the commercial controversy over valuation of shipments.

Roughly quantitative methods for detection of ten groups of nitrogen-containing compounds were described by G. H. Buchanan of the American Cyanamid Co. The qualitative scheme presented is modeled after the ordinary schemes of inorganic analysis, provision being made for interference of the more common fertilizer constituents which may be present. The ten forms included in the scheme are: ammonia and its salts, cyanamide, hydrocyanic acid and its salts, dicyandiamide, guanidine and its salts, guanylurea and its salts, nitric acid and its salts, thiocyanic acid and its salts, thiourea, and urea.

Influence of Soil Colloids

The replacement of plant food adsorbed by the hydrogels of ferric and aluminum oxides was discussed by Flenner, Lichtenwalner and Gordon, who made careful physicochemical studies of the quantity of plant foods held by these materials. They conclude that the gels hold these materials by selective adsorption, as the material is not washed out, but is subject to replacement as would be expected from adsorbed material. The application of this to soil chemistry was discussed by Wiley and Gordon in another paper on "Can Plants Use Salts Adsorbed by Soil Colloids?" Plants were permitted to root and grow in soils artificially prepared with the maximum adsorption of the various salts used in plant nutrition work. The conclusion is reached that both potash and phosphate are readily available to the plant from the adsorbed form on the gels.

Concentrated Fertilizers Recommended

W. H. Ross, of the Bureau of Chemistry, presented a further discussion of the advantages and limitations of concentrated chemical fertilizers, showing the methods followed by the Bureau of Soils in the study of the problems of how to make a complete concentrated fertilizer from ammonium phosphate, potassium phosphate, ammonium nitrate and similar combinations in various proportions. The need of further research in this problem was emphasized. It was pointed out that the bureau desired not to replace those fertilizers now used but rather to facilitate wider use of fertilizers by development of the concentrated forms, permitting the use of new sources at lower cost and the transportation of materials at less expense to points distant from the source of the materials.

Fertilizers and Plant Composition

The relation of fertilization to plant composition was discussed by H. A. Noyes, who presented experimental data on extended tests in fertilizing grape crops. He showed that from the ratio of the composition from various parts of the plant to each other one can determine the optimum fertilizer use for the specific soil in question.

Utilization of Waste Products for Organic Nitrogen

The afternoon session was opened by a paper written by E. H. Armstrong and read by the secretary, entitled "Utilization of Waste Products for Organic Nitrogen." This paper had to do with the use of such materials as wool waste, leather, hair, shoddy and other nitrogenous materials as fertilizer base. Much of this material was imported from Europe formerly and now it is made here. It goes under the trade name of tankage and contains from 8 to 11 per cent ammonia. Considerable objection used to be made to the material because it smelled of leather waste and some legislation was enacted in various quarters against its use. There exists also a considerable loss in nitrogen content because of the method of treatment.

Special Symposium

The special symposium was begun with a paper by the secretary of the section, H. C. Moore, on the "Modern Trend of Chemical Control in the Fertilizer Industry." Mr. Moore outlined the achievements of chemical control in the three divisions of the fertilizer industry—namely, sulphuric acid, acid phosphate and commercial fertilizers. Some of the triumphs of chemical control in the commercial fertilizer department are not so well known. For example, it has been found possible to select suitable proportions of available material for fertilizer mixtures so that they will not become hard in the bags nor rot the material of which the bag is made.

J. E. Breckenridge followed with a discussion of "Modern Trend of Legislation in the Fertilizer Industry." A number of points were emphasized in this paper: First, the widespread legislation which has been necessary to tax the industry for inspection revenue. Second, legislation against inert nitrogen, and in this, as in most other legislation, the co-operation between the industry and the legislature has been complete and

hearty. Inert nitrogen is, of course, something which is of no earthly good to the consumer and shows up as nitrogen in some analyses. The industry has been alert always to co-operate with the legislature against fraudulent representation of nitrogen content. Specifications are required in most states for mixed fertilizer and in these the details of the specifications must be very complete and according to a prescribed form. Some states legislate that available nitrogen be 60 to 75 per cent soluble, but the legislation on this point is not consistent or even vital. The author pointed out that legislation against special materials was unnecessary, inasmuch as the general fertilizer legislation prohibited the use of any materials injurious to plants and therefore it would be quite foolish to legislate additionally against a specific kind of injurious substance. Mr. Breckenridge finally registered a slight protest against the grading of fertilizer as inferior, passed and good, since the method of analysis did not warrant the so-called "passed" classification, which has a range of only 5 per cent. Two other papers in the symposium were read by the secretary, the first by P. S. Gilchrist on the trend of modern fertilizer plant construction, and the other by E. H. Armstrong on modern trend in fertilizer plant operation.

Division of Sugar Chemistry

The Division of Sugar Chemistry was called to order by Dr. F. W. Zerban, the vice-chairman. The secretary, Frederick Bates, had arranged a thoroughly live program. H. Z. E. Perkins brought to the attention of the section the increasing importance of hydrogen-ion determination as a method of refinery control. Like every other business, chemistry has its fads, and now it is hydrogen-ion concentration. As applied to refinery control there are several points of great interest in the use of the method. The chief use of acidity control occurs early in the process of refining. After washing, the sugar goes through the main process of clarification, bone black decolorization and crystallization without material change in ionization. Many byproducts are formed that are unstable and ferment quickly. Furthermore, they are treated with desiccating agents to complete their destruction. The ionization at these various points is variable, being the resultant of several factors, natural and artificial. The main products of sugar refining are easily tested by means of color indicators, since they are light in color and easily crystallized. With a potentiometer the results are uncertain and sluggish. The byproducts of the main refining operation are dark colored and therefore cannot be tested by means of color reactions. They seem, moreover, to respond somewhat better to electrometric tests. The paper should be regarded as a preliminary report on the subject, but shows clearly that at certain points in the refining operation hydrogen-ion control will be extremely valuable.

Dr. Jackson Confirms His Position on the Clerget Constant

Dr. R. F. Jackson of the Bureau of Standards read a paper on "The Invertase Value of the Clerget Constant." The results given in the paper gave conclusive support to Dr. Jackson's position in this moot question, but inasmuch as there was no one to take the opposite side of the question the paper received none but favorable comment during the discussion.

A paper by F. W. Zerban ably confirmed the earlier work of Dr. Peters on the comparative color determination in cane sirup and molasses. The author showed conclusively that solutions must be filtered through an asbestos layer before carrying out color determinations. Filter paper is not satisfactory, solutions remaining cloudy. This is an extremely necessary correction in procedure.

W. D. Horne described the Vallez rotary filter press and J. F. Brewster brought to the attention of the meeting a vacuum pan for laboratory use.

A New Theory of Char Efficiency

Dr. C. E. Coates discussed activated vegetable chars in some detail and advanced a theory as to the probable reason for the greater decolorizing power of activated material. Activated chars are made from many raw materials, notably lampblack, rice hulls, pine and cypress waste, lignite, bagasse and cane waste. Many experiments show that good char can be made by heating the raw material from 800 to 950 deg. C. with sufficient air to cause considerable surface combustion. A series of analytical results were presented showing that the decolorizing power of a given char varies inversely with its hydrocarbon content. This is an extremely important advance and will lead us a long way toward a proper understanding of the best method for preparing good char. Dr. Coates outlined a simple method of obtaining a cheap char from cane trash.

Inasmuch as it was shown that the hydrocarbon content of char and the decolorizing power have a quantitative and inverse relationship, we are led to a theory as to the cause of greater or less decolorizing power in char. It can be stated that absorption from solution is a selective property of carbon dependent quantitatively on free carbon surface. This surface is wholly or partly covered by hydrocarbon film in chars made without access of air and to some extent by a layer of ash in all chars. The removal of the film by selective oxidation with air and of the ash by means of acid or alkali treatment will expose more carbon surface and increase decolorizing power.

Division of Physical and Inorganic Chemistry

Although apparently we are still distant from a general theory of catalysis, yet there are gradually being accumulated series of experimental results which will be invaluable in the formulation of such a theory when the time comes. That the radiation hypothesis contains elements of truth all who have studied the matter carefully must admit, but whether it is sufficiently general in its application to be regarded as even a first approximation is a matter about which there is still some doubt. Dr. Farrington Daniels after extensive studies of the decomposition of nitrogen pentoxide is inclined to believe that it should be considered in the same way as Berthelot's rule of maximum work, while Dr. Hugh S. Taylor thinks that it is scarcely worthy of any regard. Most people who have studied the matter carefully are waiting for more experimental evidence before either rejecting or accepting this very ingenious hypothesis.

In this connection some studies by Dr. Rodebush of the University of Illinois are not without interest. By the use of statistical mechanics he has succeeded in deriving an equation similar to that developed empirically by Arrhenius for the rate of reaction as a function of temperature. This, combined with the quantum theory, gives a physical basis for Dushman"s equation. By the use of a constant characteristic of

every molecule the validity of the equation is extended so that only the most accurate of experimental data had been found to obey the law.

The study of the hydrolysis of mustard gas on cloth is important and it has been found by R. E. Wilson and E. W. Fuller that in a 2 per cent sodium carbonate solution 3 per cent of sulphonated corn oil was remarkably effective in promoting this reaction. The acid formed by the hydrolysis coagulates the oil into which the mustard gas dissolves and then on stirring the oil drops are carried up into the solution of alkali, where they are again peptized, leaving the mustard gas to be reacted upon.

Catalysts and Catalysis

Taylor and his students, working on various reactions involving contact catalysis, have observed numerous interesting phenomena. Carbon monoxide reacts very differently with copper oxide than does hydrogen. In the reduction by either substance the rate of reaction is slow until a red spot of copper is set free. As the red spot grows in size the reaction is accelerated, suggesting autocatalysis. The same thing also holds for the decomposition of a large number of substances such as calcium carbonate, hydrated salts, silver oxide, etc. R. E. Wilson in the discussion checked this up with the phase rule where the presence of the two phases in intimate contact is required for a truly stable equilibrium. At the point of contact there are different electronic configurations which seem to be important in the mechanism of this reaction. This is also probably part of the explanation of promoter action.

The use of kieselguhr as a support for the important catalyst nickel has been very effective. Hydrogen is adsorbed on the supported material to a much greater extent than on the unsupported. The temperature at which the unsupported material has been reduced is very important; for instance, nickel hydroxide unsupported when reduced at 300 deg. is much more effective than when reduced at 500 deg., but when the material is spread on kieselguhr the temperature of reduction has apparently very little effect. The amount of hydrogen adsorbed by a given sample of nickel varies with the pressure for very low pressure, but soon reaches a maximum depending on the temperature. As much hydrogen is adsorbed at 25 mm. as at 750 mm. at room temperature, according to A. W. Gauger and H. S. Taylor.

BYPRODUCT BUILDING AT CLAIRTON WORKS

A study of the rôle of hydrogen ion in the catalysis has been made by H. W. Close under the direction of H. S. Taylor, and it has been found that the unhydrated hydrogen ion was the effective agent. On dissolving a lactone in ether with 0.1 mol of hydrogen chloride the hydrolysis increased with the addition of water until with an ether solution saturated with water the rate was several hundred times as great as with a water solution saturated with ether, although the electrical conductivity of the latter was the greater. In the ether solution the water aided ionization. There was enough water to produce ionization but not much hydration.

Colloids

E. C. H. Davies read an interesting paper on the effect of gravity, which was small, and of light, which might be great, on the formation of Liesegang bands. When water passes through iron pipes, due to corrosion small amounts of ferric hydroxide hydrosol remain in the water. Filtration through sand will not remove all of the iron. Sulphates and phosphates, added in sufficiently small amounts to be harmless to the water, are not effective in removing this colloid, but with the use of about 0.06 per cent hydroxyl ion the best removal of iron is obtained. Larger amounts repeptize the hydrosol. A convenient method is simply to filter the water through magnesium oxide and then the coagulated iron will deposit on iron sheets. These interesting facts have been obtained by Robert E. Wilson and P. S. Clarke of the M.I.T. Research Laboratory of Applied Chemistry.

A very interesting new and valuable emulsifying agent was described by Harry N. Holmes and D. H. Cameron. *Gum dammar*—be sure to accent the last syllable—is insoluble in water but soluble in many other liquids, aiding in the formation of emulsions of the water-in-oil type where water is the dispersed phase. Such emulsions are more stable and may be made even richer in water than by the use of calcium soaps. By dissolving the gum in a little benzene and mixing into vaseline or heavy oil, salve-like emulsions can be obtained with water. Printer's and lithographer's inks, paints, varnishes and greases can often be greatly cheapened in this way and the properties of the products are frequently better than those of the water-free substance. The use of this emulsifying agent has already been patented.[1]

To obtain a dilute silica gel quickly Lloyd Reyerson and W. T. Morin add ammonia cautiously to the acidified water glass till barely neutral to litmus. A solid gel of half a per cent of SiO_2 may be obtained in this way, while a 2 per cent gel sets almost instantly.

Miscellaneous Papers

At very low temperatures hydrogen chloride and nitric oxide form an intensely purple liquid with a conductivity of 10^{-3} at 130 deg. K., according to Rodebush and Yntema. When the transference numbers of mixtures of sodium and potassium chloride were determined by Schneider and Braley, it was found that sodium had a net transference of zero, suggesting part of the sodium going into a complex anion. By the use of electrometric titrations simultaneously Conant and Fieser and LaMer and Lillian Baker have studied the potentials and energy relations in the reduction of numerous quinones. With a glass-stopped siphon it is possible to obtain reproducible results. Mack and Villars have found that

[1] U. S. Pat. 1,410,012, March 21, 1922.

urease not only aids in the formation of urea but also decomposes it till an equilibrium is reached. R. W. Ryan is studying the tracks of alpha particles through gases under the direction of W. D. Harkins. Silverman and Saunders have studied the formation of ozone from oxygen inclosed in a Berthelot tube.

Anderegg and Bowers describe a new form of discharge obtained by creepage over the surface of various dielectric materials which may have notable influence on the results partly due to the change in the nature of the discharge and partly to be ascribed to the catalytic action at the surfaces. Conclusions are drawn by Anderegg and McEachron after several years of work that the complicating effects of the container walls on chemical reactions in the corona may be more or less serious depending upon conditions and may in some cases cause a complete change in the nature and products of the reaction.

In the study of iron corrosion by water it seemed desirable to R. E. Wilson and D. H. Cameron to study the hydrogen-ion concentrations of buffer solutions at elevated temperatures. This was accomplished after some experimental difficulties with the hydrogen electrode, and the results indicate that there is a slight tendency to shift toward the neutral point. Indicators were found to have similar small shifts of the order of one- or two-tenths of a p_H, so that it may be stated that buffer solutions and indicators are fairly constant up to the boiling point of water.

Leather Section

The meeting of the Leather Section opened with a contribution from Dr. Edmund Stiasny, director of the Institute of Leather Chemistry at the University of Darmstadt, dealing with modern problems in leather chemistry, particularly the chemical nature of collagen, the mechanism of bating and the astringency of vegetable tannins.

Mechanism of Unhairing

In a series of experiments by John Arthur Wilson and Guido Daub, the effects of unhairing by sweating, lime liquors and caustic sulphide liquors were followed microscopically. The action of the sweating process was found to be very similar to that obtained when using an excess of lime with 0.7 grain Na_2S per liter. In both case the cells of the Malpighian layer of the epidermis first separate from the derma and from each other and then liquefy, so that the rest of the epidermis, the hair and the sebaceous and sudoriferous glands are completely separated from the derma and can then be removed mechanically. A decidedly different action was noted with the straight sulphide process using a 2 per cent solution of Na_2S. The protruding portions of the hair and the corneous layer of the epidermis were attacked rapidly, almost complete removal of these being effected before the alkaline solution has penetrated to the depths of the hair bulbs. Consequently when this method is employed the hair bulbs are usually found intact in the finished leather.

Pancreatin as an Unhairing Agent

Some of the fundamental factors in the enzyme process of unhairing were determined by John Arthur Wilson and Albert F. Gallun, Jr. When calfskin is swollen in dilute caustic soda, neutralized with sodium bicarbonate and then put into a suitable solution of pancreatin at 25 deg. C. exposed to air, the hair is completely loosened in 24 hours, but the action is not due to the enzyme, since it is checked by covering the solutions with a layer of toluene. At 40 deg. a solution of pancreatin fails to cause a loosening of the hair of fresh skin (not previously swollen) because the corneous layer of the epidermis is impermeable to the enzyme layer below. When a skin has previously been swollen by acid or alkali, and the corneous layer rendered softer and more permeable, a solution of pancreatin at 40 deg., even under toluene, will not only destroy the Malpighian layer of the epidermis and loosen the hair but it will also dissolve the elastin fibers of the skin, thus effecting both unhairing and bating in a single bath.

Plumping

Two other papers by Wilson and Gallun dealt with the subject of plumping. When the variation in degree of plumping of calfskin was plotted against hydrogen-ion concentration expressed as p_H, two points of minimum plumping were found, one at 5.1, the other at 7.6. From available data, it would seem that these two points represent different forms of skin protein, one stable only in acid solution and the other in alkaline solution.

In the course of this work a convenient method of measuring the degree of plumping was developed. The fact that the tanner tests the skins by pinching, since the resistance of the skin to compression is a measure of the plumping, suggested the use of a thickness gage similar to those used for rubber. The thickness of a given portion of skin is read off on the gage after a fixed time and the ratio of this result to that obtained on the same portion under standard conditions at a p_H of 8 is taken as the degree of plumping. As the instrument is easy to handle, measurements may be made right in the tannery.

Fixation of Tannin by Hide Substance

The fixation of tannin by hide substance was considered from many angles. Wilson and Kern showed the effect of hydrogen-ion concentration upon the analysis of vegetable tanning materials.

The per cent of tannin found by the A.L.C.A. official method increases with p_H value to a maximum at 8 and then decreases rapidly toward zero. On the other hand, p_H value appears to have no effect upon the determination by the Wilson-Kern method over the range 3.6 to 7.3, but the rate of tanning of hide powder decreases rapidly with increasing p_H value above 7. The rate of filtration of tan liquors is markedly affected by change of p_H value, which may be attributed to changing degrees of dispersion of some of the solid matter. The addition of lime to tan liquors causes a precipitation of tannin, but only at p_H values above 7.2.

Wilson and Kern also studied the stability of the hide-tannin compound at different p_H values and found that leather is resistant to washing in neutral or acid solutions, but is broken up into protein and tannin by alkaline solutions. The decomposition begins at $p_H = 7.7$ and proceeds at an increasing rate as the p_H value is raised above this value.

Continuing earlier work on quebracho and gambier, Miss Margeret W. Kelly determined the concentration curves for hemlock, larch, oak and wattle extracts. Using the modified Wilson-Kern method for determining the amount of tannin fixed, all these extracts gave the quebracho type of curve. Miss Kelly also studied the effect of hydrogen-ion and time factors. Fixation is possible on both acid and alkaline sides, the curves showing maxima at p_H values of about 2 and 8, with a

minimum for low concentrations at about 5. With increased time, the minimum at 5 and the maximum at 8 tend to disappear.

Data on the influence of neutral salts were presented by Arthur W. Thomas and Miss Kelly. The results obtained were shown to be due to two effects proceeding simultaneously but independent of each other—the decrease in the dispersion of the tannin with added salt and the increased activity of the tannin due to the hydration of the added salts. In the case of NaCl, the second factor predominates until a concentration of 2 M is reached, beyond which the influence of the first factor is felt. The work is to be continued using $CaCl_2$ and non-electrolyte such as sugar.

Further work by the same authors indicates that there is a difference between tanning fixation on one side of the iso-electric point and that on the other. Between 20 and 25 per cent of the tannin fixed by gelatine at p_H 3 and 5 can be removed by extracting the precipitate with water, whereas practically none can be extracted from the precipitate obtained on the alkaline side. In discussion, Mr. Wilson pointed out that if the character of the leather differs on either side of p_H 5, which is the concentration usually found after bating, then this point is a most critical one.

Dr. Thomas and Alexander Frieden found that the optimum mutual precipitation of gelatine and gallotannic acid took place at p_H 4.4 to 4.6. The optimum points for vegetable tannins were found to vary from 3.5 for gambier and oak to 4.0 for larch, hemlock and quebracho and 4.5 for wattle. At these points the sensitivity of the gelatine: salt test is greatly increased.

Electrophoresis experiments by Dr. Thomas and Stuart B. Foster demonstrated that vegetable tannins are amphoteric, the change in the charge of the electrical particles occurring between p_H 2 and 2.5.

Chromic Solutions

On the basis of electrophoresis experiments Frank L. Seymour-Jones concludes that a negatively charged complex may not be present in certain liquors which do tan. Further consideration of the complex nature of chrome liquors was given by the same author in a paper reviewing the disputed question as to whether the liquor contains colloidally dispersed chromium oxide or basic salts.

Other Papers

Charles S. Hollander described experiments comparing the action of artificial bates with dog manure as used in goatskin puers and with chicken manure as used for calfskin.

Color measurement of vegetable tan liquors was considered by R. O. Phillips and L. R. Brown.

Since free sulphuric acid is not the only objectionable material in synthetic tans, Dr. S. Kohn made a study of the solvent action of various syntans on tanned hide powder. Even at the same p_H the action of different syntans varied considerably.

Gelatine Symposium

Dr. Jacques Loeb's paper on "The Interpretation of the Influence of Acid on the Osmotic Pressure of Protein Solutions" was read by Dr. C. E. Davis.

When osmotic equilibrium is established between a solution of casein and hydrochloric acid inclosed in a collodion bag and an outside aqueous solution free from protein, the hydrogen-ion concentration is always greater in the outside solution than in the casein solution. The observed osmotic pressure is accounted for quantitatively by the difference in concentration of hydrochloric acid in the two solutions, without taking into consideration any possible osmotic pressure of the casein itself. The observed potential difference between the two solutions in millivolts always has the numerical value equal to 59 times the difference in p_H value between the two solutions at 24 deg., proving that the inequality in p_H value is determined by Donnan's equation for membrane equilibria.

Three papers on the program originated in the research laboratories of the Eastman Kodak Co. Dr. S. E. Sheppard presented a very comprehensive study of the characteristics of the plunger type of jelly strength tester and showed how the results obtained with this type could be referred to the twist type as standard.

In a second paper the anisotropic swelling of thin sheets of gelatine was discussed. The swelling was found to be a function of the type of gelatine used. S. S. Sweet worked with Dr. Sheppard in developing the data upon which these two papers were based.

F. A. Elliott read a paper in which Dr. Sheppard and Miss A. Benedict were co-authors, dealing with the preparation of gelatine free from ash and hydrolytic decomposition products. A 5 per cent gelatine solution is electrolyzed for 2 to 3 weeks, then poured into an equal volume of purified acetone. The precipitate is removed, heated to 60-70 deg. C. and made up to a 10 per cent solution, which is cooled on a chill table and dried. The product contains 0.01 to 0.03 per cent ash.

A paper by E. Bateman and G. G. Town was read by Mr. Town. Three series of studies relating to the moisture content of glue were made. In the first, curves were obtained showing the relation between humidity and moisture content, and an exponential equation was developed which holds better than the adsorption isotherm. Second, the tensile strength was shown to drop rapidly as the moisture increased, falling below the value for wood at about 30 per cent moisture. Third, mold growth was found to require 32 per cent or more of moisture, but as the strength is very low in this region, this effect does not become a factor unless the glued material is stored without strain at high humidity.

In conclusion, Wilson and Kern called attention to a curve giving two points of minimum swelling of gelatine, at p_H 4.7 and 7.7. The second minimum is probably the iso-electric point of the sol form of gelatine while the first is that of the gel form.

Election of Officers

Officers for the ensuing year were elected as follows: Chairman, John Arthur Wilson; vice-chairman, Charles S. Hollander; secretary, Arthur W. Thomas; executive committee to consist of officers and C. R. McKee and F. P. Veitch.

Section of Gas and Fuel Chemistry

Initial sessions of the Section of Gas and Fuel Chemistry were held under the chairmanship of Dr. A. C. Fieldner of the Bureau of Mines. The first meeting was given over to a symposium on combustion, at which Prof. R. T. Haslam, W. K. Lewis and others reviewed the physicochemical fundamentals of this subject. Of the fifteen general papers presented at the later sessions, five related to such basic considerations as the constitution of coal and its relation to carbonization and combustion. Technical abstracts of these and other important papers given before this section will be published in a subsequent issue of this magazine.

Division of Petroleum Chemistry

Each successive meeting of the new Petroleum Division is marked by an increasing attendance and a very evident desire to incorporate within this organization all of the varied interests of the petroleum chemist. The change from a section to a permanent division of the Society had been authorized at Birmingham, subject to final approval by the Council of a set of bylaws to be submitted. Unfortunately, a slight indefiniteness in outlining the scope of the division made it necessary for the Council to return these bylaws to the division for amendment and the Council's approval was postponed until its next meeting. In spite of this handicap, however, the work of formulating a business policy, electing officers, etc., proceeded without other delay.

The proposed constitution and bylaws were read by the secretary, Dr. W. A. Gruse, and each section was approved by the meeting. The only change was made in the opening paragraph, which was so modified as to show clearly that the Division of Petroleum Chemistry did not consider within its scope the preparation of standard testing methods and specifications—work which is now adequately handled by A.S.T.M. Committee D-2 and similar agencies.

The following officers were nominated and elected to serve until the meeting in September, 1923: T. G. Delbridge, chairman; Ralph R. Mathews, vice-chairman, and W. A. Gruse, secretary. The executive committee consists, in addition to these officers, of W. F. Faragher and E. W. Dean.

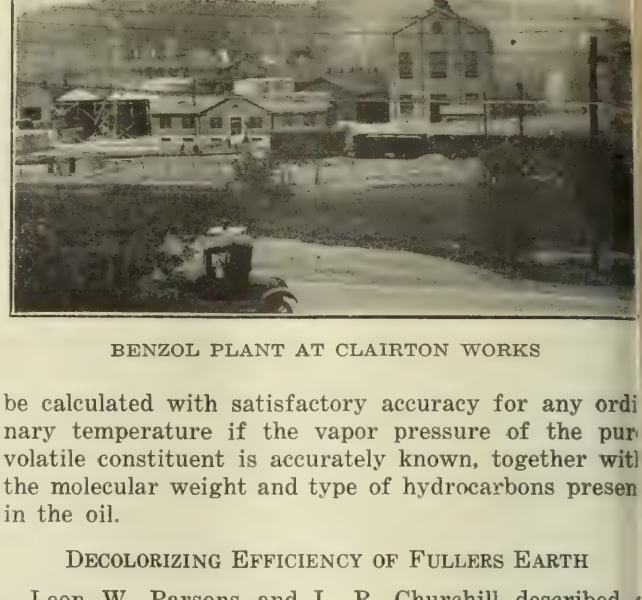
Vapor Pressure and Volatility Measurements

The first two papers to be presented were by R. E. Wilson and his co-workers in the Research Laboratory of Applied Chemistry, Massachusetts Institute of Technology. D. P. Barnard, 4th, discussed the continuation of the work of the Co-operative Fuel Research Program in measuring the effective volatility of a dozen or more motor fuels. Distillation curves were shown for various straight runs and special blends. From the data presented it is possible to draw certain generalizations as to the effect of the shape of these curves on the effective volatility of the fuel in so far as it affects the completeness of vaporization and proper distribution in the manifold.

It was pointed out in the second paper, by Wilson and Wylde, that a knowledge of the vapor pressure of volatile solvents, such as benzene and hexane, dissolved in various types of relatively non-volatile oils is of commercial importance in a considerable number of applications. Of these, the three most important are (*a*) the dilution of crank-case oils with fuels in internal combustion engines; (*b*) the complete renewal of volatile solvents from oils and fats obtained by the solvent extraction processes; and (*c*) the recovery of solvents by scrubbing with cold absorbent oils, as in benzene recovery from coal gas.

The work described in this paper makes it possible to calculate approximate figures for three general types of volatile hydrocarbons—paraffine, naphthene and aromatic—dissolved in most ordinary types of oil.

Molecular weights were determined on all of the oils used, and the amount of vapor pressure lowering for different combinations was compared with the theoretical as predicted by Raoult's law. It appears that the amount of lowering produced by different types of combinations is fairly definitely predictable and that the results for any combination met with in practice can be calculated with satisfactory accuracy for any ordinary temperature if the vapor pressure of the pure volatile constituent is accurately known, together with the molecular weight and type of hydrocarbons present in the oil.



BENZOL PLANT AT CLAIRTON WORKS

Decolorizing Efficiency of Fullers Earth

Leon W. Parsons and L. R. Churchill described a rapid test for determining the decolorizing efficiency of fullers earth. This is based on the vigorous reaction of this earth with pinene to form polymerized products with the development of a very large amount of heat. This temperature rise serves as a convenient and practical measure of the efficiency of various clays as decolorizing agents, provided the reaction is properly controlled. This paper discussed the mechanism of the reaction, the materials used and the application of the test for laboratory and plant use.

Professor Parsons also reported on the progress of his work with Brian Mead in studying the effect of certain properties of emulsifying agents on the stability of oil-water emulsions. It will be recalled that Nujol was used in building up synthetic systems comparable with commercial mineral oil emulsions. It has been found, among other things, that several common emulsifying agents give abnormal results with regard to the type of emulsions produced. This observation has an important bearing on the mechanism of the behavior of soaps and finely divided solids as emulsifying agents.

Engine and Road Tests

The engine experiments reported by Dr. Carl O. Johns of the Standard Oil Co. of N. J. were an attempt to answer the question: Do higher sulphur fuels cause trouble in Diesel motors? Several fuels were tested to ascertain the effect of both free and organic sulphur. This included high-sulphur Mexican crude and gas oils and also a polymerized byproduct from alcohol manufacture containing about 19 per cent of combined sulphur. These were mixed in proportion to give a sulphur content of 10 per cent in the fuel mixture. The Diesel engine was run for about 400 hours at a compression of 500 lb. Another run was made with a kerosene containing 0.85 per cent of free sulphur in solution. Frequent examinations of the dismantled engine disclosed no evidences of corrosion nor was the copper tubing affected appreciably. Some trouble was encountered by excessive carbon formation around the exhaust valve.

Jones and Fieldner, in a paper from the Bureau of Mines, showed the amount of gasoline saved on government trucks after the carburetors had been adjusted by exhaust gas analysis. The adjustments made by

the use of a portable CO_2 indicator gave an increase of over 20 per cent in mileage for the first month after testing and 16 per cent increase for the second month. The average for several thousand analyses from 101 cars showed that after adjustment the completeness of combustion amounted to about 70 per cent.

Prof. Ralph H. McKee exhibited a waxy distillate obtained as an intermediate product in the vacuum distillation of certain oil shales. Usual tests, such as solution in 66 deg. Bé. sulphuric acid, show this product to be highly unsaturated—sometimes as much as 100 per cent. Distillation at atmospheric pressure yields a petroleum containing 48 per cent of saturated hydrocarbons and redistillation brings about additional cracking with a further increase in saturation. In other words, this behavior is apparently the reverse of ordinary cracking, which proceeds with an increase of unsaturated constituents. In the discussion following this paper it was generally conceded by those present that the H_2SO_4 test was without value and that the term unsaturation should not be used, at least without some qualifications.

Refining Petroleum With Hypochlorite

One of the most important papers from an industrial viewpoint was the description by A. E. Dunstan and B. T. Brooks of the use of hypochlorite solutions for refining petroleum oils. This treatment, although often proposed, has usually been abandoned because of the failure to remove chlorine from the finished products. The Anglo-Persian Oil Co., however, has perfected the process and has now entirely replaced the sulphuric acid-caustic soda method in its Persian refineries. The claim is made that gasoline and kerosene are being refined by hypochlorite solutions with losses of less than 0.5 per cent. Malodorous compounds, including sulphur derivatives, are removed and the treated oil is said to be of a very superior quality. The process is carried out in the usual form of treating apparatus and the refining costs are markedly low, especially when polymerization and other losses incidental to acid refining are included in the comparison.

Report of Research Committee

Dr. W. F. Faragher, as chairman of the committee on research appointed at the Birmingham meeting, reported that a study had been made of the comprehensive list of research problems outlined by Dr. Van H. Manning, director of research, American Petroleum Institute, and that the committee had selected a smaller list of problems as the basis for an immediate research program. The following are of the type adapted to co-operative research and are of important and immediate utility to the petroleum industry:

1. Thorough scientific investigation of fractionating columns.
2. Preparation of rational specifications for petroleum products based upon the results of actual research work. More rational volatility specifications for gasoline and tests for the "oiliness" property of lubricants.
3. Investigation as to the actual need of highly refining gasoline for motor fuel; is it necessary to remove bad smelling sulphur compounds completely in order to obtain efficient service from gasoline? Will these compounds injure the engine?
4. A study of the fundamental causes of carbon formation in cylinders; elimination of polymerized products in cylinders; study effect of additions of peroxides, naphthalene, picric acid, phenanthrene, pyrene, picene, cyclohexanol, phenol, etc.
5. Thorough study of lubrication from a colloid chemical standpoint.
6. The chemistry of petroleum hydrocarbons, particularly of the higher homologs.
7. The chemistry of the sulphur, nitrogen and oxygen compounds in petroleum.
8. The chemistry of sulphuric acid refining of oils.
9. The causes and mechanism of color changes in oils.

In a discussion of the committee's report, which was participated in by Dr. Manning and the chief chemists of a number of representative refining companies, it was generally agreed that existing facilities should be utilized in carrying out this research program, but that it should be financed in such a way that its results become the property of the entire petroleum industry.

Lubrication Symposium

A feature of the division's sessions was the symposium on lubrication from the chemist's viewpoint. Prof. C. F. Mabery of the Case School of Applied Science reported the results of his classical study into the fundamentals of petroleum composition, particularly in the fractions that cannot be distilled without decomposition. A second paper on the viscosity temperature curves of fractions of typical American crude oils was presented by Lane and Dean of the Bureau of Mines. The difficulty in interpreting viscosity data at one temperature in terms of viscosity at any other temperature has led to this detailed study over a wide range of temperatures and also to formulating these data in an interpretable form. Dr. Faragher discussed a study made by himself and Ronald Reamer on the frictional coefficients obtained with a Kingsbury oil-testing machine. The symposium was closed with an interesting review by Dr. R. E. Wilson of his published work on the mechanism of partial lubrication.[1]

Division of Industrial and Engineering Chemistry

The Division of Industrial and Engineering Chemistry was called together by the chairman, W. K. Lewis, who at once introduced Dr. L. W. Parsons as chairman of the automatic process control symposium. The first paper, by J. A. Doyle, on the control of industrial heating processes, pointed out that temperature control was only one of the factors in controlling heat, the other was the time factor. In producing a material of given quality and cost, time enters into it fundamentally. Such factors as the surface exposed, the mass, the conductivity rate, the method of applying heat, all affect the time factor. It was well illustrated by a series of diagrams showing where in furnaces of given design the so-called "cold zone" occurs. It was very easy to understand why one furnace would produce material of a different quality than another furnace by simply studying the difference in size and position of this cold zone. The distinct advantage of a continuous process was pointed out in that practically all of the material is subjected to the same kind of conditions and thus quality control is much more rigid and reliable. With batch processes the position in the furnace makes a great deal of difference in the material produced; in other words, material from one part of the furnace will be quite different from the material from another part.

Guy B. Taylor presented a paper on automatic volumetric analysis with particular reference to a carbon monoxide recorder. Dr. A. T. Larson and Dr. Karrer each described some of the control devices employed in high-pressure testing of ammonia catalysts. A machine for automatically controlling the pressure on the catalyst bomb was described in detail and charts for

[1] See *J. Soc. Automotive Eng.*, vol. 11, Nos. 1 and 2, July and August, 1922, and *J. Ind. Eng. Chem.*, vol. 14, No. 8, August, 1922.

its performance were given. It indicated a remarkable performance over a period of days, the pressure holding perfectly constant under operating conditions. The principle of the control was a valve with a core held in place by a stiff spring automatically regulated by means of an electric control. Mr. Karrer's apparatus was a glass pressure gage consisting essentially of a glass diaphragm blown on the end of a tube and automatically recording pressure by means of a bent platinum wire contact. The device must have been quite difficult to make, although the author was modest to the point of disparagement.

The symposium was continued with a survey of the possibility of the recovery of gasoline from natural gas by J. B. Garner. He noted that gasoline content was on the increase in natural gas, it having risen quite appreciably in the last 3 or 4 years. The ideal conditions for absorbing gasoline are under pressure by means of an oil solvent. There seems to be no efficiency at low pressures, and refrigeration is commercially an impossibility. An absorbing temperature of 50 deg. F. for salable gasoline was prescribed. Specifications for the absorbing oil were outlined. It was developed that a paraffine base oil rather than an asphalt base oil gave the best absorbent, and curiously enough a low rate of circulation with high saturation was preferred to a high rate of circulation and low saturation. During the course of a month six volumes of oil were found to be necessary to absorb one volume of gasoline. In the recovery of the gasoline from the oil the gases are first removed, then the oil passes to heat exchangers and finally to gasoline still. There seems to be, in the author's opinion, a fertile field for work along these lines.

The Plastometer Described

Professor Bingham then read a paper on the plastometer as an instrument for process control. He pointed out that many other things were necessary besides chemical control and instanced colloids as an example. For example, what is the difference between a viscous system and a plastic material? Or to put it another way, is the viscosity of a colloidal solution a simple function of the shearing stress? Recent work has shown that this is not the case and that, for example, in a certain paint a change of viscosity of 10 per cent was evident when the shearing stress was trebled. No one class of colloids has this property peculiarly to itself nor is it necessary to have high concentration of the dispersed phase. By the use of the plastometer we can take a material such as paint, which is definitely plastic, and add successive increments of vehicle to the material, measuring each dilution in the plastometer. We then seem to have two well-defined properties, yield value and mobility. Neither of these is quite a linear function of the concentration of solids in the plastic material. One interesting point about the yield value curve is that it approaches a zero value and looks as though we would obtain a concentration of solids which would give zero yield value. This point would be the point at which the material changes from a viscous liquid to a plastic solid. As a matter of fact, the curve bends rapidly toward the zero concentration of solids. A collodial solution will have a definite yield value, whereas a true solution will not. Again, the plastometer offers a method of distinguishing between types of colloids. For example, some colloids exhibit a definite change of properties at a given temperature quite analogous to the melting point of a solid. This is the transition temperature from a plastic solid to a true liquid. Such colloids as glue and nitrocellulose exhibit this property.

Several other papers of interest were presented at the symposium, notably one by Herbert A. Clark on some phases of automatic process control. In it he describes an automatic temperature control with a time control in addition. The temperature was controlled by means of an air diaphragm valve system and over a given time by means of a cam disk on a clock mechanism. Thus a definite temperature can be maintained inside of a kettle or reaction apparatus by controlling the steam input, and this cycle can be repeated at given intervals automatically.

Cost Accounting an Aid in Process Control

The symposium closed with a paper on cost accounting by Charles Wadsworth, 3rd, of *Chemical & Metallurgical Engineering*. The author made a special plea that chemists take up this subject seriously, as executive positions demand a knowledge of it. After discussing the mechanism by which expenditures become cost accounts with the aid of diagrams, the control of production, purchasing and sales by means of costs was outlined. The symposium was then adjourned and the Industrial Division joined with the Gas and Fuel Section in the afternoon at its combustion symposium.

Corrosion of Iron by Natural Waters

The presentation of papers was resumed on Thursday morning, some of the most notable of which we have been able to abstract. Prof. R. E. Wilson presented two papers, one on the removal of small amounts of carbon monoxide from gas streams by passing over granular soda lime, and the second a more notable one on "The Mechanism of the Corrosion of Iron and Steel in Natural Waters and the Calculation of Specific Rates of Corrosion." Professor Wilson first analyzed the chemistry of corrosion and showed that it depended on three reactions. The first reaction was the action of hydrogen-ion on the iron to form ferrous ions and a kind of atomic hydrogen, not gaseous hydrogen nor yet ionic hydrogen. The second reaction was the formation of water from the atomic hydrogen with dissolved oxygen, and the third reaction was the formation of gaseous hydrogen from atomic hydrogen. Obviously the course of these reactions depends a great deal on the hydrogen-ion concentration of the water. If we took extreme cases, the limiting factors of corrosion would vary definitely with the hydrogen-ion concentration. With natural water the second chemical reaction, or the formation of water from hydrogen and the dissolved oxygen in the water, is the controlling reaction. In other words, the amount of dissolved oxygen in the natural water controls the corrosion. With higher hydrogen-ion concentrations, which do not exist in natural waters, other factors enter in and the formation of gaseous hydrogen would be a controlling factor. The fact that in natural waters oxygen diffusion through the liquid layer is the limiting factor can be proved by the fact that the velocity with which the water flows over the corrodible surface changes the rate of corrosion. Professor Wilson suggested a new unit of measurement of corrosion introducing a factor for the oxygen concentration.

Bound up with this same subject was the next paper, by F. N. Speller and V. V. Kendall, in which a method was described for measuring the corrosion of water on iron pipe and an investigation of the effect of velocity

Glimpses of the Pittsburgh Meeting American Chemical Society, Sept. 1922

Assembling for Luncheon at the Clairton Works
Carnegie Music Hall
Luncheon Time at Carnegie Cafeteria
Byproduct Exhibit at Clairton Works

Carnegie Institute From Schenley Park
Oak Manor, Scene of the Garden Party
Central Administration Building, Carnegie Institute of Technology
The Steps of Carnegie Music Hall

upon the corrosion. An experimental apparatus in which water was passed through pipes ¼, ½ and ¾ in. in diameter was described and the results were discussed. The method will be applied in future to the effect of the composition of the metal, the character of the water, etc. The method used for measuring corrosion was the decrease in oxygen content of the water before and after passing through the pipe.

A preliminary paper on the action of sodium silicate when used in soap was presented by Dr. A. S. Richardson of Procter & Gamble. It was studied from several different angles, notably water-softening action, detergent action without admixture of soap and effect on the emulsification power of soap. Dr. Richardson pointed out that the soap-sparing effect of sodium silicate varied with the conditions of its use, being pronounced at high temperature and in hard water high in magnesium salts. He went on to say that probably of itself sodium silicate had little detergent action except in so far as there was fatty acid present in the wash. There was some discussion on this point and J. G. Vail of the Philadelphia Quartz Co. exhibited some emulsions made from mineral oils with sodium silicate alone. This seemed to indicate that sodium silicate had a detergent action without any fatty acid being present at all.

A short paper by R. T. Haslam and W. P. Ryan on the counter-current digestion of wood by the soda process pointed out that in a counter-current system the decomposition of the wood was much more even than in the batch process, yielding quite properly a high alkali concentration toward the end of the digestion instead of at the start. Diagrams were presented showing the method by which eight digesters could be used in this system.

Additional data were presented by Paul Poetschke on the physical properties of dental cement. The effect of the rate of hardening and the temperature of hardening upon the ultimate hardness of the dental cement was discussed. An apparatus resembling very much a human tooth kept at the temperature of the mouth was used throughout the experiments so as to reproduce actual working conditions. In general it was found that higher temperatures of hardening gave harder cement, but it would be unsafe to go above 130 deg. or even quite that high in the hardening process, as it would be extremely painful and might injure the tooth.

Cheap Wood Alcohol From Methane

Prof. R. H. McKee and S. P. Burke discussed the interesting problem of obtaining methanol, or wood alcohol, from methane. Over 20,000,000 gal. of wood alcohol is produced each year and 10,000,000 gal. in the United States. This in itself is a rather comfortable market toward which to work. Of course it is first necessary to have cheap raw materials, and methane is cheap. It can be obtained in large quantities from natural gas in a very pure state, some gases running as high as 96 to 97 per cent methane. In addition to natural gas, methane can be manufactured cheaply also. Methane is first chlorinated and it will be worth noting that the price of chlorine is the real crux of the whole situation. The methyl chloride so obtained can be produced in fair but not quantitative yields. If now a process is worked out which will utilize the methyl chloride produced in this way without worrying too much about the quantitative transformation, the process is relatively simple. A quantitative change of methane to methyl chloride is next to impossible. The gases, then being a mixture of methane and methyl chloride, are passed with steam over lime at 375 deg. C. The gas velocity is kept down to a relatively low figure and the steam is used in large excess, since the methyl ether which is formed in some quantity from the methyl chloride is changed by means of steam to methyl alcohol. Methyl alcohol is easily condensed out and the residual gases are sent through the apparatus again.

As an alternative it is possible to pass the methyl ether formed as byproduct over aluminum oxide at about 350 deg. and change it into methyl alcohol, although the reaction takes place in steps 50 per cent at a time. It is necessary in this work to avoid iron and copper apparatus and it is also worth noting that even if the hydrochloric acid which is formed is not recovered and sold, it is possible with chlorine at 1½ cents a pound to produce methyl alcohol for 75 cents per gallon, and this allows a generous overhead of 20 cents per gallon. It is further pointed out that $1 is the necessary selling price for methyl alcohol manufactured at present if the producer is to make a profit on the product. The process looks extremely interesting, especially in view of the failing methanol supplies.

Some Objections to Filtration Formulas

Prof. W. K. Lewis pointed out the errors which are inherent in the present formulas for filtration in chamber and leaf presses when sludges which are compressible are used. In Sperry's formula, as follows, $\frac{dv}{d\theta} = \frac{P}{R} = \frac{PA^2}{rvV}$, r is assumed to be a constant for any given sludge, and this is distinctly not so with compressible sludge, because r varies with the fifth power of the voids and obviously for compressible sludges the voids diminish. Professor Lewis suggested some empirical formulas which fitted the actual plant practice fairly well, but he explained that there was no rigid theoretical basis for these formulas, yet they served a valuable purpose in the interim. Among other things which developed from this filtration study is the fact that constant rate filtration is better than constant pressure filtration. The next paper, by M. P. Woodward and W. J. Edmonds, was read by Professor Whitman of Massachusetts Institute of Technology, and discussed the experimental side of compressible sludges during filtration. Several differential equations were derived which may be regarded as fundamental for this type of work.

Paint Consistency Analyzed by the Plastometer

Another extremely interesting paper on the plastometer was read by Henry Green, who has been using it to study the property of paint consistency. This particular property is one of those indefinable things which every paint manufacturer knows and understands, but which have no lower terms or simpler terms by which they can be described. The plastometer offers a very flexible method of attacking this problem. He pointed out that viscous liquids have what is known as a telescopic flow in pipes and it is easy to photograph this telescopic flow and to distinguish it from a flocculated flow which a plastic solid would have. Paints at low temperatures show a solid flow due to flocculation and at high temperatures show a viscous flow. (This would be an additional example of Professor Bingham's differentiation of colloids into those which have a transition temperature, analogous to the melting point from plastic solid to viscous liquid.) The author added a wetting oil to a plastic mass of paint and found that the mixture became a viscous liquid. In other words,

the high wetting oil deflocculated the plastic mass. From these studies it develops that the yield value and mobility, both of which are determined in the plastometer, are dependent, first, on the viscosity of the vehicle; second, on the pigment:vehicle ratio; third, on the force of flocculation in the pigment vehicle system, and fourth, on the particle size of the pigment. The third factor is the most important and, as has been pointed out above, some methods of control and reasons for its behavior have been determined.

Corrosion of Ferrosilicon Alloys

The next paper, by Smalley, on the corrosion of iron-silicon alloys, discussed all of the iron-silicon alloys on the market in this country and in foreign countries and outlined experiments from which the optimum concentration of silicon in the alloys which would give the maximum resistance to acid corrosion could be obtained. The commercial alloys of iron and silicon are solutions of Fe_2Si in iron. The acid resistance of silicon alloys below 14 per cent silicon content is very low, but at 14 per cent it is high and remains almost constantly high until 20 per cent silicon is reached. Many faults in silicon-iron castings are due to slag inclusions and gas bubbles which are somewhat more difficult to get out than in ordinary iron castings. The most persistent concentration of silicon would be roughly 14 per cent, with some manganese present and a little carbon. The manganese in good ferrosilicon alloys, or rather, in the commercial silicon-iron, runs from as low as 0.5 per cent to as high as 2.5 per cent, and the carbon somewhere around 1 per cent or less. Rates of corrosion of various acids were studied and the corrosion of hot hydrochloric acids was found to be much the greatest. Another interesting point was the relatively low oxidation of the iron-silicon alloys at high temparatures when used in heat exchangers, etc.

A paper by Carl S. Miner, J. P. Trickey and H. J. Brownlee on furfural resins created a good deal of interest. The authors had some samples of furfural resins there and amazed some in the audience by the price which they were able to quote. Furfural has always been a very expensive chemical and the resins were therefore prohibitive in price. It is now down somewhere around 35 cents a pound, and is being produced on a commercial scale.

Prof. C. W. Foulk gave a paper on a new form of precision hydrometer, which consisted of a compensated slope and eliminated all the trouble which at the present time arises from certain tensions on the stem of the hydrometer. He has not worked out the commercial possibility of the apparatus, but present indications are that it will have a wide use. Professor Lewis then announced that the papers had been completed with the exception of one or two by title and his own paper on the decomposition of nitrates, which he did not think would be of sufficient interest to read and then deftly adjourned the meeting before anyone had time to contradict him on his own paper. *Sic semper tyrannis!*

Rubber Division

This comparatively young division treated itself to an almost ideal meeting. Our conception of an ideal meeting consists in the presentation of some new fundamental ideas and plenty of discussion of these ideas. In the paper presented by Frank G. Breyer of the New Jersey Zinc Co., data were presented which may affect our ideas on the theory of vulcanization. Mr. Breyer was describing the effect of using a new form of zinc oxide recently prepared by the New Jersey Zinc Co. on vulcanization. This oxide is by average measurement about one-fifth the size of the present marketed product. There is a very large percentage of oxide which is considerably smaller than this average. The effect of this new oxide is distinctly different from that of the normal oxide. This may be due to the average smaller size and it may possibly be due to the percentage of very fine material. The effect seems to be much greater than five times, which is the ratio of size. In compounding rubber with this zinc oxide on the rolls, very much more energy is required to push the oxide into the rubber mix and considerably more heat is therefore developed. Once the mix is compounded thoroughly, the vulcanization or curing is carried out in 30 to 40 minutes as against 150 minutes with ordinary zinc oxide. The tensile strength of this compound is 3,500 as against 2,800. The striking thing about this mix is that when an accelerator is compounded with it in addition to the zinc oxide and sulphur, the curing time is not diminished at all and the tensile strength is increased to 3,800. This is exactly the reverse of our present ideas, for zinc oxide was thought to have only a good reinforcing effect on vulcanized rubber and this new oxide is shown to have an accelerating effect as well. Furthermore, organic accelerators are shown to give additional reinforcing effect with this new zinc oxide.

In addition, this zinc oxide is neutral to phenolphthalein and it is assumed that phenolphthalein neutrality has something to do with the success of this zinc oxide, for when the oxide is sprayed with sulphur dioxide the curing time rises to 4 hours. In other words, it seems that acidic impurities completely nullify any effect which either the size or the neutrality may have had on the vulcanization time. Mr. Breyer advanced a theory to explain this which is not very different from that originally advanced by Ostwald to explain rubber vulcanization, suggestion that it is a physical rather than a chemical phenomenon. This theory was abandoned when the use of accelerators became common, and an elaborate theory of the action of the accelerator has been developed.

Mr. Breyer claims that it is only necessary to state that the zinc oxide has a definite absorptive affinity for sulphur, which affinity is poisoned to some extent by the introduction of acidic impurities. The greater surface of this new zinc oxide and its neutrality both would fit in well with this theory of explaining the acceleration of the curing time.

The Hysteresis of Rubber

Another excellent paper was presented by W. W. Vogt of Goodyear on the hysteresis of rubber. Details of a machine for determining hysteresis loss in various rubber compounds was described. The machine was ingenious and variations were measured by a pendulum throw transmitted from a rotating shaft by means of the rubber compound to be tested. Data were given showing hysteresis loss in rubber when developing 40 to 400 cycles per minute. This is substantially the condition which develops in the field when an automobile is going from 4 to 40 miles per hour. The results are very informing on the physical properties of rubber in tires. It is interesting to note in passing that carbon black shows less hysteresis loss than zinc oxide, which is in turn less than clays.

Bedford and Gray developed a theory for the action of dithiocarbamates and thiurandisulphides which is substantially the formation of zinc salts destroyed in vulcanization. Evidence for this is that excess ZnO aids the activity of these accelerators. D. F. Cranor discussed the temperature developed by certain tread pigments, confirming scientifically some popular knowledge on this subject.

Tearing Test Developed by E. C. Zimmerman

An excellent paper by E. C. Zimmerman on tearing tests described an ingenious and accurate method of estimating the rate of tearing. Another point on vulcanization not known before was brought out by Ira Williams and D. J. Beaver when they asserted that the temperatures developed in vulcanization were much higher than the temperature applied. In other words, the reaction is exothermic. These results were obtained by molding rubber mixtures around steam pipes and inserting thermocouples in the mass. The actual number of degrees rise is not significant, depending on the thickness of layer, radiation, air currents, etc. In an electric apparatus temperatures 40 deg. above the temperature of the heating unit were recorded.

Dr. E. B. Spear called attention to the fact that in using thermocouples the radiation factor must not be neglected, and in another paper with H. A. Endres discussed the limitations which had been discovered to the obscuring power test developed in the Goodyear laboratories.

A number of other interesting papers were read on effect of ingredients in vulcanized rubber, and some excellent pictures were shown on the crystallization of sulphur by H. A. Endres. Reports of committees were heard and progress was recorded.

Division of Dye Chemistry

The most interesting papers read before the Dye Division were two that the authors apologized for as being scarcely technical enough to be presented to dye chemists. As a matter of fact, J. Merritt Matthews aroused the admiration and amazement of the meeting by his collection of batiks and Oriental dyed fabrics and his description of the tedious but effective methods used for their production. Art dyeing is done practically altogether by hand methods and the color is built up on the fabric in accordance with the imagination of the artist. This, therefore, implies that the methods of dyeing must be handled in an understanding way by a craftsman or artist who must be something more than a mere artisan. The principal forms of dyeing employed in art work are the batik style, tied-and-dyed work, stenciling, block printing, spray dyeing and shaded dyeings. The second paper referred to was A. F. Shupp's talk on the laundering of textiles. Mr. Shupp described some of the work at Mellon Institute in connection with the fellowship maintained by the American Laundry Owners' Association, and it was a valuable lesson in the practical importance of the proper application of the right dyes for special purposes. Frequently, it seems, the first trip to the laundry changes a gorgeous "silk" shirt into a ludicrous bundle of rags resembling a battle-scarred flag preserved from the Crimean war and a hotel towel with the inevitable red stripe into a raveled rag with a few discouraged threads replacing the crimson band and making a last feeble effort to hold the two halves together. Popular belief and joke books to the contrary notwithstanding, these unfortunate occurrences are more often due to the improper application of dyes and finishing of the fabric than to maltreatment by the laundryman. The work at Mellon Institute protects the laundry owner from the wrath of his customers by scientifically establishing this fact in many cases where the inferior quality of the goods is responsible for its destruction.

Symposium on Methods for Standardizing and Testing Dyes

From the point of view of the dye chemist, the most important discussion before the division was aroused by the symposium on methods for standardizing and testing dyes. Robert E. Rose, of E. I. du Pont de Nemours & Co., arranged the symposium and led the discussion. Walter M. Scott, of Cheney Bros., South Manchester, Conn., presented a general discussion of various methods for estimating the strength of dyestuffs, including colorimetric comparison, the titanium chloride titration method, the Kjeldahl nitrogen determination method and the estimation of the inorganic salts which have been used in the standardization of the dyestuff. The application of these methods to typical acid, basic and direct colors was shown by tables giving the result of the analyses of several samples of each type. Edward H. Gamble and Robert E. Rose presented a discussion of the titanium chloride titration, pointing out the shortcomings of the method. W. C. Holmes described a method for the direct evaluation of dye in a sample of erythrosine based on the gravimetric determination of the color acid. The excellent results obtained have initiated further work to determine the applicability of the methods to other dyes of the eosine group and to afford evidence regarding their constitution. In the absence of interfering substances, the consumption of acid involved in the precipitation of the color acid is determined by the dye and soda ash present and may be utilized as a convenient means of estimating the latter.

A committee was appointed on methods of standardizing and testing dyes consisting of R. E. Rose, chairman, L. A. Olney, J. M. Matthews, W. M. Scott and J. A. Ambler. This committee will co-operate with the Association of Textile Chemists in this work.

Other Papers

Among the other papers of interest were three contributions from the Color Laboratory, Washington, D. C., by C. E. Senseman and O. A. Nelson, which were read by J. A. Ambler. The papers presented a mathematical treatment of some of the properties of the coal-tar hydrocarbons and intermediates. Truth be told, the majority of the audience was somewhat dizzy after watching Dr. Ambler juggle the Clapeyron equation in calculating the vapor pressures, latent heats and entropy of vaporization of naphthalene, anthracene, phenanthrene and anthraquinone. M. L. Crossley, of the Calco Chemical Co., spoke on the relation of color, constitution and chemical activity of dyes. There was nothing particularly new or startling in anything Dr. Crossley had to say, but it was an interesting survey of the subject and was well delivered by the aid of some beautiful sample charts of dyed fabrics.

Officers of the division for the coming year were elected as follows: Chairman, W. J. Hale; vice-chairman, R. E. Rose; secretary, R. N. Shreve.

Natural Dyestuff Industry and Reserves of Latin America

The Romance of the Natural Dye Industry and Its Struggle for Existence Against the Rise of Synthetic Dyes—Importance of Natural Dyes in Case of War or Other National Emergency

By Otto Wilson

EXCEPT as a reserve Latin America has long since passed its peak of importance as a source of dyeing materials. Its decline has, of course, been due to the same factor that has laid low the indigo industry in India and most others having to do with natural dyestuffs throughout the world—the irresistible advance of the synthetic dyes. The tropical forests of the Caribbean regions are still called upon for certain of their famous woods every year, but the business of gathering and working up most of these materials is in large part an industry of the past. Only a very few have been able to withstand the pressure of the synthetic products and maintain a rather precarious foothold in the world's commerce.

The true rôle of these natural dyestuffs is that which they played in the late war. They form a most convenient reserve on which our dye-using industries may fall back when for any reason the usual flow of the synthetic dyes is cut off. With an American dye industry we are not likely again to be left high and dry as we were in 1914, at least not in the near future.

Importance of a Reserve Supply

Yet that is not an impossibility. It would seem the height of absurdity to suggest that after the pinching times of 1914 to 1916, when, as one writer has said, a man could have sold a section of the rainbow to American dye users if he could have guaranteed delivery, we should calmly permit ourselves to drift back into the same dependence on a transoceanic source of supply for coloring materials as before the war.

When in addition it is noted that through the vastly increased use of explosives and the introduction of gas warfare on a large scale, the chemical industry has become practically the basis of modern warfare, it would seem obvious that national prudence would imperatively dictate the preservation of the dyestuff-manufacturing business. Yet one of the striking features of the after-the-war period is the rapidity with which the hard-learned lessons of the war are forgotten. The protecting embargo against foreign dyes was strenuously resisted in Congress when it was first proposed, and the Senate has recently refused to renew it for another year. It is not impossible that this lesson in chemistry may also fade out of our national memory and the manufacture of our dyes slip back again to German factories. So it is just as well that we keep an eye on our natural reserves. If an emergency again arises—and the day of emergencies is not over—we may again have to turn to our southern neighbors for supplies of colors until we can get our factories to work.

The Romance of Natural Dyes

If the chief future rôle of Latin-American dyewoods is to be that of a reserve, it has not been so many years since they occupied a much prouder place in the colors industry. They have been known to the white race almost as long as the New World itself, and for the better part of four centuries they played a prominent part in the stirring drama of transatlantic commerce. They were among the first of the exports by the early explorers, and in fact their abundance and quality gave a great new impulse to the whole art of dyeing in Europe. When the Spaniards saw the abundance of redwood trees in the tropical Amazon forests, they called the new country Brazil, from *braza*, or fiery red. When the marauding British buccaneers, between raids on the Spanish galleons, settled on the coast of the Spanish territory in Central America to cut logwood in defiance of the King of Spain, they gained for England what is now the colony of British Honduras. The trade was never really interrupted and before the late war Caribbean dyewoods were going to England, Holland, Germany, France and even Russia, although of course in smaller quantities than in former times. The war stimulated production and raised prices immensely, bringing a general revival in several lines of the industry. But when the factories of England, France, Italy and the United States reached full production, the

GENERAL VIEW OF LOGWOOD DEPOTS OF CAPE HAITIEN

A PATH THROUGH THE WOODS IN DUTCH GUIANA

demand dropped off and the difficulty in getting ships further checked the boom. The synthetic dyes are now in the field again in full force and the ax of the tropical woodsman is busying itself more and more with other kinds of trees than those which yield the colored woods.

Logwood

Of all the Latin-American dyestuffs, the one which has put up the most determined resistance to the conquering aniline dyes is the pioneer and leader of them all, the famous logwood. In the early years of the Spanish conquest the exporting of this wood began and its exploitation has continued from that day to this. Until the coming of the synthetic dyes it was one of the leading world sources for coloring materials, and in 1914 it was still holding an important place in the dyeing industry, although losing ground gradually to the artificial dyes. With the shutting off of the German supplies, logwood came into immediate strong demand; exports increased several hundred per cent and prices went skyward. The figures (Table I) of imports of logwood into this country show how greatly the trade increased and how it has dropped off again as our domestic dye industry has developed.

TABLE I—IMPORTS OF LOGWOOD INTO THE UNITED STATES

	Tons	Value
1912	40,030	$511,556
1913	38,277	469,430
1914	40,862	522,434
1915	60,958	832,196
1916	186,816	6,097,576
1917	61,735	1,519,878
1918	29,841	668,141
1919	29,022	549,885
1920	72,830	2,186,860
1921	26,740	636,932

The particular qualities of logwood which have enabled it to keep a place in the dyeing industry against intense competition are thus described by the United States Tariff Commission:[1]

> Logwood is the most useful dyestuff for the dyeing of blacks. It is used for blacks on silk, wool, leather, cotton, fur and straw and in the preparation of inks and color lakes for wall-paper printing. It finds considerable application also as a darkening constituent in grays, tans, browns and compound shades, and has a small use for production of blues. Salts of chromium, copper and iron serve as mordants in logwood blacks. Previous to the introduction of coal-tar dyes, logwood was used in the production of a variety of blues and purples. At present logwood is used almost exclusively in the production of blacks and as a darkening constituent in compound shades.
>
> On animal fibers the underhand solid blueness and overbloom which logwood blacks retain in artificial light have made it the standard black. The synthetic dyes have not been able to duplicate these qualities fully. On wool it offers keen competition to the coal-tar colors. On silk it is the most important black. Silks will absorb over 200 per cent of extract, thus serving as a weighting agent. A properly dyed black on silk increases the durability and resistance to wear and tear. On cotton, logwood blacks are of poor fastness and are used only for cheap blacks in dyeing and calico printing. The sulphur blacks, "aniline black" and certain "'developed blacks" have displaced it for fast shades.
>
> Up to the period of the great war the coal-tar dyes were gradually displacing logwood, due to their lower labor cost in application. In addition certain coal-tar dyes had greater fastness for special uses. The extract manufacturers are meeting this labor cost competition by new extracts which dye and mordant in one operation. Logwood, in common with the other natural dyes, was subjected to the most unscrupulous competition by the German dye firms. It apparently was their intention to annihilate the natural-dye industry.

Logwood, *Hæmatoxylon campechianum linn.*, or, as it is sometimes called in the countries where it is grown, "campeche wood," is a distinctly American product. Travelers in the forests of any section of tropical America, in Mexico, Central America, northern South America and the Caribbean Islands may occasionally come across the low trees, but the favorite growing grounds are in a belt which begins with British Honduras on the mainland and extends eastward over the islands of Cuba, Jamaica and Haiti. The British Honduras wood is said to be the best in quality, but the cost of getting it out, especially as the supplies near the river banks are cut away, have caused the traders in forest products to turn their attention more and more to mahogany and chicle.

The United States gets its supply largely from Haiti and Jamaica. In the former country logwood cutting is still one of the leading activities. One factory formerly worked up about 5,000 tons of wood each year, but it has recently burned and only the logs are now exported. Logwood grows in most parts of the island of Haiti, which includes both the country of that name and the Dominican Republic. In both countries it has been cut away near the seacoast, but great quantities are said to exist, practically untouched, in the interior, and these will become available as highways are built and transportation is made cheaper. Jamaica works up very con-

Photo by J. H. Hare, Collier's Weekly.

LOGWOOD DEPOT IN HAITI

[1] "Tanning Materials and Natural Dyes," Tariff Information Surveys, paragraphs 30 and 31 of the tariff act of 1913. (Published in 1921.)

siderable quantities of extract, using about 45,000 tons of wood a year in her two factories, and logwood extract forms an important item in the trade of the island. In the year before the war clouds broke in Europe Jamaica sent $850,000 worth of the extract to foreign countries, mostly to England and Holland, but also to Belgium, Italy, Germany, France and the United States. We took only about $10,000 worth, as our interest lay in the logwood itself. In 1913 we bought 17,000 tons, having a value of $530,000, out of the total Jamaican exports of 50,000 tons. It is said that the Jamaican industry could be developed so as to meet the full demands of the American dye users for the extract if it should be admitted free of duty.

Manufacture of Logwood Extract

The manufacture of logwood extract is carried on in a number of countries. For the most part these countries make the extract from imported logwood for their own use, but there has been some competition in international trade. England, France and the United States are probably the largest producers. In this country logwood extract has been a factory product almost as long as the country itself has existed, some plants having operated continuously since 1794. In 1914, according to the census figures for that year, nine plants produced 29,000,000 lb. of extract, valued at $1,312,000, a considerable falling off as compared with production at the beginning of the century. There are now eight large producers and several smaller plants. All the factories are on or near the Atlantic seaboard, conveniently close to the source of raw materials.

WEIGHING LOGWOOD, PORT-AU-PRINCE, HAITI

A LOGWOOD FOREST NEAR PIQUORE, HAITI

In manufacturing, the wood is first rasped or chipped into fine pieces or a coarse powder. Formerly this was simply piled in heaps, moistened and allowed to ferment or "cure," but this oxidizing process is now largely carried on in mechanical extractors. The coloring principle, hæmatoxylon ($C_{16}H_{14}O_6$), exists in the wood partly as a glucoside and partly free, and has to be oxidized to form the actual dyestuff,[2] which is hæmatein ($C_{16}H_{12}O_6$).

The uncured chips are placed in an extractor, water is added, and extraction is carried on under pressure. The thin liquid resulting is permitted to settle to remove resinous substances and is then evaporated to a consistency of 51 deg. Tw. It goes into commerce in this semi-liquid form and is also further concentrated to a solid form. By treating the extract with oxidizing agents, a substance called hæmatin extract is formed, which when evaporated forms hæmatin crystals. Logwood extract with iron or chromium mordants yields a black dye and with alumina or tin violet blues and grays.[3]

Fustic

Second only to logwood as a natural dyestuff is fustic, or old fustic, as it is sometimes called to distinguish it from young fustic, an entirely different wood. Botanically it is known as *Chlorophora tinctoria* (Gaudich), or *Morus* or *Maclura tinctoria*, and in the countries where it is grown it goes by the name of Cuba wood, yellow wood, palo amarillo or fustic. It is closely related to the osage orange that grows in this country. In fact the latter was substituted for it during the war when shipping conditions prevented importation from the West Indies.

Fustic wood is the source of a yellow dyestuff used as a distinct dye and also with other dyes for obtaining compound shades. With aluminum and tin it yields a bright yellow color and with iron and copper various olive shades. In general these colors are only indifferently fast to light, but with chromium as a mordant olive-yellow and old-gold colors are obtained which are said to be fast to both light and milling. Fustic colors were formerly widely used for dyeing wool, and they are still of much importance, although they are being more and more displaced by the coal-tar colors, which are said to be cheaper to apply and more fast. In wool dyeing, the chief mordant used is potassium bichromate and it is usually employed, on both wool and silk, in combination with other dyes to produce various shades of olive, brown, drab, etc., and in the shading of blacks. In cotton dyeing, fustic has had extensive use in coloring khaki cloth for tents and uniforms.

The "old fustic" tree is a native of the same tropical forests of America as logwood and its occurrence is about as widespread. Brazil, Colombia and Venezuela in South America; Honduras, Costa Rica and Panama in Central America; the lowlands of Mexico and the islands of Cuba, Jamaica and Haiti, all claim the fustic tree as a native product. The best wood comes from the Tampico district in Mexico and from Cuba, that from Brazil and Jamaica being regarded as of lower

[2] Thorpe, "Outlines of Industrial Chemistry."

[3] Heermann, Paul, "Dyers' Materials." London: Scott, Greenwood & Son. 1919.

FUSTIC LOGS READY FOR SHIPMENT

quality. The trees grow 60 or 70 ft. high and the wood is very heavy. Only the heartwood is used for dye-extracting purposes. A feature that materially increases the cost of bringing the wood to the market is that the trees are scattered thinly through the forests and are not found in groves like logwood.

Fustic wood has two coloring principles,[4] morin ($C_{15}H_{10}O_7\,2H_2O$) and maclurin ($C_{13}H_{10}O_6$), with quite distinct properties. In preparing the extract for dyeing, the wood is chipped and an extract obtained in the same way as from logwood. To separate the morin from the maclurin the extract is treated with a little acetic acid and then with lead acetate solution, causing the morin to precipitate as a yellow lead compound and leaving the maclurin in solution. By further treatment of this precipitate crystals of crude morin are obtained while crystals of maclurin are separated from the original solution. Both crystals are in the form of colorless, or almost colorless, needles. Maclurin is rather more soluble in water than morin.

Young fustic, *Rhus cotinus linn.*, is a native of Europe and the West Indies, and was used in Europe before old fustic was known. It also yields a yellow coloring matter, called fisetin ($C_{15}H_{10}O_6$). Young fustic is little used today, as its colors are not fast.

Annatto

A dyestuff which is now little used in coloring fabrics, but which is of considerable value for coloring butter, margarine, oils and cheese, is annatto, or "arnotto." It gives an orange-red color which is very fugitive to light, but which resists soap and acids very well. When it is used at all for dyeing cotton, it is dissolved in a boiling solution of carbonate of soda, while for silk the same chemical is used half and half with annatto. When used with alumina as a mordant, annatto forms an orange lake and with tin a lemon-yellow lake. In acid solutions it yields a red color. It is partly soluble in water and more soluble in alcohol and alkaline solutions.

Like logwood and fustic, annatto grows in the islands of the Caribbean and in the lands that border that sea on the south and west, as well as in northern Brazil. Its use antedates even that of logwood, as the natives who greeted Columbus and the later adventurers from Spain used it to paint their faces and bodies. It is cultivated in many parts of the West Indies and in the Guianas and other parts of South America. In the country around Port Limon, the Caribbean port of Costa Rica, annatto plants are said to grow abundantly and there is an opportunity to cultivate them for commercial purposes. Our supply comes in large measure from Jamaica, where continued cultivation has made it an item of some importance in the export trade.

The annatto plant, *Bixa orellana linn.*, is a small tree or shrub growing 8 to 12 ft. high. The coloring matter comes from a reddish waxy pulp which covers the seeds. Full crops are not gathered until 3 or 4 years after the seedling plants have been set out, the yield then being about 500 or 600 lb. of seed per acre, the amount increasing for several years. In Jamaica the growing of the annatto and the gathering of the seeds is almost wholly carried on by the peasant class, the women and children for the most part attending to the gathering and drying of the seeds when the miter-shaped capsules in which they are contained split open. The waxy "testa" of the seeds is removed by stirring the seeds in boiling water, and after some days it is passed through a sieve. The liquid is permitted to stand for a week or so to ferment, the dye material meanwhile settling to the bottom. The clear water is decanted off and the residue is evaporated to a putty-like consistency and shipped in rolls or casks, reaching the market as a thick paste or in dry cakes. It is possible to remove the pulp from the seeds and prepare a dyestuff for market without fermentation. The best annatto comes from the Guianas and contains 10 to 12 per cent of the pure dye.

The chief coloring matter of annatto is called bixin. It can be crystallized from a chloroform solvent into brown-red or deep-red rhombic crystals. In this form it is fairly soluble in chloroform or alcohol and less soluble in other common solvents. It dissolves in concentrated sulphuric acid to form a cornflower-blue liquid. The formula for bixin is in dispute,[5] different authorities giving it as $C_{28}H_{34}O_5$, $C_{25}H_{34}O_5$, $C_{27}H_{32}O_4$ and $C_{26}H_{30}O_4$.

Brazilwood

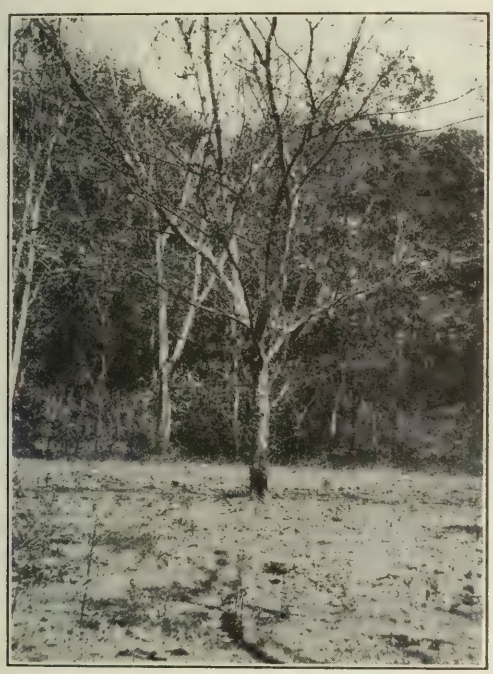
Most noted of all the Brazilian dyestuffs is the famous brazilwood, which has been known practically since the discovery of the country, but which is now of little commercial importance. This is one of a number of redwoods, of which there are two classes—soluble and insoluble. The Latin-American redwoods come under the former classification and are species of the genus *Cæsalpinia*, the four most important in America being brazilwood, Pernambuco wood, peachwood and limawood, although the term brazilwood is sometimes applied to all the woods of this class. The true brazilwood, *Cæsalpinia brasiliensis*, is very plentiful in the forests of the north. It is brick-red inside and brown-red on the surface, and is very hard. It is found only in Brazil, although the other species of *Cæsalpinia*, especially limawood, occur throughout the forests of Central America and other tropical regions.

Brazilwood extract is called "hypernic" and is obtained in much the same manner as logwood extract. It is sold as a 51 deg. Tw. extract and as a solid. Its coloring principle is brazilin ($C_{16}H_{14}O_5$), which crystal-

[4] Perkin, A. G., and Everest, A. E., "The Natural Organic Colouring Matters." London and New York: Longmans, Green & Co., 1918.

[5] Perkin and Everest, "The Natural Organic Coloring Matters."

zes either as colorless needles containing $1\frac{1}{2}$ H_2O or as olorless prisms with $1H_2O$, and is readily soluble in lcohol and water, as well as in a dilute solution of bdium carbonate, in which it gives a beautiful carmine-ed color. Brazilin is changed by oxidation to the ctual coloring matter called brazilein, a reaction which akes place readily on exposure to the air. Brazilein orms dark needles of a gray metallic luster, freely oluble in hot and slightly soluble in cold water. With luminum salts it forms a red color lake. On wool it ields brown or reddish-brown shades with bichromate, lue shades with sulphate of alumina and scarlet with tannic chloride. The colors yielded by brazilwood ex-ract are fugitive and its principal present use for extiles is as a reddening constituent to modify shades



A FUSTIC TREE

of other natural dyes. When used alone, its chief employment is for dyeing leathers dark red and red-chocolate.

Of the other redwoods mentioned, Pernambuco wood, *Cæsalpinia ciesta,* is the richest in coloring matter, containing about twice as much as brazilwood. It is abundant in Jamaica and Brazil. Peachwood, *Cæsalpinia echinata,* is found in Mexico and Central America.

Indigo

The America species of the indigo plant, *Indigofera anil linn.,* is widespread throughout Latin America, from Brazil to Mexico, but it has been little cultivated in recent years. Before the discovery of synthetic indigo the cultivation of the plant had reached important proportions in some countries. Venezuela records an exportation of 1,800,000 lb., worth $2,250,000, as far back as 1802, but the growing coffee industry attracted the attention of planters and indigo cultivation was gradually abandoned. Today the plant grows everywhere as a weed and is little utilized.

The only country in which the indigo plant has furnished important supplies for export in recent years is Salvador, where cultivation on a considerable scale has been maintained for a long while. In 1910 that country sent to Europe and the United States $314,000 worth of indigo, but the trade dropped to $55,000 in 1913. There was an increase in the next year to $98,000, of which England took the largest share, $32,000, the United States following with $20,000. Then came the war and the industry boomed, exports going as high as $600,000. Since the war production has fallen back. Colombia also sent us a few thousand dollars' worth during the war, but exports stopped when our factories became fully active. Costa Rica sent a small amount in 1919, and there is said to be some manufactured in Guatemala. Mexico in 1918 exported considerable quantities to Spain and Japan.

Cochineal

A natural dyestuff for which the world is indebted to Mexico is cochineal, the once important red color obtained from the insect *Coccus cacti.* This has been used for centuries in its native country, and from there it was early taken to the Canary Islands, Java and other parts of the Old World. It is the only important dye derived from animal life. The insects feed on a particular variety of cactus which grows wild naturally but is cultivated for the sake of its tiny guests. Only the female insects are used for making dyes, as they do not have wings and remain on one part of the plant. They are brushed off before the beginning of the rainy season and are killed either by being placed in an oven or by the use of hot water or steam. When the former process is used, a silvery down is preserved on the body of the insect and the resulting color is known as "silver gray" or "silver cochineal." When hot water or steam is used, the resulting color is dark, red or brown, and a product known as "black cochineal" results. No other preparation besides grinding is necessary before the cochineal is used as a dye.

Cochineal dyes were formerly in wide demand, but like most other natural coloring matters, they have practically yielded the field to the coal-tar products. They were little used for cottons, but were extensively employed on silks and woolens. On wool they give a fiery scarlet when mordanted with stannous chloride, oxalic acid being added to the bath, or with special preparations of stannic chloride. Wool mordanted with aluminum sulphate and tartar and then dyed in a separate bath with cochineal takes on a crimson color, and with ferrous sulphate and tartar, purplish, slate or lilac colors are produced. In dyeing silk crimson, alum or tin mordants may be used, with cream of tartar and oxalic acid. The artificial azo-scarlet dyes are now largely used in place of cochineal on textiles. To a limited extent cochineal is used as a coloring matter for foodstuffs, candies and face powders.

Miscellaneous Colors

Other dyestuffs of the Latin-American countries which have been or might be used are numerous, but there is small prospect that they will become of importance to foreign interests. The forests of Brazil[6] contain a considerable variety of dyewoods and other color-producing plants, practically all of which are now of either historical or purely local interest. In foreign markets they have little chance, but there is a limited

[6]At a cotton congress held in Rio de Janeiro in 1916 Dr. Miguel Calmon, chemical director of the Companhia Industrial do Brasil, gave an address on the use of native vegetable dyes. This address does not seem to be available in the United States, but those wishing to follow up the subject can probably obtain full information by addressing an inquiry to Dr. Calmon in care of the above company.

field for them in Brazil. That country has an important cotton-growing and cotton-manufacturing industry, both of which are receiving much encouragement from the government, and as the output of cotton cloth increases, more and more interest will naturally be taken in developing the native dyestuffs. There are already dye factories in Minas and Cubatão, and the chemists of the country are fully alive to the possibilities of its resources in color materials. In current books on Brazil mention is made of dyes from "inglotina," made from mangrove leaves; two anils, *Cissus tinctarea* and *Cissus sicyoides*, which are said to give fine blue colors; indigo; some fuchsias which give a black; and other trees which yield a brilliant yellow. Annatto grows in most parts of the country.

In Venezuela, besides fustic, brazilwood, annatto and indigo, there are several plants known locally for their coloring properties. A tree called "amarillo," *Aspidosperma vargasii*, belonging to the family of the dogbanes, has a bark which gives a yellow dye and some tannin. The bark of the onotillo tree, *Vismia ferruginea*, of the St. John's wort family, also gives a reddish-yellow, resinous substance, which can be used like gamboge. Two others yield a yellow or yellowish-red dye. They are known as "rasura de cucharo," *Condaminea tinctorea*, and "bosna" bark, *Zanthoxylum ochroxylum*, the latter containing berberidine. Red mangrove bark, *Rhizophora mangle*, yields a red pigment which can be used for coloring leather.

Mexico has a wide variety of color-bearing plants. One said to be highly regarded by dyers is *Reseda luteola*, which gives a yellow coloring principle "luteolina" ($C_{15}H_{10}O_6.2H_2O$). Other plants yielding yellow dyes are yellow or Cuba wood, malacate, curcuma or camotillo and several varieties of azafran and azafrancillo. Among those which give blue coloring materials, besides indigo and related plants, is one known locally as "muitle." A number of others yield red dyes and from a few are obtained materials for coloring fabrics green and black.[1]

Washington, D. C.

Legal Notes

By Wellington Gustin

Buyer, Committing First Breach of Contract, Cannot Sue for Seller's Subsequent Breach

In the case of Dawson Cotton Oil Co. versus Jones, the company sued E. & F. G. Jones for damages for a breach of contract for failure to deliver about 57 tons of product of 100 tons contracted for. Defendant pleaded that the company before the time fixed in the contract for final delivery, being fearful that the market price would decline, called upon it to make immediate delivery of the remaining 57 tons or give a further guarantee that the product would be delivered; then, it alleged, the company by its agent refused to accept a carload then being loaded and gave notice that it would accept no more under the contract.

In short, the defendants contended that the company first breached the contract by refusing to accept a carload and notifying them that it would accept no more of the product, all before the expiration of the time stated in the contract for delivery. This plea the Supreme Court of Florida has held to be a valid defense to an action on the contract for breach for failure to deliver according to its terms. The seller averred that the buyer committed the first breach by refusing to accept, which, if true, the Supreme Court holds to be a good defense, reversing the trial court's judgment.

This contract was in the form of a letter by the Dawson Cotton Oil Co. to E. & F. G. Jones, signed by an official of the company and accepted by E. & F. G. Jones. Among other things it provided for delivery in October, November or December following, at option of the seller; shipment made with buyer's privilege of inspection; and should there be any dissatisfaction as to the grading of the peanuts, it should be "left to the regular rules of arbitration, and the party whom it shall be decided against shall pay all costs."

Measure of Damages for Failure to Deliver Under Contract

In an action brought by H. P. Pearl & Co. against the Packard Iron & Metal Co., plaintiff sought to recover damages for a breach of contract for the non-delivery of a carload of iron. A judgment was rendered on trial for plaintiff, and defendant appealed to the Court of Appeals of Maryland, where the judgment was affirmed. (115 Atlantic, 761.)

The Court of Appeals held that in an action for damages for non-delivery of the iron, evidence as to its market value during the month wherein delivery should have been made was admissible, in view of the uniform sales act, providing that where there is an available market the measure of damages is the difference between the contract price and the market price at the time when the goods should have been delivered.

Provisions of Uniform Sales Act

Damages for failure to deliver goods as provided in uniform sales act, are set out as follows:

"(1) Where the property in the goods has not passed to the buyer and the seller wrongfully neglects or refuses to deliver the goods, the buyer may maintain an action against the seller for damages for non-delivery.

"(2) The measure of damages is the loss directly and naturally resulting, in the ordinary course of events, from the seller's breach of contract.

"(3) Where there is available market for the goods in question, the measure of damages, in the absence of special circumstances showing proximate damages of a greater amount, is the difference between the contract price and the market value or current price of the goods at the time or times when they ought to have been delivered; or, if no time was fixed, then at the time of the refusal to deliver."

Opinion on Similar Point in Another Case

On a similar point in an Illinois case, Summers vs. Hibbard, 46 Am. St. Rep., 872, the court says:

"There is no doubt of the correctness of the rule stated by appellants that, where delivery is required to be made by installments, the measure of damages will be estimated by the value at the time each delivery should be made."

[1] A full account of several dye-plants of Mexico will be found in a pamphlet (in Spanish) of thirty-eight pages entitled "Las Plantas Mexicanas y Algunas Exoticas Productoras Colorantes," by Juan Manuel Noriega, issued by the Government of Mexico in 1919.

Electrical Characteristics of Dry Cells—II*

By G. W. Vinal and L. M. Ritchie

Explaining the Behavior of a Dry Cell in a Circuit and the Effect of Internal Resistance, With Equations and Curves—Grouping of Cells Is Also Discussed and Diagrams Are Drawn

In PART I of this paper, on the characteristics and testing of dry cells,[1] are given a discussion, tables of data, and curves showing the effect of temperature on the voltage, short-circuit current and service capacity. With a rise in temperature the coefficient for the voltage, current, deterioration of cells on the shelf and at low current drains becomes positive. Capacity of the cells, which is usually measured as days or hours of service, is also expressed in terms of ampere-hours and watt-hours. The measurements are made by constant resistances on continuous and intermittent discharges and by constant current on continuous discharge. Curves of the most reliable data are shown which will permit the calculation of the capacity at different rates of discharge to a number of end points. Examples are given showing the method of reading the curves and computing the results.

This second article deals with the theory of dry cell behavior in an electrical circuit, including the effect of grouping, internal resistance of the cells, and other circuit characteristics.

Behavior in a Circuit

By the open-circuit voltage of a dry cell is meant the electromotive force of the cell when it is not producing any current. Such a measurement can be made on a potentiometer. If a resistance is connected across the terminals of a cell, a current will flow through the circuit from higher to lower potentials—that is, it flows from the carbon to the zinc. The current, however, does not begin with the carbon and end with the zinc, but flows through the cell also. It is evident, then, that within the cell the current flows from the electrode of lower potential to the electrode of higher potential, being made to do so at the expense of the chemical energy of the cell.

If a potentiometer be used to measure the potential difference at the terminals of a cell when it is discharging through an external circuit, it is found that the voltage measured is less than for the cell on open circuit. Designating the open-circuit voltage of the cell by E and the potential difference at the terminals of the cell by E' when a current I is flowing through an external resistance R it is found that:

$$E' = IR \qquad (1)$$

That is, Ohm's law is here applied to the portion of the circuit which is external to the cell. The difference $E - E'$, therefore, represents the voltage drop in the cell itself. Since the current is the same in the cell as in the external circuit Ohm's law shows that:

$$E - E' = Ib \qquad (2)$$

where b is a quantity that represents the internal resistance of the cell.

Adding equations 1 and 2 the general expression for Ohm's law as applied to the entire circuit becomes

$$E = IR + Ib$$

or

$$I = \frac{E}{R + b} \qquad (3)$$

The total resistance of the circuit is the sum of the external resistance of the circuit and the internal resistance of the cell. For the ordinary dry cell, when fresh, b is a small quantity and may usually be neglected in comparison with R, but as the cell is used up b increases and I decreases. When the cell is no longer able to perform its service, it will be found that while E has decreased somewhat, b has increased to many times its initial value.

The maximum current which a cell can deliver is, by equation 3, putting $R = 0$:

$$I = \frac{E}{b} \qquad (4)$$

In making measurements, R cannot be made exactly zero, since the shunt and lead wires of the ammeter must necessarily have some resistance. This resistance, however, can be made very small. In standard practice it is 0.01 ohm. When $R = 0$, or nearly so, the value of I is called the short-circuit current of the cell.

Electrical power is the rate of expenditure of electrical energy and is measured in watts. The watt is the power when a current of 1 amp. flows through a resistance of 1 ohm. Consequently the number of volts multiplied by the number of amperes equals the number of watts; or, in general

$$IE = P$$

The power derived from the cell at any time is, therefore, the product of its electromotive force E by the current which flows, I. Part of the energy is expended in the cell itself and part in the outside circuit. Since the current is the same throughout the circuit the expressions for the power expended in the battery and outside of it are obtained by multiplying I by the fall in potential in each part of the circuit. Inside the cell, this is

$$(E - E')I = P_1 \qquad (5)$$

Outside the cell, it is

$$E'I = P_2 \qquad (6)$$

Referring to equations 1 and 2, the values for $(E - E')$ and E' in terms of current and resistance are obtained. Substituting these in equations 5 and 6 and at the same time adding these equations

$$P = P_1 + P_2 = I^2b + I^2R \qquad (7)$$

Assuming that $R = 0$ or is nearly so, I^2R also equals zero, leaving the equation for the power expended

$$P = I^2b$$

This means that when the cell is delivering its maximum current (equation 4), all the power is expended in the cell itself and is dissipated in the form of heat. Although 25 amp. or more may thus be drawn from the cell, the current does no good except to indicate the condition of the cell. On the other hand, equation

*This paper is taken from Chap. IV of the forthcoming circular 79 of the Bureau of Standards on Electrical Characteristics and Testing of Dry Cells. Published by permission of the Director of the Bureau.

[1]See *Chem. & Met. Eng.*, vol. 27, No. 11, p. 546, Sept. 13, 1922.

7 shows that for any value of I which may be desired the smaller b is the less power is wasted in the cell itself. For this reason a small value of b is desirable. The equation also shows that the power expended in the cell increases as the square of the current flowing, which indicates that the importance of making b small in cells intended for ignition and heavy duty is greater than in the case of telephone and light-service cells. Certain practical limitations enter in fixing the resistance of the cells which show that excessive short-circuit currents are not a desirable feature.

Some dry cells which in the beginning show excessively large currents on short circuit may increase in resistance so rapidly that they will give less service than other cells of the same size, but having smaller initial currents. The tendency in this country toward cells of very large flash currents has been partly due to a mistaken idea that the more current that can be drawn from a cell the more service it will render. European cells generally are higher in internal resistance than American cells.

Internal Resistance of Dry Cells

From what has been said above about the resistance of the cell, it might be implied that b is a definite and constant physical quantity. Such, however, is not strictly the case. The resistance of a cell is ordinarily

$$\frac{E - E'}{I} = b \qquad (8)$$

but it can easily be shown that for various values of I different values of b are obtained apart from any consideration of polarization phenomena. By experiment it is found that the larger values of b correspond to the smaller values of I, but that for the currents ordinarily required of a dry cell the values of b are small and do not change very rapidly with changes in I. The practice of a few manufacturers to state the internal resistance of their dry cell to the thousandth part of an ohm is not to be commended, if it means nothing more than the open-circuit voltage divided by the short-circuit current, and it does not represent the resistance of the cell under working conditions.

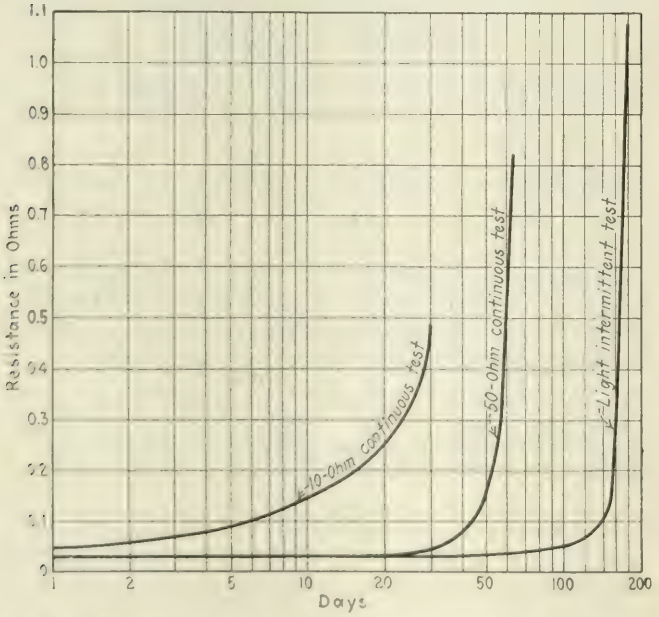


FIG. 10—PROGRESSIVE CHANGES IN RESISTANCE OF DRY CELLS MEASURED BY AN ALTERNATING-CURRENT BRIDGE IN SEVERAL TESTS

When the cell is new, the resistance b is ordinarily small, but it increases with the age and use of the cell. This is not due to the drying out of the cell by evaporation as is often supposed, although that may be a minor cause. The reactions of the cell due to the passage of electric current result in the formation of double chlorides and basic chlorides, which take up water in their formation and also clog the pores of the paper lining or paste, as well as incrust the surface of the zinc. In this way the available path for the flow of current is restricted and the resistance of the cell increased. As the cell is used, the MnO_2 is gradually reduced and the surface of the cathode moves inward. This makes the path between the zinc and the cathode a longer one, which also increases the resistance of the cell. The resistance of the cell increases slowly at first, but later increases very rapidly to large values. Fig. 10 shows the progressive changes in resistance of dry cells measured by an alternating-current bridge in the course of several tests. These curves are given for the 10-ohm test, a continuous discharge through 50 ohms and the light intermittent test.

Grouping of Cells

For most purposes dry cells are used in groups or batteries, the number of cells depending on the service required. It is desirable to arrange the grouping in such a way as to obtain the most economical service. Two factors are involved in arranging the cells; one

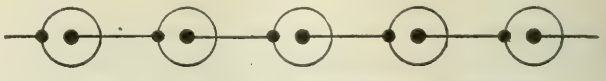


FIG. 11—CELLS CONNECTED IN SERIES

is the voltage requirement and the other the current requirement. When cells are connected in series—that is, when the positive pole of one cell is connected to the negative pole of the next and so on to the end of the row, Fig. 11—the voltage of the cells is additive. Two cells in series will give twice the voltage of one cell, and five cells will give five times the voltage of one, assuming that the cells, taken individually, are of the same voltage. If the voltage of one cell is E, the voltage of s cells in series is sE. When the cells are discharging, the voltage continually decreases. For this reason the number of cells required for a certain operation cannot be estimated on the basis of 1.5 volts per cell. The average working voltage of the dry cells may perhaps be taken as 1 volt per cell. If the voltage required is 4 volts, this means 4 cells in series. Another rule that is sometimes useful when the voltage requirement is not known is to connect cells in series, adding one at a time until the apparatus can be made to operate; then add an extra cell for each group of three or a fraction. This works out to give the same result in the example just given.

The rate at which the voltage will decrease when the cells are in use will vary with the current and duration of the discharge. A cell which will give 40 hours' service under normal conditions will not give 20 hours' service under twice the load. It may not give more than 10 hours. On the other hand, if the load is made very light, the service actually rendered may be small, because the deterioration of the cell becomes an important factor. As a guide to the proper use of the cell, information is given in Table VII.

The current drain on the cells can be relieved when

TABLE VII—CURRENT DRAINS FOR ECONOMICAL USE OF DRY CELLS

Duration of Daily Discharge, in Hours	Maximum Drain on Each Row of Cells In Series, In Amperes	Duration of Daily Discharge in Hours	Maximum Drain on Each Row of Cells In Series, In Amperes
16–24	0.02	½–[illegible]	0.75
8–16	0.04	¼– ½	1.50
4– 8	0.08	⅛– ¼	3.00
2– 4	0.16	Few moments	10 15
1– 2	0.32		

necessary by arranging the cells in parallel, or as it is also called "multiple." Cells are arranged in parallel by connecting the like poles together. Fig. 12 shows cells connected in parallel.

When more than three cells are involved in a series and parallel connection, there is a choice of arrangement. The cells may be arranged in several rows connected in series and then these rows connected in parallel (Fig. 13), or they may be arranged in parallel groups which are then put in series (Fig. 14).

Mathematically, the result is the same in either case. The voltage of the battery as shown in both figures

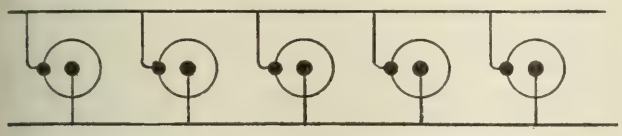


FIG. 12—CELLS CONNECTED IN PARALLEL

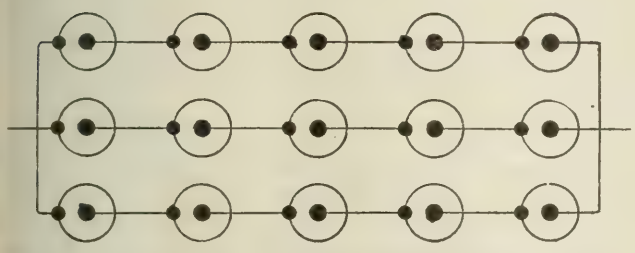


FIG. 13—PARALLEL OF SERIES-CONNECTED CELLS

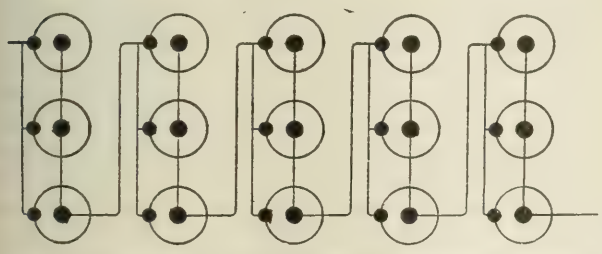


FIG. 14—SERIES OF PARALLEL-CONNECTED CELLS

is five times the voltage of a single cell, and the current furnished by any one cell is only one-third of the total current. The choice between the arrangements arises from the fact that one or more of the cells may fail before the others. For example, if any cell in each diagram should increase considerably in resistance, it would practically exclude one row of cells of the first diagram, Fig. 13, from service, reducing the battery to two rows. In the second case, Fig. 14, the battery would have four groups of three cells and one group of two cells, the effect of the bad cell being reduced to a minimum. In terms of resistance of the battery, the spoiling of the cell in the first diagram increases the resistance of the battery by 50 per cent, while in the second diagram it increases the resistance of the battery by only 10 per cent.

As the internal resistance of the dry cells increases, the current which they will deliver to any given circuit will decrease. If there are n cells, arranged s cells in series and p rows in parallel, the electromotive force of the battery will be sE, and if each cell has a resistance of b, the resistance of the battery will be $\frac{sb}{p}$. Applying Ohm's law to a circuit containing such a battery, equation 3 becomes:

$$I = \frac{sE}{R + \frac{sb}{p}} \qquad (9)$$

The maximum current that the battery can supply (when the external resistance is zero) is:

$$I = \frac{sE}{\frac{sb}{p}} = p\frac{E}{b} \qquad (10)$$

which is analogous to equation 4.

Whenever it may be necessary to use old cells for any purpose and the resistance of the cells has become of the same order of magnitude as the resistance of the external circuit, a choice arises between the series and parallel connections of the cells. If the resistance of the individual cells is less than the resistance external to the battery, more current can be forced through the circuit by putting the cells in series; but if the resistance of the individual cells is equal to the external resistance, the current is the same whether the cells are in series or parallel. If the resistance of the individual cell exceeds the resistance external to the battery, more current can be obtained by putting the cells in parallel.

Benzol Poisoning, Its Occurrence and Prevention*

By Charles F. Horan

Manager, Department of Hygiene and Safety, Hood Rubber Co., Watertown, Mass.

POISONING by industrial processes arise, for the most part, by the inhalation of the fumes. Because of its fat-dissolving qualities, benzol may also be absorbed through the unbroken skin, but it is doubtful if this mode of entry presents a serious hazard in industry. Lehman has shown that a man breathing a mixture of benzol and air actually absorbs 80 per cent of the benzol inhaled.

There seems to be some difference in the toxicity of pure and commercial benzol. The older reports indicated that commercial benzol was more dangerous than the pure, but the experience in the rubber industry would indicate that this conclusion was unfounded, there seeming to be a direct connection between the boiling points of the benzols and their ability to do harm; the compounds of lower boiling points appearing to be more dangerous than those of higher boiling points. This is probably due to the fact that the amount of vapor given off by the low-boiling point benzols is greater and thus a larger dose is breathed by employees exposed to the material. Considerable variations in individual susceptibility to benzol-poisoning exist, this being considered as the reason why the material has been used in some industries over a long period of time without serious symptoms having arisen.

Concerning this substance there is some division of opinion within the ranks of industrial hygienists as to

*Abstracted from paper read at the convention of the National Safety Council, Detroit, Mich., Aug. 30 to Sept. 1, 1922, inclusive.

its real dangers. There are those who consider the material with alarm and look upon all employees exposed to the vapors of benzol as being potential fatalities; there are others in industry who consider the vast amount of the material used and the relatively few cases of poisoning as evidence of lack of danger from benzol. These non-alarmists tell us that very few employees in industry are susceptible to benzol poisoning, and even in cases where little organized health protection is offered to employees using this material, cases of poisoning are rare and not usual happenings. They suggest to us that the statement "things are not what they seem" contains an element of truth; they remind us that industrial-accident statistics show the wheelbarrow to be more dangerous than the steam locomotive and the cement brush to be a greater fire hazard than the blowtorch.

In the central ground, and accepting the middle course, are those experienced industrial physicians and sanitarians who realize that the material is not nearly as dangerous nor as safe as some persons believe; that it can be used with relative safety only at the expense of the maintenance of certain precautionary measures.

Prior to 1914 several cases of benzol poisoning had been reported by Snelling. Three girls, aged from 14 to 16 years, were employed in a Maryland can factory in which the containers were sealed with a mixture of benzol, resin and rubber. Three other cases have since been reported from this factory. The most famous recorded cases of chronic poisoning were from a rubber tire factory in Sweden where nine young women, from 15 to 20 years of age, were taken ill with hemorrhages from the mouth, stomach, uterus and nose. Four of these girls died after an exposure to benzol lasting from 3 weeks to 3 months. In 1916 Dr. Alice Hamilton reported fourteeen new cases of sudden acute poisoning with seven deaths.

The reports of German factory inspectors for 1912 deal with three cases of poisoning, two of them being fatal. One man was employed in painting the interior of a barrel with benzol paint, another climbed into a washing machine in a dry-cleansing establishment and the third was employed in a distilling plant and forgot to turn on the cold water for the condensation. In 1918 British factory inspectors reported the case of a man overcome by benzol vapor while employed in a distillation plant. He was revived with oxygen and returned to work on the second day, only to be again overcome and die.

Recorded Cases of Poisoning

A number of cases of benzol poisoning have been recorded where employees were overcome while cleaning tanks in which benzol has been stored. In one case a benzol kettle had been empty for 24 hours, was washed out twice with steam and permitted to stand, filled with cold water, over night. As the workman went into the kettle a strong steam of air was blown in through a pipe. In spite of these precautions the workman was overcome, but was rescued. One of his fellow workmen who assisted with the rescue was overcome and died within 10 minutes.

One British case is recorded where a tank car was unloaded, washed with water, steamed out and then left, filled with water, for 20 hours; then washed twice with water, boiled for 12 hours and finally left for 10 days with a 16-in. manhole opened. A man who was then sent into the tank collapsed and, although he was revived in time, one of his rescuers died.

There have come to my personal attention, during the past 6 years, three fatal cases of poisoning to tire-builders in a pneumatic tire plant, one fatal and one acute case to female operatives in a thread-treatment room in a cord tire plant, one fatal case to a laborer engaged in digging a trench along a leaking tank of benzol, a fatal case to a foreman in a rubber-reclaiming department, three fatal cases in the coating room of an artificial leather factory, and about a dozen cases of less serious acute poisonings in a golfball department of a small rubber industry.

Condition of Temperature Is Important

So far as age is concerned, the very young, the old and the female seem to have particular susceptibility to the vapors of benzol. Debilitated conditions, organic diseases especially of the heart and kidneys, addiction to alcohol and excesses of all kinds materially increase susceptibility. Vigorous muscular individuals with rapid circulation and deep breathing are overcome more readily by benzol fumes because of the rapidity with which the vapors are absorbed.

As we would naturally expect, conditions of temperature and humidity effect susceptibility to benzol poisoning. Thus on hot, humid days, or in interiors where the air is hot and stagnant, poisonings are more likely to occur because of the greater volatility of the benzol under these conditions, and also, perhaps, because of retarded elimination, increased pulse rate, and hence the greater flow of blood through the lungs under these circumstances.

The symptoms of poisoning naturally vary according to the length of exposure, individual susceptibility and the amount of benzol absorbed. As Dr. Reifschneider will probably tell us of the symptoms of the poisoning in both the acute and chronic state, I shall pass along to the prevention of the poisoning.

From the standpoint of those engaged in safety work, the methods of prevention of benzol poisoning are of much more importance than any other phase of this problem. The first step in the prevention of the poisoning is to be found in the physical examination of each applicant for work and periodic re-examination of those exposed to the hazards of benzol. Persons suffering from organic diseases, especially of the heart and kidneys (which diseases tend to retard elimination), should not be placed on occupations where the exposure to benzol constitutes an occupational liability. Physical examinations should include a differential blood examination, an estimation of hæmoglobin and a determination of the coagulating time of the blood. Experience indicates that re-examination every 4 weeks is not too often.

Follow Up all Suspected Cases

All cases of absence from work should be investigated if the absence extends beyond 24 hours. In event of the employee being away from his occupation because of sickness, he should be visited by a physician familiar with the early symptoms of benzol poisoning. Note should be kept of the state of health of the workers, the results of periodic physical examinations, the duration of symptoms and the treatment of illnesses that occur. Care should be taken to have the records complete and entries such as "coagulating time, normal," should be discouraged. Employees should be encouraged

to use the factory dispensary in event of illness and it scarcely requires to be said that medical aid should be within easy reach.

We have now come to the subject of the education of the worker. In the prevention of occupational diseases the co-operation of the employee is indispensable and is the most important condition of an effective defence. The best regulations and preventive measures are worthless if the worker does not observe them. The employee should be advised as to the dangers incidental to his employment and he should be acquainted with the symptoms which demand early medical attention; he should be taught the aims of the management with reference to the prevention of industrial poisoning.

Fumes Must Be Driven Off at Bottom

Dr. Hamilton reports a procedure at the Gary plant of the United States Steel Corporation in connection with safety in cleaning apparatus which has been used in the manufacture or storage of benzol: After washing out the empty tank and steaming it a cage of white mice is lowered into the tank. If the mice are overcome by the gas the flooding and steaming are repeated until the mice show no effects of the benzol. The use of a portable electric-driven gasblower to exhaust air through the drain pipes of tanks has been of much value. Because of the benzol vapor being heavier than air, it is necessary to exhaust at the bottom of the tanks, and drain pipes are conveniently located for this purpose.

Where benzol is used industrially as a solvent, it has been found necessary to install general room ventilation, rather than hope to confine the ventilation to a small number of exhaust hoods. In a scheme of general room ventilation it is well again to remember that benzol vapor is heavier than air and should be exhausted at the floor level. Our experience illustrates that an air change of thirty times an hour is desirable and that the flow of air toward the floor should be not less than 6 ft. per minute. The British standards in rooms where airplane wings are "doped" concurs with our ventilation of thirty changes an hour.

In conclusion, permit me to say that with an efficient method of physical examinations, with regular reexaminations; the changing of an employee's occupation as quickly as he shows either an abnormal reduction in number of blood cells or an unusual increase in coagulating time; together with adequate ventilation, benzol not only can, but is, being used without danger. If managements and employees are willing—and most of them are—to maintain reasonable safety requirements, benzol will continue to be a cheap and powerful solvent and need not be the cause of needless sickness or death to employees in industry.

Bricks From Dolomite

At the Columbus, Ohio, ceramic experiment station, the Bureau of Mines has made standard sized bricks from calcined dolomite and from raw dolomite, using 10 per cent of the flux Fe_2O_3, Al_2O_3, SiO_2. Calcined dolomite was found undesirable for making into bricks, as the mud slakes so rapidly, and all samples cracked badly on account of enormous shrinkage during drying and burning. Raw dolomite, together with 10 per cent flux, gives excellent promise. The bricks so burned to 1,450 deg. C. were sound, of high density and have not yet shown signs of slaking when subjected to the boiling test.

Grinding Cracks

A RATHER mysterious defect—almost always charged against incorrect heat-treatment—often appears as a close network of fine cracks covering a hardened article after finish grinding, causing large losses in rejections. A practiced eye can see faint "ghosts" of such markings on an apparently perfect surface. Pickling in 10 per cent sulphuric acid brings out the defect very plainly, developing the latent cracks rapidly (Fig. 1).

Messrs. Guillet, Galibourg and Beuret have investigated this matter and show how they were able to prevent the trouble, in *Revue de Métallurgie*, 1921, p. 213. They call attention to the fact that it is a quite different phenomenon to the exfoliation or flaking away of considerable areas of carbonized surfaces. Giolitti has investigated this, and ascribes it to sudden variations in carbon content in successive layers of the cemented zone. Messrs. Hanson and Hurst[1] think grinding cracks are due to segregation of free cementite in a thick network; when this was suppressed, rejections in a hardened ground 2½ per cent nickel steel were reduced to one-tenth their former number. Impurities in the steel also are thought to have some influence; furthermore, local heating during finishing must be avoided. Other authors have called attention to the great similarity which exists in the appearance of grinding cracks to the fine surface cracks on a wheel-burnt rail (shown by J. E. Howard[2] to be due to rapid heating under a slipping engine driver and sudden chilling by conduction) to the cracks appearing on steel mill rolls and to the cracks in the bore of large caliber guns.

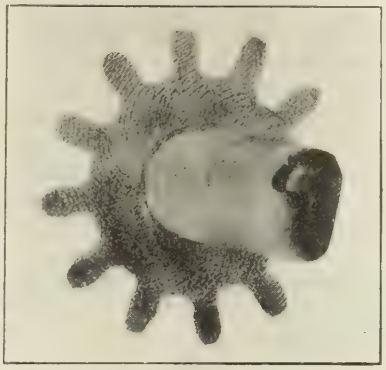


FIG. 1—GRINDING CRACKS DEVELOPED BY PICKLING THE SURFACE OF A HARDENED PINION

Many possible factors during heat-treatment or grinding might be responsible for the defect, but on account of the similarity with other imperfections found after close study to be due to transient overheating, the French authors decided to study the grinding process. Furthermore, a piece, uniformly carbonized and hardened, will show indications of cracking in certain places where the grinding conditions varied slightly. For instance, a closer network of cracks always occurs at the ends, where the wheel begins its work. Plane surfaces also seem more susceptible to the fault than cylinders. It is also very significant that whereas the specimens are file hard before grinding, those which develop cracks may easily be touched by the file after grinding. This alone would seem to indicate that they have lost some of the surface properties acquired by case-hardening, and this could best be explained by a slight heating during grinding.

To test these suppositions, a cylinder of low-carbon steel was carbonized to about 1 mm. depth over half its length only. The entire specimen was then quenched

[1] *J. Iron & Steel Institute*, 1919, I.

[2] Report to Interstate Commerce Commission on accident at Glenwood, W. Va. Abstracted in *Chem. & Met. Eng.*, May 11, 1921.

TABLE I—EXPERIMENTS ON PINIONS

Anneal	Speed of Part, r.p.m.	Result
30 min. at 150 deg.	500	No cracks on flat or shaft
30 min. at 150 deg.	120	Deep cracks on all surfaces
None	500	No cracks on flat or shaft
None	120	Deep cracks on all surfaces
None	120 (new wheel)	Deep cracks on all surfaces
None	120 (dirty wheel)	Deep cracks on all surfaces
None	440 (dirty wheel)	No cracks on flat or shaft

for maximum hardness, and ground from end to end. After pickling, cracks appeared on the carbonized end only. That part, on being broken, showed the usual coarse crystalline core, the fine crystalline muff, and, in addition, a very thin surface layer, colored bluish in tint. A micrograph of the surface layer where it was not carbonized (Fig. 2) clearly shows the effect of surface heating by the incipient decomposition of martensite areas into troostite.

Acting on the idea that superficial heating during grinding is responsible for the surface cracks under investigation, it was found possible to avoid them entirely by speeding up the rotation of the cylinder as high as possible. It is easy to see that this reduces not only the time the wheel is in contact (and the steel is being heated) but the time elapsing before the hot metal is cooled by being struck by the cooling fluid.

A number of experiments were performed, of which the following are typical:

Fifty-two bars of medium carbon crucible steel (made of blister bar) were selected. Bars 1 to 28 were carbonized 0.5 mm. and the others 1.0 mm. deep. All bars were quenched from 800 to 825 deg. C. Bars 1 to 15 and 29 to 40 were then tempered 30 minutes at 150 deg. C. Finally each lot was divided, one part being ground at 120 r.p.m. and the others at 500 r.p.m. The striking result followed that *all* bars ground when revolving at 120 r.p.m. developed quenching cracks, and *none* appeared in those ground when revolving at 500 r.p.m., notwithstanding the large variations in previous heat-treatment.

A number of hardened pinions were then studied, like those shown in Fig. 1, and which had always given

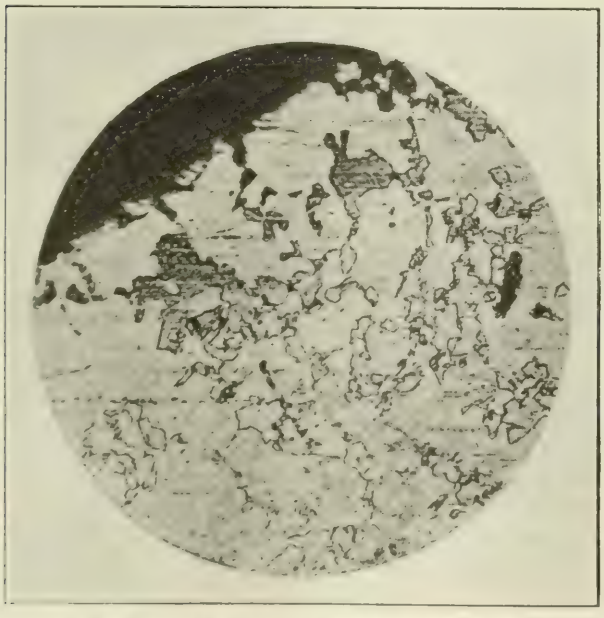
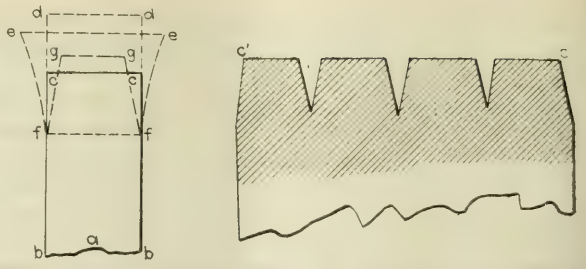


FIG. 2—DECOMPOSITION OF MARTENSITE NEAR SURFACE OF LOW-CARBON CYLINDER, QUENCHED AND GROUND



FIGS. 3 and 4—MECHANISM OF SURFACE CRACKING CAUSED BY TRANSIENT OVERHEATING

great trouble by cracking both on pinion and shaft. Table I contains the results. If the speed of the piece being ground is high enough, it seems that the condition of the grinding wheel is also only a minor factor.

Finally, it was found possible to develop the same kind of cracks at will, and without grinding, if a little molten copper be poured on a flat hardened surface, and then immediately drenched with a strong water jet.

The mechanism of the action has been explained by the late Prof. D. Tchernoff, in a paper entitled "On the Erosion of Steel Guns by Powder Gases."[3] While the tube is filled with the hot compressed gases resulting from an explosion of powder, the extreme surface of the metal is very highly heated, but almost instantly cooled after the escape of the gas by the conduction of the heat back into the underlying metal. If an elementary prism of metal supposed to be free of surroundings is heated on the end surface *cc* (Fig. 3) in the described manner, it would expand to a shape like *bfeefb*. On the other hand, if it were held in sidewise constraint, as it would be in a gun tube, the shape assumed during the transient heating would be *bddb*. It is apparent that if the heating has been high enough, the surface layers will be overstrained in compression and the metal at the surface will be plastically deformed. During cooling, therefore, the surface *dd* will contract more than enough to relieve the induced compressive stress and a state of tension will exist in the cold surface, now slightly higher than the original *cc*, which causes ruptures and radial cracks. The net result of this cycle of operations is shown in Fig. 4.

Italian Manufacturers of Tartaric Acid Merge

Commercial Attaché H. C. MacLean reports from Rome the announcement of a merger that has been effected under the auspices of the Credito Italiano between four important Italian companies manufacturing and trading in tartaric acid. The Societa Anonima L'Appula, whose main office is at Bari, has increased its capital to 25,000,000 lire, and has absorbed the Fabbrica Lombarda di Acido Tartarico, the Societa Anonima Industria Acido Tartarico and the Societa Italiana per i Derivati delle Cellulosa. The three latter companies have already ratified the conditions under which the merger will be effected.

Welding Cast Iron With Thermit

It is recommended to preheat cast-iron parts to be welded with Thermit no higher than a dull red heat. This is sufficient for perfect fusion with the hot metal being added. It has also been found that the total contraction of both cast iron and weld metal is sufficiently close so that there is little danger of hairline cracks perpendicular to the plane of break.

[3] *Revue de Métallurgie*, 1915.

Synopsis of Recent Chemical & Metallurgical Literature

Peanut Oil Industry as a Source of Byproducts

The commercial production of peanut oil, which has developed rapidly since 1915, has resulted in the appearance on the market of large quantities of byproducts that are used principally as feeds for livestock. One reason for the phenomenal growth of the industry is that the peanut can take the place of cotton as a cash crop in regions where the weevil has made the growing of the fiber crop unprofitable. The peanut has been a boon to the oil millers as well as to the planters, for the oil is produced in the same mills that are used for extracting cottonseed oil.

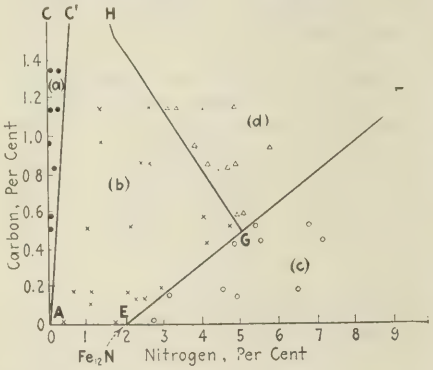
The processes of making peanut oil and the byproducts are described in Department Bulletin 1096, "Byproducts From Crushing Peanuts," by J. B. Reed, of the Bureau of Chemistry, just issued by the United States Department of Agriculture. The principal products other than the oil are peanut-oil cake, which is defined as the residue after extraction of part of the oil by pressure or solvents from peanut kernels, peanut-oil meal, which is the ground peanut-oil cake, and unhulled peanut-oil feed, which is the ground residue obtained after extraction of part of the oil from whole peanuts. The ingredients of the last-named feed must be designated as "peanut meal and hulls." Theoretically peanut-oil meal, which is made from the kernels after a part of the oil has been extracted, should contain no hulls, but because commercial methods cannot remove all the hulls, it is necessary to permit a small amount of hulls in the meal in order that the definition may be practical.

The bulletin contains detailed information and analysis of the different kinds of feeds and formulas for determining the percentage of hulls. Much of the information is technical and of interest only to feed analysts and officials having to do with the enforcement of feed laws.

Nitrogen in Steel

A series of steels and ore sample of cast iron were nitrogenized by Kiyoshi Kido[1] to various degrees by beating pulverized samples in a current of dry NH_3. They were then compressed in a small copper tube and magnetization-temperature curves obtained upon heating. One heating only was possible, since the alloy becomes unstable at temperatures higher than 700 deg. C.

Four magnetic change points were noted in addition to the well-known A_0 of cementite at 215 deg. C., and A_2 of ferrite at 750 deg. C.—viz., at 250, 350, 470 and 620 deg. C., respectively. Researches of Tschischewski[2] have given evidence of the existence of two nitrides $Fe_{12}N$ and Fe_2N. Low-carbon iron containing about 2 per cent N shows its most important magnetic change at 470 deg. C. This has been ascribed to $Fe_{12}N$. As the amount of N in low-carbon steel rises still further, another magnetic change at 250 deg. C. increases in importance—it is thought to be due to Fe_2N. The two other changes are ascribed to unknown "double carbides." The accompanying diagram shows the constitution of various alloys as determined in this manner.



Low-Pressure Absorption of Gasoline From Natural Gas

Many recent and surprising developments in low-pressure absorption practice for the recovery of gasoline from natural gas and the growing reluctance of certain purchasers of refined or partly refined products to take blended gasoline convinced the petroleum division of the Bureau of Mines that a detailed description of a large plant treating rich casinghead gas at low pressure would be of aid to the industry. Although the product of the plant described in this paper is blended, it has such a vapor pressure that blending is not necessary. Technical paper 263, by W. P. Dykema and A. A. Chenoweth, is entitled "Design and Operation of a Low-Pressure Absorption Plant."

This report deals with the construction, the operating methods, the many changes necessitated and the difficulties encountered in the recovery of gasoline from a rich casinghead natural gas by absorption at low pressure. The results of heat generated in the absorption towers are particularly noted, and a possible means of overcoming the undesirable effect of such heat is proposed.

The plant referred to was installed during the winter of 1916-17 in the Cushing oil field in Oklahoma. Far from a perfect result has been achieved in the plant; nevertheless a more or less detailed statement of the main features of the plant and its operation will probably interest, and, it is hoped, aid those persons operating or designing absorption plants to treat similar gases. The plant was designed and is operated as a low-pressure installation, the specification for the absorption tower calling for steel work to sustain a maximum pressure of 15 lb. per sq.in. The gas used comes from approximately thirty wells, drilled to the Bartlesville sand and producing oil and gas of good quality.

Part I of this paper includes a detailed outline of the plant and its regular operation with records of temperatures, pressures, production and changes in equipment. Part II considers data on the latent heat of absorbed gases and a proposed means of overcoming the increase in temperature of the oil as it circulates through the towers.

The paper may be obtained by applying to the United States Bureau of Mines, Washington, D. C.

The Quality of Motor Gasoline

For several years the Bureau of Mines has conducted surveys to determine the changes in motor gasoline being sold throughout the United States. The results of the sixth semi-annual survey are presented in the August *Reports of Investigations* (Serial No. 2,388) by A. D. Bauer, assistant petroleum chemist, and N. F. Le Jeune, assistant chemist.

The present survey shows that for the districts in which samples were collected the average gasoline is becoming more volatile instead of less so, as is sometimes supposed. This year's gasoline is much more volatile than that sold 2 years ago, and it has a somewhat better distillation range than last summer's samples. A comparison of the average figures for several years shows that motor gasoline is also becoming more uniform in character. The large seasonal change is disappearing, but "winter gasoline" still has a lower initial boiling point than "summer gasoline." This difference in volatility is made intentionally to facilitate starting the motor in cold weather. The end point shown in the present survey is slightly lower either

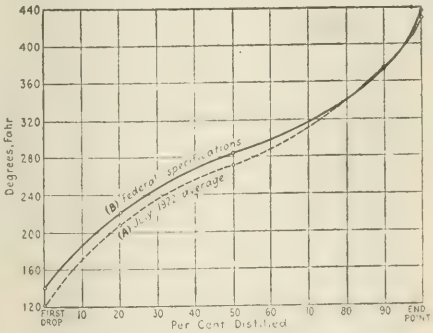


Fig. 1—Distillation curves for (*A*) Average quality of gasoline sold in July, 1922, and (*B*) gasoline meeting federal specifications.

[1] *Science Reports*, Imperial Tohoku University, vol. 10, p. 471.

[2] *J. Iron & Steel Inst.*, 1915. II.

than that of last winter or of the summer of 1921.

The average of the entire country considered as a whole does not show much change from a year ago, but samples from individual cities show some distinct changes. The average figures for Denver show that the initial point is lowered 15 deg. F., the 90 per cent point 14 deg. F. and the end point 21 deg. F., whereas the 20 and 50 per cent points increased 11 and 13 deg. F. respectively. This change may be due to the fact that Denver receives gasoline from one group of refineries at one period and from another group at other times. Of 132 samples collected in the present survey, ten failed to meet federal specifications (adopted Nov. 25, 1919) as regards the initial boiling point of 140 deg. F., and 61 samples failed at the 90 per cent point (374 deg. F.).

The city of Bartlesville, Okla., is included in the present survey, as it is in the center of the mid-continent field. The actual specific gravity at 60 deg. F., the corresponding A.P.I. gravity, the initial boiling point or first drop, the 20, 50 and 90 per cent points, the end point and average boiling point, and the percentage recovered in the receiver were determined and tabulated for each sample.

A distillation curve representing the average figures for the July, 1922, survey, and a curve showing motor gasoline meeting federal specifications are to be found in Fig. 1.

Brittleness of Tin Foil

Some interesting investigations on aluminum containing tin have been carried out by E. Heyn and E. Wetzel of the Kaiser Wilhelm Institut für Metallforschung at Neubabelsberg and have been published in the *Proceedings* of this Institute, and summarized in *The Engineer* for Aug. 18, 1922. The investigations arose from the attempts to elucidate the origin of the brittleness of certain tin foil, which when freshly rolled was as soft and pliable as the average material, but which after a few days became through and through brittle. The origin has been traced to a small amount of aluminum contained in the tin. Even 0.25 per cent of aluminum is sufficient to make the tin completely brittle in a short time, so that the foil breaks up on the slightest bending stress. The effect is probably due to great difference in electrolytic potential between tin and aluminum, which under moist atmospheric conditions results in the gradual conversion of the aluminum to aluminum oxide. The splitting process always commences at the surface and makes its way down into the center of the material. Tin which, owing to the above cause, has been rendered useless can be regenerated and completely freed from aluminum by melting, when the alumina remains as a gray residue. The addition of lead to the tin does not retard the advent of the brittleness, but the addition of 2 or more per cent of copper is advantageous.

Book Reviews

FLUIDITY AND PLASTICITY. By *Eugene C. Bingham.* 440 pp., no illustrations. New York: McGraw-Hill Book Co., Inc. Price, $4.

The author has brought together and attempted to co-ordinate the vast amount of information on the flow of materials under shearing stress which has hitherto been scattered through the journals; and the resulting volume is valuable and welcome. The subject matter falls into two categories—namely, instruments and methods for measuring rates of flow, together with the necessary mathematical theory; and the relations of the results of such measurements to the physical and chemical properties of the various fluid or semi-fluid materials in question.

It is in the second of these subjects that the author, as a chemist, seems to be most interested and most at home, and this part of his work is therefore the more satisfactory. A great number of interesting facts and relationships are described and such theory as is available or as the author has been able to devise for himself is used to systematize the material. The theoretical reasoning is sometimes not very convincing, and the author's enthusiasm over a pretty idea is apt to make him forget that what was a hypothesis on one page does not become a certainty merely by turning over a few pages and writing it down again. Furthermore, it is often quite impossible to tell, without referring to the original papers, how much of the argument is the author's and given on his own responsibility and how much is quotation. For while an admirable feature of the book is its very extensive bibliography and author index, the references given in the text are usually so vague and indefinite that one does not know just where to look or whether it is worth while to look at all.

For some readers these would be serious faults and in fact to get the best out of the book the reader should be sufficiently mature to have a good deal of critical judgment and be well past the stage of accepting things because they are written down as if with authority. But if the book is regarded in its proper light, not as a treatise or handbook but as a guide to the study of the relations or fluidity and plasticity to other properties, it will be suggestive and stimulating as well as extremely useful.

Since fluidity and plasticity are purely mechanical properties it is not to be wondered at that the discussion and theoretical treatment of instruments and methods of measurement are less satisfactory than the physico-chemical part of the work. The author does not exhibit the precision of thought necessary to the satisfactory exposition of this part of his subject matter. He is often careless or inconsistent about definitions, notation and the use of words. For example, shearing stress, which is the most fundamental and important of all the quantities with which he has to deal, is sometimes called shearing "force," but almost always "shear," which means something quite different.

As regards methods, the author confines his attention almost exclusively to the capillary type viscocimeter with which his own very extensive experimental work has been done. His discussion of the theory of this instrument is passable. He makes the common mistake of supposing that the entrance correction treated by Boussinesq is a part of the kinetic energy correction, but this makes no difference in the practical application of the equations. When he comes to his own particular specialty, the flow of "plastic" materials through capillary tubes, his disregard of logical accuracy is more injurious to his result; and his most trusted formula, equation 89, p. 225, is mathematically incompatible with the hypothesis from which it is supposed to follow (equation 73, p. 217). The theoretical treatment is defective and unsatisfactory in several other respects, as well.

But after mentioning some of the more striking faults of the book and hinting that the author's English is sometimes decidedly queer, the reviewer gladly returns to the earlier point of view, that the merits of the book far outweigh its defects. It might have been better done, but it is well worth having as it is, and the chemical public should be grateful for this monument to the author's industry.

EDGAR BUCKINGHAM.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

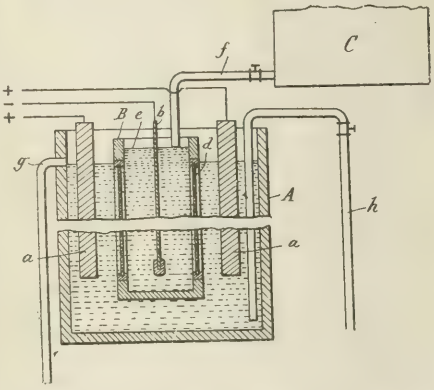
Aluminum Plating—Anselmo Ortiz, of Bayonne, N. J., notes that previous attempts to produce an aluminum coating on iron or steel articles by the hot-dipping process have resulted in a very rough surface (due to corrosion at very high temperature), or a coating consisting not of pure aluminum but an aluminum-iron alloy (when working at moderate temperatures). He proposes first to clean the steel article by pickling in 50 per cent ammonium citrate, washed and dried. Then it may be covered with a flux—a mixture of KCl, NaCl and $ZnCl_2$ melting below 600 deg. C. The aluminum is melted under a reducing atmosphere, held at 650 deg. C. or somewhat higher, and skimmed. The iron article is dipped into the bath at a rate just great enough so that the meniscus, where the aluminum wets the iron, is neither destroyed nor inverted. Its presence proves the wetting of the iron by the

aluminum, and insures that oxides or dirt at the junction will be removed from the contact. Under these conditions the steel will join to a smooth aluminum coating through a transition alloyed zone. (1,409,017; assigned to General Electric Co. March 7, 1922.)

Projectile Manufacture—John L. Cox recommends the following schedule of heat-treatments for armor-piercing shell made of nickel-chromium steel: After forging, cool quickly, at least through the critical range. Refining is done by reheating somewhat above Ac_3 and cooling rapidly to below the transformation. Grain refining preparatory to machining is done by reheating above Ac_3, cooling quickly to below Ar_1, reheating to just below Ac_1 and then cooling slowly. After rough machining, further grain refinement is done. Depending upon the caliber, it is reheated once or twice to 130 deg. C. above Ac_3, each time cooling rapidly through the transformation. Next a similar treatment is given 75 deg. C. above Ac_3. Maximum toughness is then acquired by quenching in warm water from 75 deg. C. below Ac_1, removing the projectile while fairly warm, to prevent cracking. Finish machining can then be done. Final hardening is done thus: First preheat the whole to just below Ac_1; then heat the forward part above Ac_3 by immersing the head gradually in a lead bath. It is then quenched by water jets to 120 deg. C. Immediately it is drawn for several hours in a bath of oil at 100 to 200 deg. C., depending upon the caliber and the composition. After cleaning, the base of the projectile is gradually immersed in molten lead, and drawn to about 70 deg. C. below Ac_1, then quenched in a water spray operating on the base only, so that a band of hot metal below the hardened point is untouched by the water. Then invert the projectile in a shallow bath of water, to keep the point cool. (1,407,254 and 255. Feb. 21, 1922.)

Alumina From Impure Ores—R. S. Sherwin of East St. Louis, Ill., claims that pure alumina may be recovered from low-grade bauxite, clays or aluminum-bearing residues from present processes as follows: Grind the raw material with enough lime to form $CaO.SiO_2$ with the contained silica and about one-half as much soda ash as necessary to make $Na_2O.Al_2O_3$ with the contained silica. The mixture is then sintered, and the clinker ground. Leaching with sodium hydrate solution (containing 4 molecules NaOH for each molecule of Al_2O_3) then removes the soluble aluminate, and leaves behind most of the insoluble lime silicate, if the temperature is maintained between 180 and 200 deg. F. Some silica also goes into solution, and it can be removed by digesting 2 hours in an autoclave at about 290 deg. F. Complete removal (requiring a longer time) is not required unless the Al_2O_3 is to be removed from solution by CO_2 gas. A somewhat more impure solution is suitable for the Bayer process (which precipitates Al_2O_3 by inoculating the solution with freshly precipitated $Al_2(OH)_3$ and agitating about 3 days). Alumina is then filtered off, enough of the solution evaporated to dryness to provide sodium for subsequent furnace charges, and the remainder used for another digestion. (1,422,004; assigned to the Aluminum Co. of America. July 4, 1922.)

Electrolytic Nickel—N. V. Hybinette, of Christiania, Norway, patents an improvement in his process for recovery of nickel from copper-nickel anodes (805,969; Nov. 28, 1905). As in the earlier patent, the cathode compartment *B* (see fig.) is supplied with fresh, pure nickel sulphate solution. Instead of maintaining this strictly neutral, a solution at 55 deg. C. containing 50 grams nickel sulphate and 2 grams H_2SO_4 per liter is introduced. The diaphragm *d* is not so porous as formerly, but is made of heavy cotton cloth, which permits the free SO_4 ions to migrate outward very rapidly; thus the actual conditions within compartment *B* are substantially neutral.



Maintaining a hydrostatic head of about an inch causes sufficient outward flow of liquid to prevent any copper entering the cathode compartment. Overflow electrolyte is withdrawn through *g*, and somewhat more impure liquid through *h*. This circulating liquid is purified of copper by cementation on nickel, of iron by reaction with nickel oxide, and the acid concentration is rebuilt by depositing nickel in a similar cell having insoluble anodes. Copper-nickel anodes made in an electric furnace have been found to be superior to the blast-furnace product, being denser and lower in iron and sulphur. (1,395,827. Nov. 1, 1921.)

Furnace Refining of Copper—Oliver C. Martin, of Richmond Hill, N. Y., patents an arrangement for refining copper. He utilizes a reverberatory furnace for continuous melting of cathodes or pigs of impure metal. These are side-charged, to protect the furnace walls and without opening the furnace, and the molten metal is drained out the end of the furnace as it is formed. Thence it is laundered into one of three furnaces built much after the style of a Pierce-Smith converter. These three are mounted symmetrically on a large turntable; while one is filling the second is poling and the third pouring into a casting machine of approved type. All furnaces are connected to waste-heat boilers. By means of such continuous operations, many economies may be effected. (1,400,892; assigned to Nichols Copper Co. Dec. 20, 1921.)

Manufacture of High-Silicon Sheets—Andrew Pinkerton, of Ben Avon, Pa., proposes to make high-silicon sheets (for electrical apparatus) of uniform thickness and having surfaces which will not peel and crack when the sheets are bent or sheared as follows: After the cold-rolling operation the sheets are pickled, washed and annealed. Pickling is necessary to remove the scale, but if this operation is done on annealed sheets, it requires much time and acid, and results in a very rough surface. (1,396,052; assigned to American Sheet & Tin Plate Co. Nov. 8, 1921.)

Regenerator for Furnaces Fired With Cold Dust—Paul Kühn, of Dortmund, Germany, proposes to avoid slagging in the checkerwork by coal ash as follows: Dusty gas leaves the furnace and passes through downtake and slag pocket in the usual way. The first section of the regenerator is built with sloping floor (and preferably on a movable sole plate so it can be quickly replaced). In action the dust is supposed to collect in these sloping flues and drip back into the slag pocket, from which the liquid is tapped periodically. The second portion of the regenerator is built at an angle with the first and has horizontal checkers from which, the inventor states, any dust which collects may be removed in powdered or granular condition. (1,421,259. June 27, 1922.)

Dichlorethylene—Felix Kaufler, of Munich, Germany, has patented the principle of converting tetrachlorethane to dichlorethylene at atmospheric pressure by passing it in gaseous form over a metallic catalyst with steam. It is said that the yield of crude dichlorethylene amounts to 88 per cent of the theoretical maximum. On fractional distillation, this crude product gives about 90 per cent of dichlorethylene which boils at 48 to 60 deg. C. The residue is unchanged tetrachlorethane. The process is assigned to the firm Dr. Alexander Wacker Gesellschaft für Electrochemische Industrie, Munich. (1,419,969. June 20, 1922.)

Black Powder—The use of artificial graphite from old electrodes, crucibles, etc., for glazing black powder is covered in a disclosure made by John R. Mardick, of New York City, and assigned to the Acheson Graphite Co., of Niagara Falls. It is claimed that when such waste graphite products are ground finely and used instead of natural graphite for glazing black powder grains it gives a more uniform covering and improved moisture resisting qualities, as well as increased sensitiveness, uniform progression of fire, and uniform velocity of explosion. (1,415,889. May 16, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Formaldehyde—Formaldehyde is produced by passing carbon monoxide, hydrogen and water vapor over a contact substance at a temperature of 240 to 350 deg. C. Suitable contact substances are unburnt porcelain, pumice, asbestos, coke or charcoal, preferably coated with a metallic deposit of copper, nickel, etc. (Br. Pat. 179,951. A. Heinemann, Berlin. July 5, 1922.)

Rustproof Steel—A coating composition to be applied to steel and iron surfaces to prevent rust and to convert existing rust into an inert form comprises an oxy-acid of phosphorus, an oxide of hydrate of chromium and a solvent of these, with or without oxides, hydrates or chromates of manganese, lead or nickel. According to one example, a mixture of lead oxide and orthophosphoric acid is dissolved in a mixture of wood spirit, acetone, ethyl alcohol and methylated spirits, and a mixture of chromium oxide and phosphorus acid is added thereto. According to another example, chromic hydroxide is digested in 24 hours with boiled linseed oil or other drying oil, with or without heating, orthophosphoric acid is then added and the mixture is agitated. Pigments possessing rust-reducing properties may be added. The composition after drying may be covered with a coating of paint, varnish, enamel or the like. (Br. Pat. 179,811. G. H. Howe, Birmingham, England. July 5, 1922.)

Paper Pulp—In the preparation of paper pulp from papyrus, the material is first boiled, steeped or retted, and then subjected to mechanical pressing with simultaneous washing to remove the pith, and then beaten to pulp. The removal of the pith may be effected during the pulping, the mechanical pressing being omitted. A preliminary grading may be effected by splitting off the bark either before or after the boiling or steeping. The waste products, mainly pith, are in wet condition subjected to great pressure, and formed into briquets, cakes, etc., in quantity sufficient to supply the entire fuel for the requirements of the process. (Br. Pat. 180,097; H. Steinhilber, Berlin. July 12, 1922.)

Aluminum—Aluminum is obtained by electrolysis of fused alumina mixed with barium oxide or metallic barium. Cryolite and fluorite may be added as fluxes. In an example, the alumina is first fused and barium oxide mixed with 10 per cent of powdered or fine-grained aluminum is then added, the addition being one-sixth of the weight of alumina. A little fluorspar may also be added. The bath is raised to 1,200 deg. C. by the oxidation of the aluminum and the reduction of the alumina by electrolysis then proceeds. In subsequent operations alumina is added and after fusion, aluminum mixed with a little alumina is also added, no further addition of barium oxide being necessary. Fluxing material is added to replace that volatilized. With a furnace containing 30 kg. of alumina using 20,000 amp. at a pressure of 7 volts, at least two operations per hour may be effected, each yielding 15 kg. of aluminum. (Br. Pat. 180,326, not yet accepted; M. Blasi, Barcelona, July 12, 1922.)

Extracting Vegetable Oils—Oils and fats are extracted from oleaginous vegetable matter by subjecting it, with or without previous preparation such as grinding, to the action of just sufficient solvent to soak it and then extracting the solvent and oil together under low pressure, say 1 to 10 kg. per sq.cm.

FIG.1.

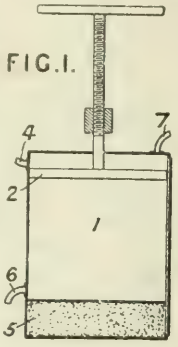
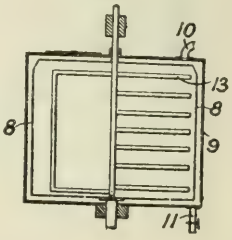


FIG.2.



The temperature of operation is kept below that of volatilization of the solvent, for example, 30 to 75 deg. C. In one form of apparatus, Fig. 1, a vessel 1, provided with a plunger 2, is used. The solvent is introduced by an inlet 4, and the oil and solvent run off through an outlet 6. The residual cake 5 may be heated to drive the solvent off through a pipe 7. Another form of apparatus, Fig. 2, consists of a rotary extractor 8, provided with an oppositely rotating agitator 13, and inclosed in a chamber 9 having an inlet 10 and an outlet 11. After soaking for, say, 10 to 20 minutes, the vegetable matter is subjected to rotation at a speed corresponding with the low pressure desired. (Br. Pat. 179,931; not yet accepted. Cellulose et Papiers Soc. de Recherches et d'Aplications, Paris. July 5, 1922.)

Formaldehyde—A gaseous mixture of carbon monoxide and hydrogen—for example, suction or water gas—is forced under pressure through a catalytic mass consisting of a hydrogen-activating catalyst such as nickel or cobalt and a hydrated metal oxide such as alumina or rare earths, the activity of the mass being maintained either by the introduction of steam into the gaseous mixture or by periodic treatment with steam. Formaldehyde is removed from the product by scrubbing with water; the residual gas, which contains methane and hydrogen, is of value as an illuminating gas. (Br. Pat. 180,016; E. J. Lush, London. July 12, 1922.)

Alcohol—Ethylene is removed from industrial gases by passing them through warm concentrated sulphuric acid containing as catalytic material a lower oxide or salt of a metal possessing more than one valency—namely, iron, cobalt, nickel, cerium, manganese, chromium, copper, lead, mercury, titanium or tin; the resulting ethyl hydrogen sulphate is then hydrolyzed in the known manner to produce alcohol or ether. Ferrous sulphate, cuprous chloride, copper sub-oxide and cuprous sulphate are specifically mentioned as catalysts; higher oxides and salts of the metals may be employed, provided that a reducing substance be present. The catalysts are insoluble in the sulphuric acid and are recovered from the product for re-use. The industrial gases referred to comprise natural gas, coke-oven gas, illuminating gas, gases obtained by cracking oils, schist gases and synthetic ethylenes. Preferably they are first freed from benzene, ammonia, water, sulphur compounds, acetylene hydrocarbons and ethylene homologs. An example is given of the recovery of ethylene from illuminating gas by passing the purified gas through a column containing pumice in which circulates sulphuric acid of 66 deg. Bé. containing 4 per cent copper sub-oxide and maintained at a temperature of 35 to 40 deg. C. (Br. Pat. 180,988; not yet accepted; A. A. L. J. Damiens, Seine, France. July 26, 1922.)

Destructive Distillation.—The destructive distillation of fuel, more particularly peat, is effected in ovens which are connected and operated after the manner of a continuous kiln. The apparatus comprises a number of chambers arranged in "ring" formation and heated by external flues in which are vertical partitions having openings alternately at top and bottom. In operation, one section of the chambers will be cooling off after firing, the cooling being effected by air which is passed through the flues on its way to the adjacent firing section. From this section the products of combustion are passed through the flues of other chambers in which the charges receive a preliminary heating. The operation is so controlled that a charge is heated up to its maximum temperature in about four days. (Br. Pat. 180,689; not yet accepted; Wessels & Wilhelmi, Hamburg, July 26, 1922.)

Hydrocarbons — Low-boiling hydrocarbons are produced by heating mineral oils, tar oils or other hydrocarbons under pressure in presence of hydrogen and a metal or alloy which melts at the reaction temperature. Soldering metals and bismuth alloys melting below 700 deg. C. are specified. (Br. Pat. 180,625; not yet accepted. M. Melamid, Freiburg. July 19, 1922.)

Inhibiting Oxidation—The oxidation of substances by the air—for instance, oils, essences, resins, animal tissues, latexes and rubber—is prevented or inhibited by the addition of a small proportion of a phenolic body, added in the form of solid, solution or vapor. According to the examples, styrolene, furfurol and acetaldehyde are stabilized by the addition of a solution of pyrogallol or guaiacol. The addition of hydroquinone to vegetable oils, such as linseed oil or nut oil, prevents their turning rancid. (Br. Pat. 181,365, not yet accepted. C. Moureu and C. Dufraisse, Paris. Aug. 2, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Dye Embargo and Potash Rates Stumbling Blocks in Final Tariff Debate

Bill Passes House After Conferees, as Instructed, Reverse Their First Action—Dye Embargo Killed and Potash Put on Free List

THE House of Representatives adopted the conference report on he Fordney-McCumber tariff bill on Friday, Sept. 15, after refusing to ecommit the report with instructions o reduce the rate on sugar. The re-ort came back to the House shorn of he dye embargo and potash tariff pro-isions, and an agreement was speedily eached to limit the general discussion n the report to one hour, divided equally between the Republicans and he Democrats.

Dye Rates

Chairman Fordney of the committee explained the action taken by the conferees to bring the report into conformity with the demands of the House. Intermediate coal-tar products were subjected to an ad valorem of 55 per cent and finished products to an ad valorem of 60 per cent, with an additional specific of 7c. per pound in each case. These rates are to remain in operation for two years, when each of the ad valorems will be reduced by 15 per cent. He was assisted by Representative Longworth, Republican, of Ohio, at whose insistence the dye embargo provisions were originally written into the bill.

Longworth Disappointed

"I do not deny that I was very greatly, even bitterly, disappointed at the result on Wednesday on the motion of the gentleman from Texas," said Mr. Longworth. "I am perfectly convinced that the restoration of potash to the free list means the absolute destruction of the industry in this country.

"I was even more bitterly disappointed at the action of the House in striking out the so-called dye embargo. That was not an embargo, for all the dyes that were necessary for any of the consumers of dyes in this country, which were not produced here and were not sold at a satisfactory price, could be imported in any quantity. Under this so-called embargo about 3,000 different dyes have been imported into this country within the last 6 months. They have been coming in ever since we have had this system and would have continued to do so if the system had been made permanent."

Numerous changes were made in the chemical schedule by the conference committee. As a general proposition, the Senate amendments to the chemical schedule were accepted. The bill as a whole is a Senate tariff. Of the 2,436 amendments, important and unimportant, which confronted the conferees, the Senate conferees receded from 71, 303 were compromised, and the House conferees agreed to 2,062 Senate changes.

Organic Acids

The conferees fixed a rate of 17c. per pound on citric acid, the House rate having been 12c. and the Senate rate 18c. Senate action in placing white arsenic on the free list was approved. The conferees struck out the Senate's rate of 4c. per pound on formic acid, with the effect of placing it in the basket clause at 25 per cent ad valorem, which was the House duty.

Alcohol

Senate action in making a rate of 3c. per pound on propyl alcohol was disagreed to and the House rate of 6c. was restored. The House rate of 6c. per pound on fusel oil was restored, in place of the Senate rate of 2c. A compromise rate of 12c. per gallon on methyl or wood alcohol was reached. The House rate of 15c. per gallon was restored on ethyl alcohol for non-beverage purposes.

Barium Salts

House rates on barium compounds were made lower than the Senate rates. These rates are 1c. per pound on carbonate precipitate; 1¼c. per pound on chloride; 4c. per pound on dioxide; 1¼c. per pound on hydroxide and 2c. per pound on barium nitrate. Comparative rates in the Underwood law were from one-fourth of a cent per pound to 15 per cent ad valorem. The duty in the Payne-Aldrich bill was 25 per cent ad valorem.

Camphor

The conferees did not change the rate of 1c. per pound on crude natural camphor and 6c. per pound on refined or synthetic camphor, but they eliminated the Senate amendment which would have imposed a duty of 25 per cent ad valorem whenever it could be shown to the satisfaction of the President that the production of synthetic camphor in the United States reaches

(Continued on page 616)

New Efforts Made for Dye Embargo

House Is Asked to Bar Imports for Three Months After Tariff Goes Into Effect

Although the provision inserted in the conference report on the tariff for another year's dye embargo, and possibly two, was denounced by the House, and overwhelmingly rejected last week, a new embargo plan appeared in Congress on Saturday, Sept. 16, to overcome the tariff agreement before it has been accepted by the Senate.

Representative Tilson of Connecticut introduced a joint resolution to extend the embargo 3 months. Senator Wadsworth of New York is sponsor for the resolution in the Senate. The House resolution reads:

> The dye and chemical control act of 1921, as extended, shall continue in full force and effect for 3 months after the date on which the tariff act of 1922 becomes effective, any provision in such act notwithstanding.

To Meet Administrative Difficulties

It is said that the agreement for an American valuation on dye duties is cumbersome and cannot be used by the customs officials at once, hence it is sought to have the embargo extended 3 months after the tariff goes into effect. This contention, placed before the Finance Committee by Treasure officials, is backed up by a letter from Secretary Mellon.

Secretary Mellon, in his letter written to Senator McLean of Connecticut, calls attention to the difficulties the customs officials will have in determining the American values, and says they should not be called upon to administer the American valuation system as to dyes immediately. He suggests, it is said, that some time be allowed for these officers to work out the American values on the different dyes.

King Will Not Oppose

Those favoring the extension of the embargo 3 months approached Senator King of Utah, a severe anti-embargo Senator, and asked him whether he would continue his opposition to the embargo as proposed in the joint resolution. His reply was that he was not disposed to do so if assured that the request was actually based upon administrative difficulties, and was not the forerunner of another move for a further extension when the 3 months' period expired. It is said that the dye interests would not give Senator King a definite promise that they would not seek another extension.

Eight-Hour Shift Recommended

Federated American Engineering Societies' Committee Reports 25 Per Cent Production Increase by Change From Twelve- to Eight-Hour Day

"THE tendency throughout the world is toward the abolition of the 12-hour shift," it is held by the report of the committee on work-periods of the American Engineering Council of the Federated American Engineering Societies, which was adopted after a long discussion by the executive board of the Council in Boston, Friday, Sept. 8. The report, in effect, finds that the two-shift day of 12 hours each is not an economic necessity in American industry.

"In almost every continuous industry," says the report, "there are plants which are operating on an 8-hour shift basis in competition with 12-hour shift plants." It is also shown that in practically every major continuous industry plants which have changed from 12 hours to 8 hours have increased the quantity of production per man up to as much as 25 per cent. In a few cases, the report states, the increase has been much higher. In the steel and iron industry, which is made the subject of a special report, it was found that "the change from the 12- to the 8-hour day has obtained results sufficient to compensate in whole or in part for the extra cost."

Advantages of 8-Hour Day

Other advantages of the 8-hour day in the steel and iron industry are described as increased efficiency, better morale, elimination of the "floating gang," which is maintained to give 12-hour men a day off a week, and greater prestige of the industry with the public.

Prof. Samuel McCune Lindsay of Columbia University, representing the Cabot Fund of Boston, officially styled the report as embodying the results of "the most important investigation of any industrial situation ever undertaken in this country." The Cabot Fund cooperated in the engineering investigation, which occupied nearly 2 years and covered practically every continuous industry in the United States. Professor Lindsay, who is president of the Academy of Political Science, authorized the statement that Prof. Henry R. Seager of Columbia, president of the American Economic Association, shared his general view.

All Major Industries Surveyed

The results of the industrial investigation, which, engineers said, will exercise a great influence on the general labor situation, were obtained through two lines of inquiry. One inquiry, embracing the steel and iron industry of the country, was directed by Bradley Stoughton of New York, former secretary of the American Institute of Mining and Metallurgical Engineers and former adjunct professor of metallurgy in Columbia University.

The second inquiry was directed by Horace B. Drury, industrial investigator and former member of the faculty of Ohio State University. Each inquiry was made the subject of a separate report, the whole investigation being in charge of the Council's committee on work-periods, of which Dr. H. E. Howe of Washington is chairman. Dr. Howe presented the report to the board. His associates on the committee are J. Parke Channing, L. P. Alford, Fred J. Miller and Dwight T. Farnham of New York; Morris L. Cooke of Philadelphia, and L. W. Wallace of Washington.

Presentation of the report by Dr. Howe caused a spirited discussion of 2 hours, during which President Cooley, urging adoption, asserted that the report was a remarkable contribution of the engineering profession toward the advancement of mankind. Others participating in the debate were Philip N. Moore of St. Louis, Prof. Joseph W. Roe of New York University, Irving E. Moulthrop of Boston and W. W. Varney of Cleveland, Calvert Townley of New York, E. S. Carman of Cleveland, John A. Stevens of Lowell, William Rolfe of St. Louis, and Messrs. Channing, Alford and Wallace, representing the committee on work-periods. The report was finally adopted by an overwhelming vote.

Iron and Steel Industry

The Stoughton report, covering iron and steel, asserts that the fact that already many plants operate successfully on the three-shift system indicates that profits need not suffer if the change is made with wisdom. The Stoughton report continues:

"The cost of all labor on either system at the blast furnace is less than $1 per ton of pig. Judge Gary testified before the Lockwood committee in New York in June, 1922, that the U. S. Steel Corporation could produce at $2 per ton less than its competitors. That shows what low overhead and technical skill can accomplish.

"The operating labor in the case of pig iron is from 5.8 to 8 per cent of the total manufacturing cost. Only a part of the labor in the industry is working the 12-hour day. If that labor was changed to the 8-hour day and paid as much per day as it is now getting for 12 hours work, even without securing any compensating advantages through increased efficiency, morale, etc., the total manufacturing cost of the product would be increased only from 3 to 15 per cent.

"This is in most cases less than the variations in cost already experienced by competing plants, due to difference in efficiency of equipment, technical skill, purchasing, location, capital resources, overhead expense and advantages due to good management.

The Stoughton Report

The Stoughton report finds that the 8-hour day makes better men physically and mentally, attracts a better class of men to the industry, improves conduct of operation, makes operation more uniform, betters the quality of product, uses less fuel, involves less waste and less repairs to equipment, and lengthens the life of apparatus. These advantages, the Stoughton report says, are bound up in "increased efficiency manifested in increased production per man per hour and per machine per day."

The 8-hour day, it is declared, produces better morale among workers, resulting in less absence and tardiness, less shirking and better discipline, which results from "better spirit of the men and the greater pressure which foremen can and will exert because they do not have to hold back out of sympathy for tired men."

According to the Stoughton report, which deals with the change from the 12-hour shift to the 8-hour shift in the iron and steel industry, there are altogether about 150,000 wage earners in the entire steel industry on 12-hour shifts.

The report makes recommendations for successful and economic change from the two-shift operation.

Chemical Engineers Dine Under Difficulty

Lack of Food Fails to Dampen Enthusiasm of Social Gathering

About seventy-five members of the American Institute of Chemical Engineers gathered at the Hotel Pennsylvania at dinner on Thursday of exposition week. There was the usual air of genial animation about the festive board and even when the dinner apparently gave out between entrée and dinner course, the diners scarcely noticed it. Finally Dr. Wesson went out and returned with the head waiter's scalp. Then food began to flow again. President Howard announced that at Council meeting it had been decided to hold the fall meeting at Richmond, Va. The membership and cash balances were reported to be in good condition and then Dr. Wesson was asked to tell the members something about Richmond. Tobacco and other large factories in the immediate vicinity, and Hopewell, within a day's excursion, make the prospect promising.

H. C. Parmelee urged the members to take an active interest in the law which has to do with the licensing of engineers. He expressed satisfaction that a committee of the Institute had been authorized to work with the Mining Engineers for the repeal of the law in New York State. J. V. N. Dorr was asked to give some impressions of Europe gathered on his recent trip. The dinner then broke up into groups, but very few broke away to go back to the exposition.

Take Fresh Start on Muscle Shoals

Engineers to Appoint Committee to Make Impartial Survey of Situation

The organized engineers of the country will attempt to solve the problems of Muscle Shoals. Through the executive board of the American Engineering Council at its closing session in Boston, Friday, Sept. 8, the Federated American Engineering Societies adopted a resolution authorizing the appointment of a committee of leading engineers to study thoroughly every phase of the Muscle Shoals problem in order to clear away what was described as "a hopeless muddle" which might lead to grave national disadvantage.

The board was moved to this action by the representatives of the Associated Engineering Societies of St. Louis, William E. Rolfe, city engineer of St. Louis, and Philip N. Moore, chairman of the War Minerals Relief Commission. In a spirited speech supporting the resolution, Mr. Moore denounced the proposal of Henry Ford, citing figures tending to show that acceptance of this proposal by the government would be unwise.

Biggest Volunteer Enterprise

The president of the Federated American Engineering Societies, Dean Mortimer E. Cooley of the University of Michigan, was directed "to appoint a committee of disinterested, distinguished and skillful engineers, to be selected by a special committee of the executive board and approved by the committee on procedure, for the purpose of making a thorough study of the assembled facts regarding the Muscle Shoals proposition, this committee to serve without compensation."

The Muscle Shoals resolution provides that the committee of engineers chosen to make the study "shall submit to the committee on procedure, and subsequently to the executive board, an outline of the scope of the investigation proposed."

The resolution, which gets under way one of the biggest volunteer enterprises ever undertaken by American engineers, declares that the results of this study will constitute "a service of great and possibly determinative value to the nation" in the settlement of the controversy over Muscle Shoals.

Calvert Townley of New York, vice-president of the Westinghouse Electric & Manufacturing Co. and past president of the American Institute of Electrical Engineers, is chairman of the committee on procedure, which will finally approve the personnel of the committee of engineers chosen. Other members of the committee are Dean Dexter S. Kimball of Cornell University, president of the American Society of Mechanical Engineers; J. Parke Channing of New York, mining engineer, prominent in the copper industry; W. E. Rolfe, St. Louis; W. W. Varney, Baltimore; H. E. Howe, Washington. President Cooley stated that concerted effort will be made to place at the disposal of the nation the services of America's best engineers.

This action by the executive board is the outcome of an attempt made 6 months ago by Mr. Moore at a meeting of the board in Chicago to enlist the impartial skill of the engineers in the Muscle Shoals proposition.

The executive board at its final sessions passed upon a great variety of questions of national engineering, social and political importance. In adopting the report of the committee on reforestration, presented by Chairman Charles H. MacDowell of Chicago, the engineers approved plans to extend the co-operation of their profession to the nation-wide movement to save the nation's forests. The engineers will work with the federal and state forestry services, farmers' organizations, the Boy Scouts and other bodies in the reforestration campaign. The aid of Will H. Hays also will be sought in an effort to acquaint the masses of the people with the danger to future generations of denuding the forests.

Favor Registration for Engineers

Gardner S. Williams of Ann Arbor, Mich., and W. B. Powell of Buffalo were appointed to draft a bill calling for the registration of engineers. This bill will incorporate the recommendations of the American Engineering Council's committee on registration of engineers.

In view of the expanding into national activities of the Council, Dr. William McClellan of Philadelphia, past president of the American Institute of Electrical Engineers, was added to the committee on foreign relations. Prof. James R. Withrow of Ohio State University was elected to the committee on membership and representation.

The executive board approved the universal contract form for building construction devised by the Department of Commerce. The board adjourned to meet in Washington on Jan. 4, when the annual meeting of the American Engineering Council also will be held. The members of the board were luncheon guests at the City Club of the Boston section of the Society of Civil Engineers.

Alpha Chi Sigma Entertains Exposition Guests

About fifty members of Alpha Chi Sigma, the professional chemical fraternity, were the guests of their New York brothers at the annual dinner given Sept. 14 in connection with the Eighth National Exposition of the Chemical Industries. Short talks were made by the principal national officers of the fraternity, including Stroud Jordan, of Brooklyn, its president; Arthur L. Davis of Wood River, Ill., secretary and treasurer; and Paul D. V. Manning, editor of the fraternity's monthly publication *The Hexagon*. A feature of the gathering was an account of the founding of the society given by F. J. Petura, general purchasing engineer, Henry L. Doherty Co. of New York.

Equipment Makers Perfect Association

Chemical Equipment Association Elects Officers and Discusses Relation to Exposition

At a meeting held in the Chemists' Club on the evening of Sept. 12, the manufacturers of chemical equipment and accessory plant apparatus formally adopted a constitution and bylaws and elected officers, thereby perfecting an organization that has been in the formative stage for the past year.

The constitution and bylaws were adopted as printed in *Chemical & Metallurgical Engineering*, p. 947, May 17, 1922, with the exception that provision was made for regional vice-presidents and for the separation of the office of secretary-treasurer, the secretary to be employed by the board of directors and to give his entire time to the work of the organization. The officers elected under this plan were: President, Pierce D. Schenck, Duriron Co.; vice-presidents, Walter E. Lummus, Walter E. Lummus Co.; Adolph Coors, Jr., Coors Porcelain Co.; George J. Lehman, Bethlehem Foundry & Machine Co.; treasurer, P. C. Kingsbury, General Ceramics Co.; directors—H. N. Spicer, Dorr Co.; J. I. Lyle, Carrier Engineering Corp.; P. S. Barnes, Pfaudler Co.; Edward C. Alford, T. Shriver & Co.; T. C. Oliver, Chemical Construction Co.; H. H. Alport, E. B. Badger & Sons Co.

It was announced that thirty-two firms have joined the association as active members and that four representatives of the business and technical press have taken associate membership.

A lively discussion was precipitated when the aims and objects of the association were discussed for the enlightenment of some of those present. When these points were cleared up by reference to the objects as stated in the constitution and through speeches of members who have been particularly active in the organization of the association, it developed that there was some misapprehension regarding the relation of the association to the Chemical Exposition. Some of those present expressed the sentiment that the association should take up with the management of the exposition certain questions relating to exhibitors' interests. It was stated emphatically by George Lehman that this had not been considered the primary purpose of the association and that it would not be undertaken except by direction of the members, now that the association is formally organized. Further discussion on the floor brought out the fact that it would be highly inadvisable for the association to engage in a controversial matter, particularly at its inception. This view finally prevailed and resulted in a decision to leave the satisfactory settlement of the relations between exhibitors and the exposition management to some other medium. Plans were immediately made for an active campaign for new members during exposition week.

Regulate Production of Coal, Says Hoover

Secretary of Commerce Addresses Chemical Salesmen's Association at Big Dinner

About 300 members of the Chemical Salesmen's Association and their guests celebrated the first anniversary of the founding of the association at dinner at the Hotel Commodore on Tuesday, Sept. 12. A very jazzy orchestra enlivened the dinner and a great many songs, old and new, were sung with more or less discord but much enthusiasm. The newly elected president of the association, Mr. Boyer, introduced Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association, as toastmaster. Dr. Herty introduced Secretary of Commerce Hoover, who addressed the association on the coal industry.

Mr. Hoover analyzed the troubles now extant in the coal industry and attributed them in part to the overproductive capacity of the industry. The 8,000 and more bituminous mines in this country can produce 50 per cent excess coal over that consumed during any given year. In other words, the industry can produce about 800,000,000 tons of coal, whereas about 500,000,000 tons is all that has ever been produced. This means that the average miner, not including the time he is on strike, is employed only 40 per cent of the time during the year, and this in turn means that the American public pays its miners a living wage for working less than 60 per cent of the time. The big problem of the industry then is to absorb or adjust in some way this overproduction. Secretary Hoover did not anticipate the findings of the commission, but went on to say that the creation of the commission which will be appointed by the President when the bill on this subject has been passed will be the most constructive step toward the solution of this whole situation, a situation which has been becoming more and more aggravated and which during the last 4 or 5 years has reduced 100,000,000 people to a point of industrial collapse for want of a prime necessity. Mr. Hoover's speech was most enthusiastically received by the association.

Banker Optimistic

In introducing S. H. Sisson, vice-president of the Guaranty Trust Co., who was the next speaker, Dr. Herty pointed out that the bankers had been quite cold on the whole toward the chemical industry, but expressed the belief that with legislation in their favor and a substantial business basis established, the bankers would collaborate with the chemists in establishing this vital industry on a firm basis.

Mr. Sisson took occasion to outline the factors which are both favorable and unfavorable in the industrial and economic situation of today. His summary was an optimistic one, since he felt that the normal productive capacity of this country will return and with it the buying power of the consumers. This, he felt, will more than counterbalance the instability of foreign exchange, the political isolation of the United States, the existence of wars, the discord among the allied powers and many other unfavorable factors. It will not be smooth sailing, but a hard and earnest effort in which the salesmen of the country will be a prominent factor in working out the success of the movement.

Tariff Bill in Final Stage

(Continued from page 613)

2,000,000 lb. a year. This amendment, based on production, was proposed to encourage development of the synthetic camphor industry principally by a St. Louis chemical company which embarked on this enterprise during the war and has since met stiff competition from the Japanese camphor monopoly.

Bleaching Powder

A compromise rate of three-tenths of a cent per pound was fixed on bleaching powder, or chlorinated lime. The Underwood rate was one-tenth of a cent, while the Payne-Aldrich rate was one-fifth of a cent. The Senate had proposed one-fifth of a cent and the House rate was three-fifths.

Vegetable Oils

Rates on vegetable oils were reduced by the conferees below the figures fixed in the Senate. Linseed oil was cut to $3\frac{5}{16}$c. per pound from $3\frac{1}{2}$c., the House rate having been $2\frac{1}{2}$c. Coconut oil was cut from 4c. to 2c. per pound and soya-bean oil from 3c. to $2\frac{1}{2}$c. per pound.

In comparing House and Senate ad valorem rates, or House ad valorems and those which appear in the final form of the bill, it must be recalled that the original House duties were based upon the American selling price, while the Senate ad valorems and those which appear in the new bill as completed were based upon the foreign price.

Personal

Dr. George Barsky, formerly a research assistant of Prof. Ralph H. McKee, department of chemical engineering, Columbia University, has been appointed to a position in the research department of the Abitibi Paper Co., Abitibi, Ont.

E. B. Benger has been appointed as chemical director of the Newburgh plant of E. I. du Pont de Nemours & Co. He was formerly director of the Redpath Laboratory at Parlin, N. J.

C. W. Crowell has recently resigned as chemist for the California-Hawaiian Sugar Refining Co., Crockett, Calif., to become plant superintendent at the works of the Rochester Germicide Co., Rochester, N. Y.

Dr. Ralph T. Goodwin, who took his degree this summer in the department of chemical engineering of Columbia University, has been appointed to a position in the research department of the Standard Oil Co. of New Jersey. Dr. Goodwin will have as his special concern the shale oil interests of that company.

Prof. Henry LeChatelier of Paris, France, has been elected to honorary membership in the American Society for Steel Treating.

E. W. McCullough has resigned as director of the division of mining and metallurgy, Republic Creosoting Co., to accept an appointment as consulting engineer for refuse disposal with the Indianapolis City Sanitary Commission. This work will involve the design and construction of a plant.

Vladimir Tuma, chemical engineer, has accepted a position with the B. F. Goodrich Co., Akron, Ohio, as the director of the technical library.

Obituary

Prof. Alexander Smith, formerly head of the department of chemistry at Columbia University, died at Edinburgh, Scotland, on Sept. 9. He was the son of Alexander W. Smith, a well-known musician of Edinburgh, where he was born on Sept. 11, 1865. He took his Bachelor's degree at the university of that city in 1886, and his Doctorate in Philosophy at Munich in 1889. He returned to the University of Edinburgh immediately, and for a year was assistant in chemistry at that institution, coming to America the following year to become professor at Wabash College, where he remained until 1894. Then he was called to Chicago, where he made a brilliant career, and in 1911 he was called to Columbia to become head of the department. He was a great teacher and the author of textbooks that became standard all over the world. Everyone knows his "Introduction to General Inorganic Chemistry," and his "General Chemistry for Colleges" has also been widely studied. Most of his works were translated into German, Russian, Italian and Portuguese, and are also extensively used where these languages are spoken. About 3 years ago while addressing a class he was overtaken by a fainting spell and shortly afterward was operated on for a tumor in his stomach. Following the operation he suffered from such intense depression that he was unable to take up his work, and he was an invalid from that time on. He worked with great intensity and used himself up in the process. We are glad to say that his "Inorganic Chemistry" has lately been thoroughly revised and brought down to date by Prof. James Kendall and others, so that its splendid qualities of order and exposition will not be lost to future students. He leaves a widow, formerly Miss Sarah Bowles of Memphis, Tenn., and two children.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Sulphuric Acid and Acid Phosphate Used in the Manufacture of Fertilizers

Statistics for Production, Stocks and Sales Reported by 198 Fertilizer Establishments, of Which 69 Manufactured Sulphuric Acid

ESTABLISHMENTS representing practically all of the fertilizer industry, with the exception of the dry mixing plants, have recently effected a co-operative arrangement with the Ceusus Bureau of the Department of Commerce whereby statistics of production and consumption are to be compiled and published twice each year. This marks the first step toward the compilation and distribution of current statistical information for this very important industry.

These data for the first 6 months of the current year are to be found in Tables I and II. From these tabulations it will be noted that the manufacturers of fertilizer producing sulphuric acid and acid phosphate had on hand Jan. 1, 1922, 129,610 net tons of sulphuric acid (basis of 50 deg. Bé.) and during the 6 months ended June 30, 1922, they produced 560,351 tons, consumed in the manufacture of fertilizer 650,189 tons and they had on hand June 30, 108,955 tons. The purchase of sulphuric acid during the 6 months period exceeded the sales by 155,429 tons.

Acid Phosphate Stocks

The same establishments reported that their stocks of acid phosphate on Jan. 1, 1922, amounted to 2,129,339 net tons, containing 32,818,093 units of available phosphoric acid, averaging 15.9 per cent. There was manufactured during the 6 months period 1,198,724 tons, containing 20,104,992 units, averaging 16 8 per cent. During the 6 months there was sold as acid phosphate, in bags and in bulk, 1,053,437 tons, containing 17,533,284 units of available phosphoric acid, averaging 16.8 per cent and there was used in manufactured goods sold 1,031,240 tons, with 15,523,095 units, or 15.1 per cent, making a total of acid phosphates sold as such or in manufactured goods of 2,378,424 tons, with 38,726,884 units of available phosphoric acid.

These data are compiled from reports made from 198 fertilizer establishments, of which 69 manufactured sulphuric acid. The next report will cover the 6 months ending Dec. 31, 1922.

TABLE I—PRODUCTION, SALES AND INVENTORY OF SULPHURIC ACID; (BASIS 50 DEG. BAUMÉ), JAN. 1 TO JUNE 30, 1922

	Net Tons
On hand Jan. 1, 1922	129,610
Manufactured	560,351
Total	689,961
Incoming shipments, on purchases *	245,081
Outgoing shipments, on sales to fertilizer manufacturers*	89,652
Net excess purchases over sales	155,429
Outgoing shipments, on sales for other purposes than making fertilizers	84,544
Used in making fertilizers	650,189
On hand June 30, 1922	108,955

* For the purpose of this compilation, transfers from or to other plants of the same company are reported as purchases or sales, as the case may be.

TABLE II—PRODUCTION, SALES AND INVENTORIES OF ACID PHOSPHATE, JAN. 1 TO JUNE 30, 1922

	Net Tons	Available Phosphoric Acid Total Units*	Per Cent Ave.	Per Cent Range
Inventory Jan. 1, 1922	2,129,339	32,818,093	15.9	.....
In pile as acid phosphate	1,490,332	25,469,294	17.1	15.3–18.0
In base and complete goods	639,007	7,348,799	11.5	6.5–24.0
Purchased	47,047	813,541	17.3	10.0–44.6
Transferred from other plants of same organization	34,554	513,353	14.9	3.1–36.0
Manufactured (made in plant reporting)	1,198,724	20,104,992	16.8	15.0–19.0
Total	3,409,664	54,249,979		
Sold as acid phosphate	1,053,437	17,533,284	16.8	.....
In bags	666,095	10,912,739	15.9	15.0–19.0
In bulk	387,342	6,620,545	17.1	14.4–18.0
Transferred to other plants of same organization	145,232	2,347,736	16.2	8.0–18.2
Inventory June 30, 1922	1,179,755	18,845,864	16.0	.....
In pile as acid phosphate	929,783	15,916,740	17.1	13.6–20.0
In base and complete goods	249,972	2,929,124	11.7	6.0–29.2
Total sales, transfers, and inventory	2,378,424	38,726,884		
Used in manufactured goods sold	1,031,240	15,523,095	15.1	.....

* A unit equals 20 lb. Total units, tons multiplied by per cent.

Exports and Imports of Chemicals

Statistics for July Show Export Trade Continuing on an Even Keel, With an Appreciable Decline in Imports

Exports of chemicals during July continued in approximately the same volume as during June. The total of chemical and allied products exported in July were valued at $8,463,366. The value of the purely chemical exports was $4,378,678. The total which includes the allied products is more than $2,000,000 greater than in July of 1921, whereas the value of chemical exports alone exceed those of July, 1921, by $1,300,000.

The July figures show the value of all exports of fertilizers and fertilizer materials to have been $1,082,850. Pigments, paints and varnishes were exported to the extent of $855,193. The value of explosives exports was $329,031. Exports of sulphate of ammonia increased from $95,633 in July of 1921 to $647,259 in July of 1922. The exports of caustic soda increased from 3,352,295 lb. in July of 1921 to 7,829,303 lb.

Exports of certain other chemicals in July were as follows: benzol, 18,282,045 lb.; acetic acid, 1,179,239 lb.; sulphuric acid, 1,034,756 lb.; boracic acid, 152,104 lb.; aluminum sulphate, 2,482,821 lb.; acetate of lime, 3,115,168 lb.; calcium carbide, 1,546,995 lb.; chloride of lime, 4,805,388 lb.; copper sulphate, 294,639 lb.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	146.67
Last week	146.67
September, 1921	147
September, 1920	267
April, 1918 (high)	286
April, 1921 (low)	140

By rare coincidence this index number has shown no change for the past week. Higher prices for citric acid, barium chloride and salt cake exactly balanced decreases due to lower prices for caustic soda and aniline oil.

Due to the interest in the exports of caustic soda at this time, the July forwardings to the different countries are set forth in detail as follows:

Countries of Destination	Quantity in Lb.	Countries of Destination	Quantity in Lb.
Denmark	100,142	French West Indies	1,120
Finland	33,000	Argentina	295,786
Germany	711,819	Brazil	842,544
Iceland	200	Chile	372,026
Italy	940,225	Colombia	117,443
Netherlands	158,324	Ecuador	13,700
Portugal	22,400	Peru	103,800
Canada	755,103	Uruguay	93,320
Costa Rica	21,204	Venezuela	38,093
Guatamala	6,640	China	407,238
Honduras	22,300	Java	282,990
Nicaragua	24,100	Hongkong	46,200
Mexico	595,726	Japan	345,840
Trinidad	5,963	Persia	8,000
Other British West Indies	45	Philippines	804,825
Cuba	586,531	Australia	43,680
Dominican Republic	6,700	Other Oceania	68
		Brit. So. Africa	3,160

Imports Decline

The imports of chemicals in July declined appreciably. The total value of chemicals on the free list imported in July was $6,021,730, while those on the dutiable list were valued at $3,365,518. This is a decline of $800,000 on the free list chemicals and over $1,000,000 on the dutiable chemicals. The totals in each instance, however, are materially larger than they were in July of 1921.

The imports of gums alone are responsible for a decline of more than $1,000,000. The total imports during July were valued at $1,961,353, whereas in June the value of the gum imports reached the unusual total of $2,994,463. Coal-tar products declined from $1,455,345 in June, 1922, to $809,638 in July. The following chemicals were imported during July in the quantities shown: muriate of ammonia, 813,323 lb.; sulphide of arsenic, 826,871 lb.; calcium salts, 6,746,896 lb.; benzol, 432,683 lb.; creosote oil, 3,898,528 gal.

The New York Market

New York, Sept. 17, 1922.

The domestic consumer has shown a greater buying interest during the past week and several price advances were recorded among leading interests. The approaching enactment of the new tariff has kept sellers somewhat cautious in booking any future business, but has stimulated speculation on the more important items. Importers are turning down shipment orders and are in fear of having a last-minute change in the tariff rate on some commodity already afloat. The present situation, in general, is very unsteady in the face of these adverse circumstances, and real tonnage business was not transacted during the interval. Producers in most instances were accepting orders for limited quantities only and consumers had to be contented with these allotments. The coal strike settlement was considered a distinctly favorable feature and recent rail peace negotiations were also regarded as an incentive to increased business. The last quarter seems to be considerably more active, and leading interests are of the opinion that business conditions will show a tremendous increase over the previous months. Copper carbonate was advanced 1c. per lb. by producers. Bleaching powder is heavily sold up for near future requirements and spot supplies are in a very strong position. Oxalic acid has ruled very steady since recent advances. Nitrite of soda was advanced during the week and considerable speculation has been noticed among prominent jobbers. Imported sulphide of soda was higher on spot, while shipment material was practically unobtainable. Sulphate of ammonia continues exceedingly strong and spot stocks for export are limited. Salt cake was quoted higher and so was red prussiate of potash. Domestic inquiry for caustic soda and soda ash continues heavy and a much larger volume of business was transacted during the past week. Yellow prussiate of soda was not as active as last week, but price changes were only fractional. Citric acid has been another of the features of the week's trading. Spot goods have been completely bought up and prices were materially advanced.

General and Special Chemicals

Acetate of Lime—The general tone is very firm and producers continue to quote $2.35 per 100 lb. The demand is steady and supplies seem to be sufficient to cover only regular orders.

Barium Carbonate and Chloride—Supplies of both products were very scarce on spot and the general condition appears much firmer. Importers of carbonate quote $65 per ton as an inside figure and hold chloride at $93 @$95 per ton.

Bichromate of Soda—Leading sellers were not eager to quote under 7½c. per lb. The demand was somewhat active for domestic consumption. The export market was irregular.

Carbon Bisulphide—Producers report a fair call for moderate quantities, with quotations held around 6¾@7c. per pound.

Carbonate of Copper—Producers advanced quotations to 20c. per lb. as an inside price and 21c. per lb. for smaller quantities. This represents an increase of 1@2c. per lb. over recent figures.

Caustic Soda—Leading interests are quoting export material at $3.55 per 100 lb. Material for domestic requirements is held around $3.75@$4 per 100 lb. Producers report moderate new business for contract at recent levels.

Nitrite of Soda—Both the domestic and imported goods have shown new strength and inside quotations range around 9c. per lb. Recently dealers have become interested and strong speculation has been noticeable.

Prussiate of Soda—Spot goods were somewhat easier during the latter part of the week, although there were no price reductions. Figures ranged around 23½@24c. per lb.

Salt Cake—Leading interests quoted higher prices for spot and shipment goods. The demand has shown a decided improvement and the lowest price heard was around $23 per ton, f.o.b. works.

Sulphide of Soda—Imported goods were advanced on spot, with 4¼c. per lb. the lowest price heard during the latter part of the week. Shipment material was practically sold up. Domestic factors quote fused 60-62 per cent at 4½ @5c. per lb.

Vegetable Oils

Castor Oil—Leading factors continue to quote the U.S.P. grade at 13c. per lb. and commercial at 12½c. The demand was moderate, with producers holding prices quite firm.

Coconut Oil—There were several transactions during the week for carload lots of Ceylon type at 7½c. per lb., nearby delivery. Ceylon type on spot closed around 8¼@8½c. per lb. Cochin type oil held at 8¾@9c. per lb.

Linseed Oil—The general condition of the market was unchanged from previous reports. Trading in prominent quarters showed very little improvement and spot prices ranged around 88c. per gal., in carload quantities. Imported oil sold at 72c. per gal., prompt shipment. Spot imported oil held around 82c. per gal. Interest in foreign goods was lively during the early part of the week, but later lessened appreciably.

The Metal Markets

Copper and zinc were quite active during the week. One of the notable features has been the advance in antimony. The high tariff rates reported by the conferees have also influenced other metals and the situation, in general, has shown a notable tendency toward livelier trading. Quicksilver and antimony have already reflected the tariff in their new prices. The official contract price of the American Smelting & Refining Co. continues at $5.90 New York. Sales have been quite satisfactory during the interval, due to the reluctance of the chief producers to make quotations. Leading copper producers quoted 14c. delivered. Several large tonnage sales were transacted at this level and the majority of sellers were inclined to hold prices firm at this level. An active market has advanced zinc prices. Sales were noted during the week around $6.40 for prompt shipment. A serious shortage is imminent if consumption keeps up at the present rate and production in leading quarters shows no sign of increasing.

Chilean Saltpeter Exports Show Increase for July

Chilean nitrate sales are increasing, according to a report to the Department of Commerce. July exports of nitrates are in excess of those effected during the month of June and the fact that the nitrate association's sales for future delivery subsequent to June 30 now approximate 500,000 tons presages increased exports during the coming months. A rumor is current to the effect that Germany is negotiating for 600,000 tons to supply a shortage resulting from its deficient production of synthetic nitrate.

The Chicago Market

CHICAGO, ILL., Sept. 14, 1922.

The industrial chemical market was steady and strong during the past 2 weeks. Buying interest continued on a good scale accompanied by price advances on several important items. There was a pronounced scarcity of spot supplies on quite a few items and this, coupled with the uncertainties of future deliveries, forced prices upward. A good increase in the volume of orders received was reported by several concerns, with practically no one offering any complaints.

General Chemicals

Caustic soda continued firm, with only moderate supplies available. The solid 76 per cent material was offered in one direction today at $3.25 per 100 lb. and the ground from the same source at $4.25. *Caustic potash* was in moderate demand, with spot goods offered at 6½c. per lb., basis 88-92 per cent. *Soda ash* moved in the regular channels at $2.25 per 100 lb. for material in cooperage.

Potash alums moved in a good volume and prices were steady. The iron-free lump was quoted at 5@5½c. per lb. and the powdered at 5½@6c. *Sal ammoniac* maintained a firm position and spot material was available at 7¾c. per lb. for the white granular. *Barium carbonate* was firm, with only moderate supplies available for immediate delivery at $80 per ton. *Barium chloride* continued firm and was offered at $110 per ton. *Bleach* was quoted higher at $2.35 per 100 lb. ex-warehouse and was reported to be moving very well. *Copperas* was firm and scarce, with small lots of the crystals offered at $1.40@$1.60 per 100 lb. ex-warehouse. *Copper sulphate* was very firm and moderate supplies were available at 6½c. per lb. *Carbon bisulphide* was rather scarce on spot and holders were reluctant to shade 7½c. per lb. *Carbon tetrachloride* was unsteady and supplies could have been purchased at 8½@9c. per lb. *Formaldehyde* was in a very firm position due to the strength of methanol and was quoted higher at 9½c. per lb. for barrels. *Furfural* was unchanged at 35c. per lb. in 1,000-lb. lots. *Glycerine* was very firm and refiners advanced their prices to 17½@18c. per lb. for the c.p. material in drums. *Lead acetate* was unchanged and supplies were offered at 11@12c. per lb. for the white crystals. *Magnesium metal powder* was offered at the lower figure of $1.20 per lb. for 100-lb. lots.

The coal shortage had a strengthening effect on the bichromate market and supplies were reported to be moving well with prices very firm. *Potash bichromate* of standard brand was quoted at 12c. per lb. and the *soda* at 9@9½c. *Potassium carbonate* moved in a fair way and was firm, with the 96-98 per cent material offered at 6c. per lb. *Potassium permanganate* was advanced by the leading dealers to 17@18c. per lb., price according to quantity. *Sodium bicarbonate* moved in a routine way and was firm at 2¼c. per lb. *Sodium cyanide* was in fair demand and the imported 128 per cent material sold at 25c. per lb. *Sodium fluoride* was quiet at 10½c. per lb. *Zinc chloride* was available at 6½@7c. per lb. for the granular.

Linseed Oil and Turpentine

Linseed oil continued to move in a fair volume, but the price was considered high by some of the dealers. The boiled oil was quoted at the close of today's market at $1.07 per gal. in single-bbl. lots with similar quantities of the raw at $1.05. *Turpentine* was in a position similar to linseed oil and was believed to be too high priced. It was quoted today by the leading interests at $1.40 per gal. for single-bbl. lots.

The Iron and Steel Market

PITTSBURGH, Sept. 15, 1922.

Operations at the steel plants continue to increase. More than a score of steel works blast furnaces have resumed operations since the end of August, when the low point fell in pig iron and steel production. There has been very little increase in the supply of Connellsville coke. The chief factor has been heavier deliveries of union-mined coal to byproduct ovens at steel plants.

From the production of the thirty steel companies which make monthly returns to the American Iron and Steel Institute it may be computed that the industry as a whole produced ingots during August at the average rate of 30,000,000 tons a year, and an estimate may be made that the opening rate of the month was about 34,000,000 tons and the closing rate about 26,000,000 tons. The high point of the year was a 37,000,000-ton rate, reached late in June.

There has been a substantial gain in steel production from the low rate of a fortnight ago, but it is doubtful whether the higher rate of last June will be attained in the near future. Railroad congestion is becoming severe and it is possible that the present rate of coal shipping cannot be maintained.

There are more cases of car shortages at steel plants. More than half the plants requiring box cars are short. A practically new development, of the past week, is the placing of embargoes against shipments to various points, consumers thus being shut off from the receipt of steel.

The steel market is now almost entirely one of early deliveries. Jobbers and manufacturing consumers exhibit little interest in late deliveries in December or the first quarter of the new year, and any earlier delivery is more or less a special delivery, involving a premium.

Steel Prices

It is understood in the trade that Carnegie prices are still 1.90c. on bars and 2c. on shapes and plates, deliveries being far in the future and by no means guaranteed. The common price among independents is 2.25c. for all three products, but a few are taking orders from regular customers at 2.15c. in the case of bars.

In sheets there are no sellers left on the 3.35c. basis except the Steel Corporation, the two most conservative independents having advanced to a 3.50c. basis. Reports are of sales at 3.75c., but such sales are probably of quite small volume, since at 3.50c. one can obtain delivery in a few weeks.

All the independent wire mills have advanced their prices $3 a ton, to 2.50c. for plain wire and $2.75 for nails. The prices are readily obtained by such mills as can make early deliveries. One mill is able to ship nails in a fortnight.

Under date of Sept. 13 the Reading Iron Co. has advanced wrought iron pipe 5½ points, or about $11 a ton, and it is expected other makers will follow. This is the second advance in a short time. The new basing discount is 34 per cent.

Pig Iron Uncertain

Question is being raised whether pig iron can hold its recently attained levels, and predictions that further advances will occur, to $40 or $50, have become quite unpopular. The demand for foundry iron, which has been quotable at $35@$36, valley basis, on the strength of some resales and some purchases of Buffalo iron, has been decidedly light. In the case of basic iron, the $30 valley price recently quoted as the nominal market is considered rather more than consumers are able to pay. It is stated positively that a steel works did buy 2,000 tons a few days ago at $32.50 valley, the iron coming from a speculative interest that had held it since early in the year, but on the other hand it is related that $30 has been quoted since then without finding any taker.

Production of merchant pig iron is very light and is increasing but little if at all. The blast-furnace resumptions have been almost wholly of steel works stacks, resulting from better coal deliveries to their attendant byproduct ovens. Offerings of Connellsville coke have increased a trifle, but are still very meager, and the chief dependence of merchant furnaces normally is on Connellsville coke or surplus coke from byproduct plants of steel interests. Connellsville furnace coke is quotable at $11@$11.50, but the market is made almost wholly by purchases of water-gas manufacturers, lime burners, brickyards, etc. Foundry coke is $12.50 @$13. For a fortnight car supplies in the Connellsville region have been no more than adequate, and in the past couple of days some really serious shortages have been reported. Nominally, the strike is still on in the region, but practically it is no longer of consequence, as increasing working forces and decreasing transportation facilities have now practically met.

Pittsburgh district steam coal has softened 25c. in the week, being now quotable at $4.25@$4.50. Connellsville steam coal is held at $4.25, but is not in favor in competition with Pittsburgh coal. Byproduct coal is $4.75@$5.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0 13½ – $0 13¾	.14 – .14¼
Acid, acetic, 28 per cent	100 lbs.	2 70 – 2 80	2 85 – 3 30
Acetic, 56 per cent	100 lbs.	5 35 – 5 40	5.45 – 5 75
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	11 00 – 11 25	11.50 – 12.00
Boric, crystals	lb.	11 – 11½	.11¾ – .12
Boric, powder	lb.	11 – 11½	.11¾ – .12½
Citric	lb.	..... –	.47 – .48
Hydrochloric	100 lb.	1.10 – 1 20	1.25 – 1 70
Hydrofluoric, 52 per cent	lb.	.11 – 11½	.11½ – .12
Lactic, 44 per cent tech	lb.	09½ – 10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – 04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3 25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06½	.06¾ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	17¼ – .17½	.17¾ – .18½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	10 00 – 10 50	..... – .....
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15 00 – 16 00	..... – .....
Sulphuric, 66 deg., drums	ton	19 00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.29½ – .30
Tartaric acid, imported, powdered	lb.	..... –	.30 – .31
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1 10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.34 – .35
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.34 – .35
Alum, ammonia, lump	lb.	.03¼ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03¾ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05½ – 06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2 25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07¼
Amylacetate tech	gal.	..... –	2.25 – 2 35
Arsenic, white, powdered	lb.	.08½ – 09	.09¼ – .09½
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	65.00 – 67 00	68 00 – 70 00
Barium chloride	ton	93.00 – 95 00	96.00 –100 00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05¼ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2 40	2.45 – 2.50
Calcium carbide	lb.	.04½ – 04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22 00 – 23 00	23.50 – 27 00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.83 – 85
Carbon bisulphide	lb.	.06¾ – .07	.07¼ – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04¼ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2 10
Copperas	ton	20.00 – 22 00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.20 – .20½	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.25 – 6.50	6.60 – 6.75
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.09 – .09¼	.09½ – .10
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00	..... – .....
Fullers earth—imported powdered—net	ton	30 00 – 32.00	..... – .....
Fusel oil, ref.	gal.	..... –	2.75 – 2.90
Fusel oil, crude	gal.	..... –	1.55 – 1.75
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.17 – .17½
Iodine, resublimed	lb.	..... –	4.40 – 4 50
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.10½ – .11½
Lead arsenate, powd	lb.	13 – 13½	.13½ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08 – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U. S. P.	100 lb.	2 00 – 2 25	2 30 – 2 50
Magnesium sulphate, technical	100 lb.	..... –	1.60 – 1 80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – 60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.12 – .12½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.10½ – .10¾	.11 – 11½
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07¼ – .08
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6 25
Potassium iodide	lb.	..... –	3.45 – 3 55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.14½ – .15	.15¼ – .16
Potassium prussiate, red	lb.	..... –	.95 – 1.00
Potassium prussiate, yellow	lb.	.35½ – .35¾	.36 – .36½
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06 – .06¼	.06¾ – .07
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1 60
Salt cake (bulk)	ton	25.00 –27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07¼ – .07½	.07¾ – .08
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13 00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09½	.09¾ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .03	.03¼ – .03½
Sodium nitrite	lb.	.09 – .09½	.09¾ – .09¾
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.23½ – .23¾	.24 – .24½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1 25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2 75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04½	.04¾ – .05
Sodium sulphite, crystals	lb.	.03½ – .03¾	.03¾ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	..... – .....
Talc—domestic powdered	ton	18 00 –25 00	..... – .....
Tin bichloride	lb.	.09 – .09½	.09¾ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran	lb.	.5½ – .06	.06½ – .06½
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.20 — .22
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.35 — 1.50
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.70 — .75
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.55 — .60
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15 —	$0.10
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.10 —	2.15
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.75 —	.77
Ortho-nitro-toluene	lb.	.10 —	.13
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.21 —	.22
Pyridine	gal.	1.75 —	2.75
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.25 —	.27
Salicylic acid, U. S. P	lb.	.29 —	.30
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12 —	.14
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.19½ —	$0.20
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.38 —	.42
Candellila, wax	lb.	.38 —	.40
Carnauba, No. 1	lb.	.40 —	.42
Carnauba No. 2, North Country	lb.	.25 —	.26
Carnauba, No. 3, North Country	lb.	.19 —	.19½
Japan	lb.	.15½ —	.16
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04¼ —	....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¾ —	.03¾
Paraffine waxes, refined, 125 m.p.	lb.	.03½ —	.03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09¼
Stearic acid, double pressed	lb.	.09½ —	.09¾
Stearic acid, triple pressed	lb.	.10¼ —	.10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.25 —	$6.30
Rosin E-I	280 lb.	6.35 —	6.40
Rosin K-N	280 lb.	6.45 —	6.65
Rosin W. G.-W. W	280 lb.	7.85 —	8.40
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.23 —	1.24
Wood turpentine, steam dist	gal.	1.15 —	....
Wood turpentine, dest. dist	gal.	1.12 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.38 —	....
Rosin oil, second run	gal.	.41 —	....
Rosin oil, third run	gal.	.48 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Quotations same as previous report.

Crude Rubber

Para—Upriver fine	lb.	$0.18½ —	.18½
Upriver coarse	lb.	.13½ —	.14
Upriver caucho ball	lb.	.13½ —	.13¾
Plantation—First latex crepe	lb.	.14½ —	.14¾
Ribbed smoked sheets	lb.	.14½ —	.14¾
Brown crepe, thin, clean	lb.	.13½ —	....
Amber crepe No. 1	lb.	.14 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12½ —	.12¾
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¼ —	.08½
Cocoanut oil, Cochin grade, in bbls	lb.	.08¾ —	.09
Corn oil, crude, in bbls	lb.	.10¼ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.06½ —	.07
Cottonseed oil, summer yellow	lb.	.09 —	.09¼
Cottonseed oil, winter yellow	lb.	.10 —	.10½
Linseed oil, raw, car lots (domestic)	gal.	.88 —	.88½
Linseed oil, raw, tank cars (domestic)	gal.	.83 —	.84
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.91
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.06¾ —	.07
Palm, Niger	lb.	.06 —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¼ —	.08½
Peanut oil, refined, in bbls	lb.	.12 —	.12½
Rapeseed oil, refined in bbls	gal.	.79 —	.80
Rapeseed oil, blown, in bbls	gal.	.86 —	.87
Soya bean oil (Manchurian), in bbls N. Y.	lb.	.11¾ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09⅞ —	....

FISH

Light pressed menhaden	gal.	$0.53 —	....
Yellow bleached menhaden	gal.	.54 —	.55
White bleached menhaden	gal.	.56 —	.57
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1, crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700 00	$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65 00 —	100 00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17 00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24 00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	16.00 —	20.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, No. 1 pottery grade	long ton	7.00 —	7.50
Feldspar, No. 2 pottery grade	long ton	5.75 —	5.90
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21 00 —	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05 —	.05¼
Graphite, Ceylon chip	lb.	.04 —	.04¼
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	....
Kieselguhr, f.o.b. N. Y	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00 —	15.00
Pumice stone, imported	lb.	.03 —	.05
Pumice stone, domestic, lump	lb.	.05 —	.05¾
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.70 —	.71
Shellac, orange superfine	lb.	.72 —	.73
Shellac, A. C. garnet	lb.	.70 —	.71
Shellac, T. N.	lb.	.68 —	.69
Silica, glass sand, f.o.b. Indiana	per ton	1 50 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2 50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16 00 —	16.00
Silica, building sand, f.o.b. Pa	per ton	2 00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7 50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00 —	17.00

Refractories

Prices remain unchanged.

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	72.00
Spiegeleisen, 19-21% Mn	gross ton	36 00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	1.85 —	2.00
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58 00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

Prices remain quotably unchanged.

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent	18.00-18.50
Antimony, wholesale lots, Chinese and Japanese	6.00-6.50
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32 00-33.00
Nickel, ingot and shot, resale	30.00-31.00
Monel metal, shot and blocks	32 00
Monel metal, ingots	35 00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	32.25
Lead, New York, spot	5.90
Lead, E. St. Louis, spot	5.625
Zinc, spot, New York	6.70-6.75
Zinc, spot, E. St. Louis	6.35-6.40

OTHER METALS

Silver (commercial)	oz.	$0.69⅝
Cadmium	lb.	1.20-1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$118.00
Iridium	oz.	2.75@3.00
Palladium	oz.	55.00@60.00
Mercury	75 lb.	67.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The Phœnix Portland Cement Co., Real Estate Trust Bldg., Philadelphia, Pa., with cement mill at Nazareth, Pa., has taken title to a tract of property at North Birmingham, totaling about 70 acres, heretofore held by the Sloss-Sheffield Steel & Iron Co., as a site for a new plant. Plans are being completed and a portion of the primary equipment ordered. Work will be placed under way on the initial buildings at an early date. The mill will have a capacity of about 1,500,000 bbl. of cement per year, and is estimated to cost in excess of $2,000,000, complete. Lindley C. Morton is president, and R. S. Scott, consulting engineer in charge.

TARRANT CITY—The Alabama Byproducts Co. has construction in progress on an addition to its byproducts coke plant, to increase the capacity close to 50 per cent. The new units will be placed in service at the earliest date.

Arizona

AJO—The New Cornelia Co. is perfecting plans for the construction of a new flotation plant at its local copper properties. Work will be commenced at an early date.

Arkansas

VAN BUREN—The Van Buren Glass Co., recently organized, has arranged to take over the plant of the Arkansas Products Co., which has been closed for about a year past, and which previously was devoted to the manufacture of glass tubing, etc. The new owner will remodel and improve the works, and plans to resume production at an early date. A new line of glassware will be manufactured at the plant.

California

NEVADA CITY—W. F. Heffinger and A. A. Tibbe, both of Oakland, Calif., are organizing a company to manufacture oil products, with pine needle extraction the primary basis of production. Negotiations are under way with the Chamber of Commerce, Nevada City, for a site for the proposed new mill. A selection will be made at an early date, and plans prepared.

Florida

JACKSONVILLE—The Kreiss Process Products Co., recently organized with a capital of $750,000, to manufacture potassium phosphate, etc., has preliminary plans in progress for the erection of a local plant, to be equipped for a monthly output of about 4,000 tons. It is estimated to cost approximately $75,000, including equipment. E. R. Taber is president, and Charles N. Weishans, secretary and treasurer.

Georgia

MCINTYRE—The Walden & Massengill Co., recently organized to operate a kaolin mine in this section, has tentative plans under consideration for the installation of a refining plant in the near future. H. A. Walden and C. G. Messengill head the company.

ATLANTA—The I. V. Sutphin Paper Co. has preliminary plans under way for the rebuilding of the portion of its local building, recently damaged by fire.

SAVANNAH—The Western Paper Makers' Chemical Co., Kalamazoo, Mich., with branch plants at Pensacola and Jacksonville, Fla., is reported to be planning for the establishment of a new paper mill in the vicinity of Savannah, with adjoining works for resin refining. The company is capitalized at $1,000,000, and recently acquired the properties of the Grecian-American Turpentine Co. in this section.

Illinois

JOLIET—The Illinois Wall Paper Co., affiliated with the York Card & Paper Co., York, Pa., Robert D. McCoy, president, has excavations under way for the construction of a new 1-story plant on Logan St., to be 100x300 ft., and estimated to cost about $75,000. R. C. Hoen, National Bank Bldg., Joliet, is architect.

Indiana

CARBON—The Carbon Firebrick & Coal Co. has completed plans for the erection of an addition to its local firebrick and refractory plant, to cost about $130,000, including machinery. E. E. Dean is president.

JEFFERSONVILLE—The Falls City Hydraulic Brick Co. is perfecting plans for the immediate installation of new equipment at its plant. A new kiln will also be constructed. Robert Akers is superintendent.

Kansas

ELDORADO—The Lewis Co. has commenced the construction of a new gasoline absorption plant in the Molter district. The plant will be equipped to handle about 5,000,000 cu.ft. of gas per day, with output averaging from 1 to 3 gal. per 1,000 cu.ft.

Louisiana

ELIZABETH—The Calcasieu Paper Mfg. Co., recently organized with a capital of $250,000, has plans under way for the erection of a new mill on local site for the production of kraft paper. A plant unit will also be installed for the production of tissue paper, with initial output approximating 10 tons per day. The project will include a byproducts plant for the recovery of turpentine and resin. The works will cost close to $150,000. R. M. Hallowell is president.

KENTWOOD—The local Chamber of Commerce has negotiations under way for the establishment of a new paper mill. A company will be organized to operate the plant. C. A. Kent, Sr., president of the Chamber of Commerce, is interested in the project.

Maine

WOODLAND—The St. Croix Paper Co. is reported to be planning for the rebuilding of the portion of its mill at Woodland Junction, recently destroyed by fire with loss of about $40,000.

Massachusetts

LEE—The Mountain Mill Paper Co. has commenced the erection of an addition to its mill at East Lee, comprising a main 1-story building, 40x150 ft., estimated to cost close to $60,000. It is planned to install equipment at an early date.

Michigan

KALAMAZOO—The Council is having plans prepared for the construction of a new municipal gas works, comprising six buildings, estimated to cost close to $2,000,000, including machinery. Burns & McDonnell 402 Interstate Bldg., Kansas City, Mo., are engineers. C. L. Miller is city manager.

JACKSON—The J. & S. Plating Co. has arranged for the establishment of a new metal plating plant at 112 East Washington St., and plan to commence operations at an early date. George J. Sights is general manager.

MUSKEGON — The Campbell-Wyant-Cannon Foundry Co., operating a foundry at Muskegon Heights, has perfected plans for the establishment of a large foundry in Muskegon proper, and will commence production at an early date. It is expected to provide facilities to give employment to a working force of about 1,000 men during the next few months. Frank E. McKee is vice-president.

New Jersey

GLOUCESTER—The Hinde & Dauch Paper Co., manufacturer of corrugated paper products, will soon commence the erection of an addition to its local mill, 1-story, 60x140 ft., to be used for increased capacity in the taping, slitting and affiliated departments.

WHIPPANY—R. B. McEwan & Sons are arranging for the rebuilding of the portion of their local paperboard mill, destroyed by fire, Aug. 30, with loss estimated at about $25,000. The fire originated in the boiler plant.

New Mexico

HILLSBORO—The Bonanza Mine is planning for improvements in its milling plant, including repairs to machinery, new operating equipment, etc., and purposes to place the mill in service at an early date.

New York

BUFFALO—The Angola Tire & Rubber Co., 270 North Division St., has awarded a contract to John A. Zoll, 398 Bird Ave., for the erection of a 1-story addition to its plant, 30x80 ft.

TONAWANDA—The J. Spaulding & Sons Co., 484 Broome St., New York, manufacturer of fiber products, has commenced the erection of a new 1- and 2-story addition to its plant at Tonawanda, 60x200 ft. and 100x300 ft., respectively, for general increase in production. The structures will cost about $250,000, including machinery. George F. Hardy, 309 Broadway, New York, is engineer.

North Carolina

BADIN—The Tallahassee Power Co. is planning for the installation of additional equipment at its local aluminum refining plant.

FLETCHER—George C. Sheehan, Asheville, N. C., is organizing a company to construct and operate a local brick and clay products manufacturing plant. A site totaling over 75 acres of land, including extensive clay deposits, has been acquired. The initial works are estimated to cost about $60,000.

Ohio

AKRON—Fire, Sept. 5, destroyed the plant of the Leo Meyer Co., North and Furnace Sts., comprising a 2-story building, equipped for rubber reclaiming operations, with loss estimated in excess of $80,000, including machinery. It is said that the plant will be rebuilt.

MIDDLETOWN—The Gardner-Harvey Paper Co., has awarded a contract to the F. H. Vaughn Building Co., Hamilton, O., for the erection of a new 1-story and part basement plant addition, 200x400 ft., estimated to cost close to $150,000. The plant will be used primarily for the manufacture of boxboard specialties, with machinery installation estimated to cost in excess of $30,000. Thomas H. Scott, P. A. Sorg Bldg., Middletown, is architect. E. T. Gardner is president.

YOUNGSTOWN—The Youngstown Steel Co. will soon commence the erection of a new mechanically operated puddling plant. It is expected to have the mill ready for service early in the coming year.

Oklahoma

DEWAR—The United States Zinc Smelting Co. is planning for the rebuilding of the portion of its local mill, including crusher and mixer rooms recently destroyed by fire, with loss reported at about $17,000.

ADA—The Choctaw Cotton Oil Co. has acquired the cottonseed oil mills of the Osage Cotton Oil Co., consisting of a number of plants in Oklahoma, Louisiana, Arkansas and Florida. The new owner will make a number of improvements and extensions in a number of the mills. A total of 26 oil mills, 1 oil refinery and 1 lard compounding plant will be operated. J. F. Phillips is president, and P. A. Norris, general manager.

Oregon

SALEM—The Oregon Pulp & Paper Co. has awarded a general contract to C. Van Patten & Son, Salem, for the erection of a new plant unit, consisting of a 4-story, reinforced-concrete mill, 75x80 ft., estimated to cost about $300,000, including machinery Work will be placed under way at an early date. Knighton & Howell, United States Bank Bldg., Portland, are architects.

Pennsylvania

KITTANNING—The Kittanning Limestone Co. will soon take bids for the erection of a new 2-story building at its plant, 25x100 ft.

BRACKENRIDGE—The Atlantic Bottle Co., 90 West Broadway, New York, is said to have tentative plans under consideration for the rebuilding of the portion of its local glass manufacturing plant, destroyed by fire, Aug. 28, with loss estimated at about $300,000, including equipment.

YORK—The Gilbert Wall Paper Co., 728 Linden Ave., has plans under way for the

erection of a new plant at State St. and the Pennsylvania Railroad. J. A. Dempwolf, Casset Bldg., is architect. Paul J. Gilbert is president.

JOHNSONBURG—The Kistler Leather Co., 319 A St., Boston, Mass., has preliminary plans under consideration for the rebuilding of its local leather plant, known as the Rolfe Tannery, recently destroyed by fire, with loss estimated at about $150,000, including equipment.

PITTSBURGH—The Keystone Hair Insulating Co., 1243 Spring Garden Ave., will commence the immediate erection of a 1-story addition to its plant to cost about $42,000. Plans have been filed.

PHILADELPHIA—The Alemite Grease Cartridge Co., New York, represented by Charles M. Russell, 50 Church St., recently organized with a capital of $500,000, to manufacture lubricating greases, etc., has work under way on the establishment of a local plant, to be equipped for an initial capacity of about 20,000 grease-filled cartridges per day. The company is headed by C. E. Roberts and E. C. Landgren.

Tennessee

KNOXVILLE—The Knoxville Gas Co. is planning for extensions and improvements in its plant, including the installation of new equipment, estimated to cost close to $200,000. Alfred W. Young is president.

NASHVILLE—The Federal Chemical Co. is said to be planning for the rebuilding of the portion of its local acid works, destroyed by fire, Aug. 28, with loss estimated in excess of $150,000.

Texas

HOUSTON—C. A. Benton, 720 Oxford St., Monrose, Houston, has plans under way for the establishment of a new plant for the manufacture of pressed brick and other burned clay products. A list of equipment for installation will be arranged at an early date. A site for the plant has been selected.

ODESSA—A. P. Jordan, Winters, Tex., has organized a company to construct and operate a plant near Odessa for the manufacture of gypsum wall plaster. A complete refinery will be installed, with equipment to provide for an initial output of about 70 tons of plaster per day. A site for the mill, including raw material deposits adjoining, has been acquired. The plant is estimated to cost close to $40,000.

ROBSTOWN—W. C. Craig, Brownsville, Tex., is perfecting plans for the establishment of a local plant for the manufacture of brick and kindred burned clay products. A site has been secured.

WICHITA FALLS—The Empire Gas & Fuel Co., operated by the Cities Service Co., 60 Wall St., New York, has acquired the plants and oil properties of the Planet Petroleum Co., comprising more than 200 acres of land in the Electra and South Electra fields, for a consideration said to be about $3,000,000. The present leases and works have a daily output of about 5,000 bbl., and the new owner plans for enlargements and improvements.

Utah

SALT LAKE CITY—The Utah Oil Refinery Co., a subsidiary of the Midwest Refining Co., operated by the Standard Oil Co. of Indiana, Indianapolis, has plans in progress for the erection of an addition to its local oil-refining plant, to increase the capacity from 5,000 to 6,000 bbl. of crude oil per day. Two new crude oil stills, 3 high-pressure stills and auxiliary equipment will be installed.

Capital Increases, Etc.

THE CAYUGA ROCK SALT CO., Harrisburg, Pa., has filed notice of increase in capital from $500,000 to $800,000, for general expansion.

THE PITTSBURGH CRUCIBLE STEEL CO., Empire Bldg., Pittsburgh, Pa., has arranged for a bond issue of $150,000, for general operations, expansion, etc.

THE ATLANTIC DRIER & VARNISH CO., 57 Front St., New York, N. Y., manufacturer of varnishes and other paint products, has arranged for an issue of 5,000 shares of preferred stock and 10,000 shares of common stock, the proceeds to be used for general expansion.

ALEXANDER SEIDLER, INC., Newark, N. J., recently organized with a capital of $500,000, to manufacture chemicals, chemical by-products and affiliated specialties, will form a consolidation of the Alexander Seidler Co., 2 Orange St., and the Meyer & Carmody Import Co., both of Newark. The merged organization will extend its line of production. Alexander Seidler is president.

THE GENERAL PETROLEUM CORP., 71 Broadway, New York, is disposing of a note issue of $5,000,000, the proceeds to be used in part for general operations and proposed expansion.

THE TARX CHEMICAL CO., Chicago, Ill., has added 2,000 shares of stock, no par value, to its capitalization of $25,000, for proposed expansion.

THE ATLAS POWDER CO., 200 5th Ave., New York, has disposed of a stock issue of $4,080,000, a portion of the proceeds to be used for general operations, financing, etc.

THE EASTERN STRAWBOARD CO., Manchester, Conn., has filed notice of dissolution under state laws.

THE W. S. ALLING RUBBER CO., Norwich, Conn., has filed notice of increase in capital from $200,000 to $350,000.

Industrial Developments

GLASS—The Macbeth-Evans Glass Co., Pittsburgh, Pa., is arranging for the immediate resumption of production in the idle portion of its plant at Elwood, Ind., comprising one complete plant unit. This will place the works on a capacity basis for the first time in a number of months. Additions will be made to the working force.

The Wichita Falls Window Glass Co., Wichita Falls, Tex., is planning for the reopening of its plant early in October, following a curtailment of a number of months. It is said that the works will return to hand-blowing method of production, discarding the automatic process. Improvements will be made.

Glass factories at Millville, N. J., giving employment to a total of about 3,000 operatives, are delaying the resumption of production owing to difficulty in securing fuel. A number of plants purpose to install oil furnaces unless the situation improves.

Owing to car shortage, the Pennsylvania Glass Sand Co., has been compelled to curtail operations at its Keystone Works, Mapleton, Pa. It is expected to resume capacity production at an early date.

CERAMIC—The West Branch Brick Works, Renovo, Pa., has resumed production at its local plant, following a period of curtailment. It is expected to increase the present working force in the near future.

The Harbison-Walker Refractories Co., Pittsburgh, Pa., is maintaining capacity production at its plants at Flemington, Mill Hall and Farrandsville, Pa., with full working forces. An effort is being made, it is said, to obtain additional employees at the plants. Wages have been advanced from 6 to 10 cents an hour.

The Frankford Brick Co., Philadelphia, Pa., has adopted a production schedule of 35,000 bricks a day, and expects to maintain this basis for an indefinite period.

A number of brick plants in Eastern Carolina districts have been forced to suspend production on account of the railroad strike and fuel shortage.

LEATHER—The Standard Kid Co., Wilmington, Del., specializing in the manufacture of glazed kid, has adopted a production schedule of about 80 per cent of capacity, and has sufficient orders on hand to maintain this basis for a number of months to come.

Hide tackers at the plant of the A. C. Lawrence Leather Co., Peabody, Mass., have made a wage demand from 11½ to 12½ cents per hide. The men have been averaging from $35 to $44 a week, and ask for $50 average per week.

The New Castle Leather Co., Wilmington, Del., is operating at about 75 per cent of full capacity, and will maintain this schedule for an indefinite period.

The Beadenkopf Leather Co., Wilmington, Del., has resumed operations at its local plants, and plans to increase the present production schedule in the near future.

Robert Foerderer, Inc., Philadelphia, Pa., manufacturer of patent leather, has adopted a capacity production basis at its tannery. The plant was forced to curtail recently due to a shortage of raw skins.

IRON AND STEEL—The Replogle Steel Co., Dover, N. J., is arranging to blow in another blast furnace at its Wharton plant. Wages have recently been advanced 5 cents an hour at the mills. The iron ore properties of the company at Mount Hope have been reopened, giving employment to about 400 men.

The Bethlehem Steel Co., has blown in another furnace at its plant at Steelton, Pa. An additional battery of coke ovens has also been started.

The Lukens Steel Co. is maintaining active production at its Coatesville, Pa., plant, used for the manufacture of steel sheets, giving employment to close to 3,000 men. Wages have been advanced from 25 to 30 cents an hour, effective Sept. 15.

The Shenango Furnace Co., Sharpsville, Pa., has blown in its local blast furnace, following a shut-down for about 5 weeks.

The Valley Mould & Iron Co., Youngstown, O., has resumed operations at its plant, following a recent curtailment due to coal and coke shortage.

The American Rolling Mill Co., Middletown, O., is maintaining active production at its plant, giving employment to a full working force in the majority of departments. Wages of laborers have been advanced 6 cents an hour, and proportionate increases have been made in the wages of other operatives. Salaried employees have been granted a 10 per cent advance.

The Gulf States Steel Co., Birmingham, Ala., has adopted a double working shift at its 13-in. mill at the Gadsden, Ala., steel works. The 20-in. mill has recently been placed in operation for the first time since 1920.

The Glasgow Iron Co., Pottstown, Pa., is running full at its local mills, and has advanced the puddling rate from $7 to $8 a ton. Laborers have been granted an increase of from 27½ to 30 cents an hour.

The Colorado Fuel & Iron Co., Pueblo, Colo., has resumed operations in all departments with the exception of the rail mill, following a curtailment for a number of weeks. Wages of all classes of employees at the plant have been increased.

MISCELLANEOUS—The Bethlehem Spark Plug Co., Bethlehem, Pa., manufacturer of porcelain spark plugs, is operating its plant at capacity, with two departments working on a 14-hour day basis.

The Electric Hose & Rubber Co., Wilmington, Del., manufacturer of heavy rubber products, has advanced production to include a night shift in addition to regular day operation. Additional operatives are being employed.

The United States Industrial Alcohol Co., New York, has advanced production to a capacity schedule at its three plants at New Orleans, La., which have been running on a half-time basis for a number of months past. Employment will be given to about 500 men.

Owing to the high cost of coal, ranging from a former basis of $4 a ton to a present rate of $11 a ton, the Durex Chemical Co., Sweetwater, Tex., has closed down its local plant, used for the manufacture of barium compounds, for an indefinite period.

The Traveler Rubber Co., Bethlehem, Pa., has adopted an operating schedule of 450 automobile tires a day, as compared with about 75 tires daily at this time last year. The plant is giving employment to about 160 men, and has orders on hand to insure the present basis of production for a number of months to come.

The Exeloid Co., Stroudsburg, Pa., manufacturer of celluloid toys and kindred products, is planning for the reopening of its local plant, following a shut down for some time past.

New Companies

THE BELLBY NATURAL GASOLINE CO., Wichita Falls, Tex., has been incorporated with a capital of $150,000, to operate a gasoline refining plant. The incorporators are J. F. Darby, O. J. McKnight and W. K. Campbell, all of Wichita Falls.

THE TRINITY PAPER MILLS CORP., care of Boyce & Magee, Dover, Del., representatives, has been incorporated under state laws with a capital of $6,000,000, to manufacture paper and pulp products.

THE VELVETONE PRODUCTS CORP., New York, N. Y., care of J. J. Ryan, 355 East 149th St., New York, representative, has been incorporated with a capital of $10,000, to manufacture polishes, etc. The incorporators are J. and D. S. Rouse, and S. K. Haines.

THE ARKANSAS HOMESTEAD OIL CO., Fort Smith, Ark., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are Stephen Gilbert, Charles Clark and Hugh Johnson, all of Fort Smith.

THE GEES-HAMMOND CO., Springfield, Mo., has been incorporated with a capital of $100,000, to manufacture soaps and kindred products. The incorporators are John J. Gees and J. M. Hammond, both of Springfield.

THE SUPERIOR MAGNESITE PRODUCTS CO., Escanaba, Mich., has been incorporated with a capital of $25,000, to manufacture magne-

site specialties. The incorporators are P. L. Sullivan, E. W. Sivertsen and W. J. Clark, all of Escanaba.

THE R. E. CARPENTER CO., Henry St., Elizabeth, N. J., has been incorporated with a capital of $50,000, to manufacture chemical products. The incorporators are Stephen France, A. Vance Pierson and William R. Morris, all of Elizabeth.

THE STANDARD ENAMELING & MFG. CO., Camden, N. J., care of A. Moulton McNutt, 207 Market St., representative, has been incorporated with a capital of $125,000, to manufacture enameled products. The incorporators are Orlando S. Watts, John Predow and Morris Redi, all of Camden.

M. L. ULLMAN, INC., New York, N. Y., care of Sigmund Honig, 799 Broadway, representative, has been incorporated with a capital of $20,000, to manufacture chemicals and affiliated products. The incorporators are C. H. Halper, L. Arnoff and M. L. Ullman.

THE FIBRE PRODUCTS CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture fiber goods. Arthur N. Rice, 4 Liberty Square, Boston, is president and treasurer.

THE ARLINGTON PAINT & VARNISH CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $7,500,000 to manufacture paints, varnishes, stains, etc.

THE CALDWELL OIL & REFINING CO., Louisville, Ky., has been incorporated with a nominal capital of $5,000, to manufacture refined petroleum products. The incorporators are Farley M. Caldwell, William Yentch and R. Sterling Sanford, all of Louisville.

THE COLUMBIA BRICK CO., East Orange, N. J., has been incorporated with a capital of 5,000 shares of stock, no par value, to manufacture brick and kindred burned clay products. The incorporators are Richard and Daniel Reagan, Washington St., East Orange.

THE PROGRESSIVE FOUNDRY CO., Rochester, N. Y., care of Crittenden & Crittenden, Powers Bldg., representative, has been incorporated with a capital of $100,000, to manufacture iron, steel and other metal castings. The incorporators are P. Bittner, C. Bennett, and C. Hobbing.

THE EUREKA CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by Vincent Ambrosiano, 104 London St., East Boston.

THE KLEN-ZIT MFG. CO., Portland, Me., has been incorporated with a capital of $50,000, to manufacture chemical specialties. E. Sturdivant is president, and H. P. Sweetser, Portland, treasurer. The last noted represents the company.

THE OTSTOT DEVELOPMENT CO., Blackwell, Okla., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated with a capital of $250,000, under Delaware laws, to manufacture petrcleum products. The incorporators are R. Otstot, Edward Shaft, Blackwell; and T. K. Vance, Enid, Okla.

THE HOOSIER FERTILIZER CO., 1400 North Halsted St., Chicago, Ill., has been incorporated with a capital of $40,000, to manufacture fertilizer products. The incorporators are Samuel L. Sarnatzky and Barnard Margolis.

THE MILNE FOUNDRY CO., Schenectady, N. Y., care of L. W. Block, Albany, N. Y., representative, has been incorporated with a capital of $100,000, to manufacture iron, steel and other metal castings. The incorporators are W. H. Milne, J. E. Laurie and G. C. Ratchford, all of Schenectady.

THE ORRITE CO., Nashville, Tenn., has been incorporated with a capital of $200,000, to manufacture composition stone and other composition products. The incorporators are W. H. Millard, Arthur W. Vantrease and King Sparks, all of Nashville.

THE SALEM FIBRE PRODUCTS CO., Salem, Mass., has been incorporated with a capital of $25,000, to manufacture fiber specialties. Everett B. Cook, Salem, is president; and Jennie O. Cook, Beverly, Mass., treasurer. The last noted represents the company.

THE GYPSUM ENGINEERING & MFG. CO., Room 717, 111 West Washington St., Chicago, Ill., has been organized under state laws to manufacture gypsum specialties, and magnesite byproducts. The incorporators are Willard L. King, Sanson Gusdorf, and Robert I. Rheinstrom.

THE STICKEL-HEFTER YEAST CO., Bedford Park, N. J., has been incorporated with a capital of $500,000, to manufacture yeast and kindred products. The incorporators are C. H. Hefter, Herman Abbenseth and John Stickel, Mill St. and Willett Ave., Bedford Park. The last noted represents the company.

DYES & CHEMICALS, INC., Montclair, N. J., has been incorporated with a capital of $150,000, to manufacture chemicals, chemical byproducts, dyes, etc. The incorporators are Lennox C. Brennan, William H. Orr and Francis Earle, 120 Highland Ave., Montclair. The last noted represents the company.

THE ORIOLE PETROLEUM CORP., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated with a capital of $100,000, under Delaware laws, to manufacture oil products.

THE HOFFMAN CHEMICAL CO., Brooklyn, N. Y., care of J. A. McNamara, 165 Broadway, New York, representative, has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are D. J. Murphy, J. M. McNamara and T. P. Mackey.

THE TARVER BROTHERS PETROLEUM CORP., Houston, Tex., has been incorporated with a capital of $100,000, to manufacture oil products. The incorporators are G. B. Outlaw, J. B. Warren, and J. D. Tarver, all of Houston.

THE OPEN-HEARTH FIREBRICK CO., care of the Delaware Incorporating Co., Wilmington, Del., representative, has been incorporated under state laws with a capital of $5,500,000, to manufacture firebrick and other refractory products.

THE WATERMAN OIL CO., 2nd St., Waterman, Ill., has been incorporated with a capital of $5,000, to manufacture oil products. The incorporators are C. W. Smith, H. Roberts and A. R. Wollenweber, all of Waterman.

THE WILKINSON GUANO CO., Spartansburg, S. C., has been incorporated with a capital of $25,000, to manufacture fertilizer products. Floyd T. Smith is president; and J. C. Wilkinson, vice-president, both of Spartansburg.

THE SERVO SALES CORP., Brooklyn, N. Y., care of J. A. McNamara, 165 Broadway, New York, representative, has been incorporated with a capital of $50,000, to manufacture chemical products. The incorporators are D. J. Murphy and T. P. Mackey.

THE CODDE BRASS & ALUMINUM CO., 1006-7 Hammond Bldg., Detroit, Mich., has been incorporated with a capital of $30,000, to manufacture brass, aluminum, bronze and other metal products. The incorporators are Mayer C. Brown and Harry A. Codde.

THE TEX PRODUCTS, INC., Brooklyn, N. Y., care of S. Rosenfeld, 808 Broadway, Brooklyn, representative, has been incorporated with a capital of $50,000, to manufacture cleansing powders, chemical specialties, etc. The incorporators are H. Pearlman, and H. F. Pearsall.

THE EASTLAND PIONEER OIL REFINING CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $1,000,000, to manufacture refined petroleum products.

THE UNITED STATES LEAD CO., 237 Baldwin Ave., Jersey City, N. J., has filed notice of organization to manufacture white lead and kindred products. Alfred J. Parker heads the company.

Industrial Notes

THE SCHEID ENGINEERING CORP., 90 West St., New York City, has been appointed metropolitan and export representative for the Franklin Moore Co., Winsted, Conn., manufacturer of material-handling machinery for industrial plants.

THE NATIONAL CARBON CO., in order to reduce the time required for handling small and other emergency requirements of carbon brushes and to give better service to its customers, has established two finishing plants, one located at 337 East 41st St., New York, and the other at 560 West Congress St., Chicago. These supplement the emergency department maintained for some time at the Cleveland factory. Both of these plants carry complete stocks of all leading grades of Columbia carbon, graphite and metal graphite brushes, and are prepared to furnish all sizes equipped with standard types of shunt connections, or other special methods of finishing. The same standards of workmanship and the same close attention to and inspection of detail as obtained in the larger brush plants of the company are strictly observed in these small plants. Necessarily the capacity of these plants is limited and it is the desire of the company that, where delivery conditions will permit, orders for material of this kind be forwarded to Cleveland, O. as in the past. However, on breakdown jobs and other requirements of an emergency nature, the users of brushes in the surrounding territories should avail themselves of the special facilities at New York, Cleveland and Chicago, and should send their orders to the nearest plant.

On Aug. 1 the SCHAEFFER & BUDENBERG MFG. CO. acquired the business and good will of the American Steam Gauge & Valve Mfg. Co. of Boston, Mass., and is operating it as a division of its own business, with headquarters and sales department located at 338 Berry St., Brooklyn, N. Y.

THE NELSON VALVE CO. announces that its office at 90 West St., New York City, is now under the management of Walter S. Dickson, who is in charge of the New York district and export departments.

THE CHICAGO FLEXIBLE SHAFT CO., Chicago, Ill., announces that the address of its New York office, of Stewart industrial furnaces, which has been located at 350 Broadway since it was established early in 1920, has been changed to 16 Reade St. The office, as before, is in charge of J. W. Lazear.

THE CLEVELAND COOPERAGE CO., Cleveland, O., has taken over the manufacture and sale of a rubber-lined barrel originally invented by James H. Gravell, president of the American Chemical Paint Co., and used in carrying the production of that company. The new Lastik barrel is used for the transportation of acids, extracts, tinctures, oils, varnishes and chemicals.

THE DARCO SALES CORP. has announced the appointment of Jayne & Sidebottom, Inc., 17 Battery Place, N. Y., as its sole selling agent in the New York metropolitan district and the State of New Jersey, for Darco decolorizing carbons.

THE PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., announces that James A. Beaubien, formerly vice-president and general manager of the Weber Subterranean Pump Co., is now manager of its New York office at 30 Church St.

THE HEYDEN CHEMICAL CO. of New York City has elected Bernard R. Armour president. F. H. Chamberlain, formerly president, will continue as chairman of the board of directors. George L. Armour has been elected treasurer, and James Branegan has been re-elected vice-president. George F. Lewis will retain his connection with the company for the present as secretary. William Weckman has been elected assistant secretary.

THE FOAMITE-CHILDS CORP. is the name of the company representing the consolidation of the Foamite Firefoam Co. of New York and the O. J. Childs Co., Inc., Utica, N. Y., both of which handle complete fire-protection service. The following officers were elected: W. J. Childs, president; F. M. Watters, vice-president; E. Janeway, secretary, and F. J. Maginniss, treasurer. James C. Patterson will continue as a director in full charge of sales. It has been announced that there will be no change in the sales policies of the consolidating companies. Executive offices are located at Utica, N. Y.

THE WALKER CHEMICAL CO. and the SELDEN CO. of Pittsburgh, Pa., have been consolidated into one concern and the business of both companies will be carried on in the name of the Selden Co. No change of any kind has been made in either the personnel or management.

Coming Meetings and Events

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
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The New Tariff Law of the Land

REVISING the tariff has been such a slow and disgusting process that most of us are glad it is over and that the Fordney-McCumber act has at last found its place on the statute books. The uncertainties that for twenty months have attended the maneuvering of the politicians and lobbyists have had a most depressing influence on business and, to a lesser extent, will continue to have until the courts have given final interpretation to the involved construction of many of the new tariff schedules. As for the law itself there is but little good to be said about it. Probably it is too early to pass judgment on its effect on industry, but after a brief study of its make-up we would hesitate to predict for it the quality of permanency which in the early stages of its preparation was supposed to be its distinguishing characteristic.

If there is any single feature in the new law, however, that marks an advance in tariff legislation, it is the provision for flexible administration. When Congress surrendered to the President the authority to raise or lower duties in order to meet changing conditions of competition, the first step was taken toward divorcing the tariff from politics. That beginning carried to its logical conclusion may some day mean a tariff controlled and administered by an impartial, non-political agency.

The dye and chemical provisions are no more satisfactory to our industries than is the law itself. It would seem that the dye embargo is a dead issue. On different occasions the Ways and Means Committee, the Finance Committee and the joint conference have each succeeded in inserting the embargo feature in the bill only to see it rejected subsequently by a majority vote of the Senate or House. Its last appearance in the original report of the conferees was something of a surprise to the industry, but is now generally regarded as a clever political move on the part of one of the embargo's most bitter opponents. The net effect as far as the industry is concerned is a much lower duty than had been approved by the Senate under the Bursum amendment.

But the sorest loss of all arises from the fact that the provision for synthetic organic chemicals other than from coal tar somehow got lost in the shuffle and emerged from the conference with a paltry 25 per cent ad valorem—and on foreign valuation at that. This strikes at the very root of our fine chemical industry and efforts are already under way to remedy the situation. It is our sincere hope that they will be successful, but from experience and some little knowledge of the workings of that inexorable body in Washington, we can scarcely regard the outlook as promising. For our own part we are inclined to believe that the chemical industry should make the best of a sorry situation. We should forget about the tariff and get down to work building an industry on that solid foundation of research and technology which will not be swept away by the changing tides of politics.

The Chemical Industry And Its Exposition

WORSE than the confusion of tongues at Babel is the diversity of criticism current for the past two weeks regarding the Chemical Exposition and its management. Most of the talk is beside the point because it deals with numerous non-essentials that are a by-product of any controversy.

The elements of the situation are these: We have an exposition managed by a company that is in that business. The show is conducted for profit. Naturally there has been some dissatisfaction with the service rendered to exhibitors. It seems inevitable. The essence of the criticism is that the exposition management makes too great a profit; that it has departed from the ideals of the founders; and that exhibitors have no voice in many features of the show affecting their personal interests. More concretely, dissatisfaction has found expression in the proposal to organize and run another exposition.

Without launching into a long discussion of the whole subject, it can be set down as final that the chemical industry does not want and will not support two expositions. An attempt to put them on will result in disaster for both and perhaps final abandonment of any show. In our judgment the present management, with its experienced organization, offers the most practical means of continuing the exposition as long and as frequently as the industry wants it. If its methods and ideals are not agreeable to some of the exhibitors, an attempt should be made to change them, rather than to launch a new exposition. The management has repeatedly expressed not only its willingness, but its desire, to meet exhibitors' wishes as far as possible.

The crux of the whole matter is the necessity of having but one exposition, and the thing for exhibitors to determine is the most practical means of attaining that end. The expense of exhibiting at one show will be quite as great as at another if both are free to the public; and the advantages of a co-operative show are more imaginary than real, if we may accept the opinion of those who have tried both. Co-operative exhibitors must be prepared to meet deficits as well as to share profits. In short, we are inclined to the view that dissatisfaction over costs and profits will not be diminished by supporting a new exposition on a co-operative basis.

Undoubtedly much of the present criticism would disappear if the exposition management had a closer con-

tact with its exhibitors. This is not impossible of accomplishment and perhaps some way can be found whereby the exhibitors can transmit their views and sentiments to the management, and through occasional conferences come to agreement on moot points. Every reasonable means of attaining this end should be exhausted before resorting to more drastic action.

The Riddle Of Corrosion

PROBABLY more than one philosophic Indian, during the course of the last 1,500 years, has looked with envy on the remarkable iron pillar at Delhi, and wondered how it continued standing through the ages, rustless, while his own iron tools and kettles, made of the same stuff and in the same way, wasted away during his lifetime. Apparently the same, yet somehow different.

That riddle is still unsolved. Science, during the last century, has invented many names to denote many facts and phenomena concerning rusting, but we still wonder why one lot of condenser tubes will stand almost indefinitely under sea water, while another batch from the same reliable maker—indistinguishable except for labels—will be perforated by pitting within a few months. Apparently the same, yet somehow different! The differences may be so obscure as to yet escape detection, or for that matter may even be too minute for observation by our present-day apparatus.

Much careful study has been given the corrosion problem—and not more than it deserves, since it undoubtedly costs the world billions of dollars annually to protect its metal and replace that which was not protected in time. Innumerable laboratory determinations have been made, measuring the amount of weight lost by a metal when exposed to certain more or less well-controlled circumstances. But the trouble is that the metal does not always waste away uniformly or at a constant rate—localized corrosion and corrosion products are often the most dangerous. Hence, thinking back, it has been agreed that a very important factor is the action of the metal immediately upon immersion; its future history is dependent upon whether the first products of corrosion stick to the metal and protect its foundation.

So far, so good! Given the undoubted fact that a surface film forms, everybody interested in corrosion ought to start studying surface films, and discover what kind of film will stick tightly to the metal and not split off when the temperature changes (or if torn off, will immediately re-form), what kind of a film will be so impervious to its surroundings that it will not continue to grow, nor be continually removed as fast as or faster than it forms. But it's not as easy as it sounds. These films, in the first place, may, and quite often are, perfectly colorless and transparent. A logical deduction from the ideas presented elsewhere in this issue by Dr. SAKLATWALLA is that they are often only a few molecules thick and far below the limits of our most powerful microscopes. Or if we lean toward LANGMUIR'S ideas, the metal is joined to its gaseous surroundings by the same kind of forces that hold chemical compounds together, and has no independent existence.

To study such stuff a new technique is needed. Some new instruments, employing vaguely known or undiscovered physical properties, will be necessary before one can study the nature of such diaphanous garments. Microchemistry and microphysics, of which we know only a smattering, will have to be extended to ultra-micro regions before the kind of atoms contained in these protective films and their spatial arrangements can be known.

It will be a safe prediction that many years will elapse before we shall be able to draw a correct space lattice of the surface film on freshly cut aluminum or iron. Even if they are so obviously different in construction as to indicate immediately why the former resists the corrosion of the atmosphere while the latter does not, we shall still have to discover the way to make iron or a simple alloy of iron automatically build up a coating of the desired type.

Empirical trials may hit upon that method before we know much more about the real mechanism of corrosion, just as we have discovered that copper-bearing steel is excellent metal for sheathing. Furthermore, we have given up the search for an absolutely incorrodible metal, or one which will resist equally all reagents, gaseous, liquid and solid. A certain amount of wastage will always occur, but it can be minimized by careful selection of metals based upon an intelligent interpretation of available data. First approximations in this respect can be now made for hitherto untried conditions by remembering that corrosion is a compound action, consisting first of the formation of a reaction product, and second the removal of this product. If the two rates can be determined in the laboratory and the first is more rapid than the second, the metal will have a fair chance to endure.

Wanted—An Immigration Policy

THE PRESENT 3 per cent immigration law, having outlived its usefulness, if it was ever to be commended at all, is destined to be followed by something else. Instead of a makeshift being put on the statute books as another experiment, a definite and intelligent immigration policy should be adopted, and legislation worked out accordingly.

Republics are said to be in the habit of doing things too late. They certainly are slow in recognizing new conditions such as require new policies and new legislation. The disposition is to assume that as we have got along all right so far we can peg along for a few years more.

It should be emphasized that new conditions exist, and the public should be told what changes have occurred. The prevalent view seems to be that the great new condition that exists is the one growing out of the war. That is a change in conditions abroad. We should like to point out that long antedating the war a change occurred in the United States, a very important one and one that must be considered in all its bearings or nothing like a proper immigration policy can be developed.

That change is in the opportunity the country offers the immigrant. We have been an independent country for fourteen decades. For a little more than half the time we offered great opportunities for the pioneer, the man who came here to act of his own initiative, to do something himself. The opening of the West and Northwest after the Civil War offered the last great opportunity of this sort. In the recent decades the chief attraction to the immigrant has been nothing more than a job in the mine or mill or perhaps at coke ovens. Of course in the earlier period some men came over merely to hold a job, and in the later period some have come

over to make a fortune, possibly as a fruit peddler or as a dealer in old clothes. In general, however, the distinction holds good.

That our immigration has not been as satisfactory in recent decades as formerly, from the viewpoint of the general good of the country, is very well recognized. The difference is often mentioned, but usually it is left to be assumed that the difference is chargeable against those who choose between coming to the United States and staying at home. The real difference, however, is due to changes that have occurred in the United States, and that fact should be the starting point for the development of an immigration policy. Realization of the fact will banish the notion that since we used to get along we ought to be able to continue getting along.

The ordinary habits of thought of the individual are not always logical. Conclusions parading as the result of logical thought are frequently the product of emotions. With collective thought or conclusions the divergences are still more common. As a people we should decide upon certain definite premises and then seek the answer. Do we want immigration? For what purpose do we want it? What kind of immigration do we want to meet that purpose? How shall we obtain it? How shall we handle it when it comes?

If we settle these questions step by step, we shall accomplish intelligent results. If we slur them over, we shall have simply a hodgepodge debate in Congress with makeshift legislation calculated to get votes rather than good immigrants.

To illustrate: There are those who do not want any immigration. They should be yielded to or silenced at the outset. They cannot be expected to give wise counsel when we are attempting to decide how we shall obtain immigration.

Black Fractures in Carbon Tool Steels

IN OUR ISSUE for August 9 we published a short article by Mr. GREEN on "Black Fractures in Carbon Tool Steels." Since then many of our friends have been good enough to point out that the occurrence is a simple case of graphitization. Steel makers have apparently seen the structure before—sometimes oftener than they wish—but have said very little about it in print.

On page 650 of the present issue we publish the results of a brief supplementary study of Mr. GREEN'S steel by Messrs. RAWDON and EPSTEIN of the Bureau of Standards. A careful study of the two papers will doubtless reveal the fact that the case is not so simple as it appears.

In the first place, silicon—which all authorities agree is the thing that accelerates graphitization—is uniform and far below the danger point (0.10 per cent) in both light and dark zones. Second, why should there be such a pronounced and regular outline to the graphitized areas (suggesting the outline of the ingot or the roll-passes) and yet a pencil of ungraphitized metal occupy the very axis? Third, the sharp line of demarcation between structures is very peculiar. Fourth, the ease with which the graphite carbon is redissolved upon annealing even for a short period, as pointed out by RAWDON and EPSTEIN, is surprising, in comparison with the rather stable conditions obtaining in other portions of the bar having a light fracture but also containing considerable graphite. Fifth, long heating at a rolling temperature seems to be one of the works conditions favoring graphitization; but if this temperature is in the austenitic area of the equilibrium diagram, the carbon or carbide would be uniformly distributed in solid solution with no tendency to segregate.

From a commercial point of view these questions have real importance, for we are assured that sometimes steel with black fractures arrives by the ton, instead of by the bar, as found by Mr. GREEN. Consequently the reasons for its occurrence should be determined with the greatest possible precision. From a theoretical point of view it has interest almost as great. We find it difficult to accept the dictum, "Graphite is the stable form of carbon," as a self-evident and sufficient premise from which to explain all the facts surrounding the graphitization of cementite—either in tool steel, gray cast iron or malleable iron. Since all the irons and steels which graphitize easily contain important amounts of many elements other than iron and carbon, it does not seem apparent on the face of it that the iron-cementite system is doomed forever as "metastable."

The Proper Training Of a Chemical Engineer

A SUBSCRIBER whose comments are always illuminating to us and who, although a manufacturer of heavy chemicals, is without professional training and has not been in his present occupation more than a few years, writes us about the way he is training a student of chemistry in whom he is interested. We may say that in the short time of his engagement in chemical industry he has insisted upon being taught the nature of every technical problem in his work, that he has accomplished large savings of wastes and that he has been successful. It may be that his previous experience in an industry that is chemical, although he did not know it, has opened his mind. Here is what he says:

"I have a young man associated with me who is in his first year of college. He is taking chemical engineering and will spend three months each year at my plant. This year he is helping the lead burner and will get a thorough knowledge of lead burning. Next summer he will unload hopper cars, heave coal, fire boilers under the instruction of our stationary engineer. Three months of that will give him a fairly good working knowledge of the process of the boiler, its economy and utilities.

"The next vacation he will spend in the plant operating digesters and other chemical equipment, then, when he graduates, I will take him into the office and let him handle shipping, accounting, telephone work, payrolls—in fact, all the various things that go to make up a man's commercial education. *After that* he will be permitted to go into the laboratory and start to work on the things for which he was educated. He will then realize that making mud pies in a beaker in ounce quantities is quite different from making them in 100-ton lots in great steel retorts and digesters. He will also realize that it takes labor to produce chemicals commercially. If he does not make a good successful chemical engineer of himself with that opportunity, I shall give up and admit I don't know how to train boys."

If he does not succeed with the young man in question, it will be the fault of the young one, and not the old. It is well for every student to bear in mind that business, properly administered, is one of the most difficult of arts and that he can never be fully in the game of manufacturing unless he has a clear sense of business.

Readers' Views and Comments

Chemists in Public Life

To the Editor of Chemical & Metallurgical Engineering

SIR:—Randolph Bolling in his letter appearing in your issue of Sept. 6, commenting on S. L. Redman's communication concerning "Chemists in Public Life" seems to indicate the soul of a chemist in the statement, "We just want to be left alone."

A splendid isolation seemingly is the main desire of chemists. They prefer routine. Anyone who has tried to get a rush test for control work in industrial processes can verify this tendency of chemists. A laboratorian simply can't be rushed. Possibly $1,000 may be at stake—he should worry, just so long as his 2 cents worth of this and 1 cent worth of that react on a sample that costs nothing according to all the rules and the classics.

Chemists assuredly must be in public life. They should live, not as hermits, as alchemists, but as men. All the angles of modern industrialism demand analysis, and after analysis comes decision. Certainly analysis of all the facts is much more involved than a grouping of chemical elements, often sadly done empirically, and the man best equipped to make the analysis is a chemist who appreciates business. Public life is business, not politics, and most if not all our universities provide an elective if not compulsory course in "business" or "efficiency," in which a certain amount of vocational guidance is provided in the order of things. The chemist with the spirit of "we just want to be left alone" habitually neglects this offering. The great teacher on the order of things is commercial experience, and the wide-awake chemist, the real analyist, should welcome offerings of positions such as Mr. Redman mentions, and not desire to be a hermit, for hermits have been known to starve to death.

SIDNEY CORNELL.

New York City.

Proteins and the Theory of Colloidal Behavior

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your issue of Aug. 23 there appears a review by Jerome Alexander of Loeb's excellent book "Proteins and the Theory of Colloidal Behavior" that appears to me very unfortunate because it may give those of your readers who have not seen Loeb's book the erroneous impression that his work is not fundamentally sound, whereas it is evident that Alexander has failed to grasp Loeb's ideas. For example, he regards Loeb's thesis as standing or falling with the assumption that gelatin is a definite chemical entity. On the contrary, Loeb's theory is quite independent of this assumption; it assumes only that a highly ionizable chloride of gelatin is formed when gelatin is brought into contact with an aqueous solution of hydrochloric acid, and this is substantiated quantitatively in so many different ways as to give it a place among the facts of physical chemistry. Whether or not Loeb's gelatin was a mixture of proteins of variable molecular weight has no bearing upon the fundamental conception.

Loeb, as well as Procter and Wilson, has proved that the equilibria of aqueous protein systems are determined by the Donnan equilibrium, and it seems significant that no other view has ever passed the stage of qualitative speculation. Alexander's reference to "the adsorption view" means nothing, since adsorption as something distinct from the equilibria described by Loeb has not been resolved into anything more than a vague conception, which I believe will prove to be nothing more than a flight of the imagination of those who have tried to dodge the mathematics of the Donnan equilibrium.

I regard Loeb's book as marking the greatest advance yet made in this field and recommend it unreservedly to all interested in the subject indicated by its title.

JOHN ARTHUR WILSON.

Milwaukee, Wis.

Modern Handling Methods in the Manufacture of Electrical Porcelain

To the Editor of Chemical & Metallurgical Engineering

SIR:—With reference to the article which appeared in *Chem. & Met.* for July 12, 1922, entitled "Modern Handling Methods in the Manufacture of Electrical Porcelain," I have read this article with much interest. An article in the May *Journal of the American Ceramic Society* dealing with the same subject has also been brought to my attention.

I have carefully read these articles and, while we manufacture strictly sanitary plumbing fixtures and do not manufacture anything in the electrical porcelain line, still such papers are of great interest to us. There are a number of methods used in the manufacture of electrical porcelain that can be adapted to the sanitary line. There is no question that the pottery industry has been the slowest in putting in modern labor-saving devices; but I believe that the time is rapidly coming when the pottery industry will learn that it is best for it to use labor-saving devices as used in other industries, where they have been found to pay for themselves many times over.

It is becoming more necessary every day that the manufacturer cut down his manufacturing expenses so that he will be able to manufacture his wares at a minimum cost. If it is ever expected to reduce costs to what they were 10 years ago, the only possible way to do this is by the economical operation of the factory and by every possible labor-saving device that is practical to put into service. The price of labor will not go back to what it was 10 years ago; and for that reason the only way to reduce and keep costs down is by the careful and close study of the operation of the factory.

It is by such papers, read before the American Ceramic Society and published in the technical journals, that we conceive ideas and suggestions; and from these develop practical operations that are of great benefit to the industries.

TRENTON FIRE CLAY & PORCELAIN CO.,
PER O. O. BOWMAN, 2ND.

Trenton, N. J.

Eighth National Chemical Exposition

Report of the General Meetings and Technical Sessions, Including Symposia on the Paper Industry, Technical Photography, Ceramics and Standardization—Attitude of Anti-Saloon League Toward Manufacture and Sale of Industrial Alcohol

EDITORIAL STAFF REPORT

THE Eighth National Exposition of Chemical Industries, which was formally opened on Monday evening, Sept. 11, marked the return to Grand Central Palace after an enforced absence at the Armory last year.

Interest in the technical programs centered in the address of Wayne B. Wheeler, general counsel for the Anti-Saloon League, who spoke on "The Attitude of the Anti-Saloon League Toward Industrial Alcohol." Chemical manufacturers wanted to know just what this attitude is, and were particularly glad of an opportunity to have Mr. Wheeler express it. Mr. Wheeler was introduced by Dr. Charles H. Herty, who presided.

ADDRESS OF WAYNE B. WHEELER

The substance of his presentment was that the organization he represents is in largest possible sympathy with the alcohol industry in its industrial aspect, and with chemical industry at large. He said that the organization's slogan is that the more alcohol we can get into industry and the less we get into people the better it will be all around. He was very particular to emphasize the statement that the Anti-Saloon League is strongly and urgently in favor of the widest manufacture and use of industrial alcohol. Following this, he noted that the Anti-Saloon League and the producers of, dealers in and users of industrial alcohol thus had a common purpose, which he construed as not only the development and furtherance of the alcohol industry as applied to arts and manufactures, but also in the prevention of its use as a beverage. For instance, he said, "You have a common purpose with us in keeping this trade within the scope of its purpose." Again, "When people have a common purpose they should get along."

He called attention to the fact that the present regulations in regard to tax-free alcohol are fewer in number than before prohibition, and that, while only 2,000,000 gal. of tax-free alcohol was sold in 1906, there was 35,000,000 sold in 1919. "But, remember," he shouted, "the alcoholic is here with his thirst!" And he went on to say that, while some regulations to prevent its unholy quenching may be a little burdensome, no burdensome regulation would have the backing of the friends of the Eighteenth Amendment so long as it did not encourage drinking. The close of his speech centered more and more on the obligation to society of the tax-free alcohol and chemical industries to enforce the Volstead act (which he did not once refer to under this name) and the provisions of the Eighteenth Amendment. It was a shrewd speech that may be used as an argument in favor of any kind of restrictive legislation unless chemical industry will pay the price of dropping everything and starting on the hunt for bootleggers. "Some method is necessary," he said, "to check up where alcohol goes!"

THE REACTIONS TO MR. WHEELER'S SPEECH

After discussing the address with others who heard it we find that some thought that Mr. Wheeler had shown great growth in his concept of industrial alcohol and that the prohibition slogan, heard all too often, that "all alcohol is booze, anyway," is losing force with the chief representative of the Anti-Saloon League, the strongest organized prohibition society.

That the government, through the corruption of its enforcement agents, is failing to suppress the liquor traffic is a point which the speaker missed. We doubt if many unauthorized sales of alcohol are made in the first instance. We are convinced that all legitimate producers keep their accounts clean. The alcohol usually leaves the warehouse with a clean bill of health, duly attested by an authorized permit. That is all we can properly ask of the seller. Purchaser No. 1 may be wholly honest and hold the goods strictly to legal requirements, refusing to part with them save under proper authorization. By the time it reaches purchaser No. 2 the original seller has lost track of it. Purchaser No. 3 or No. 4 may and probably does show a duly certified authorization, but after he has had it he may turn the alcohol into potable liquor. Mr. Wheeler said (in the manuscript prepared for the press which we have before us): "The industry itself must take into account the fact that it is handling a commodity which is liable to produce great evil. It must help in the policing of the commodity—so as to prevent the evils which might otherwise follow." We fail to see how "the industry," which has none of the facilities of search enjoyed by the government, can find out what is done with the property of others, or even that it should if it could. The cheerful wholesale bootlegger who went to Canada with an authorized and approved certificate for the purchase of 250 cases of Scotch whiskey "for sacramental purposes" and got away with it into the United States represents the kind of leak which the industry cannot control.

Chemists, like clergymen and teachers, belong to the poorly paid professions, and few of them drink, for economic reasons, no matter what their opinions of the law may be. The real hindrance to enforcement lies in the fact that a great number of otherwise law-abiding citizens are so firmly set against the prohibition laws that they do not propose to observe them and are willing to take the consequence of their infringements if they are found out. The Haig & Haig distillery in Scotland, despite greatly restricted sales in Great Britain, owing to the tax of eight and five pence the bottle, declared a dividend of 18 per cent this last year, which would have been 34 per cent, as we recall it, but for the income tax. Its product comes here.

CHANGE IN PUBLIC OPINION NECESSARY FOR EFFECTIVE ENFORCEMENT

The real trouble lies in public opinion, which has not as yet matured to catch up with the law. The call for help from the industry by the Anti-Saloon League has been granted in many ways, but the demand that it shall aid in "policing" the sale of alcohol after it has left its control under government certification seems to us to be asking more than is fair.

The S.O.C.M.A. Meeting

Dr. Herty was again in evidence on Tuesday, for the afternoon session of that day was under the direction of the Synthetic Organic Chemical Manufacturers' Association of the United States. As president of that organization he dedicated the meeting to the purpose of convincing the public that synthetic organic chemicals included not only dyes but medicinals, perfume materials, photographic chemicals, explosives and a great many other products. The first speaker was Burton T. Bush, president of Antoine Chiris & Co., whose subject was "Synthetic Perfumes."

Synthetic Perfumes

Perfumery is an art and always will be, according to Mr. Bush. But just as the chemist has improved the work of the artist in other lines by giving him finer colors, purer oils and better paper, so the perfumer will be benefited by the contributions of this science. He will be given a wider range of materials with which to work. The odors of the lily of the valley, the lilac and other sweet-smelling flowers which are impossible to obtain by any known physical means have already been duplicated with a fair degree of success by the organic chemist, and many more are to come. Here, indeed, is a fertile field calling for the highest type of synthetic chemistry.

H. E. Howe spoke of chemistry as productive science. The fact that the volume of manufactures has increased four times since 1880 is due largely, in his opinion, to the two sciences of chemistry and physics, which through improvement in process and equipment have made this advance possible.

Synthetic Organic Medicinals

The session was concluded with an address by Dr. Frank R. Eldred, who took for his subject "Synthetic Organic Medicinals." "From the standpoint of health and happiness," he said, "there can be no more important application of organic chemistry than in the production of substances for the relief of suffering and the cure of disease. During the last few weeks the medical profession of the country has protested in no uncertain terms against the executive and legislative acts that threaten to wipe out all of the progress which we have made in the manufacture of synthetic organic medicinals since we were cut off from the former German source of supply during the war. We have just cause to be proud of the fact that the manufacture of every important medicinal product has now been established in the United States and that in quality these products are equal and in many cases superior to the German medicinals."

Peace-Time Uses for Poison Gas

Ellwood Hendrick was the genial chairman of a well-attended session on Tuesday evening. The first speaker to be introduced by him was Brigadier-General Amos A. Fries, chief of the Chemical Warfare Service, U. S. Army. The committee had asked General Fries to speak on the elimination of insect and other pests and he said he was inclined to believe that the latter category included the human pest, which "combines the deviltry of all other known pests." But speaking in a more serious vein, the General was able to show many important peace-time applications of the various toxic and tear gases developed during the war. Insect and animal extermination is one of these applications, so is mob control and the protection of life and property. The co-operative work of the Chemical Welfare Service and the Department of Commerce in studying the boll weevil problem of the South was cited as an example of a very practical application of our knowledge of poisonous compounds.

Another great economic problem to which some attention is being given is the control of the teredo and limmoria that destroy piling in sea water. The tremendous losses from these pests have already been partially stopped by the use of creosote, but it is the present belief that a poisonous compound of most specific action will soon be found.

The Chemical Warfare Service has worked with even greater success in destroying gophers, rats and other rodents so destructive to pastures and fields and which also carry fleas or other insects that may infect human beings with the bubonic plague. It is now engaged in a study with the Philippine authorities on the adaptation of poisonous compounds to the destruction of the locusts that cause great loss to crops in the Philippine Islands.

Replacing HCN in Ship Fumigation

An interesting development of recent months has been the help given the Public Health Service in preventing accidents in fumigating ships. It has been shown that cyanogen chloride, a war gas well known though not much used, is probably a better vermicide than hydrocyanic acid gas itself. It is a powerful tear gas in concentrations only one-eighth that which is dangerous, so that accidents are completely guarded against. No human will resist the blinding tears produced by this gas, even in concentrations too low to be dangerous, any longer than is absolutely necessary to get out of the way. This will not only make the fumigation of ships safe, but should lead to the extensive use of cyanogen chloride in the fumigation of houses, factories, etc., in place of more dangerous and less efficient germicides.

The Place of Research

General Fries took a strong stand on the question of continuing fundamental research along these lines. In this connection he said:

> The one place where America fell down in the war was in producing the special technical supplies needed in war, in time for general use. In making a fetish of practicability, we lost sight of the necessity for deep research. If we will only learn to apply continually the lesson that deep research alone will enable us in the future to maintain our place in the sun, the benefits of the war will in time outnumber the losses.

Chemistry Viewed by a Southerner

The chemical industry has a loyal and able friend in the person of United States Senator Joseph E. Ransdell of Louisiana. It is most significant that as a member of the political party opposed to the protective tariff Senator Ransdell has been a stanch supporter of high duties on all chemical products—believing, as he does, that these are "essential to the proper development and maintenance of industry in this country." His address is in part as follows:

> Chemical industry in the United States should be developed along the broadest and most comprehensive lines for three reasons:
>
> *A.* Chemistry is essential to the successful prosecution of practically all the arts and sciences. In fact, there is no industry of modern civilization which does not require the constant aid of chemistry to its successful application. Therefore, we cannot afford to be dependent upon the chemists of any other country, and should develop every branch of the art in America.

B. The wonderful advance in chemical inventions and discoveries during the past century warrant us in believing that innumerable things are still hidden which will respond to intelligent, persistent effort on the part of chemists. Many of the diseases of man have been greatly ameliorated by chemical inventions and discoveries of recent years, such as aspirin, novocaine, salvarsan, etc. Why can we not expect the discovery of remedies that will give relief, and possibly effect cures, of such diseases as leprosy, cancer, pneumonia, tuberculosis, and others which afflict mankind so terribly?

C. It is unfortunate that nations of the world cannot remain at peace and ignore all preparations for war, but so long as this greatly desired end seems still in the distant future it behooves wise men to prepare for possible conflict. Most thinkers agree that the next war will be decided by chemical preparedness and foresight of the contestants, and that it will be a chemical war.

Possibilities in the South

In concluding his remarks the speaker reviewed the wonderful possibilities for chemical development in the "land of Dixie." After touching on such well-known industries as naval stores, phosphate rock and cottonseed oil, he spoke of the South's great wood pulp resources—as yet entirely undeveloped. He declared that more than enough wood is being wasted annually in the Southern States to supply the country's requirements for all kinds of paper.

The chemist and the chemical industry will find in the single state of Louisiana the following resources awaiting exploitation: Limestone, sulphur, lignite, clay, salt, oil, gas, cotton, wood and sugar. Surely these are the basic raw materials for a remarkable industrial development.

Governmental Co-operation With the Chemical Industries

C. R. DeLong, chief of the new Chemical Division in the Bureau of Foreign and Domestic Commerce, told how the Department of Commerce under Secretary Hoover's direction is becoming of real service to industry. The Chemical Division has for its particular field the general inorganic and organic chemicals, drugs and medicinal preparations, essential oils, perfumery and toilet preparations, pigments, paints and varnishes, fertilizers, explosives and pyrotechnics.

Some of the ways in which the division can be of additional service were outlined by Mr. DeLong as follows:

One of the important considerations is the means at the disposal of the bureau for the collection of information relating to foreign markets and industries. The department maintains twenty permanent offices in the important commercial centers of foreign countries. These offices are in charge of business men and economists acquainted with the commercial conditions surrounding the trade of each particular country. In addition, the department enjoys the co-operation of more than five hundred consular officers of the State Department. It is evident that these outposts of the government form a vast network of lines of communication on conditions in foreign countries. These representatives are constantly forwarding to the department at Washington inquiries for American goods and information on the competitive conditions which are met with in the individual countries of the world.

These representatives are in a position to advise American firms and manuafcturers as to agencies qualified to handle their products, as to the customs duties in force in the various countries, and as to other commercial regulations governing the sale of products in a particular country. This information on the world's markets, as received, is centralized in the various commodity and regional divisions of the Bureau of Foreign and Domestic Commerce. Here it is carefully studied and abstracted before being distributed to American industries. I believe that through these sources the Chemical Division will be able to assemble in Washington accurate and detailed information on the world's production and requirements for chemical products.

An Example—Caustic Soda in Germany

For the intelligent exportation of products it is necessary to keep in constant touch with changing conditions in the various markets of the world. For example, one would not ordinarily consider that there would be a market for American caustic soda in Germany, yet information reaching the Department of Commerce recently shows that there is an apparent shortage of caustic soda in this market, and that the demand is being largely supplied by the United States. As a matter of fact, approximately one-half of the caustic soda being imported by Germany is originating in this country. It can therefore be seen that with rapidly changing market conditions it is necessary to keep in constant touch with the various foreign markets if advantage is to be taken of these opportunities to sell American chemical products abroad.

In order that American firms interested in the exportation of chemical products may receive the benefit of confidential information on trade opportunities in foreign countries, the department maintains a classified list of American exporters and manufacturers, which is known as the "Exporters' Index." It should be emphasized that only American-owned firms interested primarily in the promotion and sale of products of domestic manufacture are eligible for listing on this "Index." A firm once listed on this "Index" is entitled to receive without charge confidential information on trade opportunities, such as financial references, reputation and standing of the firm making the inquiry, and other information helpful in the marketing of a particular commodity in a foreign country. Such firms are also entitled to receive, whenever requested, trade lists of firms capable of handling their products in foreign countries.

Statistical Information

The department can be of further aid to the chemical industry by supplying accurate and detailed statistics of the trade in chemical commodities, both in the United States and in foreign countries. It is essential to the intelligent conduct of business to know the extent of domestic and foreign markets, the degree to which these demands are being met, and the countries supplying the products. It is planned that the Chemical Division shall make a periodic analysis of domestic and foreign trade statistics so as to make available the extent of the world's trade in chemical products.

A recent gratifying advance has been made in this direction in the case of the statistics for sulphuric acid and acid phosphate produced by the fertilizer industry, through the co-operative efforts of the National Fertilizer Association and the Bureau of the Census. That bureau has recently published statements showing the production, stocks and sales of these products for the first 6 months of 1922 and, it is reported, will continue the collection of such statistics for 6-month periods. It is to be hoped that other branches of the chemical industry will see the advantage of such statistical information and that it will only be a short time until such statistics have been expanded to include other basic chemical commodities.

Co-operation of Industry Necessary

Trade associations and individual manufacturers should not wait for an invitation from the department to co-operate with the Chemical Division. The division is beginning to function, and has been established for the sole purpose of facilitating contact between the department and the chemical industry. It is earnestly desired that the industry will come to consider that the Chemical Division is a part of the industry itself and that it is the industry's means of contact with the government. We want trade associations and individual manufacturers in the chemical industry to feel that they can lay their problems before the division with the knowledge that their confidences will be respected and that we will endeavor to aid them in solving these problems by every means at the disposal of the department.

Carbon Dioxide in Food Products

P. W. Heath presented a paper on substituting carbon dioxide for air in food products. He said the

American people spends millions of dollars each year for bread, butter and ice cream, but doesn't know that 10 per cent of the volume of butter is air, and so, too, is 40 to 50 per cent of the volume of ice cream. What Mr. Heath recommends, and we are informed that he has patents which cover the process, is the provision of an atmosphere of CO_2 to cover the materials during the processes of kneading or agitation, in the place of air.

Carbon dioxide thus provides various distinct advantages. Milk fresh from the cow's udder contains 10 per cent CO_2 by volume. Half of this escapes shortly after milking, and a quarter more is lost through pasteurization. To bring milk back to an approximate normal condition he recommended the introduction of 22 oz. of CO_2 into every 1,000 gal. of milk. He said that CO_2 improves the flavor of foods when good raw materials are used, and that it stimulates the nerves of taste and smell.

He quoted a bulletin of the U. S. Department of Agriculture of 1916 on the progressive oxidation of cold storage butter. In this it is said that in 2½ days under storage at freezing point temperature, one-eighth of the imprisoned oxygen in butter becomes chemically combined and over three-quarters becomes combined in less than 2 months, and that the production of off flavors in cold storage butter is attributable to slow oxidation. CO_2 is approximately free from dust, whereas ordinary air contains from 20,000 to 40,000 visible dust particles per cubic inch, and CO_2 treatment tends to keep out molds, yeast and bacteria.

Ice cream beaten in air contains from 25 to several hundred per cent more bacteria than ice cream beaten in CO_2, while butter churned in the same medium shows a greater reduction.

The destructive effect of air on vitamins A and C was discussed, and many instances given to prove it. At the University of Minnesota, butter intended for animal feeding is kept under an atmosphere of CO_2 to conserve its vitamin A. He quoted McClendon of the University of Minnesota, who powdered orange juice by spraying it respectively into hot air and hot CO_2. Vitamin C was destroyed in the air-dried material while 1 oz. daily of the CO_2-dried juice protected 500 guinea pigs from scurvy. Three years ago, he said, only two Western cities were mixing foods in CO_2 instead of air. The practice is now becoming general.

Mr. Heath was introduced by E. D. Hale of the Liquid Carbonic Co. of Chicago.

Pulp and Paper Day

In arranging the program for the meeting of the Technical Association of the Pulp and Paper Industry held Wednesday afternoon, Sept. 13, a departure was made from the usual custom of having problems of pulp and paper technology presented by men in the industry. Instead, representatives of firms exhibiting equipment and devices used in this field were given an opportunity to explain these in detail.

A few of the papers dealt with equipment devised particularly for the paper industry, others covered the application of standard machines to specific problems in this field, while still another group treated such general subjects as draft gages, CO_2 recorders, steel belts, the V-notch meter, recording instruments and methods of testing for fastness to light.

Under the first classification came a paper by E. ... Trimbey, of the Trimbey Machine Works, describing a meter for use in conjunction with an automatic consistency regulator in controlling the proportional volumes of ground wood and sulphite pulp where these are used in the form of soft stock. Color and size may be regulated in the same manner. Individual drive with d.c. motors connected to a motor-generator set makes it possible to vary the proportion of any constituent, or to vary the speed of the whole system without changing the proportions by means of a rheostat on the generator.

Continuous Causticizing and Filtration

Among the more important papers stressing the application of standard equipment to paper mill problems were the following:

W. D. Mount, of the Glamorgan Pipe & Foundry Co. demonstrated the advantages of the continuous causticization process in which the lime moves in a cycle through the following equipment: continuous causticizer, decanter, rotary filter, rotary kiln, continuous lime slaker.

Further information on the use of rotary filters for handling sludge from the causticizing process was given by G. D. Dickey, of the Industrial Filtration Corporation, and H. A. Morrison, of the Oliver Continuous Filter Co. Mr. Dickey also pointed out the possibility of washing paper pulp efficiently on rotary hopper dewaterers. Other applications of the continuous drum filter were considered by Mr. Morrison, particularly for brown stock washing, thickening before bleaching and in place of deckers and save-alls.

Meeting of Technical Photographic and Microscopical Society

Members of the Technical Photographic and Microscopical Society were well satisfied with the interest aroused by the large collection of photographs which constituted the society's exhibit. There was a crowd before the remarkable aërial photographs of Manhattan Island constantly, while photographers and technical men who investigated more carefully the work displayed learned much of the latest developments of the art and its numerous applications to industry and scientific research. Consequently, it was an enthusiastic group of members who assembled on Thursday, Sept. 14, for the annual meeting of the society in the large conference room at the Grand Central Palace.

Reports were submitted by officers and committees. Officers for the coming year were elected as follows: President, Prof. E. M. Chamot, of Cornell University; vice-presidents, Bennett Grotta, Atlas Power Co., J. A. Lucas, McGraw-Hill Co., C. E. K. Mees, Eastman Kodak Co.; secretary-treasurer, T. J. Keenan, editor of *Paper*. A vote of thanks was extended to the retiring officers for their efforts in establishing the organization on a firm basis.

Technical Sessions

The program arranged for this meeting was extremely broad, ranging from the general subjects of pulp and paper manufacture to wireless telephony, the one common idea being the application of photography and microscopy to the various subjects. Unfortunately, the program was too long for the time available and several of the papers had to be read by title.

One of the most interesting subjects presented was Henry Green's discussion of "The Photomicroscopy of

DONT FAIL TO SEE ALL EXHIBITS
ON MAIN-MEZZANINE-THIRD and FOURTH FLOORS

Paint and Rubber Pigments." Mr. Green described the work of the New Jersey Zinc Co. in the development of zinc oxide and other pigments.

Photomicrography in Paper Research

"Photomicrography in Pulp and Paper Research Problems" was the title of a contribution from the Forest Products Laboratory prepared by Eloise Gerry and E. M. Diemer and read by the secretary. The paper was illustrated by numerous lantern slides showing the method of distinguishing woods by means of the microscope. Woods of similar appearance, such as red gum, birch and mahogany, are clearly distinguished by their totally different cellular structure under the microscope. It was interesting to observe the accuracy to which the mechanical strength of a wood can be estimated by a study of its structure. The samples observed under the microscope ranged from $\frac{1}{5{,}000}$ to $\frac{1}{800}$ in. in thickness.

Examples of the valuable information contributed by photomicrography in the manufacture of sulphite and soda pulp were shown, such as the marked effect of beating in the two processes. Another very practical application of the microscope was revealed by photographs showing the formation of the gum ducts in various conifers. By a careful study of this formation the cut can be made in such a way as to increase materially the yield of gum from the tree.

D. S. Mungillo presented a reel of motion pictures showing the methods used in a modern motion picture laboratory. This was followed by a brief description of modern machinery for developing, fixing, drying, printing and polishing.

The Motion Picture in Industry

The motion picture as an aid to industry was discussed by Alfred B. Hitchins, director of the Ansco Research Laboratory. Dr. Hitchins pointed out the fields in which the industrial movie is beginning to be utilized. It is of value for purely scientific problems in throwing light on the mechanism of natural phenomena, for the education of workers by reducing waste motion and eliminating unnecessary details in shop work and for sales demonstrations. Obviously, there is no more effective way of conveying a message than by a visual presentation of the story. It is possible to present any idea in an interesting and dramatic manner by using the artifices of photography for which the modern camera is equipped. By the use of the slow speed camera, motion can be synthesized, while for its analysis the ultra-rapid camera is admirably adapted.

An interesting example of the practical application of the motion picture to mechanical stoker construction was described. Motion pictures were made of the stoker in operation, the camera protected from the intense heat by a series of Pyrex glasses set in asbestos and cooled by a stream of air. One exposure was made every 8 seconds, with the result that so much additional light was thrown on the actual working of the machine that the engineers were able to design a much larger and better stoker.

John Mills, of the Western Electric Co., gave a talk on the principles of radio-telephony and the operation of the audion. Aside from the general interest in the subject matter, the audience was impressed with the facility with which a complex description of a highly theoretical subject was reduced to a very simple explanation by means of animated diagrams. It was a good example of the educational possibilities of motion pictures.

Clarence W. Gibbs described some of the most recent developments in motion picture photography and outlined some of the refinements and improvements that are being studied and tried.

A film entitled "Thirsty Cotton" was projected, accompanied by a talk by Thayer Francis of the Parks-Cramer Co. Some of the views showing the effect of moisture on the tensile strength of cotton and its appearance under the microscope were especially interesting.

Colors That Please Us

Giving a popular talk on synthetic organic chemistry before an audience that included several well-known dye chemists as well as a number of individuals who wandered in because someone gave them tickets is obviously no light pastime. M. L. Crossley, of the Calco Chemical Co., undoubtedly realized this when he prepared the paper which he delivered Tuesday evening in the conference room at the exposition. It was an earnest attempt to convey the story of the American synthetic organic chemical industry to the public.

Dr. Crossley had prepared a spectacular chart headed "Evolution of the Dye Race." He pictured "Adam" Coal, "Eve" Science and "Abel" Industry as progenitors of the race, showing the "descendents" of anthracene, benzene and naphthalene as dyed samples of cotton, paper, wood, wool, silk and leather.

The speaker outlined the history of the development of synthetic dyes up to the present time and dwelt upon the present status of the industry in the United States. He explained, in simple language, the relation between the dye industry and the organic chemical industry in general, but particularly its connection with national defense, sanitation and medicine. The interlacing of the dye industry with consuming industries was also discussed.

In concluding, Dr. Crossley touched upon the tariff situation, explaining that the continued existence of the industry depends upon adequate protection from the established German competition. He pointed out that the additional cost of goods to the ultimate consumer caused by the tariff would be practically negligible. As to the possibility of establishing a monopoly in this country, Dr. Crossley said, there is little possibility of such an occurrence, for about two hundred American manufacturers are engaged in the keenest competition. It is a case of choosing between this domestic competition and complete domination by the German cartel.

Ceramic Day

Friday afternoon the technical program was conducted by the American Ceramic Society, the general secretary, Ross C. Purdy, acting as chairman.

Feldspar Colloquium

A most important phase of the meeting was the feldspar colloquium. Some time ago dissatisfaction on the part of users of feldspar with regard to quality and price prompted R. B. Ladoo to make a thorough investigation of the situation. The publication of his report on feldspar and feldspar grinding brought forth much comment and considerable space in recent issues of the *Journal* of the American Ceramic Society has been devoted to the publication of discussions on this subject.

Several further contributions were received far

enough in advance of the meeting so that it was possible to have them available for distribution in mimeographed form. The papers read were chiefly comments on the mimeographed material.

The necessity for agreeing upon standard specifications was pointed out at length in a report by W. H. Landers. As the requirements of the three great groups of users—the manufacturers of pottery and tile, enamel ware and glass—differ considerably in many particulars, it will probably be necessary for each group to outline its own standards rather than attempt any uniform specifications for all users. In many cases little exact information is available regarding the effect of various impurities in specific applications.

Take the case of iron. With the exception of the glass trade, where the effects of iron are definitely known, it does not seem clear, outside of the question of forming black specks in the ware, just what results from the presence of iron, and whether the same effects are obtained from the various oxides of iron as are noticed from metallic particles only. In addition to the iron which occurs naturally with the feldspar, appreciable amounts may be added as a result of carelessness during mining, grinding and handling.

After considering a number of other factors, Mr. Landers turned to the question of fineness, which must be considered from the users' standpoint. For the potter, it is customary to grind so that less than ½ per cent remains on 140-mesh Tyler standard screen. The enamel trade would like to get a feldspar free from lumps, which would leave no residue on an 80-mesh screen and contain no material finer than 250 mesh, as the very fine material causes trouble by forming lumps. The glass manufacturer could quite profitably use feldspar which had passed through 40 mesh but remained on 100, and contained not over 10 per cent finer than 100.

The mutual benefit which would result from the adoption of workable specifications for each branch of the trade is self-evident.

In a paper discussing Mr. Landers' report, Raymond B. Ladoo emphasized the need for standardization and registered his hope that definite action be taken soon. He suggested that the whole subject of feldspar specifications for various uses be gone into very carefully by a committee composed of both producers and consumers of feldspar.

Other phases of this timely and important subject were presented by George M. Darby, O. O. Bowman, 2nd, V. A. Stout, C. R. Moore and C. M. Franzheim.

Fineness of Grind and Screen Analysis

Two other papers had a direct bearing on some of the topics considered in the colloquium. Eric Turner showed an apparatus for quickly determining the fineness of grind, which is the factor determining the finishing point when grinding such materials as feldspar and flint in the intermittent type of pebble mill. The residue obtained by washing a 300-gram sample through a 160-mesh brass screen of the Tyler testing type is washed into a long-stemmed funnel, where it is permitted to settle. The stem is graduated in tenths of 1 per cent, so that the percentage of oversize material may be read off directly.

The whole subject of the value of screen analysis in ceramics was treated in a most comprehensive way by F. P. Nickerson, of the W. S. Tyler Co. Illustrations were given of practical results obtained from the use of screen analysis curves in the form of either cumulative direct plots or cumulative logarithmic plots.

Gray Enameled Ware

Problems encountered in the production of single coat mottled gray enamel ware formed the subject of an interesting paper by Howard C. Arnold. Briefly, the points which have to be considered are these:

The black shape has to be covered completely in one coat. The lack of a second coat makes it impossible to hide blemishes and imperfections. This coat must have all the gloss, luster and appearance of a finish coat. The two colors must be produced from the same enamel in one dipping. The two colors must be present in correct amounts and so distributed as to produce a pleasing effect. The chemical reactions which produce the two colors in the single coat introduce many troubles not met in two or three coat work.

Gas Producers for Glass Works

A most instructive talk on the development of gas producers for use in connection with glass furnaces was given by W. B. Chapman, of the Chapman Engineering Co. By means of lantern slides the steps in the progress from the old stationary producer to the present mechanical type were clearly shown. Mr. Chapman also had a model of a new type of closed pot furnace designed to replace furnaces of the reversing type. The pots are set in a circle with the burner at the center. The flame passes over and down the sides of the pots, then through flues in the bottom of the setting, where some of the heat is given up to the incoming air supply in adjacent sets of flues. The gas is not preheated, as it comes from the producer at 1,000 deg. F.

Other Papers

High-temperature cements were discussed by W. H. Gaylord, Jr., of the Quigley Furnace Specialties Co., and Charles E. Kraus of Johns-Manville, Inc.

According to G. O. Dickey, of the Industrial Filtration Corporation, the difficulties of handling clay mixtures containing a large proportion of ball clay on rotary filters have been overcome in a special continuous filter which will handle any kind of clay. The removal of iron from clay slips and glazes by means of magnetic separators was considered by E. S. Hirshberg, of the Dings Magnetic Separator Co.

Chemistry in Medicine

At the Wednesday evening session Arch E. Olpp, a physician and member of the House of Representatives, was introduced. In discussing "Chemistry in Medicine," he mentioned the fact that originally the chemist worked to produce drugs for the physician and that later had come a not unnatural split—the chemist turning toward industry in the days of Agricola. Later the physician turned back to his former aid and found most useful substances awaiting him. For example, ether was discovered in the thirteenth century, but its value as an anesthetic was not definitely recognized until 1846; during the interval of five or six hundred years untold suffering resulted from the lack of knowledge of its application to produce insensitiveness to pain.

So today the medical departments and colleges are devoting much more attention to chemistry than heretofore, evidently realizing at last the great necessity of co-operation between these two sciences.

Dr. Olpp instanced a number of examples of the

chemists' skill in preparing drugs and medicines, one notable example being salvarsan.

By the study of the structures of the molecules of a number of dyes, the key to the whole mystery of color production and color quality has been gained by man. Therefore, by such conquests we can readily appreciate the necessity for the co-operating work of the chemist, biologist and physician in an ultimate conquest in the domain of life products.

Thus, for example, cocaine has at least forty-three atoms in the molecule, arranged in a peculiarly complex, labyrinthal fashion, and it took three successive attacks by leading chemists to reach a final solution of the problem.

It was found that only part of the molecule has the beneficent anesthetic effects of cocaine, while another is related to the deadly principle of hemlock, coniine, famous as the poison Socrates drank, and a third part is related to nicotine. And from this the chemist reconstructed new and less harmful drugs—procaine, beta eucaine, apothecaine, which are better than cocaine and less poisonous.

Government Regulation of Industrial Alcohol

C. P. Smith, Assistant Commissioner of the U. S. Internal Revenue Bureau, then discussed the government regulation of the industrial use of alcohol. He pointed out the three phases of the national prohibition act: First, to prevent the sale of alcoholic beverages; second, to encourage the manufacture of industrial alcohol, and third, to control the distribution of high-proof alcohol. The latter is a big problem and one phase of it is illustrated in the quotation given below.

"Heretofore applications of permits to purchase alcohol for manufacturing purposes have generally been granted where nothing can be found against the applicant. The result has been the granting of thousands of permits to persons desiring to manufacture hair tonics, flavoring extracts and patent medicines. The situation in the flavoring extract industry is demoralized. It is needless to say that much of the alcohol sold to these small manufacturers for industrial purposes is utilized in the making of 'bootleg' whiskey. It is very probable that there will come a time when a man must show more than that he has never served a jail sentence before he will be entitled to receive a permit to purchase pure alcohol for manufacturing purposes. That day will be hailed with delight by legitimate users of alcohol."

The American Chemical Society Meeting

On Friday evening, Sept. 15, the New York Section of the American Chemical Society held a meeting at the Chemical Exposition. A symposium on standardization had been prepared and a number of papers on the subject were to be presented. Dr. Martin H. Ittner, chairman of the New York Section, called the meeting to order and introduced Dr. W. D. Collins of the U. S. Geological Survey, who made a plea for moderation in standardization. The advantages of standardization are very apparent and it so happens that natural conditions of trade bring about a great amount of standardization without conscious effort. The author advises against ill-considered standardization as being costly, with losses which far outweigh the gains. The author conceived his text from the experience of the chemical laboratory apparatus manufacturers where an apparent capriciousness on the part of the consuming public may not be capriciousness at all and therefore too great standardization and too great elimination of existing types of apparatus may be distinctly undesirable.

I. G. Jennings, of the Glass Container Association, followed with a discussion of the problems which are to be met by this association in making standard specifications. Mr. Jennings recommended co-operation between the industry and the consumer and announced that his association would be glad to further such co-operation to the fullest extent possible.

The Hoover Method Explained

The chairman then introduced William A. Durgin, of the U. S. Department of Commerce, who told the Society about the Hoover idea. Mr. Durgin's talk was well illustrated with lantern slides and was on the whole very refreshing. He began by disclaiming any desire on the part of the Department of Commerce so to standardize life that the wearing apparel of the citizens would be uniform and that the size and shape of the clouds which hung over the city would also be standard, but he went on to outline the many advantages of standardization and gave specific examples from a dozen or more industries. Such things as berry baskets, writing paper, tile and brick and many other commodities have been standardized so that there are now somewhere in the neighborhood of 10 to 15 per cent of the number of kinds originally manufactured. The Master Car Builders Association has eliminated 96 per cent of the parts which formerly had to be kept in stock. This has effected a tremendous saving. The story of beds is another interesting chapter. Furniture manufacturers made beds of almost any size. In fact, they were rather hostile to the idea of standardization, stating that designers could not be hampered by dimensions. This led to an innumerable quantity of mattress sizes, which now have been cut down to a reasonable number. The Hoover method is, first, a publicity campaign in a particular field, then a scientific survey of the conditions in that field followed by a general conference of the manufacturers with representative consumers under the auspices of the Department of Commerce. It is essentially a peace-time application of the co-operation which we first learned was possible during the war.

Secretary J. M. Roberts of the Apparatus Manufacturers Association told of the advances which had been made in that field during the past year. The industry has had an interesting problem on its hands inasmuch as it is so new in this country. The first questionnaire sent out by the association gave 80 per cent full agreement by manufacturing firms and approximately 80 per cent agreement on the part of the consumers (through the American Chemical Society's committee) on the elimination necessary. There were originally 148 gas burners on sale in the country and 70 of these have been eliminated. Over 10,000 lipped beakers are sold to less than 100 without lip. Knowledge of this figure made possible an elimination of 31 out of 48 sizes. Similar corrections have been made in other types.

The next paper, by Ross C. Purdy, secretary of the American Ceramic Society, is printed in full on another page of this issue.

The symposium was closed by a set of pictures presented by Emerson P. Poste, of the Elyria Enameled Products Co., on standardization of enameled ware for chemical purposes. The pictures were most interesting and bore evidence that close co-operation exists among manufacturers of these materials.

Standardization of Refractories*

By Ross C. Purdy
General Secretary, American Ceramic Society

STANDARDIZATION of refractories has been the desideratum of manufacturers and users of refractories the world over for several years. Technologists and scientists have made researches and developed methods of tests; associations have adopted so-called standard tests and definitions; associations of manufacturers of refractories and associations of users of refractories have joined with the federal bureaus and with collegiate institutes in conducting searching investigations of the required refractory properties for each of the many industrial uses; individual industrial concerns, both producers and consumers, have been spending annually large sums of money in searches for refractories that would best serve specific purposes.

Co-operation Among Searching Agencies

This earnest searching has been in progress for years not alone in one country but in all the industrial countries. All these searching agencies, private, semi-public and public, associated and individual, have published freely their results and all have co-operated to their limit in every attempt to standardize tests and to write specifications for refractories for specific purposes. Technical and scientific societies have had research committees collaborating with all the institutional and industrial groups. Nothing has been left undone that could with intelligence have been done by any of these several agencies to hasten the day when standardizations and specifications could be agreed upon not alone in one country but also internationally.

Progress Has Kept Pace With Knowledge

Much exact information has been gained and great progress has been made by and through all of these efforts. The many things that apparently conflict are rapidly being aligned and the fundamental facts quite generally understood by the producers and the users alike. It would have been impossible to have made more rapid progress than has been made in determining the fundamentals of the problems involved. There can be no just criticism or reproach made because of inadequacy of our present knowledge of the fundamental requisites to the making of satisfactory standards and specifications, and that which I will relate as my understanding of the present-day situation should not be considered iconoclastic or critical. Nothing short of most sincere praise for and genuine satisfaction with the accomplishment to date should be expressed, but we must face the facts viewed in the light of the present-day requirements.

Increasing Severity of Industrial Requirements for Refractories

The industrial requirements for refractories have been steadily increasing in severity; the refractories that were satisfactory in the furnaces and with practices of the immediate past will not meet the present-day requirements. New demands, much more severe than any heretofore known, have developed with the introduction of electric furnaces and with the efficiency studies directed to lowering of costs of manufacturing, calling for certain properties not possessed by the refractories of the immediate past. It has been impossible to write specifications or to adopt standards that would for a reasonable period of time satisfactorily fit with the changing industrial requirements. This is not an alibi; it is not an excuse; it is merely a statement of facts.

Classification of Refractories

Refractories may be classified according to the material of which they are made; such as clay, flint clay, bauxite, diaspore, fused alumina, corundum, chrome, magnesia, zirconia, silica, silicon carbide, carbon, nitrides, etc. We are rapidly learning where each of these classes of brick serves best.

No one, however, can today intelligently sub-classify any of these types of refractories into No. 1, 2 and 3, or *a*, *b* and *c*, except in relation to some given property such as temperature range through which it resists tendency to deform.

The industrial condition in each and every case calls for a combination of several requisite properties in refractories, the emphasis on particular properties varying in what superficially appear to be identical requirements. Malleable iron foundries will have differing requirements. So will furnaces in other industries, depending upon the particular conditions of the individual plant operation.

Satisfactory Classification Not Possible With Present Knowledge

Classification of refractories as "heavy," "medium" and "light duty" based upon properties disclosed by standardized tests is, in a very general way, satisfactory for particular purposes, but the "heavy duty" refractory suitable for one industrial purpose will not be the "heavy duty" refractory for all purposes.

No classification of refractories yet made is satisfactory, and I confess frankly that I do not possess requisite information for recommending a satisfactory and just classification.

Standard Tests Do Not Check With Operating Results

Committee C-8 on refractories of the American Society for Testing Materials has compiled all the known information on methods of testing and has made very successful attempts to standardize the tests. The inadequacies in the standard tests as they stand today are due altogether to the inadequacy of our knowledge of industrial requirements. That the standard slag test fails utterly to disclose which of two blocks would resist slag corrosion in a cupola furnace is due wholly to the inadequacy of our knowledge of the cupola conditions and of the properties in refractories necessary to best meet them.

In a certain test, privately reported, two cupola blocks showed striking contrasts in results in the actual furnace test and in the standard slag test. In practice the slag did not penetrate more than 0.25 in. in depth, while in the standard test the penetration amounted to 0.5, 2.0, 2.5 and 3.5 in. In practice the penetration and corrosion were rather uniform, while in standard test it was not. In practice the *B* blocks were better by 400 per cent, whereas in the standard slag test the *A* blocks were better by 50 per cent.

The coarser grog blocks, *B*, although permitting greater penetration, actually resisted corrosion far better than did the *A* blocks.

A fair test of the present status of our scientific knowledge of the factors involved in this case would

*Paper presented at the Eighth National Exposition of the Chemical Industries, Ceramic Day, Sept. 15.

be to submit the analysis of these *A* and *B* blocks—as given in the accompanying table—to any ten ceramists or chemists as a basis for prediction as to which one of these blocks would most successfully withstand corrosion in a cupola furnace.

ANALYSIS OF CUPOLA BLOCKS

	A	*B*
Silicon oxide	52.70	57.84
Aluminum oxide	38.17	34.14
Ferric oxide	6.30	2.75
Calcium oxide	0.18	0.30
Magnesium oxide	0.13	0.58
Total alkalis	0.93	1.39
Totanium oxide	1.89	2.75
Total	100.30	99.75

A was made of finely ground material and hard burned and *B* was made of coarsely ground material and only medium hard burned. Both fused at cone 31.

Modifications Required for Specific Cases

It would require much more time than has been alotted to analyze critically all of the "standard tests" as to their inadequacies when applied to a given industrial requirement. All of them will be subjected to refinement as knowledge is obtained, but each and all of them represent the best that can today be written. This broad justification can be stated notwithstanding the fact that whenever a set of standard specifications is attempted for refractories for a specific purpose, good reasons have appeared for a modification of most of the standard tests.

Just recently a selected group of technical men representing the users and producers of boiler refractories wrote specifications in collaboration with the best informed ceramists in this country. When the specifications were applied, they found that over 50 per cent of the refractory bricks which were known to be giving satisfactory results were, according to the adopted specifications, condemned, while some bricks which were known to be unsatisfactory in boiler construction met the specifications satisfactorily.

Suitability and Control Tests

We can today specify "suitability" and "control" tests for refractories for specific purposes. The federal departments have done a great deal, as have many of the users of refractories, in determining suitability tests. These, however, cannot be used as the basis of standards or specifications.

Data on Service Conditions Needed as Well as Fundamental Facts

The American Society for Testing Materials and the Refractories Manufacturers Association are laying plans for a joint survey with the several industrial associations to obtain exact information concerning the conditions under which refractories are used. Based on this information the A.S.T.M. Committee C-8 expects to be able to prepare standard tests which will apply in each industrial case and the manufacturers and users will be able to decide upon "suitability" and "control" tests.

This sort of close co-operation on the part of the several industrial and technical associations, contemporary with the new fundamental facts which will be brought forth by the several laboratories, will hasten the clearing of the present apparent chaos. Then and only then will it be possible to standardize refractories.

Investigate Zirconia-Alumina Refractory Crucibles for Steel

Difficulty is experienced in obtaining a refractory crucible, other than ones of carbon, which will not react with the carbon in steels and give fictitious values for carbon monoxide. The most promising results obtained to date from crucible tests have been secured with a refractory of zirconium oxide (practically free from silica) with the admixture of 10 per cent of aluminum oxide. The latter addition is made for the purpose of improving the mechanical rather than the chemical properties of the crucible. A medium-carbon steel melted in this type of crucible was quite easily pumped free from gas while still molten and the carbon in the vacuum-melted metal was only slightly lower than in the original sample. It is, therefore, to be concluded that there is very little if any reaction between the oxides of this refractory and iron carbide even at high temperature and low pressures.

The results obtained on electrolytic iron by the direct fusion method and by the Gorens (antimony-tin alloy) method have been compared. The results for total oxygen are practically alike. The hydrogen is higher as determined by the Gorens method. The ratio CO_2:CO was found to be 1:1 in the Gorens method but 1:4 in the direct fusion method. These differences are probably to be attributed to the lower temperature required in the alloy method.

Runs have been made on a medium-carbon steel by the two methods. The results are not yet conclusive, since the type of crucible used for the direct fusion of the steel was of a composition different from the other crucibles used in the test.

Canadian Topographical Survey Equipped for Thermometer Standardization

Until recently the lack of proper facilities for thermometer testing in Canada was such that scientific laboratories and others found it necessary to send their instruments outside the dominion if tests of a high order were required. Since the Department of the Interior established a thermometer section at the Surveys Laboratory of the Topographical Surveys branch this procedure is no longer necessary. Thermometers tested at the Surveys Laboratory include precise instruments for scientific work and also industrial, clinical, high-temperature and meteorological thermometers. These thermometers are calibrated and their various constants and corrections determined in terms of the standard temperature scale.

The nearest approach to an ideal or absolute scale of temperature—i.e., one in which every degree is of equal value—is given by a thermometer in which temperatures are measured by the expansion of certain gases. Even this is not strictly accurate, but the deviations from the ideal scale can be calculated. The gas thermometer is a very elaborate apparatus, and it has been found that a thermometer in which temperatures are measured by the electrical resistance of platinum wire will produce the absolute scale to a high degree of accuracy, if calibrated at several points on this scale. Hence this thermometer is now generally used as a reference standard for accurate temperature measurements by such institutions as the Surveys Laboratory.

With the precision now possible in scientific measurements appliances for testing thermometers must be of special construction and provided with means for closely controlling and measuring the temperature.

Sidelights on the Exposition

Random Impressions Indicate That the 1922 Exposition Made a Greater Appeal to Utility Than to the Colorful and Garish—Notes on Interesting Things, Both New and Old, Which Were Exhibited in an Attractive Manner

CONTRASTING the Chemical Show with the one held last year and with the earlier ones of previous years, it might be said that the industry has taken off its frock coat, and even its collar, and rolled up its shirt sleeves and was there for business. There were very few, or relatively few, spectacular exhibits appealing to the popular eye rather than the scientific eye, which have marked the earlier shows. But there was a wealth of technical material, which made the show extremely profitable.

CONSIDERABLE INTEREST was evidenced in the vegetable chars on exhibit. Darco and Suchar seem to be traveling much the same road that Norit traveled about 4 years ago, before the vaulting ambition of its inventor o'erleaped itself. These chars have been tried out on plant scale and results have been satisfactory, but the length of use of the chars and the possible regeneration of them has only been touched on. That is the ultimate stumbling block for all chars in sugar work.

MATERIAL HANDLING is coming more and more into its own in chemical industry, and therefore it is not strange that a miniature material handling exhibit, such as the Dow Company of Louisville, Ky., put on, was observed with great interest. Of course, we none of us quite outgrow the joy of seeing the wheels go round, and even now you will see grown men crowd around F. A. O. Schwartz's window and watch little electric trains glide around on tracks. And it may have been some such impulse that made the crowd pause and watch the little boxes and barrels go up the belt conveyors and around down the incline rollers on the Dow apparatus. In any case, it was one of the high spots.

PERHAPS it was a similar childish impulse that made the crowd revel in the little models of plants for making bleach out of liquid chlorine, which were put on by both the Electro Bleaching Gas Co. and by the Mathieson Alkali Co. Both of these exhibits were quite significant because they illustrate conclusively the importance which liquid chlorine is assuming in industry. It is much easier to transport than bleaching powder, and with equipment such as was shown in the models is extremely easy to handle. It is likely to be an increasing factor in those trades which consume bleaching materials.

NEVER SAY the public doesn't appreciate true art. There at the Chemical Show was Ivan Petrovich (some abominable realist has said that his name was Lutz. It shouldn't be) working a potter's wheel at the General Ceramics Co. booth and the crowd watched him with much interest. He would turn out a beautiful pot all ready for baking, and then crumble it up into a shapeless mass and make clay of it again. That is really the essence of true art, to create a beautiful thing and then to smash it. You have satisfied the creative impulse, and you have not bartered your soul to mammon in doing it. Anyway, it was fun to watch him, and his name might not have been Ivan Petrovich, but it must have been something which was not Kelly or Lutz. Incidentally, it was interesting to see the unbaked clay from which good pottery, acid-proof stoneware, is made.

HEAVY CHEMICAL MANUFACTURERS were quite noticeable by their absence, and it was with immense relief that one observed the Merrimac Chemical Co. booth, for it was one of the few evidences at the show that America had not gone out of the heavy chemical business. One unique feature of the Merrimac booth was the miniature containers, exact replicas of the life-sized barrels and drums and carboys which the Merrimac sends out, with the colors painted on and the lettering exactly as it occurs in commerce.

MANY'S THE TIME we have wanted to do some experiments at home, but have been restrained by fear of the wrath which descends upon those unlucky enough to get acid on the bathroom floor, or foolish enough to store cultures in the refrigerator next to the baby's milk. So that the sight of the neatest little table built by the Kewaunee Manufacturing Co. for a private laboratory filled us with the sudden desire to order one for the library. It looks more like a desk than a workbench, the brass connections for gas, water and electricity being not at all conspicuous. The stone top has a combination sink and basin built into it at one end. A microscope cupboard on one side, deep drawers at the other to hold reagents and supplies, and a shallow drawer across the top for miscellanea would appear to be adequate for nearly every demand.

CHEMISTS should not object to the synthetic orange drink served here and there, especially when adulterated with a scraping of rind. But a metallurgist would acknowledge that it is a good deal like circus lemonade —cold but not a quencher.

MEN AND WOMEN would rather "make believe" than do anything else. Children dress up in grown-up clothes and play house. Even Mr. Bryan, knight errant against all frauds, has bought a toupee. And the rest of us like to put on a good appearance, even in our work.

We always relished the thought of the early land surveyors on the Western plains. The pretty maps which they filed in the Land Office show that they carefully measured, with transit and tape, all the borders of the sections and townships and planted the corners into the ground according to law. But they didn't, they were frauds; they climbed into a wagon, drove along, and every now and then kicked out a stone. It must have been fun!

Once we saw some other frauds. They were traveling up and down the country roads in a Ford, in an aimless sort of way, like people who had no place to go and had lost their way. But they weren't. In the back of the machine they had a little box, and in it some glassware, by which they could analyze the air for one or two parts per million of SO_2—about a tenth of a smell!

Now the dairymen and creameries must be on the lookout for a smooth actor. He will come along with

a natty leather suitcase, which he got from the Central Scientific Co. He will look like a college chap asking his way to the railway station. But the suitcase doesn't contain socks; all packed away in the cosiest sort of manner is lamp, beaker, test tubes, slides and all the paraphernalia of Frost's field outfit for counting bacteria in milk.

WE RAN ACROSS an old friend we hadn't seen since doughboy days and were quite surprised to find him still in pursuit of the dogs of war. "Buddy," he said as we passed the exhibit of the Mine Safety Appliance Co., "it was a durned good thing these scientific birds had 4 months and not 4 years to make those gas mask chokers we wore in France. Take a slant at that complicated contrivance over there! It looks like a cross between a gas mask, a moving picture machine and a Ford engine—and I'll bet it weighs 150 lb." Our exaggerating companion was apparently referring to the new Gibbs self-contained oxygen breathing apparatus and some of its highly efficient accessories. Automatic cooling systems for the canister, timing devices definitely controlled by inhalation and exhalation and absolute protection against CO are some of the refinements that have found their way into gas masks since some of us used them in Sunny France.

SOMETIMES a combination of circumstances or events or even well-known chemical engineering equipment will produce more or less startling results. Thus whoever hit upon the idea of running an endless conveyor belt over a rotary vacuum filter, compressing the cake into the belt and finally passing belt and cake into a chamber drier deserves credit for bringing together in a practical way two of our fundamental chemical engineering operations. Proctor & Schwartz of Philadelphia and the Filtration Engineers, Inc., of New York had a joint exhibit of just such an ingenious combination in their new continuous filter and drier. In operation it was shown to work somewhat as follows: The vacuum filter drum revolves in a slurry of the material to be filtered, which is deposited on a woven wire conveyor belt.

Rolls of the cake compressor squeeze out the excess moisture and a thin, continuous cake, firmly enmeshed in the belt, passes into the drying inclosure. There it is automatically hung in loops or festoons for drying by heated air. At the delivery end of the compartment the dried material is beaten loose from the belt and falls into a hopper, from which it is removed by a screw conveyor.

We have been told that installations have already been made for drying certain pottery clays and decolorizing carbons in this way and it would seem that this is merely the beginning of a broad field of usefulness.

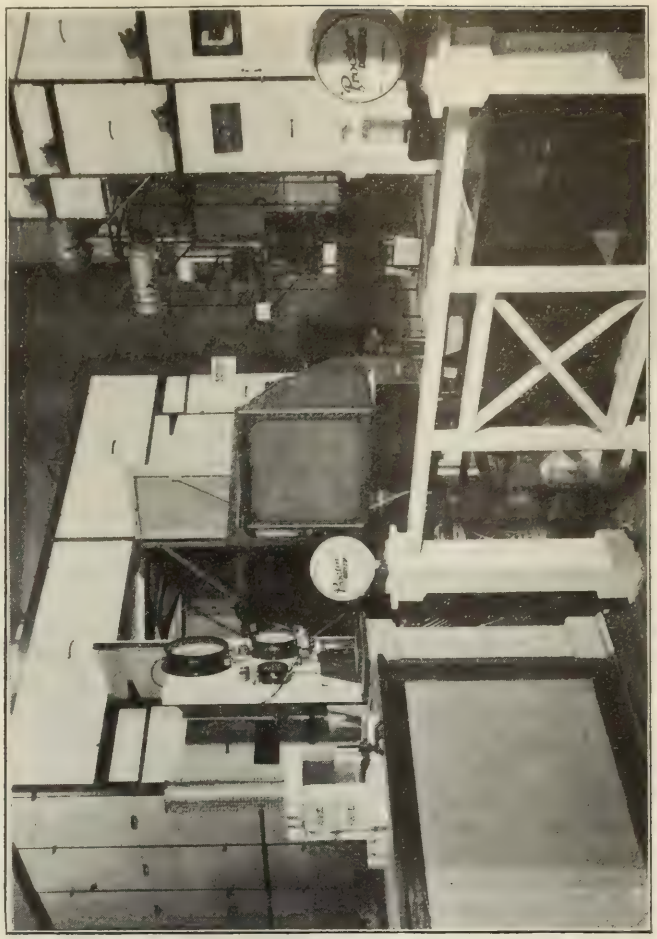
WHEN YOU ARE in the laboratory it is a comparatively simple job to make bleach liquor from chlorine gas. But when you are in a pulp or paper mill and want to make a 10,000-gal. batch in the same way you run up against a number of man-sized difficulties. Had you been at the Chemical Show, however, you might have found a solution for your problem in the two systems demonstrated there. The one shown by the Mathieson Alkali Works is brand new—in fact Mr. McMahon's patent was issued only Aug. 22, 1922. In it the operation is carried out by filling a concrete tank with just enough hydrated lime and water to react with the chlorine from a standard container (and it will be recalled that the Mathieson company has a decided preference for the 1-ton drum). The liquid chlorine is led from a pipe into an expansion coil within the tank. Here advantage is taken of the latent heat of vaporization of the liquid chlorine to counteract the heat developed by the reaction of the lime and chlorine. The gas from the coil is sucked into the pump that keeps the liquor in continuous circulation. After the chlorine in the container is exhausted, the clear bleach liquor is drawn off and the batch is completed.

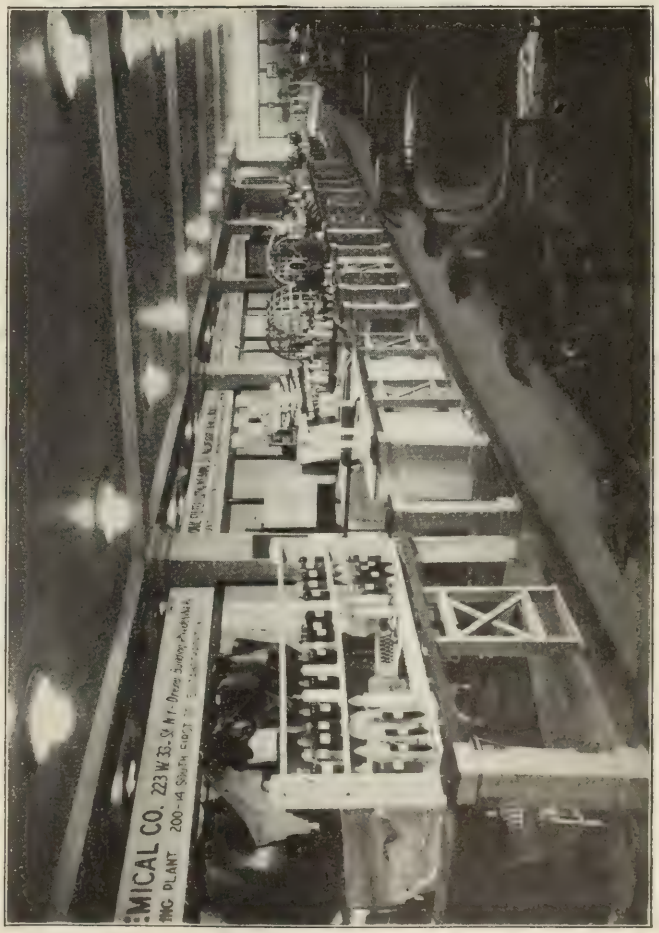
The older of the two systems is that of the Electro Bleaching Gas Co., which boasts of an operating installation as far back as 1919. Briefly, the system is made up of a circulation tank, a sludge tank, a centrifugal pump, an absorption tower and a storage tank. A measured quantity of lime and water is continually agitated in the tank and the solution pumped to the top of the stoneware absorption tower. The chlorine gas enters at the base of this tower, where countercurrents of gas and solution afford suitable conditions for the reaction.

Circulation is continued until the desired strength of liquor is obtained or, if chlorine containers are used, until the supply is exhausted. If the chlorine comes in tank cars (and, you know, Electro Bleach likes to ship it that way), the gas is either measured through a flow meter or the strength of the liquor is determined by titration.

THE TEXAS GULF SULPHUR CO., besides its general exhibit and suggestions for new uses of its product, had one display with a story attached to it. Gulf sulphur is all at least 99½ per cent pure. But it all contains also from 0.002 to 0.5 per cent crude petroleum. Now, when sulphur is burned in a pan, this minute quantity of oil combines with the sulphur to form a very thin asphaltic film which puts out the fire. If one stirs it with a stick or if the sulphur is burned in a rotary kiln, the difficulty is overcome, but that does not satisfy the hop growers, prune producers, makers of other dried fruits, woolen manufacturers, bleachers of grains and others generally interested. Experience teaches that it is unprofitable to stir up burning sulphur with a stick in a closed room during a bleaching process, and rotary kilns are cumbersome. After a year's unsuccessful research in an endeavor to extract the oil or to provide a simple mechanical device to take the place of the convenient pans, it occurred to a gentleman connected with the company that, if the pans were lighted and set zigzag, one on top of the other, they might help one another along in combustion by the excess heat developed and thus overcome the film. Presto! It makes the sulphur boil, works completely (and the notion is patented).

THE ANACONDA CO. made an interesting display of hundreds of different forms of copper, zinc, lead and their alloys and compounds, not forgetting copper shingles in greens, browns and other shades. In addition to these tonnage metals, other rare ones like tellurium and selenium are recovered. Although they exist in the ores in almost indistinguishable traces, some is recovered. It's an everyday application of the rather foolish mathematical truth that zero times infinity may be finite. The company has sold over a ton of tellurium for radio detectors alone. When we consider the small fraction of a gram in each detector, we get a notion of how many people are listening in to




MICAL CO.
INC PLANT

the broadcast "entertainments." And they say the glass industry takes all the selenium the company can produce.

THE CONTINUAL CRY, "Filter press has got to be cleaned!" which makes the life of a raw sugar manufacturer miserable, may not be heard, ever again. At least not if Messrs. Petree and Dow succeed in disposing of enough of their "cane juice clarifiers." This is a modification of the Dow tray thickener and the company claims that $2 legal currency per ton can be saved if you install this apparatus in place of filter presses. They like to deal with people from Missouri. A good deal of interest was developed in this apparatus and in the booth itself—for many lady visitors mistook the white wicker furniture and pink cretonnes for some kind of a nursery exhibit.

THE FENCE around the booth of the Corning Glass Works had 6-in. Pyrex tubes for posts and the rails were 3-in. pipe lines of the same material. This was but a little of the outside evidence of the recent development of Pyrex glass in industrial shapes and sizes suited to the needs of the chemical manufacturer. A 12-in. tubing is offered for chemical towers, which, in addition to its resistance to acids and temperature changes, has the advantage of enabling one to observe what is going on inside. These tubes withstand temperatures up to 600 deg. C. Other examples of industrial ware include 3- to 6-in. socket pipes and bends, distillation retorts containing up to 12 liters, 18-in. evaporating dishes, carboys, cylinders, etc. Within 6 weeks it is reported that 25-in. dishes holding 10 gal. will be on the market. "S" bends capable of use in many practical operations, such as cooling hot acid gases and liquids, in acid-condensing systems and for conveying hot liquids from condensers to receivers, are already being manufactured in various bores and lengths. One that has proved popular in distillation sets has an inside diameter of 2 in. and is 72 in. long.

But speaking of some of the domestic utilities of Pyrex, an unexpected convenience is to be found in an infant's nursing bottle which may be sterilized with boiling water without danger of breakage. Ardent testimonials from fathers with legs sensitive to the cold have followed the decreased time factor in preparing baby's meal on a freezing night when baby has announced his readiness to receive it.

In closing this little squib we are forced to add a plaintive note of despair. The remains of our beautiful Pyrex cigarette holder now repose in the gutter. Alas, its brief journey through life was suddenly and painfully interrupted by an accidental collision with the cement sidewalk!

AIR CONDITIONING, for the good of the product and for the health and comfort of the workers, has been the topic of much recent discussion. So it is natural that the Chemical Exposition should have its full quota of exhibits of conditioning apparatus. These exhibits ranged from the simple apparatus capable only of humidifying an atmosphere deficient in moisture to the elaborate units by means of which absolute control may be maintained over moisture and temperature within the building walls, regardless of the condition of the entering air.

Among other exhibits of this type the writer's eye was caught by the Bahnson Humidifier. Here is an extremely simple piece of apparatus—the principal part being an ordinary electric motor driving something which looked like a turbine impellor. It provides positive air circulation and will increase the humidity to any desired point above that of the entering air. And this without the aid of any auxiliary apparatus. The control depends on the moisture content of the atmosphere in the room which is being humidified, is positive and gradual in action and can be set to operate at any desired degree of saturation.

To go to the other pole of air conditioning, the B. F. Sturtevant Co. and the W. L. Fleisher Co. exhibited a complete, self-contained and compact unit for air conditioning, including refrigerating coils by which any temperature of entering air and any degree of humidification or dehumidification could be maintained as desired.

WHAT SHALL WE MEASURE NEXT? There seems to be a recording meter for almost every possible property that any possible form of matter could attain. There have lately been rumors of a recorder for measuring the specific gravity of liquids and, sure enough, we found it prominently exhibited by the Bailey Meter Co. at the show.

EVERY SHOW must have its mystery. And from the comments of the crowd, I should say that a goldfish bowl in the booth of Elyria Enameled Products Co. was the enigma of the year. People saw the bowl resting upside down on a nice blue-enameled surface—while the water stayed in and the fish swam contentedly about. "How do they do it?" everyone asked. And they felt the enamel and found it had just enough wavy feel to make the thing seem improbable, to say the least. Anyway, it was a nice piece of enamel!

IT HAS ALWAYS BEEN a pet theory of the present writer that the control of the generation and application of power in the average plant of a chemical or allied industry must be in charge of the plant engineer and that that plant engineer would be, nine times out of ten, a chemical engineer. This view is also, apparently, the view of the makers of power generating and control equipment. Every year shows a better representation of this class of apparatus at the Chemical Exposition.

SUCH AN OPERATION as the placing of a label on a bottle, can or other container may not seem of marked importance, but a surprising amount of time and money can be wasted where this is not efficiently done. That such considerations are uppermost in the minds of many just now was clearly demonstrated by the interest shown in the various exhibits of labeling machinery. The modern labeling machine, either automatic or hand operated, can place practically any kind of label on any shape of container, from a wooden packing box to a tiny vial of perfume.

SURPRISING AND NOVEL RESULTS are often obtained by the simple expedient of reversing the principle employed in some familiar device. At first sight the long boxlike affair displayed by the Carborundum Co. seemed to bear little relation to other parts of the exhibit, but in fact it was simply the reverse of the carborundum

uffle shown in another corner. Build a muffle of carorundum plates with a horizontal baffle, burn fuel—oil, as or powdered coal—inside of this and you have the annon radiating furnace. The high thermal conducivity of the wall material favors rapid radiation of the eat, forming an ideal heating unit for many purposes. When applied to boilers it is claimed by the makers hat an efficiency of 7 b.hp. per cu.ft. of combustion pace is obtained.

SEVERAL BOOTHS were occupied by chemical societies nd organizations of various kinds. Most of them were urnished with comfortable chairs, and were intended or meeting places and lounges. The "baby" of them ll, the Technical Photographic and Microscopical ociety, endeavored to show how photography is being sed by industry. Its exhibits overflowed the railing. Iundreds of fine prints were mounted on the assembly oom halls—ranging all the way from aërial mosaics aken 10,000 ft. high to glimpses of organisms observble only at 1,000 diameters.

To a metallurgist or a metallographist, by far the nost striking was a series of micrographs of aluminum lloys, made at McCook field by the Army Air Service. Aluminum is notoriously difficult to polish and etch, so nuch so that early investigators thought the metal nique in possessing no crystalline structure. Yet here re views at 500 diameters, taken of polished surfaces, *inetched,* showing two or three constituents in the most ninute detail and wonderful contrast!

EXTRAVAGANTLY DESIGNED DISPLAYS have been succeeded by more conventional efforts. Even the rainbow-hued color and dye exhibits were few in number. Perhaps the Bakelite Co. would have received the prize for colorful and artistic arrangement of its products, he brilliantly colored, amber-like materials being very effectively shown. The dazzling white of metal and ights at the New Jersey Zinc Co. and the brilliant eds and yellows at the Anaconda Copper Mining Co. gave natural tones which could be surpassed with difficulty. The United States Industrial Alcohol Co. had some purple hangings and royally carved furniture which contrasted strangely with the paper cartons of Alcorub which flanked them.

STATISTICS ARE INESCAPABLE, and when you saw the red light flashing at the National Lime Association booth and realized that every time it flashed a ton of lime had passed the way of all good things, you couldn't help sympathizing with the next ton of lime and holding your breath until the light went on again and you realized that it had also had its throat cut. The flashing light, however, did bring home to the visitors to the show the fundamental value of this commodity and its increasing importance. The National Lime Association is undertaking valuable work in enlarging our knowledge on this important commodity. Ample evidence of this work was apparent at the booth.

PROBABLY THERE WASN'T over a bushel basket of coke at the Koppers Co. exhibit, but many a longing eye was cast at that much fuel, and it would be interesting to know who finally got the stuff before it was transported from the Chemical Exposition. This company was exhibiting a revision of its design of coke oven, which looks promising. Instead of having the fuel burn at one end of the retorts and then exit from the flues to the regenerators at the other end (in other words, instead of having a lengthwise combustion of the fuel), the gases flow up on one side of retort and down on the other. This makes for much more even burning, and the quality of coke will be more uniform throughout the length of the burner. It is also reported that it is easier to regulate. The U. S. Steel Corporation has already decided to install these ovens at Clairton and at another one of its plants. It will be interesting to see whether the independent coke companies will take up with the new oven as enthusiastically as the proprietors of it.

MANY OF THE LARGER DYE MANUFACTURERS who have always taken space at the show were conspicuous by their absence this year. The Newport Company had a rather attractive booth, and dealers in dyes, such as Bachmeier & Co. and others, were represented.

Perhaps the most interesting booth was that of Zinsser & Co., who were presenting samples of alizarine colors on various fabrics. A number of hats were interesting in that they were among the first hats dyed with bottom chrome alizarines and marked a new era in hat dyeing. Some excellent woolen cloth from the famous Worumbo Mills dyed with brown and black alizarines indicated the use of these dyes on finer grades of woolens and worsteds. In addition, there were skeins of silk and printed goods of various kinds. There was also some worsted and woolen cloth for suiting, the origin of which was not revealed, but which was very satisfactory cloth. The successful distribution and use of these dyes make an optimistic note in the somewhat gloomy dye forecast. Here are colors which will compete with Germany on her most sacred ground of fine dyestuffs.

WE DOUBT if there is a chemical engineer in the country who has not at one time or another tried to dope out some way of measuring a quantity of water or other given liquids. They have struggled with the calculation of the V-notch meter and recording devices therefor. The Johns-Manville exhibit was, therefore, very interesting to them. This company has developed a meter which works on air pressure. The liquid fills up a cylinder on one side and is then discharged through a siphon while the liquid fills up its twin cylinder. Each time the cylinder discharges, a small cyclometer registers the fact that a unit volume has passed through the apparatus. The salesmen at the booth were either reticent or ignorant of the method of operation of the instrument, and no diagrams were available, but it was a very interesting advance and looks extremely promising.

LET US CONSIDER for a moment the case of an organic chemist with an idea the commercial development of which has been delayed only because of difficulty in obtaining the requisite quantities of a certain product—a compound answering to the name of furfural. At each exposition he has searched in vain for even a glimpse of the material which would mean success. Suddenly he stops in amazement, scarcely able to believe his own eyes, before a booth containing not simply a bottle of furfural but two standard drums!

So rapid has been the development of chemical industry that such an instance might be duplicated a dozen times.

Establishing a Rational Basis For Industrial Analyses

The Elements of Production Are Equipment, Personnel and Materials—Analysis of the Costs Involved in Each Leads to a Rational Basis for Future Analyses—Method Illustrated From Statistics of U. S. Railroads

By Harrington Emerson
President, The Emerson Engineers, Inc.

THERE are three elements in modern production, three partners with equal rights if not with equal interests. These three are like the three legs of a stool, which must be the same length, but need not be of the same thickness.

The three elements are:

The equipment.

The personnel.

The materials.

The function of each is different. The equipment does the work, the personnel supervises and directs the equipment which fashions and changes the materials.

These three are combined into a simple formula:

Product = Equipment Costs + Personal Compensation + Materials Used

Basic Example From Railroad Operation

In order to make the matter clearer, we shall illustrate all the steps, by using for the purpose, railroad operations.

Product, $1,000 of revenues, should be produced by equipment charges of $400 + compensation of $400 + materials $200.

The question immediately arises as to why $400 for equipment charges, why $400 for personal compensation and why $200 for materials?

To operate a railroad, there must be roadway, track and rolling equipment. These must come up to certain standards which the public and its representatives have grown to expect.

I have traveled on railroads where the only accommodation was an open flat car and where, under penalty of not arriving in time for dinner, the passengers had to cut wood for the locomotive. This would scarcely be tolerated anywhere in the United States.

It is demanded of a railroad that the transportation it furnishes shall be safe, convenient, frequent, rapid, punctual, comfortable and, lastly, decent. Each one of these requirements adds to the first cost of the equipment and also to the operating expense.

What Equipment Charges Comprise

If we examine the records of all the Class I railroads in the United States, about 200, we shall find that the investment in physical equipment is on the average $3,000 for each $1,000 of revenues. Some of the best roads have kept their investment down to about $2,000 for each $1,000 of revenues, but they are exceptions.

We can consider that $2,500 of investment in physical operating property for each $1,000 of revenues is conservative and that less than this would give rise to complaint.

The possession of equipment, even if it is not operating, causes various expenses that are in the long run inevitable, even if, for a short time, a few years, they can be deferred or be capitalized. The items making up the various expenses which perpetuate the property are only a few, as taxes, exactions, insurance, rentals, depreciation (the anticipation of future shrink), amortization (the making good of past shrink), unpaying betterments and, finally, the return on the investment.

These items are best expressed in the form of a percentage rate on the investment:

	Per Cent
Taxes	1.5
Exactions	1.0
Insurance, rentals	0.5
Depreciation	4.0
Amortization	1.0
Unpaying betterments	2.0
Return on investments	6.0
	16.0

Equipment Charges Increases as Property Ages

No one of these can be neglected, and a most disquieting fact is that the older the property the heavier are the charges.

At first taxes, exactions, depreciation and unpaying betterments are very low. Against a new railroad in a new country, all the charges might be as low as 8 per cent, but over the whole United States at the present time they average 16 per cent.

The normal, expected investment is $2,500, on which the perpetuation charges are at the rate of 16 per cent, or $400 out of a normal revenue of $1,000.

If the revenue is low in proportion to investment, either because rates are forced down or because investment has been made too large, the perpetuation expenses would amount to more than 40 per cent of the revenues, making this leg of the industrial stool too long.

The American railroad equipment perpetuation rate is 16 per cent, but amounted to $563 for each $1,000 of revenues in 1921.

Compensation's Share of Revenue

It is also stated that personal compensation can amount to $400. Why? After paying the perpetuation charges of $400, there is $600 left for operation. Part of this is for personal compensation and part for materials. How much for each?

The experience of the last 30 years in North America and in the United Kingdom shows that the material expenses are almost exactly one-half the personal compensation charges. This happens to be the railroad personal and material ratio and it is unchangeable, since material costs in the last analysis consist largely of personal costs. When personal compensation rises as it did during the war, materials also rise. When material costs drop, it is because personal costs have dropped. Therefore, of the $600 remaining out of $1,000 of revenues, $400 can be appropriated for personal compensation and $200 for materials to be used in operation and maintenance. Then $1,000 revenues

= $400 perpetuation + $400 compensation + $200 materials.

This is exceedingly simple, but usually not understood and not observed. Because personal compensation has to be met regularly and because material bills must also be paid promptly and because many of the equipment perpetuation costs can be deferred, be ignored, be charged to capital, the very vicious condition has arisen of paying more for personal compensation and for materials than the revenues justify. Two legs of the industrial stool, the compensation leg and the material leg, are too long. Sailors know enough to keep a ship on an even keel. She must not be down at the head or down at the stern, or show a bad list. Industrially, railroads are badly out of balance.

The figures, actual and standard are:

Actual: Revenues = $156 perpetuation + $563 compensation + $281 materials
Standard: Revenues = $400 perpetuation + $400 compensation + $200 materials

Whatever is added to compensation and to materials is at the expense of perpetuation. The roads have been living, and are living, on their own fat and some of them have already starved to death. If it is necessary to pay $563 for compensation, then without increasing the volume of business, it would be necessary to increase revenues to $1,400, an increase in ratio of 40 per cent.

The Universal Formula

The formula, however, as above given, is too simple and elementary. Each of the items—equipment charges, compensation and material—consists of two factors, the quantity factor and the quality factor.

The universal formula is written as follows:

$$\text{Product} = tR + TW + QP$$

in which tR stands for the equipment charges, TW for compensation and QP for materials.

t = hours in year that the equipment works.
R = rate per hour of all the equipment.

Analysis of Equipment Charges

Assume the total railroad valuation at $20,000,000,000; then with the perpetuation rate of 16 per cent, the total perpetuation charges are $3,200,000,000 = tR.

There are 8,760 hours in the year, and if the equipment worked every hour, the rate R per hour would be $365,000.

Unfortunately on the average railroad physical investment works only 5 per cent of the time, therefore 438 hours in the year. This boosts the rate R up to $7,300,000 an hour. We all know, of course, that a railroad cannot work all the time as a waterfall does, or a pipe line; nor nearly all the time, as paper mills and glass plants do, or as many mines do; but a railroad could improve very much. It could utilize its equipment two-thirds of the time, as some ocean steamers do. It uses some of its equipment, now, 25 per cent of the time, some 10 per cent of the time and a very large part of it only 2 per cent of the time. It would be quite possible at least to double the actual time-use of the equipment, not by increasing to 50 per cent the use of the few buildings and offices, but by increasing to 5 per cent time-use the enormously costly way and track.

The Question of Standards

This immediately brings up the question of standards. I can assume the railroad's full use of the hours of the year at 876, or 10 per cent of the whole time.

If this were done for the same volume of revenues, the equipment values could be reduced one-half, and instead of using $20,000,000,000 of equipment with an annual cost of $3,200,000,000 we should use $10,000,000,000 of equipment at an annual cost of $1,600,000,000 and an hourly rate of $1,827,500.

One-half the equipment working twice as many hours cuts the actual yearly cost in half and cuts the hourly rate to one-quarter. It means, were it possible, a yearly saving of $1,600,000,000.

It is of course not possible to reduce a horse to the size of a pony by starving him, even if he does travel only 5 miles a day. However big the horse, he must be fed, but in a new departure, I would invest in a pony and let him travel at least 10 miles.

The cost of a passenger train on the Kansas City, Mexico & Orient is about $2 a mile; an autobus in California carries as many passengers at a mile cost of 25 cents. The Kansas City, Mexico & Orient has an enormous and most idle investment in way, track and equipment; the California bus has no investment in way or road and a minimum investment in car.

We can now introduce standards with the formula:

$$\text{Actual: } t_a R_a = 438 \times \$7{,}300{,}000$$
$$\text{Standard: } t_s R_s = 876 \times \$1{,}827{,}500$$
$$\text{Efficiency: } \frac{t_s R_s}{t_a R_a} = 50 \text{ per cent}$$

It is evident that the best practice as to equipment is to use as little as possible, but to make it work all the time. The great world gain of using power-driven equipment is that it can work all the time, while man and animals can work only part of the time; but we have not yet outgrown the idea that, because man wants to rest two-thirds of the time, therefore the waterwheel should also rest two-thirds of the time, forever and irrecoverably wasting the unused water that goes over the dam instead of through the wheel.

Analysis of Personal Compensation

We next come to the leg of personal compensation. On the railroads the amount available for personal compensation is $2,500,000,000 yearly. The two factors are: T, the total hours of all men, and W, the compensation rate per hour.

The actual average compensation rate per hour was $0.76. We can expect of each man 2,400 hours in the year; $2,500,000,000 at $0.76 will pay for 3,300,000,000 hours, and, giving each man 2,400 hours, it would be possible to employ 1,375,000 men.

B. M. Jewell, president of the railway department of the American Federation of Labor, is reported to have stated that the annual minimum wage for a railroad employee is $2,133, or $0.90 an hour. This establishes the quality of the worker. Divide the available compensation fund equally between all workers, it would be limited to 1,125,000 employees. The actual total is over 2,000,000. Each man now supervises $10,000 worth of equipment. Each man to be worth $2,133 should supervise $18,000 worth of equipment.

Actual: $T_a W_a$ = 4,900,000,000 hr. at $0.76 = $3,724,000,000
Standard: $T_s W_s$ = 2,778,000,000 hr. at $0.90 = $2,500,000,000

Efficiency and Compensation

In bridge building, piano wire costs more than cast iron, but it carries a greater weight for each dollar paid. The $0.90 an hour man must supervise more per

dollar paid him (the machine does the work) than the $0.60 an hour man or the $0.20 an hour man.

$$\text{Efficiency: } \frac{T_s W_s}{T_a W_a} = \frac{2{,}778}{4{,}900} \times \frac{90}{76} = 67 \text{ per cent}$$

If the revenues are right, then the efficiency of the workers is only 67 per cent. If the men are actually 100 per cent efficient, then the revenues should be increased 50 per cent.

Caught between the devil of low revenues imposed by the Interstate Commerce Commission and the deep sea of high yearly compensation demanded by the unions and more or less forced by the President, the railroad executive should curtail the non-essentials of service until he can perpetuate and operate within his revenues.

Safety need not be waived, but frequency, speed, punctuality and comfort could each be abated.

Analysis of Material Costs

The next item is materials—QP. Q is the number of units as tons of coal and P is the price per unit. The general law holds good for materials: The better the quality the lower the end cost, as a less quantity is used.

This is particularly true of coal. Coal with 40 per cent ash has two-thirds of the heat units of 10 per cent ash coal, but it has no steaming value and is worthless.

Materials cannot be aggregated into a single unit, as some are measured by the foot, others by the pound, others by the gallon. We can, therefore, give for materials only the total cost QP = $1,443,000,000.

In industrial plants the efficiency of materials of operation and maintenance is rarely over 60 per cent, but we can assume it at 67 per cent, the same efficiency as the compensation.

$$\text{Actual: } Q_a P_a = \$1{,}443{,}000{,}000$$
$$\text{Standard: } Q_s P_s = \$942{,}000{,}000$$
$$\frac{Q_s P_s}{Q_a P_a} = 67 \text{ per cent}$$

Effect of Equipment on Compensation and Materials

We have, however, not yet finished. The standard equipment is only one-half the actual equipment, and such standard equipment might on the whole require three-quarters of the men and four-fifths as much material. This would bring down compensation efficiency:

$$\frac{T_s W_s}{T_a W_a} = 67 \text{ per cent} \times 75 = 50.25$$

and material efficiency:

$$\frac{Q_s P_s}{Q_a P_a} = 67 \text{ per cent} \times 80 = 53.6 \text{ per cent}$$

Applying the Above to Industry in General

American industrial activities, almost without exception, are overequipped and undersupervised; too much equipment of poor quality, too many men of insufficient competence, too many low-grade materials.

A Ford costs more per pound than a locomotive, a chauffeur averages more than a railroad employee and gasoline costs much more than coal, but t is more, T is less and Q is less and the autobus operates at $0.25 a mile.

The summary of the whole can now be made in millions:

$$\frac{t_s R_s + T_s W_s + Q_s P_s}{t_a R_a + T_a W_a + Q_a P_a} = \frac{\$1{,}600 + \$1{,}996 + \$771}{\$3{,}200 + \$3{,}724 + \$1{,}443} = 52.2$$

Necessity of Getting the Elements of Industry in Hand

Until the big essentials are well in hand, until all three legs are of the same length, until each leg is of the best material, heat-treated, it is inept to puzzle about details. If the equipment is basically too heavy and too expensive, if the horse is too big, there is little gain in cutting down on his oats. If owing to imperfect planning and inadequate supervision, more men are on the payroll than the revenues justify, the difficulty is not remedied by holding a stop watch over the supervisor. Unless there are standards as to every item of material, efficiency checks accomplish but little.

I have used the railroads to illustrate the value of the formula as a means of analysis. The railroads are a very large business, intimately interwoven with all other industrial activities.

How This Formula Is Applied

The formula has been used to reduce the cost of the staples in a periodical, and it has also been used to show the aggregated condition of all the industries in the United States; it is a formula of universal application.

Columbus, with three little caravels and a few men and a few tons of stores, in 3 months' time discovered a new world. Everything was small except the personality of Columbus.

It is not far fetched to believe that the duty and destiny of man is, with greater and greater competence, during shorter and shorter hours, to supervise larger and better equipment working continuously, and to use materials to 100 per cent of their possibilities.

There has been a bitter struggle, wasteful, unscientific and unnecessary, between the railroad executives and the railroad shop employees. Compensation during the last few years has taken too large a proportion of the revenues. The employees, having made substantial gains in rates of pay per hour, in reduction of hours and in strenuousness of work during the war period, are very reluctant to go back to former conditions. Railroad executives, knowing that compensation must be reduced in volume, have erroneously supposed that the only way was to reduce hourly rates. The workers, learning of proposed reduction in total compensation, have erroneously supposed that this must mean either reductions per hour, longer hours per day or harder work. On account of these misconceptions the clash occurred.

By the use of demonstrated methods, unknown both to executives and to shopmen, it would be not only possible but comparatively easy to reduce total compensation 33 per cent, yet not discharge a single worker, not reduce any hourly rate, not require longer hours, nor the exaction of greater effort per hour. By adopting the proved out methods, by co-operating to make them a success, the executives could have attained what is imperatively needed, if railroads are to endure—a reduction in total compensation costs—and the shopmen could have retained what they won during the war—higher rates, shorter hours, lessened effort, all desirable if civilization is to progress.

New York City.

Adsorption a Criterion of Corrosion

By B. D. Saklatwalla
General Superintendent, Vanadium Corporation of America

One of the most actively exploited fields of metallurgy today is the search after alloys, ferrous and non-ferrous, which will withstand corrosion. Experimenting has been practically the sole guide in this exploitation, and very many of the results achieved have been more or less accidental. We have known from times long gone by that certain alloys and metals have withstood corrosion for centuries, without our being able to attribute satisfactory reasons.

In our efforts to bring light into the subject and scientifically co-ordinate cause and effect, we have in recent years set up several theories as to the cause of corrosion. As such may be mentioned: the electrolytic, the film and the colloidal theories. Even with these at command, we do not seem to have made any great progress in understanding the phenomena. More so than the lack of understanding is the lack of a criterion or means of measurement of corrosion, which has hindered practical progress. Undoubtedly experimental investigation would be greatly accelerated and practical results more quickly achieved if such could be found, instead of relying upon actual service test as we are compiled to do at present.

It is remarkable that most of the so-called noble metals, especially of the platinum group, have the capability of taking up large volumes of gases. These gases are occluded not only in the pores of the metal in a loose condition, as in platinum sponge, but also are adsorbed on the surface and sometimes dissolved in the metal, forming a solution. It appears that the phenomenon of adsorption, whereby gases are condensed on the surface of a metal or of any other solid body, would have the tendency of imparting to that body surface activities, depending on the degree of adsorption. According to many investigators who have studied the phenomena of adsorption, it appears that every solid body in contact with a gas has the capability of condensing this gas on its surface. This condensation, in certain cases, reaches a magnitude corresponding to a pressure of several thousand atmospheres. Quincke advances the opinion that the film of adsorbed gas on the surface of a solid body shows a decreasing density, within the film, outward from the surface in contact with the solid body, and that at the surface of contact the density of the film corresponds to that of a solid body. Thus, the solid body will not be surrounded by the gas atmosphere in which it exists, but by a film of highly condensed gas constituting that atmosphere.

We are all aware of the fact that the velocity of a chemical reaction depends on the physical conditions of pressure, concentration, etc. The rate of interaction between the condensed gas of the film and the solid body will depend, therefore, on the density of the film. If a body has a high degree of adsorption, the condensation and consequent interaction velocity will be great and hence surface oxidation of the solid will take place quickly, probably instantaneously. We can thus see how a protective film will be formed immediately, which if it has the necessary physical qualifications of homogeneity, right thermal expansion, and so on, will prevent or slow up the velocity of further interaction. The presence of this reaction film will change the surface qualities of the body and hence its adsorption capability. However, if part of this protecting reaction film is removed by abrasion, the original metal surface with its adsorption capability comes again into play and instantaneously replaces the removed film. We have herein an explanation of the self-healing property of a protective film.

The corrodibility of a solid in a gas atmosphere will consequently depend on its capability of adsorbing this gas to a greater or less pressure, thus increasing or diminishing the velocity of surface interaction, hence being capable of instantaneously forming a protective film or not. Our experience in the past regarding metals such as platinum or palladium, which are non-corrosive and produce adsorbed surface gas films of a high degree of concentration, leads us to believe that the high interacting velocity and consequent nearly instantaneous production of the protective film is the essential factor in producing non-corrodibility. Hence the higher the adsorption capability the higher should be the non-corrodibility.

Another possibility of high degree of adsorption preventing corrosion is the fact that the high-pressure gas film, having the characteristics of a solid body, might act as protection itself without forming the secondary reaction protective film.

Owing to the high-density film being in contact with the solid another very important phenomenon may be brought into consideration—namely, diffusion. We might be able to explain on this basis how slight additions of another element to a metal, or difference in heat-treatment, or mechanical condition of the surface—i.e., whether strained or not—play a big part in accelerating or retarding corrosion. These influences might have a great bearing in changing not only the adsorption capability and consequently the rate of interaction chemically, but also of diffusion physically, between the solid and the condensed gas film. This rate of diffusion will undoubtedly have considerable bearing on promoting the speed of formation of the protective film.

As a remarkable example of the connection between adsorption and corrosion appears to be a fact mentioned by Dr. Balke in a recent address on tungsten and similar metals. He remarked that metallic tantalum was absolutely non-corrosive, having withstood the attack of boiling aqua regia for several hours, and at the same time mentioned the characteristic that it was capable of absorbing a very large volume of gas, thus being similar to palladium.

If the above contentions can be proved to be correct by experimental research, a definite relationship established between corrosion and adsorption, and an experimental method devised for measuring adsorption, we might have at command a simple and quick method of judging the adaptability of alloys and metals for corrosion. The method would be applicable as a criterion for atmospheric as well as submerged corrosion. It has been more or less firmly established that, for instance, in boiler water the dissolved gases are responsible for the corrosion and that by their removal corrosion can be checked. The study of submerged corrosion from the adsoption standpoint would therefore reduce itself to the study of the dissolved gases.

The above remarks are offered as a mere suggestion which may incite research in a new direction and may be of practical help toward solving the most imminent metallurgical problem now confronting us.

Pittsburgh Meeting, A.C.S., Section of Gas and Fuel Chemistry

EDITORIAL STAFF REPORT

THE Section of Gas and Fuel Chemistry of the American Chemical Society held its initial sessions at the Pittsburgh meeting with Dr. A. C. Fieldner of the Bureau of Mines as chairman and R. S. McBride, assistant editor of *Chemical & Metallurgical Engineering*, as secretary. The first session was a "Symposium on Combustion," under the chairmanship of Prof. R. T. Haslam, of Massachusetts Institute of Technology. Two other sessions were devoted to technical papers.

More than 300 persons were in attendance at the symposium as the Division of Industrial and Engineering Chemistry met with the Gas and Fuel group. The other sessions also developed a large number of worthwhile reports, as well as lively discussion, among the hundred or more persons in attendance. It was enthusiastically voted that the officers of the Society be asked to authorize the continuance of the Section for the New Haven meeting.

NEW KOPPERS OVEN DESCRIBED

The carbonization of coal was one of the most important general subjects considered in several of the papers. H. J. Rose described the new Becker coke oven, which has been developed by the Koppers Co., indicating the important increases in oven capacity which this new system of oven heating permits. As an example of the advance thus made it was reported that thirty-seven ovens of the new type will suffice to give the coke which would formerly have required fifty or more of the best previous type of ovens. This increase in speed of coking is the result of heating-flue construction. In the new oven the products of combustion of the heating gas pass over the top of the oven through cross-over flues and down the wall on the opposite side of the coal mass. Thus the horizontal heating flue, formerly the weakest structural feature of the oven, is greatly reduced in size.

The same author discussed the new electric oven method which has been developed at the Mellon Institute laboratories of the Koppers Co. for determining the byproduct yields which can be expected from any coal.

THERMAL EFFICIENCY OF A COKE OVEN

The thermal efficiency of modern regenerative coke ovens was discussed by Wilson, Forrest and Herty of the Massachusetts Institute of Technology staff, as a result of extended plant tests from which complete engineering data were obtained. There were included in this report: "First, discussion of data needed to show completely the thermal operation of a modern regenerator coke-oven battery; second, description of the experimental methods employed to obtain the needed data, together with a table giving experimental figures obtained; third, a table balancing total heat input against total heat output is given, with a discussion of this and a calculation of the efficiency of the ovens; fourth, a so-called sensible heat balance is tabulated, the net heat effect of the coking process is discussed and the relation between the sensible heat balance and the exothermicity of the conversion from coal to coke is indicated."

The authors conclude that the reactions involved in coking are exothermic to the extent of approximately 450 B.t.u. per pound of coal for the sample treated.

COAL CONSTITUTION AND ITS SIGNIFICANCE

A group of five papers by S. W. Parr, T. E. Layng and their assistants at the University of Illinois presented various phases of the problem of determining the constitution of coal and the relation of coal constitution to carbonization and to combustion of stored fuel. A study of solvents for the separation of coal into its type constituents has been made, with particular reference to the use of benzene, toluene and xylene. The investigators show that pyridine or acid solvents tend to react with the coal substance and do not give true indication of the constitution of the coal substance. Of the three neutral solvents, xylene gives the best and most complete removal of the bituminic material from the cellulosic material. The significance of these two groups of constituents is very effectively set out in the other papers.

During storage of coal there is no loss in the total B.t.u. of the fuel, but only a slight increase in B.t.u. per pound corresponding to the increase in weight which results from the absorption of oxygen. Mid-continent coals particularly have a large absorptive capacity for oxygen. As a consequence when the coal is burned in a furnace the oxygen is present intimately associated with the coal and goes off as carbon dioxide. This gas gives a blanketing effect over the fuel bed which deadens the fire and is the cause of the loss in efficiency and the practical plant troubles which follow the burning of mid-continent coal which has been a long time in storage.

By fractional decomposition these investigators have produced valuable data as to the behavior of the different constituents in the fuel. They have been able to carbonize separately the two groups of constituents and each of them when saturated with oxygen. For purposes of discussion the two groups of constituents are called bituminic and cellulosic. When these two constituents hold as much oxygen as they will combine with or absorb at low temperatures, they are spoken of as "oxygen saturated."

NEW THEORY OF COAL CARBONIZATION

From results upon these constituents the investigators propose a new theory of coal carbonization. Evidence shows that the bituminic bodies can often be oxygen saturated without destroying the utility of this constituent to bond the carbonized product into a good coke. It is this bituminic material which makes the coke coherent and gives rise to the cell structure. However, it appears that if the cellulosic material is oxygen saturated under many circumstances, the coking property is destroyed, even though a bituminic material of high bonding power be used. The evidence thus far available indicates a close co-ordination between experimental results and the practical experience with coals of different types. The authors conclude that the production of coke is not a simple matter of decomposition of organic matter. It is rather a destructive decomposition accompanied by cross-reactions which are largely affected by the oxygen content of the cellulosic group of constituents and to a lesser extent by the oxygen content of the bituminic group. The physical character of the final product depends upon the influence of the oxygen content more than any other single factor.

Parr and Layng, with assistants, reported on a

method for determining the softening point of coal, which consisted of heating the material in a tube while passing through it a stream of inert gas. When the coal softens, the particles of finely divided material coalesce and interrupt the flow of gas through the mass, evidenced by an increase in pressure at the inlet. When the heating has progressed further, the softened material loses its plastic form, becomes coked and is again porous to gas. By the time coking is complete the pressure required on the gas stream reaches a minimum again.

The application of this method to various types of coals gives a significant, distinctive set of results for each type. The authors indicate in this preliminary report that they hope to be able to distinguish between types of coals, the behavior of the types in storage, the behavior during coking, and to prophesy the relative value for coking from these characteristics of the raw fuels.

Products of Low-Temperature Carbonization

The coke produced from low-temperature carbonization of coal has in general been unsuited to general use because it is soft and subject to spontaneous combustion, making its storage and handling impracticable. Harry A. Curtis, of the International Coal Products Co., reported upon the Carbocoal process used by that concern for utilizing the coke produced by low-temperature methods. In this process, which has previously been described in *Chem. & Met.*, low-temperature coke is ground, briquetted after blending with pitch, and the briquets carbonized until a low percentage volatile product is obtained. The result is a dense, strong briquet which can be handled and burned almost exactly like anthracite.

In the report by Dr. Curtis are given the results of boiler tests of the unbriquetted low-temperature char, known in this process as semi-Carbocoal. These results show that attempts to burn this semi-coke on a Coxe stoker are impractical unless further prepared. The percentage efficiency obtained is rather low and the percentage capacity obtained from the furnace is not quite equal to that usually demanded in commercial practice. The heat absorption in the two cases reported is 59 and 63 per cent respectively, and the capacities obtained were 153 and 205 per cent of the rating.

Use of the low-temperature coke in powdered form in powdered fuel equipment gave slightly greater plant capacity and distinctly higher thermal efficiency, but the fuel is somewhat difficult to pulverize, so that it does not promise to be as widely useful in this form as when briquetted.

The methods used for examination of low-temperature coal tars were described by Prof. J. J. Morgan and R. P. Soule of Columbia University. The methods given were those given in articles which have already been reported by *Chem. & Met.*

Study of Coke Structure and of Sulphur in Coke

The character of coke as judged by its macrostructure is of great importance in valuing this material. A paper was given by H. J. Rose describing a system of impregnating the cut surface of a coke sample with a mixture of plaster of paris and magnesia in order that the delicate detail of structure can be brought out. Another novel method proposed is the direct ink printing from polished coke surfaces properly sectioned.

Physicochemical studies of the forms of sulphur in coke indicate, according to the report of A. R. Powell of the Bureau of Mines, that the sulphur exists in two distinctive forms: (1) a stable form which exhibits all the properties of a solid solution, and (2) free sulphur physically absorbed by the carbon. Coke may contain both of these forms in addition to some sulphur combined with iron as ferrous sulphide. At temperatures about 500 deg. C. the ferrous sulphide of coke oxidizes very readily in the presence of air to ferric oxide and free sulphur. This reaction seems to occur during the quenching of coke and explains the disappearance of ferrous sulphide from coke rather than any reaction which occurs during the coking process.

Discussion of Powell's work developed the suggestion that the same general scheme might perhaps be applied to nitrogen in coal and coke to gain an insight into the reactions that render it available as ammonia during coking.

Producer Gas From Powdered Coal

The making of producer gas from powdered coal in order to achieve higher over-all efficiencies from fuel use was discussed by R. T. Haslam and L. Harris of the Massachusetts Institute of Technology. Aside from the possibility of using a low-grade fuel, the use of powdered coal for the manufacture of producer gas would give a constant composition gas free from tar, thus being easily cleaned, and the producer would be flexible, rapidly handling changes in load up to full capacity. As a result of experimental work not yet completed a gas of 12 per cent CO and 7 per cent CO_2 has been generated. Theoretical and experimental considerations show that the main factors are, first, high temperature in the combustion chamber (1,100 to 1,300 deg. C.); second, air for combustion highly preheated (900 to 1,000 deg. C.); third, coal finely pulverized, and fourth, air and coal well mixed together and so maintained until the end of the reaction.

Gases in Brittle Boiler Plate

Steel samples from two boilers which had failed from caustic embrittlement have been analyzed by the Bureau of Standards. One boiler was several years old, the other comparatively new. Analyses for gases were made on samples representing the material from the center of the plate where no cracks had developed and from the edge of the plate between rivet holes where cracks had developed. There was but little variation between the combined nitrogen content of the center and the edge of the same plate or between the different plates.

The results for oxygen and hydrogen by the vacuum fusion method with antimony-tin alloy indicated 0.02 to 0.03 per cent oxygen and 0.0020 to 0.0030 per cent hydrogen in the plate.

Whiteware Studies in Pacific Northwest

The United States Bureau of Mines, in co-operation with the University of Washington, will undertake an investigation of the residual kaolins and feldspars of eastern Washington and northwestern Idaho for whiteware bodies.

The work which will be done will follow the lines of the kaolin investigations now under way at the ceramic experiment station at Columbus, Ohio, and will be performed in the new mines laboratory of the University of Washington at Seattle.

Graphitization in a Carbon Tool Steel

By Henry S. Rawdon and Samuel Epstein
Physicist and Associate Physicist, Bureau of Standards

In A recent article in this journal[1] a peculiar type of black fracture occasionally occurring in annealed carbon tool steel bars was described. Although the examination appeared to have been rather complete, no definite conclusion could be reached by the author as to the fundamental nature of the phenomenon or as to the reason for its occurrence. Advantage was taken of the offer to furnish a specimen for study, and the results of the examination of the specimen obtained in this way constitute the present article.

The sample was a short section of a 1⅛-in. bar; its fracture showed the same characteristic features as those previously illustrated in Fig. 1 of Mr. Green's article. In what follows, the light-colored muff will be called zone *a*, the black interior, *b*, and the light-colored pencil of material at the axis, zone *c*. The pronounced difference in structure existing across the section of bar was evident even in the rough-sawed face.

Microstructure

Fig. 1 is a micrograph illustrating the appearance of the material, "as received" polished but unetched. In each of the three zones isolated black spots were found; in zones *a* and *c*, which are very similar in appearance, the number of these was very much less than in zone *b*. In this one, the spots were arranged in a manner very suggestive of the crystalline structure of the metal.

The structure of the specimen as revealed by etching is shown in Fig. 2. Zones *a* and *c*, which appeared to be essentially identical, consisted of a ferrite matrix imbedded in which were numerous granules of spheroidized cementite together with the irregular black spots previously referred to. Zone *b* appeared to be practically free from cementite, either pearlitic or spheroidized, and showed only a ferrite matrix in which was the network of black patches noted in the unetched state. Presumably these black spots are graphite; they have the appearance of "temper" graphite such as results upon annealing rather than the flaky variety which separates directly from the alloy when in the molten state.

Heat-Treatment

The specimen was first given a "mild" hardening treatment: water quenched from 740 deg. C. (1,365 deg. F.), which is just above the beginning of the Ac transformation (according to Mr. Green's curves). It was put into the hot furnace, brought up to the desired temperature and held for approximately 5 minutes. After examination, the sample was given a more severe treatment: water quenched after being held for one hour at 775 deg. C. (1,427 deg. F.), which is considerably above the end of the Ac transformation.

TABLE I—BRINELL HARDNESS (1/16-IN. BALL, 15 KG. LOAD)

Treatment	Zone *a**		Zone *b**		Zone *c**	
Initial state	102	globular cementite and ferrite	67	graphite and ferrite	102	globular cementite and ferrite
First hardening (740° C.; 5 min.)	477	martensite and cementite	138	graphite, martensite and ferrite	225	troostite and globular cementite
Second hardening, (775° C.; 1 hour)	515	martensite	467	martensite and graphite	510	martensite
Annealed (775° C.; furnace-cooled)	120	pearlite and globular cementite	108	pearlite and graphite	127	pearlite and globular cementite

* In addition to the micro-constituents given, *a* and *c* also contained small amounts of graphite throughout.

In each case the outer light-colored layer, zone *a*, showed a martensitic structure. After the first or "mild" hardening treatment, a considerable amount of globular cementite remained scattered throughout the martensitic matrix (see Fig. 4). After the second quenching (Fig. 6), almost all of this had been dissolved in the matrix, thus accounting for the slight gain in hardness noted in Table I.

In zone *b*, the portion corresponding to the mossy black fracture, the structure varied considerably according to the severity of the hardening treatment. In Fig. 3 this zone was only partly hardened, each black (graphite?) spot acted as a center for the formation of martensite. Evidently these spots were the source of the carbon which dissolved in the ferrite matrix. The relatively low quenching temperature used and the very short sojourn at this temperature prevented complete diffusion of the dissolved carbon in the ferrite so that, in the quenched sample, portions of the unaffected ferrite matrix were still to be seen between the martensitic patches surrounding the black spots. This structural condition should properly be regarded as one of the transition stages through which the specimen, upon receiving the more severe treatment, passed. In this latter case (Fig. 5) no ferrite was found, the solution of carbon was uniform throughout the entire zone. It will be noted, however, that the black spots did not entirely disappear, but remained as a conspicuous feature of the microstructure.

Zone *c*, being at the center of the specimen, was not hardened completely by the mild quenching. This portion showed a troostitic structure and, as indicated in Table I, was much softer than the martensitic condition which resulted in this zone after the second or *severe* hardening treatment. Traces of graphite were found in the martensitic matrix of both zone *a* and *c* after both hardening treatments. These correspond to the isolated spots in these zones in the initial state of the material.

[1] Arthur W. F. Green, "Black Fractures in Carbon Tool Steel," *Chem. & Met. Eng.*, Aug. 9, 1922, p. 265.

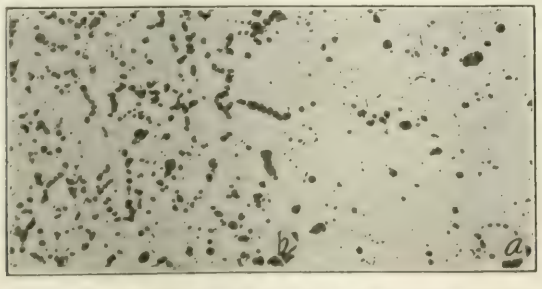


FIG. 1—UNETCHED SPECIMEN AT TRANSITION FROM BLACK TO LIGHT FRACTURE. × 100

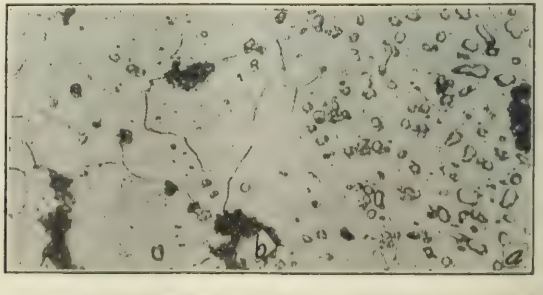
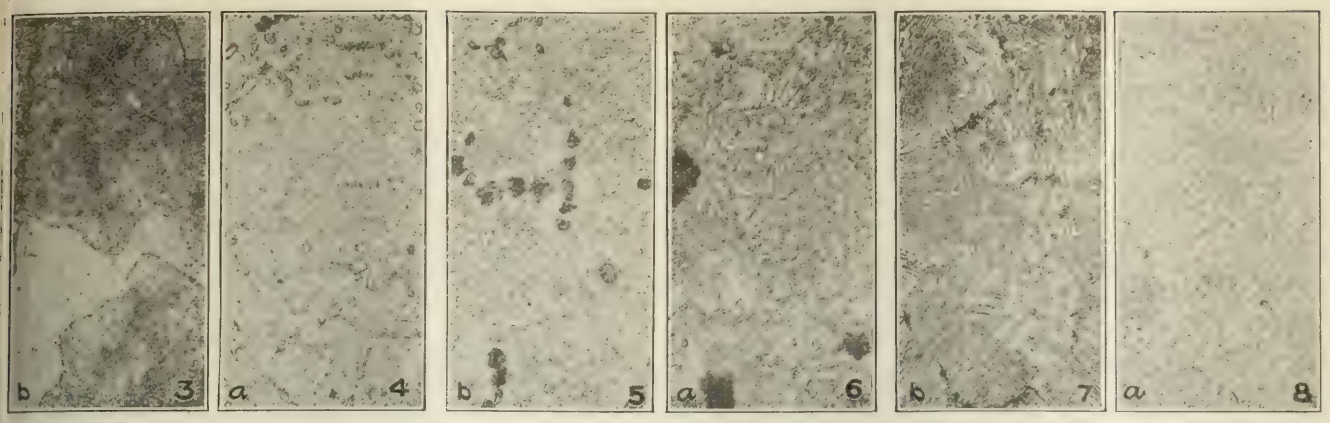


FIG. 2—SAME SPECIMEN AS FIG. 1, ETCHED WITH 5 PER CENT PICRIC ACID. × 500



FIGS. 3 TO 8—STRUCTURE AFTER VARIOUS HEAT-TREATMENTS. ETCHED WITH PICRIC ACID. × 500

Figs. 3 and 4—Black and light areas after mild hardening.

Figs. 5 and 6—Black and light areas after full hardening.

Figs. 7 and 8—Black and light areas after annealing.

The hardened specimen was then annealed at 775 deg. C. and furnace-cooled. The resulting structure of zones *b* and *a* are given in Figs. 7 and 8. A comparison with Fig. 1 shows to what extent the condition and distribution of the carbon were affected by the series of heat-treatments described. In addition to the black areas, still to be seen, zone *b* showed considerable pearlite which formed from the carbon which dissolved upon heating the specimen above the Ac transformation, instead of the initial structureless ferrite matrix. As might be expected, zones *a* and *c* also showed a considerable amount of pearlite after the series of treatments instead of being completely spheroidized as in the initial condition.

Chemical Composition

The specimen, after the heat-treatment was completed, was analyzed chemically, the sampling being carefully done so as to keep zones *a* and *b* separate. (The small amount of material available did not permit of an analysis being made to represent the initial state of the steel.) The results are summarized in Table II.

TABLE II—CHEMICAL COMPOSITION*

Specimen	Carbon, Total	Carbon, Graphite, Per Cent	Manganese, Per Cent	Sulphur, Per Cent	Silicon, Per Cent	Nickel, Per Cent
Zone *a*...	1.20	0.30	0.15	0.024	0.07	not detected
Zone *b*...	1.24	0.45	0.15	0.023	0.08	not detected

* Analysis by H. A. Bright, associate chemist, Bureau of Standards.

So far as should be judged from the microstructure of the material in its initial condition, the outer layer, or zone *a*, did not contain much more graphite than was found by analysis. In zone *b*, however, essentially all of the carbon was in the graphitic form in the initial state of the material. After being subjected to our series of heat-treatments, however, the analysis indicated that the greater portion had reverted to the combined form. The other results of the analysis summarized above indicate no other feature of composition which throws any light on the unusual behavior of this specimen.

Nitrogen in Steel

A method for determining total nitrogen in steel has been under investigaton by the Bureau of Standards. It depends on the absorption in calcium vapor of all the gases evolved from the steel sample when fused *in vacuo*. The nitrogen is fixed as calcium nitride, which is then readily determined by solution in acid and distillation with sodium hydroxide.

Acetone as a Solvent for Bitumens, Asphalts, Animal and Vegetable Oils

An extensive investigation of the solvent properties of acetone is being conducted at the Mellon Institute of Industrial Research of the University of Pittsburgh, in order to ascertain its value as a commercial solvent. In the course of the work a number of bitumens and of natural and artificial asphalts have been tested. From the data obtained it has been concluded that the percentage of acetone soluble material decreases as the hardness of the asphalt or bitumen increases; it also decreases with the time of blowing, in the case of mineral rubbers. It was further noted that acetone possesses higher solvent properties for wood-tar pitch than various other commercial solvents. These conclusions, however, merely corroborate statements made by other investigators.

The acetone used in this investigation was obtained by the destructive distillation of calcium acetate and was of excellent homogeneity and uniformity. Its low specific gravity lowers its cost below or equal to other commercial solvents of high specific gravity, when purchased by the pound. Acetone is miscible with all ordinary commercial solvents and possesses the property of forming a homogeneous solution when added to two immiscible solvents.

A number of commercial and refined vegetable and animal oils have been tested and found miscible in all proportions with acetone at 25 deg. C. A small percentage of insoluble material was found in a few of the crude products, due, no doubt, to some foreign matter. The part soluble in these cases at 25 deg. C. is miscible in all proportions with acetone. The heavy greases and hydrogenated oils are only partly soluble at 25 deg. C., but are miscible in all proportions with acetone at its boiling point. A number of essential oils have also been tested and found miscible in all proportions.

The present grade of acetone obtained from calcium acetate is entirely volatile and therefore does not leave a residue in or impart an odor to the extract or extracted material. Its low boiling point permits the carrying out of extractions without danger of chemical changes in the product. Acetone is miscible in all proportions with and has a great affinity for water and thus acts as an excellent dehydrating agent. Acetone is less flammable than benzene, toluene, ethyl ether, gasoline, petroleum ether or pentane. Its physiological effects are negligible, if ordinary care is used in handling the solvent.

"You Know Me, Al Uminum"

As Presented at the Smoker of the American Chemical Society at Pittsburgh

AT EVERY MEETING of the American Chemical Society the local entertainment committee prepares "stunts" to be given at the smoker, when all dignity is relaxed and everyone becomes a boy again for the evening. The sixty-fourth meeting in Pittsburgh was no exception and that the efforts of the committee were appreciated was evident from the congratulations they received during the remaining days of the meeting.

One of the most amusing of the stunts was the presentation of a skit "You Know Me, Al Uminum," presented by the New Kensington Laboratory, Aluminum Company of America, written by H. V. Churchill. It is here presented in its entirety.

You Know Me, Al Uminum

Cast of Characters

AL UMINUM (A brilliant lightweight)....W. I. Sivitz
SILLY CON (A hard character).....E. L. McMahon
HYDRO GEN (A lady of volatile temperament) .....Emma Svenson
OXY GEN (A cosmopolite who loves 'em all).....Roberta Bridges

PROLOGUE

When Laugmuir writes for the learned *Journal*
Of concentric rings with an inner kernel,
He's miles ahead of the common herd;
The rank and file don't grasp the word.

So Ellwood Hendrick for *Chem. & Met.*
Sought to explain, but even yet
Lingers the question, persists the doubt,
If even Hendrick knew what 'twas about.

Our colloid friend from old Cornell
May know, but time alone will tell
If even dear wise Wilder D.
Does comprehend this theory.

Hildebrand of the Sunkist State
May understand, but it is fate
That gives him valiant aid;
Lewis tells him what was said.

William D. Harkins of isotope fame
Could yet enrich his well-known name
If he by hint or demonstration
Would make quite plain this lucubration.

Bill Lloyd Evans of Ohio State
Might cease his oxidation
And lend his ever trenchant pen
To mend our education.

H. P. Cady of old K. U.
Might cease his deep research,
But H. P., like the rest of them,
Has left us in the lurch.

Herty's too busy with colors and dyes
To waft to our ears the wanted replies;
He's been too busy at work on the tariff;
There's really more than he can take care of.

The cosmic urge to relieve the strain,
To make it simple, to make it plain,
Is the sole excuse for our present act
To now make plain what the others lacked.

The elements both great and small
Are sentient beings we can call
To tell their stories of life and love
As clear and bright as the stars above.

Al Uminum, a brilliant scout,
Loves all flappers round about,
While Silly Con, his foolish friend,
Has love affairs that never mend.

Two sisters come to see these men,
Two sisters of the name of Gen:
Oxy, the vamp, with vivid hair;
Hydro, her sister, almost as fair.

As said above, the learned men
Have sought ere this to wield their pen
In explanation of what it is
That makes each element just as is.

But now the truth will come to light
That elements may live and fight
And love and move, improve their soul
And move to their eternal goal.

Scene: Beyond the Chemical Veil

The curtain rises disclosing AL

AL (*soliliquizing*): Ah me! For years I've served my time in the kitchen. But if the world expects me to be happy *wearever* I may be, and whatever I'm called upon to do, the world is wrong. But then I'm ambitious and long for better things. I trust that when my time for better things has come I will have the best. Yes, better a hub cap on a Lincoln than to rattle and shake in the frame of a "car" I cannot well *afford.*

Enter SILLY CON

SILLY CON: Ah, milord, many times have I mixed in your affairs, and it is true that in time to come I will mingle once again, for methinks I'm happier in your affairs than when subjected to the heats and tempers of a career with F. Eric Iron, where usually my hopes are blasted, or at least withered in the fierce heat of the crucible of living. But enough of hopes. I just met the Gen family, the two sisters Oxy and Hydro.

AL: But tell me, where are they?

SILLY CON: They will be down here to call soon. They got mixed up with a couple of live ones from the Bureau of Standards, but the Washington boys couldn't give them Civil Service, so they shook them.

AL: Silly, old chap—you know I can't make up my mind about those girls or even their sister Nitro. When I am with Nitro Gen I would have none but her, and then a caustic word or two and we are thrust apart. She gives me a most unstable feeling. At that I'm losing weight, I fear; up at Harvard they say I weigh only 27, while the Bureau of Mines has claimed that I weighed only 26.8, but those fellows aren't always right. They talked about Hydro Gen too, but then Hydro Gen is not so dense as they claimed; she's a clever girl, and certainly fooled them just as I did.

SILLY CON: I have nothing to do with Nitro Gen, but what thinkest thou of Hydro Gen?

AL: Well, it's hard to say; she's always sticking with Oxy, which makes things rather damp, and only the other day Hydro said to me that when I really warmed up I was a most absorbing chap, but when my ardor died I was not at all so attractive to her.

SILLY CON: Well, for me, I'll say Hydro is much more attractive than Nitro.

AL: But, O boy! Little Oxy, she's the kind that always sticks around. Hot or cold, once with me she sticks. That's why I hesitate. When I'm apart from her I'm fairly neutral, but she is such a feminist that if we really wed I'd have to change the gender of my name like Maggie Sulf's brother did.

SILLY CON: What! Does that loose character have a brother?

AL: Sure! Years ago her elder brother Magnes married Oxy Gen. They since have been divorced, but while still married old Magnes was known far and wide as Magnesia.

AL: Speaking of Oxy Gen reminds me of a bit of gossip that may interest you. You are familiar with the publication that is always printing scandal about the elements?

SILLY CON: Do you mean the publication that is always telling what great discoveries are being made at the Mellon Institute, such as Pittsburgh fog dispellers, and——?

AL: Oh, no! I know what you mean. You have reference to the New York *Journal* or the New Kensington *Dispatch*. Now let me think. *Chemical Abstracts?* No! That is Organically too Complex. I have it! It is a McGraw-Hill weekly—*Chem. & Met.* Well, anyway, the story goes that one night Oxy Gen met that crude, unrefined Pete Roleum, and off together they went.

(SILLY CON *expresses surprise and horror*)

AL (*continuing*): The next morning Oxy Gen claimed an alibi. She said that man, Dr. James up there, enticed her by using a catalyzer.

SILLY CON: Ha! Ha! Ha!

AL: I tell you, Silly Con, it is contact catalysis which makes these blue-eyed flappers of Broadway wild—all of which makes Bancroft wilder.

(*A noise is heard without. Enter the two sisters. A general greeting occurs.*)

AL (*greeting girls*): I'm glad to see you. I miss your sister Nitro, but you know that girl ought to be careful. She should be taught to avoid the *Shoals* and beware the *Henry* or she will be fixed good and plenty.

SILLY CON: Al, you're lightweighted mentally as well as physically. Henry says he'll give Nitro Gen many a trip to the rural districts if Uncle Sam will give him the plants and a dam site more.

AL: Well, enough of Nitro. (*Turning to* HYDRO). And, Hydro, have you a rich auto maker to befriend you?

HYDRO: No, I'm pretty particular. Some auto makers I know of are not only interested in Nitro, but also in my cousin Hydro-Electric. Sort of Mormon-like, you know.

SILLY CON: Gee, Hydro Gen; you're easy to get up in the air.

OXY GEN: Isn't any one going to pay attention to me?

AL: Well, Oxy, old girl, we aren't neglecting you. But Silly and I are alike in one respect: You are so fascinating to both of us we are pretty cautious about too close contact. But that aside, Oxy, sing us some of that electron jazz stuff, but cut out that Brownian motion.

(OXY *sings*)

Al Uminum, with form so light,
Al Uminum, your face so bright;
Your valence three, while mine is two,
Your silv'ry grace makes me love you.

Al Uminum, I love you, I love you;
Each passing moment I'm longing for you,
You can't escape my caresses at all;
Your brilliant polish, your silv'ry finish,
With all my bonds I'll dull you, I'll dull you;
We cannot live apart, our love will live,
We have naught to forgive,
I love you, Al Uminum.

SILLY CON: By the way, Oxy, where is your brother?

OXY: Oh, you mean old Dry?

SILLY CON: Yes, old Dry Gin.

OXY: Why, he still has that old one on the brain. He's just full of that old Ethyl.

AL: Huh! Thought she was deported.

OXY: Technically yes, but practically no. She's quite elusive, you know, and she keeps slipping back. My goodness, Al, the names that girl goes under!

AL: I suppose I ought to be still about Ethyl, but after all I guess the Copper on this beat has the best reason to be still.

AL (*suddenly*): Oxy, I wonder if you'll let me whisper the old, old story once more; I don't care if we aren't alone.

OXY: Well, I suppose I'll have to get this over with.

AL: Oxy, I've tried both ways, with you and without you. In your presence I can't maintain my individuality.

OXY: Yes, I've heard that in my absence you were quite brilliant.

AL: And that isn't all. When I'm apart from you I am put to all sorts of tasks, in the kitchen, in the garage—I rather like that, though the engines are dirty—but when I am on those tasks I'm supposed to leave you strictly alone, and some way or other I realize when I am with you that I cannot exist without you. Oxy Gen, will you be mine?

OXY: Well, to tell the truth I'm not very coy, but if you will agree to share me with F. Eric Iron and old Silly Con, I will be yours in part.

AL: Sort of trial marriage, eh? Well, divorce is always possible, if things are not satisfactory. Maybe I'm giving up a lot, but I feel so isolated when I'm not with you. But, Oxy, I don't want to share you with others. You mention F. Eric Iron and dear old Silly Con, and truth to tell I've heard of others despite the fact we are natural affinities. If I alone can't have you, that settles it. Goodby.

OXY GEN: Oh, very well. It's all very well for you to talk that way, but mark my word, sooner or later I'll get you and have you for mine.

SILLY CON: Well, Oxy, I'm not so strait-laced as old Al. I'll just trot along and bask in your smiles as long as I can. No use sticking around, Hydro; you'd better trot along too.

OXY: Goodby, Al, old thing. Remember what I said. I've got old Silly, and I will get you yet.

AL (*slumps into chair*): What a common creature! She would tarnish whomever she would touch; even old F. Eric Iron has been looking rusty lately. However, life is that way. It is a Weidlein which keeps some of these elements from bringing home the Bacon. Oxy Gen seems to take old Al for a sucker, but that's the way with all Fishers. No matter how scientific they are or what the materials, they think old Al can be caught with the same bait used for F. Eric Iron or old Pete Roleum. Well, I wonder if Oxy is right. Will she finally get me? You know her list of victims is pretty long. But the solitary life for me, with just a few boon companions and not too much of them—old Copper, F. Eric Iron, Silly Con, Maggie Sulf's brother and a few others—but when old age comes creeping in and I am no longer on my mettle I will turn to Oxy Gen and yielding to her embrace cling fast till in some other phase I am reborn.

Properties and Manufacture of Aluminum-Silicon Alloys

By Junius David Edwards
Assistant Director of Research, Aluminum Company of America

SILICON is assuming importance as an alloying ingredient in aluminum. As a minor constituent, say in amounts of 1 per cent and less, it has always appeared as an impurity in aluminum alloys. As a major constituent in amounts up to about 15 per cent, it is capable of conferring very valuable properties upon aluminum alloys. Aluminum-silicon alloys have long been known, but their commercial development is comparatively recent.[1]

Aluminum-silicon alloys may be grouped in two classes. What may be called the "normal alloys" are made by melting silicon (or a rich alloy of silicon and aluminum) with aluminum, and casting in sand according to the usual foundry practice for aluminum alloys, except that in most cases all chills may be omitted. They are characterized by a relatively coarse crystalline fracture (Fig. 1), especially when the silicon is high. When

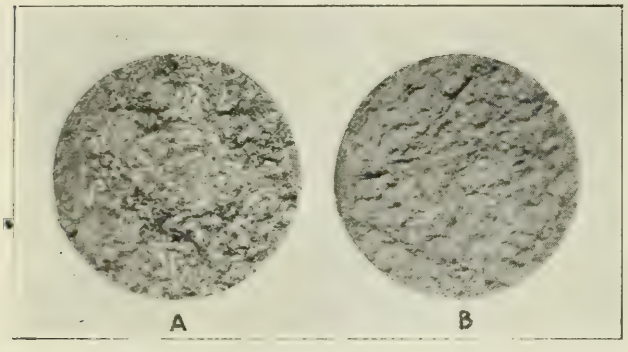


FIG. 1—ALUMINUM-SILICON ALLOY
(12.5 per cent silicon)
A—Shows relatively coarse crystalline fracture of **unmodified alloy.**
B—Shows very fine grained fracture of modified alloy.

the iron content is also high, excessively coarse-grained structures are produced. When polished and viewed under the microscope, they reveal the presence of silicon as relatively large plates and needles in a matrix of aluminum.

What are known as the "modified alloys" are given a special treatment in the molten state immediately before casting. The Aluminum Company of America's process[2] of modifying aluminum-silicon alloys consists in the addition of very small amounts of metallic sodium to the molten alloy a short time before casting. The modified alloy exhibits an exceedingly fine-grained fracture (Fig. 1); the microscope shows the silicon to be present as very finely dispersed particles;[1] the silicon particles are sometimes so small as to be resolvable with difficulty even at very high magnifications.

The modified alloy largely reverts to the normal alloy on remelting, so that to secure a completely modified alloy, the molten metal must usually be re-treated each time before casting.

The aluminum-silicon alloys possess a combination of desirable properties which fit them for many uses, especially for the production of difficult castings, involving both thick and thin sections. Some of their most useful characteristics fall under the term of "casting properties." They flow readily, may be cast into very thin sections without cracking, and are quite free from shrinks and the porosity which is not uncommon in some other aluminum alloys, so that they are "water-tight." These same good casting properties are found in both the normal and modified alloys, so that the use of the modified alloy is, in general, only indicated where its increased strength and ductility will prove advantageous. The proportion of silicon to be used in any alloy will depend on its particular application. In general, a somewhat higher proportion of silicon can be used in the modified alloy than in the normal alloy. This is due to the fact that the process of modification raises the apparent eutectic composition considerably above its normal figure (11.5 per cent silicon), and changes what would have been relatively large particles of excess silicon (in alloys containing over 11.5 per cent silicon) to very finely dispersed particles of eutectic silicon.

The modified alloys should contain from about 8 to 15 per cent silicon; 12 per cent silicon makes a good alloy. The normal alloys may contain from 4 to 10 per cent silicon; 5 per cent silicon has been found to make a very satisfactory alloy for sand castings.

In the following paragraphs will be found values for a number of the physical properties of aluminum-silicon alloys, which are pertinent to their commercial application.

Density

Silicon is lighter than aluminum; its density is about 2.4, as compared with 2.7 for aluminum. The alloys have densities intermediate between these two values. The 10 per cent silicon alloy will have a density of approximately 2.65 grams per c.c. There is a tendency for the modified alloys to be slightly lower in density than the normal alloy, but the difference is not significant. The 10 per cent silicon alloy is 7 to 8 per cent lower in density than No. 12 alloy (8 per cent copper), and weighs approximately 166 lb. per cu.ft.

Expansivity

The splendid casting qualities of the aluminum-silicon alloys are in part the result of their relatively low shrinkage. The pattern shrinkage is the same as for other aluminum alloys—namely, $\frac{5}{32}$ (0.156) in. per foot. The aluminum-silicon alloys have a very much smaller crystallization shrinkage than either No. 12 alloy or pure aluminum. Pure aluminum contracts between 6 and 7 per cent in volume on solidifying; this contraction in volume results in the formation of a cavity or pipe. This crystallization shrinkage or contraction is reduced to 4 per cent or lower in the 12 per cent silicon alloy. The thermal expansivity of the 10 per cent silicon alloy is about 0.000021 per deg. C., in the range 20 to 100 deg. C.

Tensile Strength and Elongation

The modified alloy has considerably greater strength and ductility than the normal alloy. Typical results for various alloys are given in the following tabulation:

STRENGTH AND DUCTILITY OF ALUMINUM-SILICON ALLOYS AS CAST IN GREEN SAND

Composition	Character of Alloy	Tensile Strength, Lb./Sq.In.	Elongation, Per Cent in 2 In
Silicon 5%	Normal	18,000	5-6
Silicon 8%	Normal	19,000	4
Silicon 8%	Modified	24,500	12
Silicon 13%	Normal	21,000	2
Silicon 13%	Modified	28,000	8

Better or poorer results than the above can be obtained with varying conditions. The proportion of iron

[1] A concise and authoritative account of their history was printed in *Chem. & Met. Eng.*, vol. 26, p. 750 (April 19, 1922).

[2] U. S. Pat. 1,410,461, J. D. Edwards, F. C. Frary and H. V. Churchill.

in the alloy should be strictly limited for the best result. Iron forms with silicon an iron silicide, which appears as needles in the microstructure. The modifying treatment has little refining effect on the particle size of this constituent, and its presence tends to reduce the ductility. The alloy as cast should preferably contain not over 0.5 to 0.6 per cent iron. The copper content of the modified alloy should also be held below about 0.8 per cent if the highest combination of strength and ductility is desired.

Electrical Conductivity

The modified aluminum-silicon alloy containing about 12 per cent silicon will have an electrical conductivity of about 34 per cent referred to the International Annealed Copper Standard; this conductivity is only slightly higher than that of No. 12 alloy. The conductivity of the normal alloy is usually somewhat lower than that of the modified alloy.

Thermal Conductivity

The thermal conductivity probably corresponds to the electrical conductivity—that is, it is slightly higher than that of No. 12 alloy. This statement is apparently confirmed by observations recently recorded in the literature.

Resistance to Corrosion

The aluminum-silicon alloys are quite superior to No. 12 alloy in their ability to resist most types of corrosion. This property is shared equally by the normal and modified alloys. The alkali metal added to effect conversion of the alloy to the modified form is present in such minute amounts that it exerts no apparent effect on the resistance to corrosion.

Machining Qualities

The aluminum-silicon alloys are not quite so easily machined as No. 12 alloy. They exhibit a very pronounced tendency to drag under the tool. Particles of excess silicon, if present, add greatly to the difficulty of machining or polishing, as they tear out readily, and are exceedingly hard and scratch the soft aluminum readily. Normal alloys containing less than about 11.5 per cent silicon will contain no excess silicon. Above this proportion, they may contain excess silicon unless completely modified.

Production of Castings in the Foundry

For the preparation of the alloy, the rich silicon alloy supplied by the Aluminum Company of America should be used.[3] This alloy contains approximately 20 per cent silicon, has a melting range of about 1,070 to 1,290 deg. F. (577 to 700 deg. C.), and dissolves readily in aluminum at temperatures not over 1,300 deg. F. High-grade ingot should be used in diluting the rich alloy to the required composition, so as to keep the iron content to a minimum. This point is mentioned again, for the highest strength and ductility are developed only when the iron is 0.6 per cent or under, and the rich silicon alloy, although made from a specially pure grade of silicon, may unavoidably contain considerable iron.

[3]It looks like plain advertising to state that "for the preparation of the alloy the rich silicon alloy supplied by the Aluminum Company of America should be used," and if it were just advertising such a statement would be out of place in this article. However, our experience has demonstrated that to obtain the results described, it is necessary that the alloy shall be prepared from that particular rich alloy. There are sound metallurgical reasons for this statement also, as the method of manufacture produces an alloy which has already been modified and which gives superior results in the subsequent alloying and casting.

Process of Modification

The Aluminum Company of America's process of producing modified alloy castings consists in adding to the aluminum-silicon alloy a very small percentage of metallic sodium. The correct amount of sodium to treat a definite weight of aluminum-silicon alloy is supplied in a sealed aluminum capsule. The aluminum-silicon alloy is heated to a temperature of about 1,500 deg. F. and the proper number of aluminum capsules placed in a phosphorizer, which is plunged to the bottom of the crucible. The phosphorizer, so called, is an inverted cup, formed from a graphite crucible or a short piece of iron pipe and held on the end of an iron rod; the iron parts are coated with graphite or lime wash to prevent attack by the aluminum. The aluminum capsules are wedged into the inverted cup and melt when plunged into the molten alloy. The melted sodium then escapes slowly into the alloy through a series of small holes in the sides of the cup near its top. The sodium diffuses through the metal, and a certain amount rises to the surface and burns. The liquid alloy should be kept up to a relatively high temperature until all of the sodium has disappeared from the phosphorizer. The operator can tell when all of the sodium has dissolved by lifting the phosphorizer until it comes in contact with the air. If there is no sodium flame, the modifying process is complete. When the modifying operation has thus been completed, the metal is skimmed. Stirring is not advisable, as it facilitates the oxidation and loss of the contained sodium. Skimming, however, should be performed with great care. When the metal has reached the proper pouring temperature, it can be cast in the usual way. As low a pouring temperature as possible should be employed. Too long a period should not intervene between the time of treatment and the time of pouring, if complete modification is desired. The metallic sodium is lighter than aluminum and relatively insoluble in it, so that it is gradually lost from the molten metal on standing. The modified alloy exists in a potential form only, in the liquid state; the actual modification results from the modified mechanism of solidification in the presence of the sodium.

Requirements for Electrical Mica

Requirements for mica for electrical purposes relate to dielectric strength, heat resistance and flexibility, states the Bureau of Mines in Serial 2,357. All good electrical mica is sufficiently resistant to heat for ordinary electrical equipment and this quality is, therefore, rarely specified. Specifications for dielectric strength vary for different uses and with different consumers for similar uses. Navy Department specifications call for a dielectric strength of not less than 25,000 volts for each $\frac{1}{32}$ in. thickness. Mica has such a high dielectric strength that failures most commonly occur in defective spots. It is very important, therefore, in selecting material where high dielectric strength is required that the mica be given a careful visual examination so that all defective sheets may be rejected.

Department of Agriculture Exhibits

During the fiscal year 1921-22 exhibits by the United States Department of Agriculture were shown at about 70 fairs and expositions held in thirty-nine states and in the District of Columbia. These figures include many occasions for which special exhibits were prepared.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Electrolytic Refining of Tin—F. C. Mathers, of Bloomington, Ind., patents a modification of the Whitehead process (Patent 1,157,830; Oct. 26, 1915) whereby the electrolyte may hold as little as 2 per cent of tin, instead of 6, and 5 per cent of hydrofluosilicic acid, instead of 15 to 20. Furthermore, the amount of H_2SO_4 carried may be largely increased. Dense, coherent deposits, analyzing 99.9 per cent tin, may be had when electrolyzing impure Bolivian anodes, when to this electrolyte is added a fraction of 1 per cent of cresylic acid residues or mixtures of meta-, ortho- and para-cresol. Some unknown substance, which is common to these hydrocarbons, is thought to be responsible for the peculiar action of the electrolyte specified. (1,397,222; assigned to American Smelting & Refining Co. Nov. 15, 1921.)

Sulphonating Hydrocarbons — A method of sulphonating the aromatic hydrocarbons which is said to increase the efficiency of the sulphonating operation by decreasing the amount of sulphones formed during the process has been patented by A. R. Grob and C. C. Adams, of Wilmington, Del., and assigned to E. I. du Pont de Nemours & Co. The feature of the process is the use of liquid sulphur dioxide as a medium for the sulphonation process. The excellence of sulphur trioxide as a sulphonating agent is due to the fact that it is very active chemically—much more so from the standpoint of sulphonation than sulphuric acid or any other sulphur compound—and also because its sulphonates by direct addition without the formation of water. Its greater activity enables a sulphonation to proceed with less excess acid and without the employment of very high temperatures, which would have a tendency to cause decomposition. By preventing the formation of water, the isomeric rearrangement of the molecule is obviated. When sulphur trioxide is used undiluted, it acts too vigorously, making the reaction difficult to control and causing a greater degree of sulphonation than desired. It may cause charring and oxidation of the compound. It is usually diluted with sulphuric acid, but this makes a strong dehydrating mixture which favors decomposition, especially when oxygen is present in the compound, and also promotes the formation of sulphones. It is claimed that by diluting the sulphur trioxide with liquid sulphur dioxide, the action of the former can be made less vigorous and the reaction more easy to control. The presence of sulphur dioxide, which is a strong reducing agent, lessens oxidation. Finally, since the dehydrating action is minimized by using sulphur dioxide instead of sulphuric acid as a diluent, less decomposition and sulphone formation is encountered. The process is carried out by mixing a liquid sulphur dioxide solution of sulphur trioxide with a liquid sulphur dioxide solution of benzene, maintaining the resulting mixture under pressure until the desired degree of sulphonation has occurred, the temperature being maintained at about 0 deg. C. during the addition of the sulphur trioxide, and then permitting the temperature to rise to about 30 deg. C. under pressure. (1,422,564. July 11, 1922.)

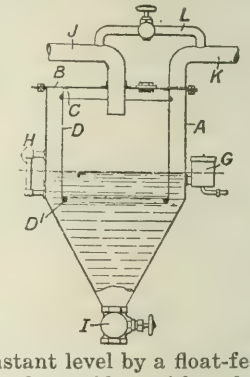
Pulp Washer—Carlton H. Allen, of Millinocket, Me., has assigned half rights in a modified pulp-thickening machine to the Great Northern Paper Co. The inventor has attempted so to design the apparatus that it will have a greater capacity for a given area of screening or filtering surface, produce more uniform results and be more easily repaired than machines heretofore used. The apparatus comprises a rotary drum with sixteen faces, covered with a wire cloth filter. The drum is supported on trunnions in a closed box so that it runs entirely submerged in the "stuff." The casing is constructed in such a manner that in two points on its circumference of the drum, contact is made between drum and casing by the layer of thick slushy pulp adhering to the filter. The pulp is discharged continuously from the casing between these two points of seal. The filtering is speeded by the hydraulic pressure maintained on the drum by the thin pulp supply. (1,421,364. July 4, 1922.)

Beryllium—A process for the extraction of beryllium from its ores which involves the reduction of the ore to the silicide or the carbide and a subsequent treatment with hydrochloric acid gas to form the volatile chloride of the rare metal is covered in a specification granted to Louis Burgess, of Bayonne, N. J. The ore is ground and mixed with a suitable hydrocarbon bonding agent, preferably a high-melting petroleum pitch which on heating will yield approximately 50 per cent of carbon. The mixture is placed in an electric furnace and is reduced by the heat of an arc, the operation being conducted under about 30 lb. pressure. The resulting product is ground and subjected to a treatment with hydrochloric acid gas at a temperature of about 450 deg. C. The beryllium chloride is volatilized by the heat and condensed in a series of chambers maintained at temperatures below that at which beryllium choride sublimes, but above the boiling or sublimation temperature of aluminum chloride or zirconium chloride, or approximately 200 to 250 deg. C. The beryllium chloride is then converted to the oxide by treatment with water. The second specification covers the application of the same idea to the metallurgy of zirconium. The chloridizing reaction is exothermic, and it is said that a very complete reaction is obtained by introducing the silicide or carbide as a powder into an atmosphere of hydrochloric acid gas. (1,418,527. June 6, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Gas Scrubber—Producer and like gas is simultaneously cleansed and enriched by passage through a porous screen fed with liquid by capillary action. The apparatus shown comprises a casing *A* tapered at the bottom and covered with a gas-tight lid *B* to which an annular flange *C* is secured, the flange having secured to it a wick or filtering cloth *D* weighted with a leaden rod or wire *D*¹. The lower edge of this wick dips into a bath of oil maintained



at a constant level by a float-feed chamber *G* and provided with a level indicator *H*. The gas entering by a pipe *J* passes through the wick, being thereby cleansed and enriched, and escapes by a pipe *K*. A bypass *L* is provided. The casing may be heated by engine exhaust gases or jacket water passed through a jacket. Impurities are removed through a valve *I*. A perforated ring of pipe may be disposed in the upper part of the casing in communication with the outlet *K*, or an annular chamber may be formed by the provision of a perforated disk fitted at right angles to the flange *C*. (Br. Pat. 181,102. T. G. Tulloch and D. J. Smith, London. Aug. 2, 1922.)

Calcium Hypochlorite — Calcium hypochlorite is rendered stable by mixing it, in the dry state, with purified sodium chloride, free from magnesium chloride and other hygroscopic impurities. The proportions are such that the product contains at least 10 per cent of active chlorine. The mixtures can be moulded into shape. (Br. Pat. 181,153. Chemische Fabrik Griesheim-Elektron, Frankfurt-on-Main, and H. Reitz, Bitterfeld. Aug. 2, 1922.)

Sulphuric Acid—In the manufacture of sulphuric acid, a stream of cold acid is made to trickle permanently over the whole inner surface of the walls of the lead chambers or towers for the purpose of protecting them from corrosion. Preferably chambers are constructed as cylinders or reversed truncated cones, cold acid being directed on to the walls by a turbine of resistant material placed axially near the top of the chamber and fitted with jets or wings to ensure the wetting of the whole inner surface. Nitrous vitriol may be introduced into the chamber in the same way. (Br. Pat. 180,546. E. A. Gaillard, Barcelona. July 19, 1922.)

Book Reviews

TECHNOLOGY OF CELLULOSE ESTERS. By *Edward Chauncey Worden, Ph.C., B.S., M.A., F.C.S.* Volume I, in five parts. Part 1, cxxv + 664 pp.; Part 2, cxvii + 902 pp.; Part 3, cxvii + 810 pp.; Part 4, cxvii + 710 pp.; Part 5, 623 pp.; 296 illustrations. New York: D. Van Nostrand Co., 1921. Price $40.

Work, for the night is coming,
When man's work is done.

This is the quotation selected by the author for the flyleaf of Vol. I, Part 1, of the above series, and regarded from the point of view of the magnitude of the task undertaken it cannot but be considered an appropriate one. Some idea of the labor involved in the preparation of the treatise may be gleaned from the fact that the accumulation of the entire material has extended over a period of 25 years and includes about 335,000 references relating to the work of 55,000 separate investigators and to 58,000 patent topics. In the words of the author, "The aim of the work is to present the entire subject of the combinations of normal and modified cellulose with the acidyl and alkyl radicles . . ."

The first volume (under review) consists of five parts—viz., Part 1, embracing the raw materials, cellulose, starch and cotton; Part 2, dealing with the manufacture of nitric, sulphuric and mixed acids; Part 3, describing the history, theory, chemical and physical properties of cellulose nitrates and other nitrated carbohydrates; Part 4, giving the synoptical development of the cellulose industry; and Part 5, containing the patent, name and subject index of the entire volume.

Volume I aims to give a complete review of cellulose, starch and cotton, and it is difficult to think of any branch of the subject to which reference is not made in some portion of the work, although it may not always be an easy matter to locate it. For example, the reader in a search of the literature on the decomposition of cellulose by bacteria will find, on consulting the index, only a single reference and this an incorrect one. If he should then recall that one of the important papers on this subject (published in 1912) relates to the intermediate formation of cellobiose as one of the degradation products and should search the index under this heading, his efforts would again be fruitless. It would be necessary for him to recall the name of the author—viz., Pringsheim—before he would be able to obtain the information desired. It may also be mentioned that while attention is drawn in the text (p. 339) to the fact "that in the breaking down of the cellulose molecule by the aid of bacteria no intermediate compounds have been isolated" the accepted work of Pringsheim proving the contrary—viz., the intermediate formation of cellobiose and dextrose—is quoted only as a note (p. 343).

A question of general interest is that of the manufacture of a highly purified cotton, and many chemists will feel that the method of Robinoff and Bay (as developed in the laboratory of Schwalbe) referred to casually (p. 144) in the discussion on hydrocellulose is a better one than that quoted by the author (p. 26).

No reference in the text could be found to the interesting work of F. Bergius on the action of water on cellulose at high temperatures and pressures, but on consulting the index it was located in a footnote under the heading of "Maltol" (!).

Part 2 contains a comprehensive review of the manufacture of nitric, sulphuric and mixed acid, and provides a wealth of information regarding the source of raw materials, manufacturing processes, analytical data, etc. Unfortunately the footnotes quoted suffer from a failing which is apparently common to the entire work—namely, the inclusion under a given heading, for example, nitric acid, of a large number of references, many of which do not refer to this specific subject, although they do refer to the nitrogen industry. It is to be regretted that it was not found possible to insert in the footnotes some kind of secondary classification through which their accessibility and usefulness might have been much increased.

There are also occasional statements in the text which are likely to mislead, as for instance the one quoted on p. 746 to the effect that "The du Pont company heats by means of an oil bath," the presumption being that this is an actual operation, whereas it merely represents a patent taken out in the name of F. T. Beers and assigned to the du Pont company.

On p. 988, Fig. 86, there is apparently a mistake in the title of the illustration, this reading "Jensen Nitric Acid Concentrating Plant," while in fact the drawing is from a patent granted to F. C. Zeisberg of the du Pont company on "Nitric Acid Concentration."

Part 3 takes up the historical development, theory and practice of nitrocellulose manufacture and undoubtedly represents the most complete bibliography of the subject in any language. It also contains a review of the preparation and properties of the nitrated carbohydrates, a description of the layout and construction of a modern guncotton plant and of the analytical data relating to cellulose nitrates.

In Part 4 the author states (p. 2378), "The subject matter of this section is intended as a general epitome of the more important and noteworthy of the technical advances of the cellulose esters . . ." It includes a description of the organic liquids used as solvents for the esters and the manufacture and use of synthetic and natural camphor, the greater part of the volume, however, being devoted to an account of the varied uses to which the cellulose esters have been applied in the industry.

Of Part 5 the author states in the introduction, "The belief formerly held by us that the index was the most important part of a technical work has long since become a conviction, many an otherwise valuable book having been materially impaired by the omission, incompleteness, brevity or faulty construction of the index—in our judgment without question the most important and painstaking portion of a work of this character"—an opinion in which the reviewer heartily concurs.

It is impossible to peruse the index without at once realizing the incredible amount of time, thought and actual drudgery which has been spent upon it by the author and his assistant, Mr. Rutstein. Technical chemists will be especially grateful for the valuable patent compilation, in itself a work of no small proportion, and readers of the volumes will doubtless consider it a duty to acquaint the author with any slips or omissions.

It is of interest that he states in the introduction, p. lx, "It is but necessary to glance at the 'Index of Names' in this volume to realize how essential it is that at least the initials of writers should always be given." Unfortunately, this idea is not always carried out, as for example in the case of the two authors designated under A. Hill, one of which should read A. J. Hill.

The reviewer is compelled to admit that the treatise contains many grammatical errors.

If considered as an authoritative work, it would be subject to criticism, but regarded from the point of view of a bibliography of the subject, it represents the most complete in existence and will undoubtedly take its place as part of the indispensable equipment of all workers in the field of cellulose chemistry.

No one can peruse the volumes without being impressed by the magnitude of the task undertaken and experiencing a feeling of gratitude toward the author. Add to this his statement in the introduction that "the entire cost of the preparation, printing and publishing of this work has been met by the author personally from his private funds," and it will be possible to realize to some extent the obligation under which he has placed his fellow chemists.

HAROLD HIBBERT.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Dye Embargo Dies Hard

Strenuous Attempts to Obtain Extension of Dye and Chemical Restrictions Fail—Will Attempt Readjustment of Rates at Next Session of Congress

WITH a quietus put upon the proposal to extend the dye and chemical embargo through failure of the Senate Finance Committee to report the resolution favorably and refusal of House leaders to act before this had been done, a definite move has already been started to attempt to get Congress to adjust the tariff rates on coal-tar products and synthetic organic chemicals by means of a separate bill.

The death of the proposed temporary extension of the dye and chemical control act was rather unexpected, in view of the letter of Secretary Mellon stating that the Treasury Department lacked the necessary machinery to administer tariff rates on coal-tar products on the basis of American valuations.

Finance Committee Rejects Proposal

The Senate Finance Committee considered the resolution proposing extension of the embargo for 3 months on three occasions, twice at a meeting Wednesday, Sept. 20, and again at a meeting Thursday, Sept. 21. The first vote in the committee was 5 to 3 against a favorable report. The resolution then was amended to read 60 days instead of 3 months and because of the small attendance at the committee meeting, it was decided that Senator McCumber should cast the votes of the absent Republican members, and Senator Simmons the votes of the Democratic absentees. On this vote there was a tie, 8 to 8, with Senators Smoot and LaFollette voting with the Democrats in opposition. It was generally considered that this tie vote ended the matter, but on the following day it was revived before the committee with fourteen of the sixteen members actually in attendance. Senator Reed of Missouri raised the point of order that inasmuch as this resolution affected the revenue of the country, it could not constitutionally be considered by a Senate body until it had been acted upon by the House. This point was sustained by a vote of 7 to 5, with Senators Smoot, LaFollette, Dillingham and Watson of Indiana joining the three Democratic members present. This ended the effort.

The House Ways and Means Committee had handled the resolution, which was introduced in that body by Representative Tilson, rather gingerly, and reported it favorably by a vote of 10 to 7, with three Republicans, Representatives Green, Watson and Young, voting with four Democrats against the report. Following this action, Republican members of the committee sent word to Senate leaders that they would not press the resolution in the House unless it first had been passed by the Senate, as they did not wish to be put in a position of attempting to push it through the House while there was a possibility that the Senate might not act favorably. Therefore no action further than this report was taken in the House.

Smoot Suspicious of Motive

In explaining his attitude, Senator Smoot declared that the Treasury Department had had an organization to administer the licensing system of the dye and chemical control act and that he thought this could easily be transferred and adjusted to administer the American valuation tariff rates. He would have been willing for a 60-day extension, he said, if he could have received assurances that no effort at the next session of Congress would be made to extend the embargo further. Most of the other leading opponents of the embargo had virtually agreed to withhold opposition from the resolution if the time were reduced to 60 days. Senator Wadsworth, sponsor of the resolution in the upper chamber, stated that he himself would not ask further extension at a later session of Congress but that he could not be understood as attempting to control the acts of other Senators.

Mellon Asks Time for Organization

In his letter regarding the administrative difficulties attendant upon inclusion in the tariff bill of American valuation on coal-tar products, which was addressed to Senator McLean in response to an inquiry from the latter and dated Sept. 7, Secretary Mellon asked that a 90-day extension of the dye and chemical control act be given so that the Customs Service might organize to administer these rates. The Secretary also asked that domestic manufacturers be compelled to file statements of their products with the

(*Continued on page* 663)

A.C.S. Committee Invites Criticism of Society Policies

Powers of Committee on Procedure Enlarged to Include All Matters Relating to Management and Policy

The committee of the American Chemical Society which was appointed at the Birmingham meeting to consider the advisability of changes in society procedure is endeavoring to collect all the specific questions which should be considered in this connection. The powers of the committee have been enlarged, by action of the advisory committee, to cover any subject relating to the management, procedure or policy of the American Chemical Society in order that there will be no doubt of the thoroughness of the inquiry. It was also voted to appropriate funds necessary for the proper functioning of this committee.

The vote passed at the meeting of the advisory committee in Pittsburgh Sept. 4 follows:

> Resolved, That the powers of the committee on progress in society procedure, voted at the Birmingham meeting, be enlarged and that the committee be requested to consider and report upon any subject relating to the management, procedure or business policy of the society requested by any local section, or which in their judgment should be investigated, in order that the society may have full confidence in the efficient handling of its affairs by its elected officers.
>
> Be it further resolved, That the committee on national policy request the directors of the society to appropriate, if possible, funds not exceeding $500 to enable the committee to meet together or to visit, as a committee, such offices of the society as they deem desirable, in order that their inquiry may have unquestioned thoroughness.

The committee is anxious to have the ideas of the various sections on specific questions which should be considered under this new scope. It is hoped that the criticism by individuals will be introduced at sectional meetings so that the report of the committee may embody its suggestions toward remedying all obsolete or objectionable methods of procedure in the conduct of the society.

Government Offers Sodium Nitrate

The War Department has called for bids on 26,900 short tons of sodium nitrate located at the Picatinny Arsenal, Dover, N. J. The material will be sold in lots of 100 short tons or more. The bids will be opened Sept. 29 at the Philadelphia District Ordnance Salvage Board.

New Muscle Shoals Resolution Would Vest Negotiations in War Department

Representative Hull Will Press Bill to Straighten Out Tangled Interests in Big Power Development for Most Advantageous Disposal

A NEW measure for the disposition of the government properties at Muscle Shoals, which in effect would pass the entire subject back to the Secretary of War, with authority to dispose of the various units on the best terms possible, appeared in the final days of the session of Congress in the form of a resolution introduced by Representative H. E. Hull of Iowa, a member of the Military Affairs Committee.

The resolution would authorize the Secretary to sell to the Alabama Power Co. the government's interest in the Gorgas steam plant and the transmission line to Sheffield at a price not less than $3,000,000, or if unable to negotiate a sale, the Secretary would be authorized to purchase the sites and rights of way from the Alabama Power Co. at a fair price within his discretion or to take the property by condemnation proceedings if necessary.

Purchase of all property and flowage rights abutting the site of proposed dam No. 3 and which belong to the Alabama Power Co. at a price not to exceed $100,000 would be authorized, condemnation proceedings to be instituted if agreement could not be reached.

The Secretary would be authorized to complete dam No. 2 at government expense and to construct dam No. 3 and to lease these dams together with the power houses and appurtenances for not to exceed 50 years at a rental of not less than 4 per cent of the cost of finishing dam No. 2 and constructing dam No. 3, including in the latter case the cost of the site and flowage rights. The lessee would assume the obligation of keeping the property in repair during the life of the lease.

May Lease Nitrate Plants

As to the nitrate plants, the resolution provides that the Secretary in his discretion may lease for not exceeding 50 years Nitrate Plants Nos. 1 and 2 and Waco quarry, either separately or completely, at $1 per year for each plant. The condition of such lease would be that the nitrate plant or plants should be operated at capacity for the production of fertilizer components for sale to the public at a price not to exceed 8 per cent profit and that the plants be kept in condition to produce to present capacity nitrates and other components of munitions, the plants together with their personnel to be turned over to the federal government in the case of a national emergency.

The Secretary would be authorized to lease the dams and nitrate plants and quarry separately or completely to the same lessee and to make the consideration interdependent.

Authority to sell or dispose of all lands and properties owned by the government not necessary for the operation of the nitrate plants, the steam electric plants or for the construction and operation of the dams will be given the Secretary.

Ultimate Disposal Open

In explaining his resolution, Representative Hull said that it was designed to solve the problems confronting the government in connection with the Muscle Shoals project. Its terms, he said, would permit Henry Ford or the Alabama Power Co., or any other reliable person or organization, to make the contract. Mr. Hull pointed out that even the Committee on Military Affairs, composed of twenty-one members, had found it impossible to solve the problems and he predicted that it would be still more difficult for the whole membership of the House to do so. Stating that while he had signed the majority report of the Military Affairs Committee, he realized that Mr. Ford might not accept the provisions of the McKenzie bill and that this measure might be materially amended during consideration. Mr. Hull declared that his resolution would afford the Detroit manufacturer or anyone else a better opportunity to operate the nitrate plants for the benefit of the people of the country than Mr. Ford's own offer. As for the Gorgas steam plant, which Henry Ford insists be included in his bid, Representative Hull declares that "in all fairness" the Alabama Power Co. is entitled to purchase this property. Mr. Hull also believes that a 50-year lease will meet greater approval from the people than the 100-year lease in the Ford bill.

Representative Hull states that he will press his resolution at the December session of Congress.

Bureau of Mines Concludes Clay Products Study

With the conclusion of comprehensive tests and observations at brick kilns at Bradford, Pa., and at Peoria, Ill., the Bureau of Mines car, Holmes, and its crew have concluded an extended series of tests throughout the country in cooperation with the manufacturers of heavy clay products. The tests at Bradford were at a kiln of the Dressler type. That test was of particular interest, since that type of furnace has been used almost exclusively in the making of expensive clay wares. It is contended, however, that this better type of kiln can be used to advantage in ordinary brick production, since it makes possible economies not practicable in the cheaper kilns.

The crew of the car now go to Columbus and Pittsburgh to complete their calculations and to prepare their report.

Paper Production Growing Rapidly in Canada

Output Is Increased by 38 Per Cent for First Half of 1922

While the United States leads in the production of newsprint paper, the Canadian mills are growing rapidly, according to an analysis just made by the paper division of the Department of Commerce. Statistics show that there was a marked increase in production during the first 6 months of 1922 as compared with the corresponding period in 1921.

Gaining on U. S.

Canada, during the period Jan. 1 to June 30, 1921, produced 373,988 tons, as against 615,448 tons produced in the United States. In the corresponding period for 1922 Canada produced 516,506 tons, as against 690,142 tons produced in the United States. This shows an increase of 38 per cent in Canadian production, as against 12 per cent in American production. Canadian shipments for same period increased 43 per cent over the corresponding period in 1921, while shipments from American mills increased only 13 per cent.

With these figures before us there can be no doubt about the growing competition from Canada. In the United States very little has been done in the way of additional equipment for the manufacture of newsprint, whereas in Canada a number of the large mills have greatly increased their productive capacity and with one of the largest American producers opening a mill in Canada it would seem that eventually this large industry will be transferred to Canada.

Question of Wood Supply

If this industry is to be kept alive in the United States, says the report, the main problem confronting us is the supply of pulp wood. It would perhaps be impossible for anyone to make a definite statement as to our total resources, but we do know for a certainty that the supply in our Eastern and Lake States is inadequate. Thirty per cent of the newsprint manufacturing industry is in New England, approximately 50 per cent in New York and 15 per cent in the Lake State regions, and in this district as a whole the annual cut of pulp wood greatly exceeds the forest growth. In other words, in this district we have mills without forests, whereas in the Western states and Alaska we have the forests with a practically unlimited supply, without adequate production facilities. Cost of transportation prohibits bringing Western pulp wood to Eastern mills.

Ceramic Study at Cornell

A series of tests of Florida clays is now being made at Cornell University, with a view to ascertaining the value of the local production for different branches of ceramic manufacture. As a result of the work, it is expected that the brick and clay products industries of the state will be expanded materially.

Big Guns to Entertain Visitors

Many Technical Men Expected at Aberdeen During Ordnance Tests

More than one thousand engineers are expected to attend the fourth annual meeting of the Army Ordnance Association, which will be held at the Aberdeen Proving Ground on Oct. 6. A program of test firings and demonstration of the more recent developments in ordnance material and ammunition has been arranged. A year ago a similar demonstration was attended by 800 engineers. So much of value to the members of a number of classes of engineering developed on that occasion that it is believed a much larger gathering will be had at this year's demonstration.

While the invitation is limited to members of the Army Ordnance Association, the American Society of Mechanical Engineers and the Society of Automotive Engineers, it is pointed out that there will be so many features on the program of interest to chemists, electrical and civil engineers that a large representation from these branches of engineering probably will be present. The requirements for an invitation can be met by anyone who is not a member of any one of the three societies mentioned by taking out membership in the Army Ordnance Association. Any American citizen is eligible to membership in that organization who is interested in extending and disseminating technical knowledge which has a bearing on the improvement of munition power as a factor in maintaining peace. Such a person can be enrolled as a member of the Army Ordnance Association on remitting $5 to cover the annual dues.

Tests of Flashless Powder

Chemists will be interested particularly in the tests of the recently devised non-hygroscopic, flashless, smokeless powder. The tendency of smokeless powder to absorb moisture has interfered with its ballastic properties. Efforts long have been under way looking to the control of the combustible gases which ignite on contact with the air and result in the flash which it is so desirable to eliminate in the use of artillery.

At the Railway and Seacoast Range a 16-in. gun en barbette and a 16-in. howitzer at high angle using solenoid chronograph will be demonstrated. Armor-piercing projectiles of various calibers which have passed through armor plate and the penetrated armor plate will be exhibited. Two 600-lb. bombs will be dropped from an airplane in the water, one with delay action fuse and one with instantaneous fuse.

Upon conclusion of the exhibition at the Railway and Seacoast Mount Range, the party will remain aboard the train and proceed to the aviation field. Upon arrival there, the party will detrain and inspect an exhibition of bombs, at which all types of American bombs and all available types of foreign bombs will be shown. The party will then witness a demonstration of machine gun firing from airplanes. This demonstration will be made on the ground in order that details may be visible. The plane is the DH4B, an observation and day bombing type. Firings will also be made with plane in air. The ammunition will be about 20 per cent tracer bullets.

The party will then inspect the airplanes and the dirigible balloons which are on hand at the proving ground. Flights will be made after inspection.

Luncheon will be served at the Visitors' House at 12:45 p.m. Immediately after luncheon the party will entrain and proceed to the main front, at which place it will detrain in order to witness the exhibition of various ordnance material.

At the main front a number of rounds will be fired from mobile artillery material for comparison. Firings will also be conducted from six powder guns or machine guns mounted in a moving tank, the target being an old tank on the main range.

Small Arms and Machine Gun Material

There will be a small arms booth at which will be shown the latest types of small arms and machine guns and their ammunition. Machine guns of various calibers will be fired with ordinary ammunition, armor-piercing ammunition and bursts of tracer ammunition. Firings of the 0.30-caliber and 11-mm. will be made against toy balloons and the 0.50-caliber against a tank or tank armor target.

At this time there will be dropped from planes one 2,000-lb. bomb for function test from an altitude of 8,000 ft., two 600-lb. bombs equipped with Mark V and VII nose and tail fuses. One fuse will be set for instantaneous function, the other for delay action.

As soon as the firings as outlined above have been completed a variety of self-propelled mounts, tanks, tractors and trailers will be exhibited and maneuvered.

Upon completion of the demonstration at the main front, the party will be conducted to the Exhibition Building for the purpose of inspecting the various automotive vehicles and other equipment in the building. Dinner will be served at 5:45 p.m., after which firings will take place from the main front, which visitors may witness if they so desire. A train will leave the Visitors' House for the main front for this purpose at 6:50 p.m. These firings will include demonstration of flashless powder, 75-mm. gun or other caliber; 0.30-caliber tracer ammunition; 11-mm. tracer ammunition; 0.50-caliber tracer ammunition; pyrotechnics.

Immediately after this firing, at about 7:30 p.m., the Proving Ground train will leave the main front, stopping at the Visitors' House for the purpose of taking the party to Aberdeen to catch the trains going north and south.

Action of Alkali on Concrete to Be Studied

Canadian Interests Co-operate in Investigations of Effect of Soil

The governments of the Dominion, Alberta and Saskatchewan, the Canadian Pacific Railway and the Canada Cement Co. have provided funds and have appointed a committee of experts under the chairmanship of Prof. C. J. Mackenzie, of the University of Saskatchewan to make an investigation of the action of alkali soils and waters on concrete. In a number of instances in the prairie provinces the action of alkaline salts in the soil has so deteriorated concrete foundations that alarm is felt for the safety of structures superimposed on them.

The word "alkali" as applied to soils and waters is used exceedingly loosely in the west, being made to cover practically any salt of the alkalis or alkaline earths, or any group of such salts, quite regardless of whether they are acid, alkaline or neutral. The nature of so-called alkali waters varies enormously in different parts of the Canadian West. Lakes are found within a comparatively short distance of each other in which the predominating salts are sodium sulphate, sodium carbonate and magnesium sulphate, respectively; and these salts occur in sufficient quantity to make the commercial recovery of them a profitable enterprise during the drier months of the year, when the concentration is greatest. In the northern part of the prairie provinces springs, the waters of which are saturated with sodium chloride and with sodium and magnesium chlorides, are common, so it will be evident that the investigators have a broad problem before them, for, obviously, a remedy that might combat one form of "alkali" may be ineffective against another.

A fund has been created to finance the work totaling $13,200, of which the Research Council of Canada gave $5,000.

Chemical and Physical Tests

It was decided to divide the work into two phases: physical field tests and chemical research. Two hundred and fifty blocks of cement were exposed to the action of alkaline water at different points, this stage of the experiments being conducted under the charge of Professor Williams of the University of Saskatchewan. The work is now about to enter on the second stage, that of chemical research. The test blocks will be taken to the University of Saskatchewan and there chemical research work will be carried on under Professor Thoroldson, assisted by five chemists. It is not expected, however, that any results will be ready for publication for another year.

Disintegration of cement construction, under the influence of alkaline water, has, it is stated, reached such a point that until more is known, it is doubted whether cement can be used where alkaline water is encountered.

Hearings Open on Bill Providing Hydraulic Lab

Advocates Claim That Establishment Would Pay Dividends

In the course of the hearing on the bill providing for a National Hydraulic Laboratory, Senator du Pont of Delaware pointed out that industries are doubling and trebling their laboratory expense. John R. Freeman, the president of the American Institute of Civil Engineers, in advocating a laboratory to study flood control and all the problems of river hydraulics, declared that in his experience of more than 40 years he had never known a laboratory of any character which had not paid dividends, in some cases as high as thousands per cent.

Secretaries of the three executive departments that will be affected by this legislation were asked to submit reports and opinions on its establishment. The Secretary of Commerce and Secretary of the Interior see in the laboratory an important aid in solving problems of river hydraulics, while the Secretary of War submitted an adverse report, which is believed to reflect the opinion of the Corps of Engineers.

Secretary Hoover has submitted the following opinion: "There are many problems arising in connection with hydraulics, irrigation and the determination of the fundamental laws relating to stream flow and deposit which such a laboratory would assist in solving. Without question, the solution of the tremendous waste problem due to floods rests on fundamental data concerning the flow of water, the wearing of structural and natural materials, the transportation of material and water, and chemical and physical deposition, together with such general field data as can be gathered all over the country."

Secretary Fall states: "This department for many years has recognized the necessity and the value of scientific research in river hydraulics undertaken to obtain accurate and reliable data for use in the design, construction and operation of works intended for the utilization and control of the rivers of the country."

Weeks Opposed

In contrast to these opinions, the Secretary of War states that: "The hydraulic laboratory proposed would have no value whatever in solving flood control." He further states that he "would regard it as a misapplication of government funds to establish such a laboratory for the study of flood problems."

Further extracts from his letter are as follows: "The measures that can be taken to control floods are limited to the construction of dams to hold back the waters, levees to prevent them from overflowing the land, and such enlargements and outlets as may be practicable to pass the flood as promptly as possible to the sea. I omit reforestation, which some claim would have a beneficial effect, as, in my opinion, any effect of reforestation on the flood problems of this country is too insignificant to warrant serious consideration.

"It has been established that the reservoir control of the Mississippi flood problem is not practicable. In any event, the art of dam construction is so far advanced in this country that a national hydraulic laboratory is not necessary to advance that science. The hydraulic laboratory is certainly unnecessary to determine the proper design of the levees.

"There remains the problem of the practicability of designing outlets on the basis of laboratory experiments. I think it should be clear that the forces of nature let loose in a flood in one of our great rivers cannot be reproduced in a laboratory."

Ohio State Chemists at Pittsburgh A.C.S. Meeting

The accompanying photograph, taken on the steps of Carnegie Music Hall during the Pittsburgh meeting of the American Chemical Society, shows the large representation of chemists from Ohio State University that attended the meeting. The picture was taken immediately after the Ohio State luncheon on Sept. 6 at which ninety were present. Many meetings of various institutions were held during the convention, but this was the largest luncheon or dinner attendance reported by a single university.

Birds' Happy Home Doomed by Oil Seekers

Charles Stewart, Dominion Government Minister of Interior, has announced that his department has made an arrangement with a powerful United States syndicate by which the famous Pakowski bird sanctuary is to be thoroughly explored for oil. The bird sanctuary, which is 44 square miles in extent, lies immediately to the north of the Sweetgrass oil field in Montana and according to Dr. Dowling, oil expert for the Canadian Geological Survey, the oil-bearing formation extends well into southern Alberta.

Under the terms of the arrangement, the syndicate has been granted three leases of 640 acres each, and in the event of discovery is to be granted one-half of the whole sanctuary, in consideration for which it is to explore thoroughly the leases it has been granted. Mr. Stewart points out that the Dominion Government will retain the other half of the sanctuary, which, in the event of the discovery of oil in commercial quantities, will be greatly enhanced in value. Mr. Stewart stated that he recently visited the Montana field, where forty drilling outfits are at work. Work already has been started on the Canadian side, and Dr. Dowling is on the ground, watching developments on behalf of the Dominion Government.

American Sulphur Industry Competing Successfully With Italian

A message from Palermo, Italy, says that owing to the development of the sulphur industry in America and the fall in freight rates, American producers are competing very keenly on the sulphur market and the situation of Italian producers is becoming daily more difficult. The consortium holds stocks which cannot be disposed of except at serious losses. The following figures show the decrease in the export of Sicilian sulphur and the increase in the American production:

	Metric Tons	
	1920	1913
Italian exports.....	148,044	351,338
American production	1,230,000	498,937

Short Course for Flour Chemists an Innovation in Education

Unique in being the only educational project of its kind in the world, a 4-day short course for flour mill and bakery chemists has been scheduled at the University of Minnesota for Jan. 2 to 5, 1923. Complete and intensive instruction in the latest developments in the chemistry of flour and baking will be given by university experts of the agricultural biochemistry division. Supplementary lectures on wheat classification, wheat breeding, wheat diseases and insects infesting wheat and flour are also planned. Attendance will be restricted to twenty-four, and registration opens Oct. 1, 1922.

Canadian Paper Makers Oppose Development of Newfoundland

British manufacturers of print and other pulp papers have joined with Canadian manufacturers in opposing British aid to the proposed pulp and paper industry development of Newfoundland and admit in their protest to the British Government that their opposition is based on the fact that manufacturing costs in Newfoundland will be so small that the closing of British mills will result.

This information was contained in a cablegram received from Sir Richard A. Squires, Premier of Newfoundland, who has been in London several weeks negotiating with the Imperial Government for aid under the British trade facilities act. The proposed development in Newfoundland includes the harnessing of the Humber River. The cablegram received from Premier Squires follows:

"Canadian pulp and paper interests have succeeded in getting the Paper Makers Association of Great Britain and Ireland to enter formal protest to the Imperial Government against any guarantee being granted under the trade facilities act for the development of water power and timber areas in Newfoundland, on the ground that timber areas in Newfoundland are so vast and water power so gigantic that the manufacture of pulp and paper in Newfoundland on a large scale would have the effect of closing the paper mills in Great Britain because Great Britain paper manufacturers could not compete with Newfoundland manufacturers in quality or price."

Trade Association Will Foster Russian Paper Industry

That the immense possibilities of Russia as a source of wood pulp and paper are not being overlooked by the Soviet Government is indicated by the organization of a so-called Tecnic-Economical Council of the paper industry which has recently been formed, with headquarters in Moscow. The report of the formation of this organization sets forth as its object the correlation and dissemination of scientific, technical and economic information for the benefit of the industry and the education of the public. The council plans to maintain a library, an experimental laboratory and a vocational training school, and plans to enter into relations with the scientific and technical associations of Europe and America.

The council has three sections—the technical, the economic, and the professional instruction sections. General meetings are to be held every 2 months. The board of directors consists of five persons. Work of the council is financed by the manufacturing concerns which make up its membership.

Reports are current of the formation of an American company for the operation of a pulp and paper mill in Russia, which has been approved by the Soviet. The names of the Americans who are promoting the enterprise have not been made public, and particulars of the plant and its location are not at present available.

E. C. Franklin Plans Lecture Tour

At the Pittsburgh meeting of the chairmen and secretaries of the various divisions of the American Chemical Society, a plan was launched by which Prof. E. C. Franklin of Leland Stanford University will give a series of lectures before several of the local sections of the society. These will be given near the time of the spring meeting—that is, the latter part of March and the early part of April. The following sections have asked Dr. Franklin to speak before them on this trip: Chicago, Detroit, East Lansing, University of Michigan, Purdue, Cleveland, New Orleans, West Virginia, Pittsburgh, Buffalo, Rochester, Syracuse and Philadelphia.

If there are other sections of the American Chemical Society or other scientific bodies which would like to have Dr. Franklin speak before them, information can be obtained by writing to E. M. Billings, Kodak Park, Rochester, N. Y.

Free Courses in Dyeing at New York Textile School

Registration is now open at the New York Evening Textile High School, 124 West 30th St., New York City, for two courses in dyeing which will enable those interested to obtain a wider perspective of the entire field of the textile and dyeing industries.

The first of these courses, the elementary, is given on Monday and Wednesday evenings, and the advanced course on Tuesdays and Thursdays. The class is held from 7 to 9 p.m. and the work is partly lecture and partly laboratory, the former consisting of talks on textile fibers and dyes, while the latter covers practical dyeing. From time to time lectures will be given by authorities in the profession. All instruction and materials are free.

Capital Increases Rumored for German Dye Concerns

A Berlin dispatch to the New York *Times*, dated Sept. 24, states that new stocks in the German dye industry to the extent of 1,800,000,000 marks are expected to be thrown on the market in the near future. As a forerunner of this the directorates of two large firms already have decided to virtually double their capital stock.

The firm of Farbwerke, formerly known as Meister Lucius & Bruening of Hoechst-on-Main, has voted an increase of 470,000,000 marks, which will make a total capital stock of 940,000,000 marks. Other concerns in this group have similar increases in prospect. The directorate of the Chemische Fabriken has decided to increase its total stock from 33,000,000 to 64,000,000 marks.

Regulation of Butter Substitute in Canada

Under the regulations effective Au 19, importation, manufacture and sa of margarine in Canada shall be special license only, and the manufa ture of nut butters and oleomargarin is prohibited wherever the manufactu of butter or the reworking of ranc butter takes place, Vice-Consul Vys Ottawa, informs the Foodstuffs Div sion of the Department of Commerc Even the materials used for the man facture of dairy butter substitute mu undergo official government inspectio and approval, so interested are th dairies in safeguarding the health o the people preferring nut butters. I a picture of a cow or the name of an breed of cattle or the words "butter, "creamery" or "dairy" appear upon th package of dairy butter substitute o are used in advertising the article, th manufacturers are heavily liable.

Among the many sale restriction there is one that margarine must b sold in the original package, must b stamped with the official inspection sea of the Canadian Dominion, Ministry of Agriculture, and must conspicuously bear the word "oleomargarine." If a restaurant, hotel or lunch room serves margarine and doesn't announce that fact by prominent notices around the walls of the dining rooms, in the kitchens and elsewhere, it is a violation of the law and will cost about $500.

Chemical Industries Growing in India

The Bengal Agricultural and Industrial Committee has recommended the expansion of the manufacture of sulphuric acid and the establishment of factories for the manufacture of white lead, red lead, etc. Raw materials are readily obtainable.

The question of the manufacture of cement in the Jaffma island is being investigated. The experiments in testing materials carried out by the Technological Institute at Cawnpore have proved the feasibility of starting cement factories at Cawnpore and Lucknow.

The Director of Industries, Mysore, has been asked by the Durbar to ascertain if any private capitalist is willing to establish a paper factory in the state under the scheme prepared with the assistance of Bertram & Sons, of Edinburgh.

It is understood that the Nizam's Government has granted concessions to the Oosmania Mills Co., Ltd., which has been registered with a capital of one crore to start four cotton mills in the Hyderabad State.

Civil Service Openings

The U. S. Civil Service Commission announces the following open competitive examinations: Laboratory assistant, senior grade, at $1,200 to $1,380 a year; laboratory assistant, junior grade, at $1,000 a year; senior aid, at $900 a year; junior aid, at $540 a year, and junior aid, grade 2, at $720 to $840 a year.

Dye Embargo Dies Hard

(Continued from page 658)

Secretary; that imports be confined to certain specified ports; and that the tariff bill be amended so as to provide that the decision of the Secretary as to similitude be final and without appeal. Subsequent to the receipt of this letter the tariff conferees extended the embargo in the bill and placed the rates on coal-tar products on foreign valuation. They, therefore, did not make any changes in the text suggested by the Secretary. The House rejected the embargo and recommitted the bill to conference to have it stricken out. In their second conference, which lasted only 4 hours, the conferees changed the basis of the valuation on coal-tar products back to the American selling price and changed the figures in the paragraph, but found themselves unable to make the changes in phraseology which had been suggested by Secretary Mellon.

The greatest difficulty expected in administering the tariff on coal-tar products as it appears in the bill now is in determining similitude. The paragraph reads that imported dyes and chemicals from a coal-tar base shall be assessed for duty on the basis of the selling price of a comparable American product and that a domestic product may be considered comparable with an imported product if it produces results "substantially equal." The determination of whether results are similar is expected to lead to considerable litigation. In a case where similitude is not claimed and where there is no directly comparable American product, the rates are to be assessed on the foreign selling price or the export price, whichever is the higher.

Plan to Ask Readjustment of Rates

The movement for rearrangement of the duties not only on coal-tar products but upon synthetic organic chemicals of non-coal-tar origin was begun before the death of the temporary embargo extension. In a letter to all Republican members of Congress, dated Tuesday, Sept. 19, Dr. Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association, asked that the embargo be extended for 3 months and in concluding his letter said: "The enactment of this resolution will protect our industry and give time for the framing of legislation based on rates, which will safeguard the uncompleted American industry."

The exact basis of rates which will be asked when Congress reconvenes has not been determined, but in general it is proposed to increase greatly the 25 per cent ad valorem foreign valuation duty on synthetic organic chemicals (under the general or "basket" clause) and to rearrange completely the rates on coal-tar products. It is proposed in the case of the latter to make more than one rate, as it is claimed that some of the products need very high protection, while others can exist on low protection. The rates in the new tariff act on coal-tar products are 55 per cent ad valorem, American valuation, plus 7 cents per pound on intermediates, and 60 per cent ad valorem, American valuation, plus 7 cents per pound on finished products, these rates to continue 2 years, after which the ad valorems are to be reduced to 40 and 45 per cent, respectively.

Wisconsin Gives First Course in Paper Making by Mail

The first correspondence study course on the manufacture of pulp and paper will be given this September by the University of Wisconsin extension division in co-operation with the Forest Products Laboratory. The vocational education committee of the pulp and paper industry and the Wisconsin Board of Vocational Education helped to plan the course.

Five courses based on the textbooks prepared by the vocational education committee of the pulp and paper industry will be given. According to the co-operative arrangement, the extension division will administer the courses and the Forest Products Laboratory will correct the papers and have actual charge of the teaching of the courses. All of the information in the laboratory files and such technical advice as the members of the pulp and paper staff can give will be available to all students who take the course.

Railroad Must Stand Cost of Spotting Freight Cars

The Indiana Harbor Belt R.R. Co. has been ordered to pay the United Chemical and Organic Products Co. and the Central Chemical Co. of West Hammond, Ill., the costs of terminal service performed by the chemical companies' engine. The spotting of cars and other work in handling shipments from their own establishments was undertaken by the chemical companies when the belt railroad was not in a position to furnish prompt and adequate terminal service.

Paper Mill for East Kootenay, B. C.

The Wigwam Pulp & Paper Co., Ltd., has been formed for the purpose of building a pulp and paper mill at Philip's Bridge, 9 miles from Elko, in the East Kootenay region of British Columbia. The company is composed of United States and Canadian capitalists, the Chicago *Tribune* and other large daily paper owners being interested. The plant is to be built in three units, each having a daily capacity of 100 tons of newsprint, and a contract for the construction of the first unit, which is to cost $3,500,000, has been let to McDougald-McNeil, Ltd., of Calgary.

It is stated that it will take 3 years to build the complete plant, which will cost in the neighborhood of $12,000,000 and when finished will give employment to 1,500 men. Timber limits assuring a supply of pulpwood over 30 years are said to have been obtained, also water rights on the Elk and Bull rivers, providing ample power.

Natural Tannic Acid Plant to Be Established in Fiji Isle

Melbourne, Australia, papers report that the Doga Timber & Tannin Extraction Company has been formed in Suva, Fiji, for the purpose of extracting tannic acid from the bark of the doga tree, which grows in the mangrove swamps on the foreshores all around the islands. The proposal is to extract the tannic acid and ship the crystals to England. The company has a monopoly of Vitilevu, the largest island. Machinery has been imported, and operations are to be started soon.

Personal

EDWARD BARTOW and his family returned to the United States Sept. 2 after a 3 months' trip in Europe.

A. B. DAVIS and R. W. HILTON, formerly with the firm of Ault & Wiborg, have formed the firm of Hilton & Davis, to be manufacturers and distributors of fine chemicals.

FEDERICO GIOLITTI is at present in the United States.

HARRY H. HILL, formerly superintendent of the Bartlesville experiment station of the Bureau of Mines, has been designated to succeed F. B. Tough as supervisor of oil and gas leases. He will be succeeded by Theodore E. Swigart.

H. W. LOEBEL of McGill University, Montreal, Canada, has recently been added to the staff of the National Malleable Castings Co., Chicago, Ill.

RUSSELL E. LOWE, formerly works manager and technologist for the Maine Power Sales Co., maker of ferroalloys, is now metallurgist in charge of operation for the Bario Metal Corporation of New York.

R. B. MOORE, chief mineral technologist of the Bureau of Mines, is making a tour of the bureau's experiment stations in the West.

HENRY C. PEARSON, editor of the *India Rubber World*, will celebrate on Oct. 1 the thirty-third anniversary of the publication of which he has been editor from the beginning. Not only are there few business publications today that have reached the advanced age of 33, but there are still fewer editors who enjoy the unique distinction of having directed the editorial policies of their magazines from the beginning. *Chem. & Met.* extends its congratulations and best wishes.

J. A. STEFFENS, for the past 5 years chemical engineer of the U. S. Industrial Alcohol Co. at the research laboratories in South Baltimore, Md., has resigned and will engage in business for himself in New York.

WILLIAM STERICKER, formerly an industrial fellow at the Mellon Institute, Pittsburgh, Pa., is now research chemist with the Philadelphia Quartz Co., Philadelphia, Pa., the donor of the fellowship Mr. Stericker held at the Mellon Institute.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commoditi
Prevailing Prices and Market Letters From Principal Industrial Centers

The Tariff Act of 1922 and Its Probable Effect on the Chemical Market

A Study of the Rates of Duty and Administrative Provisions Most Likely to Influence Trade in the Products of the Chemical Industry

DOUBTLESS the single factor most likely to have permanent effect on market conditions in the chemical and allied industries is the new tariff law, signed by the President on Sept. 21, 1922. A certain measure of relief is to be felt immediately simply because the final enactment of the Fordney-McCumber bill puts an end to the 20 months of uncertainty which have characterized its making. To be sure, there is a wide difference of opinion as to probable revenue yields, the effects on domestic prices and on foreign trade, but aside from these controversial issues there are certain provisions in the new law which are of vital and immediate interest to the chemical industry.

The Possibilities in the Flexible Tariff

The outstanding feature of the new law is the provision empowering the President to raise or lower duties following the recommendation of the Tariff Commission. Under this arrangement rates of duty can be altered within the range of 50 per cent in order to meet changing conditions of competition or to correct inequalities in the operation of the different provisions.

Tariff Chronology

Jan. 6, 1921. Hearings began by Ways and Means Committee.
June 29, 1921. Bill introduced into the House of Representatives.
July 21, 1921. Passed by House.
July 22, 1921. Referred to Senate Finance Committee.
July 25, 1921. Hearings begun by Finance Committee.
Jan. 3, 1922. Hearings concluded.
April 11, 1922. Reported to Senate.
Aug. 19, 1922. Passed by Senate.
Aug. 22, 1922. Referred to conference.
Sept. 11, 1922. Reported by conference.
Sept. 13, 1922. Returned to conference by House.
Sept. 15, 1922. Conference report approved by House.
Sept. 19, 1922. Conference report approved by Senate.
Sept. 21, 1922. Fordney-McCumber tariff signed by the President.

The surrender to this extent of the Congressional prerogative of rate making is the first step toward taking the tariff out of politics and placing it on a logical and scientific basis. This provision offers many difficulties in the way of administration, but the success or failure of the new law will depend largely on the way in which the flexible tariff clauses are interpreted by the executive and administrative agencies.

As in all previous tariff acts, the ad valorem rates are based on foreign valuation with the single exception of coal-tar products, where the American selling price is the basis of assessment. It will be recalled that the House originally applied American valuation to the entire act, but because of very strong protest the provision was eliminated by the Senate. It is significant, however, that under the flexible tariff clause the President may extend American valuation to other articles where the additional protection is deemed necessary.

Dyes and Coal-Tar Products

The chemical industries are most concerned with the rates imposed on their products. In the accompanying table these rates have been compared

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	146.86
Last week	146.67
September, 1921	147
September, 1920	267
April, 1918 (high)	286
April, 1921 (low)	140

Indications are that the chemical market has already reached the lowest level of its present movement and unless interrupted by difficulties now unforeseen, it may be expected to show a gradual but material improvement within the next few months.

A COMPARISON OF THE RATES OF DUTY ON IMPORTANT CHEMICALS IN THE FORDNEY-McCUMBER TARIFF ACT OF 1922 AND IN ITS PREDECESSOR, THE UNDERWOOD-SIMMONS ACT OF 1913

(Specific Duties are on per pound basis unless otherwise noted.)

Commodity	Underwood-Simmons Act of 1913	Fordney-McCumber Act of 1922
Acetic acid, 65% and less	Free	¾c.
Acetic acid, over 65%	Free	2c.
Acetic anhydride	2½c.	5c.
Boric acid	¾c.	1½c.
Chloroacetic acid	15% n.s.p.f.*	5c.
Citric acid	5c.	17c.
Lactic acid	1½c.	2c.–9c.†
Tannic acid and tannin	5c.	4c.–20c.†
Tartaric acid	3½c.	6c.
Arsenic acid	Free	3c.
Formic acid	1½c.	25% n.s.p.f.
Gallic acid	6c.	8c.
Oleic acid	15% n.s.p.f.	1½c.
Oxalic acid	1½c.	4c.
Phosphoric acid	Free	2c.
Pyrogallic acid	12c.	12c.
Stearic acid	15% n.s.p.f.	1½c.
Acetaldehyde, etc.	15% n.s.p.f.	6c. + 30%
Acetone	1c. per lb.	25%
Alcohol, amyl	¾c.	6c.
Alcohol, butyl and propyl	¾c.	6c.
Fusel oil	¾c.	6c.
Alcohol, methyl	Free	12c. per gal.
Alcohol, ethyl	$2.60 gal.	15c. per pr gal.
Aluminum hydroxide	15%	½c.
Alums	15%	½c. & ¾c.†
Aluminum compounds	15% n.s.p.f.	2½%
Ammonium carbonate	¾c.	1½c.
Ammonium chloride	¾c.	1½c.

Commodity	Underwood-Simmons Act of 1913	Fordney-McCumber Act of 1922
Ammonium sulphate	Free	¼c.
Anhydrous ammonia	2½c.	2½c.
Antimony oxide	25%	2c.
Tartar emetic	15% n.s.p.f.	6c.
Argols and wine lees	5%	5%
Cream of tartar	2½c.	5c.
Rochelle salts	2½c.	5c.
Balsams, crude	10%	10%
Balsams, refined	15%	
Barium carbonate	15%	1c.
Barium chloride	¼c.	1½c.
Barium dioxide	1½c.	4c.
Barium hydroxide	15% n.s.p.f.	1½c.
Barium nitrate	15% n.s.p.f.	2c.
Bleaching powder	½c.	½c.
Caffeine	$1	$1.50
Tea waste	1c.	1c.
Calcium carbide	Free	1c.
Calomel	15%	45c.
Carbon tetrachloride	1c.	2½c.
Chloroform	2c.	6c.
Casein	Free	2½c.
Casein plastics, unfinished	Free	25%
Casein plastics, finished	10%	40c. + 25%
Chalk, precipitated	25%	25%
Chicle, crude	15c.	10c.
Chicle, refined	20c.	15c.
Chloral hydrate	25%	35%
Terpin hydrate	25%	35%
Thymol	25%	35%

Commodity	Underwood-Simmons Act of 1913	Fordney-McCumber Act of 1922
Urea	25%	35%
Glycerophosphoric acid	25%	35%
Coal-tar products: Intermediates used in manufacture of dyes, medicinals, explosives, photographic chemicals, perfumes, etc.	10%	7c. + 55%‡
Coal-tar products: dyes, color lakes, medicinals, explosives, photographic chemicals, aromatic chemicals, tanning materials, etc.	30%	7c. + 60%‡
Cobalt oxide	10c.	20c.
Collodion	1c%	35c.
Pyroxylin, unfinished	25%	40c.
Pyroxylin, finished	40%	60%
Drugs, crude, exotic	Free	Free
Drugs, crude domestic	Free	10%
Drugs, exotic advanced in value	10%	10%
Buchu leaves	10c.	10c.
Coca leaves	10c.	10c.
Gentian	½c.	½c.
Licorice root	½c.	½c.
Sarsaparilla root	1c.	1c.
Belladonna	10%	25%
Digitalis	10%	25%
Henbane	10%	25%

Commodity	Underwood-Simmons Act of 1913	Fordney-McCumber Act of 1922
monium	10%	25%
anide: potassium cyanide, sodium cyanide, compound and mixtures	Free	Free
got	10c.	10c.
ethylsulphate	15% n.s.p.f.	25%
methylsulphate	15% n.s.p.f.	25%
hyl acetate	5c.	3c.
hyl chloride	20%	15c.
hyl ether	4c.	4c.
tracts for dyeing and tanning	⅜c.	15%
avoring extracts, non-alcoholic	20%	25%
rmaldehyde	1c.	2c.
raformaldehyde	1c.	8c.
examethylenetetramine	15% n.s.p.f.	25%
lycerine, crude	1c.	1c.
lycerine, refined	2c.	2c.
ums: amber and ambroid	$1	$1
um arabic	½c.	½c.
k and ink powders	15%	20%
dine, resublimed	Free	20c.
romine	Free	10c.
romine compounds	15% n.s.p.f.	10c.
ead acetate, white	1¼c.	2½c.
ead acetate, brown	1c.	2c.
ead nitrate, arsenate and resinate	1¼c.	3c.
ime, citrate of	1c.	7c.
agnesium carbonate	1½c.	1½c.
agnesium chloride, anhydrous	15% n.s.p.f.	1c.
agnesium chloride, n.s.p.f.	15%	⅝c.
agnesium sulphate	0.1c.	½c.
agnesium oxide	3½c.	3½c.
agnesia, calcined	Free	3½c.
anganese compounds	15% n.s.p.f.	25% n.s.p.f.
enthol	50c.	50c.
amphor, crude	1c.	1c.
amphor, refined	5c	6c.
ils, animal, n.s.p.f.	15%	20%
ils, fish, n.s.p.f.	3c. per gal.	20%
ils, vegetable, n.s.p.f.	15%	20%
astor oil	12c. per gal.	3c.
ottonseed oil	Free	3c.
oconut oil	Free	2c.
oya-bean oil	Free	2½c.
empseed oil	3c. per gal.	1½c.
inseed oil	10c. per gal.	3.3c.
live oil, less than 5 gal.	30c. per gal.	7½c.
live oil, more than 5 gal.	20c. per gal.	6½c.
eanut oil	6c. per gal.	4c.
oppyseed oil	6c. per gal.	2c.
apeseed oil	6c. per gal.	6c. per gal.
urkey-red oils	25%	35%
ils, essential, n.s.p.f.	20%	25%
range and lemon oils	10%	25%
eppermint oil	25c.	25%
pium, crude	$3	$3
pium, manufactured	$4	$4
orphine	$3 per oz.	$3 per oz.
ocaine	$2 per oz.	$2.60 per oz.
erfume materials, synthetic	20%	45%
erfume materials, animal	Free	20%
erfume mixtures and compounds	20%	40c.+50%
erfumery, alcoholic	40c. + 60%	40c. + 75%
erfumery, non-alcoholic	60%	75%
loral waters	20%	20%

Commodity	Underwood-Simmons Act of 1913	Fordney-McCumber Act of 1922
Bay rum	$1.75 per pr. ga.	40c. + 60%
Paris green	Free	15%
Phosphorus	Free	8c.
Paints, artists'	20%	40%
Paints and pigments, n.s.p.f.	20%	25%
Barytes, crude	15%	$4 per ton
Barytes, ground	20%	$7.50 per ton
Prussian blue	20%	8c.
Ultramarine	15%	3c.
Bone black	15%	20%
Decolorizing carbons	Free	20%
Chrome colors	20%	25%
Gas black	15%	20%
Litharge	25%	2½c.
Orange mineral	25%	3c.
Red lead	25%	2¾c.
White lead	25%	2½c.
Ochers, siennas, umbers	5%	½-⅝c.
Satin white	20%	½c.
Spirit varnishes, denatured	10%	25%
Spirit varnishes, not denatured	$1.32 per gal.+35%	$2.20 per gal.+25%
Vermilion reds	15%	28c.
Zinc oxides	10%	1¾c.
Zinc oxides, in oil	15%	2¼c.
Lithopone	15%	1¾c.
Potassium chromate	1c.	2½c.
Potassium dichromate	1c.	2½c.
Potassium chlorate	½c.	1½c.
Potassium ferricyanide	2c.	7c.
Potassium ferrocyanide	1¼c.	4c.
Potassium iodide	15c.	25c.
Potassium bicarbonate	½c.	1½c.
Potassium bromide	15% n.s.p.f.	10c.
Potassium carbonate	Free	¾c.
Potassium hydroxide	Free	1c.
Potassium nitrate	0.35c.	½c.
Potassium permanganate	1c.	4c.
Santonin	Free	75c.
Soap, castile	10%	15%
Soap, toilet	30%	30%
Soap, all other	5%	15%
Sodium arsenate	Free	1c.
Sodium bicarbonate	¼c.	¼c.
Sodium borate	⅛c.	⅛c.
Sodium bromide	15% n.s.p.f.	10c.
Sodium carbonates	Free or ⅛c.	¼c.
Sodium chlorate	¼c.	1½c.
Sodium chloride, bags	Free	0.11c.
Sodium chloride, bulk	Free	0.7c.
Sodium chromate	½c.	1¾c.
Sodium dichromate	¾c.	1¾c.
Sodium formate	15% n.s.p.f.	2c.
Sodium ferrocyanide	¾c.	2c.
Sodium hydroxide	¼c.	½c.
Sodium nitrite	½c.	3c.
Sodium phosphate	½c.	½c.
Sodium sulphate, crystals	Free	0.05c.
Sodium sulphate, anhydrous	Free	0.1c.
Sodium sulphide	½c.	⅜-¾c.†
Sodium silicate	Free	⅛c.
Sodium sulphites	½c.	⅛c.
Sodium hydrosulphite	15% n.s.p.f.	35%
Sulphoxylates	15% n.s.p.f.	35%
Starch, potato	1c.	1¾c.
Starch, all other	½c.	1c.

Commodity	Underwood Simmons Act of 1913	Fordney-McCumber Act of 1922
Dextrine, potato	1¼c.	2¼c.
Dextrine, all other	¾c.	1¼c.
Strontium salts	15% n.s.p.f.	25%
Strychnine	Free	15c. per oz.
Thorium nitrate	25%	35%
Tin compounds	10%	25%
Titanium compounds	15% n.s.p.f.	30%
Vanilla beans	30c.	30c.
Tonka beans	25c.	25c.
Zinc chloride	½c.	1 9/10c.
Zinc sulphate	½c.	¾c.
Zinc sulphide	15%	1½c.
CHEMICALS ON THE FREE LIST		
Arsenious acid or white arsenic	Free	Free
Arsenic sulphide	Free	Free
Chromic acid	Free	Free
Hydrofluoric acid	Free	Free
Hydrochloric acid	Free	Free
Nitric acid	Free	Free
Sulphuric acid	Free	Free
Cinchona bark	Free	Free
Albumen	3c.	Free
Calcium acetate	Free	Free§
Calcium chloride	Free	Free
Calcium nitrate	Free	Free
Calcium cyanamide	Free	Free
Coal-tar products including crude anthracene, acenaphthene, benzene, carbazole, naphthalene, coal tar, etc.	Free	Free
Copper sulphate	Free	Free
Copper acetate	Free	Free
Crude drugs	Free	Free
Dyeing and tanning woods	Free	Free
Enfluerage grease	20%	Free
Floral essences	20%	Free
Ferrous sulphate	Free	Free
Gum damar, kauri, copal, tragacanth, tragasol, etc.	Free	Free
Iodine, crude	Free	Free
Monazite sand	25%	Free
Oil bearing seeds and nuts	Free	Free
Oils, essential	20%	Free
Potassium cyanide	Free	Free
Sodium cyanide	Free	Free
Potassium chloride, crude	Free	Free
Potassium sulphate, crude	Free	Free
Potash salts, crude, n.s.p.f.	Free	Free
Quinine	Free	Free
Radium salts	Free	Free
Sodium nitrate	Free	Free
Sodium sulphate, crude	Free	Free
Sulphur	Free	Free
Pyrites	Free	Free
Tapioca or cassava	Free	Free
Turpentine and rosin	Free	Free
Uranium salts	Free	Free
Waxes	Free	Free

* Not specially provided for.

† Depending on strength o grade.

‡ After 2 years the ad-valorem rates on intermediates and dyes will be reduced respectively to 40 and 45 per cent. These duties are to be based on the American selling price of similar competitive articles of American manufacture. Lacking such an article the duty is based on the American selling price of the imported article.

§ Provided the country of origin assesses no duty on calcium acetate when imported from the United States.

with those in the Underwood-Simmons ct of Oct. 3, 1913.

Of most general interest are the rates n dyes and other coal-tar products. The Ways and Means Committee, the Senate Finance Committee and the oint conference each had the experi-nce of inserting provisions for the ex-ension of the recent embargo system—nd each in turn saw it rejected. After he House had returned the bill to the onferees with instructions that they liminate the dye embargo and place otash on the free list, it was evident hat a higher tariff was the only accept-ble compromise. Accordingly in the ew law the coal-tar products known s intermediates and used in the manu-facture of such finished articles as lyes, medicinals and photographic hemicals are made dutiable at 1c. per b. and 55 per cent ad valorem based n the American selling price of any imilar competitive product made in the Jnited States. These rates, however, re to apply for only 2 years, after vhich time they are to be reduced to 0 per cent ad valorem and 7c. per lb. The finished coal-tar products—dyes, stains, color lakes, medicinals, aromatic chemicals, flavors, synthetic tanning materials, synthetic resins and explosives—are to be dutiable at 60 per cent ad valorem and 7c. per lb. for 2 years and thereafter the ad valorem rate is reduced to 55 per cent.

If there is no "similar competitive article" manufactured in the United States, then the ad valorem rate is to be based on the foreign value of the product plus certain specified additions for packing, shipping, etc. The terms "similar" and "competitive" are defined as follows:

> Any coal-tar product provided for in this act shall be considered similar to or competitive with any imported coal-tar product which accomplishes results substantially equal to those accomplished by the domestic product when used in substantially the same manner.

Many Synthetic Organic Chemicals Are Unprotected

Except for those of coal-tar origin and a few others mentioned specifically in the different paragraphs, synthetic organic chemicals are not specifically provided for and must therefore be included in the basket clause of paragraph 5 at a rate of 25 per cent ad valorem. This is a tremendous reduction in duty, for under the Bursum amendment to the Senate bill all synthetic organic chemicals, whether of coal-tar origin or not, were to receive the high compound duties based on American valuation. The compounds which suffer most by this omission are the organic medicinals such as barbital, certain of the acetylene, ethylene, propylene and other hydrocarbon derivatives, and many of the highly purified chemicals developed for research and experimental purposes.

Dye Duties Based on Strength

There are two important administrative features of the dye schedules which have appeared in all of the varied drafts of the bill but which have not received the attention they deserve. The first provides that the specific duties on dyes shall be based on standards of strength to be established by the Secretary of the Treasury and on all im-

portations which exceed these standards the duty shall be computed on the weight the article would have if it were diluted to standard strength. This will make it necessary for the Treasury Department to sample and report on all dye imports, but it will have the beneficial effect of preventing evasion of duties through the importation of highly concentrated dyes and their subsequent dilution in this country. Incidentally the standards of strength are to conform as nearly as practicable with those in ordinary commercial usage in this country prior to July 1, 1914.

The second provision is that beginning March 21, 1923, every package of imported dyes must be labeled with a "plain, conspicuous and truly descriptive statement" of the identity and percentage of actual dye contained therein. Furthermore, this label must not bear any fraudulent or misleading statement regarding the origin of the dye. This application of the principles of the pure food and drugs act to dyestuffs is an innovation that should eventually result in a marked improvement in the marketing of both imported and foreign dyes.

Other Changes in the Chemical Schedules

Potash as a result of the final mêlée in the conference was relegated to the free list—that is, as far as the crude salts are concerned. The refined compounds of potassium, with the exception of KCN, carry specific duties ranging between one-half cent on the nitrate and 25c. per lb. on the iodide.

Ammonium sulphate, originally introduced in the House bill with a duty of two-fifths of a cent per lb., emerged from the conference with the ¼c. rate imposed by the Senate.

Citric acid, always a source of controversy in tariff debates, was finally made dutiable at 17c. per lb. after the duty on its raw material, citrate of lime, had been boosted to 7c. per lb.

The rates on the higher strengths of lactic acid were increased to 4c. per lb. for the 30-55 per cent grades and 9c. per lb. for all strengths above 55 per cent.

The Underwood rate on fusel oil was ½c. per lb. The House bill raised this to 6c., which was subsequently lowered to 2c. by the Senate, but the conferees saw fit to return to the House rate of 6c. per lb.

Casein had been on the free list for many years when the emergency tariff separated it out for a protective duty. In the new law it continues to be dutiable at a rate of 2½c. per lb. The plastic compounds of casein known as galalith are mentioned for the first time in this tariff act.

A feature of the vegetable oil paragraph is that all of the rates, with the single exception of rapeseed oil, are based on weight rather than measure. In the case of many of the oils which are imported in large quantities it has always been a difficult matter for the customs officials to assess duties based on gallonage when the products are bought and sold on a pound or ton basis.

I.C.C. Modifies Rail Priorities

In a service order effective Sept. 20, the Interstate Commerce Commission has modified its rules regarding preferential shipments eastward from the Mississippi River. Medicines, fertilizers, seeds, newsprint paper, mine supplies and petroleum have been added to the list of commodities entitled to priority movement.

It is understood that the new order was issued because of the complaint that various commodities had not been handled currently and promptly because of the different embargoes issued by the railroads during the coal and rail strikes.

The New York Market

New York, Sept. 24, 1922.

The enactment of the new tariff bill has already had some influence on the prices of chemicals and allied products. Advances have been quite common, especially among items frequently imported. The market, in general, may be said to be decidedly stronger than at any other time this year, and while business has not been materially increased, the consuming element has shown some inclination to emerge from its former status of extreme conservatism. The feature of the past week's activities has been the advance in acetate of lime quotations. This has been the third increase during the past few months and it is understood that prices on all acetate products will automatically be higher. Crude fusel oil and tartaric acid manufacturers have advanced quotations. Acetate of soda, sal ammoniac, barium chloride and carbonate, caustic potash, permanganate of potash, prussiates of potash and soda have all shown more activity at higher figures during the interval. Imported citric acid is soaring under the impetus of the 17c. per lb. duty provided by the new tariff.

General and Special Chemicals

Acetate of Lime—Increased production costs have been directly responsible for the recent advance in this commodity. Supplies are very firm among producers at $2.75 per 100 lb. Demand is fairly active.

Acetate of Soda—Spot and immediate shipment material is in very light supply and sellers have advanced quotations to 7½c. per lb. Buyers are showing considerable interest in the position of available supplies.

Barium Chloride—Large dealers were quite firm around $97 per ton for spot supplies. The general tone of the market is much firmer and the consuming demand has been moderately active.

Caustic Potash—The demand for this item has shown an appreciable increase and prices have been materially advanced. During the late trading 6½c. per lb. for 88-92 per cent goods was considered an inside figure for spot material.

Chlorate of Potash—Domestic factors were quoting 8½c. per lb. f.o.b. works.

Citric Acid—Imported material has been advanced to 48½c. per lb. on spot. Domestic producers are withholding quotations in an effort to prevent second-hand speculation. The shipment market is a nominal affair.

Nitrite of Soda—Prices have been firmly maintained at the recent advance and 9¼c. per lb. was about the lowest figure heard on actual transactions. Offerings were rather light on spot.

Prussiate of Potash—Yellow material was quoted as high as 37c. per lb., although on some odd lots a shade lower might have been done on firm business. The red variety held at 95c. per lb. Demand has been quite active of late.

Prussiate of Soda—Leading dealers quoted the spot market around 24@24¼c. per lb. The general tone of this market is much firmer than recently reported, due to the added costs of importations.

Sal Ammoniac—Sales of imported white granular were reported at 6½c. per lb. Some sellers were asking from 6¾@7c. per lb. The demand has shown a noticeable increase and sellers have shown no anxiety to offer any large quantities.

Tartaric Acid—Producers have advanced prices of the U.S.P. to 32c. per lb. on all varieties. Imported crystals were quoted at 31c. per lb., with the powdered at 31¼@31½c. per lb.

Coal-Tar Products

The market, in general, has been much healthier during the past week and producers are all of the opinion that the last quarter will bring considerable activity on items that have been dormant during the earlier months of this year. There has been a pronounced scarcity, with very little relief in sight, in phenol, toluene and benzene.

The selective embargo on coal-tar products contained in the emergency tariff law came to an end on Sept. 21, 1922, with the enactment of the new tariff law. It would appear quite probable that imports of certain crudes now on the free list may again appear on the market shortly.

Aniline Oil—Large factors quote the market at 15c. per lb. and report several sales at this figure. The tone of the market is somewhat stronger.

Benzoic Acid—The market remained quite firm and producers report sales at 72@75c. per lb. for the U.S.P. material. Small lots seemed to feature the trading.

Beta Naphthol—The demand for the technical variety has not been very active and the tone was much easier. Producers quote 23c. per lb. for immediate shipment.

Cresylic Acid—Prices on this commodity were very firm and sellers found some difficulty to meet the increased demand. The 97-99 per cent is quoted around 56@58c. per gal. and the 95 per cent at 51@53c. per gal.

Phenol—Producers named 18@20c. per lb. for shipments. Spot supplies are very light and holders are asking 21@22c. per lb. for the U.S.P. prime white crystals. The general condition of the market is extremely firm.

The St. Louis Market

ST. LOUIS, Sept. 19, 1922.

Trading conditions in this market ve been very good during the past weeks and prices very firm. The de- and for domestic goods is increasing adily, as stocks of imported material e comparatively light.

ALKALIS

Apparently the alkali market has ached the period of "normalcy." For ite a while now there has been no ange of note in prices, while the lume of business being done is at ast normal. *Solid caustic soda* in 5- 10-drum lots is holding firm at $3.90 r 100 lb. delivered buyer's door and *ke caustic*, on the same basis of antity and delivery, is quoted at .25. *Soda ash* is also thriving on a isk market, and while no advance in ices has been reported, volume of siness is good. In 5- to 10-bag lots is quoted at $2.20 per 100 lb., with e usual differential of 20c. for bar- ls. *Bicarbonate of soda* is moving in s usual channels and has retained the ice of $2.25 in 5-bbl. lots. Carload otations in this market are around .85 per 100 lb,. f.o.b. buyer's ship- ng point. *Sal soda* is the weak sister the alkali group at this time and is ally without a price. Prices range om $1.50@$1.75 per 100 lb. in 1- to bbl. lots.

GENERAL AND SPECIAL CHEMICALS

Heavy mineral acids continue to ove in a fair way with prices un- anged. With the government surplus ocks of *carbolic acid* practically de- leted, the market is becoming very rm and the demand seemingly good. *itric acid* is not moving so well. *mmonia water*, 26 deg., is moving rough regular channels and prices re- ain the same. *White arsenic, pow- ered*, is still in heavy demand and sup- lies are light, with prices ruling about ie same as our last report. There as been very little change in the *rpperas* situation and the market is ery firm. *Glycerine* has enjoyed an- her advance since our last report and now quoted on a firm basis at 17½c. er lb. in drums. We expect to see our revious prediction of 18c. glycerine ulfilled in the near future. *Sulphur* as not changed since our last report nd has, we think, reached bottom. While there has been no startling mount of sulphur business transacted ecently, the market can scarcely be alled stagnant.

VEGETABLE OILS AND NAVAL STORES

Castor oil is still holding firm at 4c., with no indication of a decline. would not be at all surprising to see further advance soon. *Turpentine* as advanced sharply again and to- ay's quotation on single barrels is 1.40 per gal. and 5-bbl. lots at $1.34. *inseed oil* has generally remained teady at the market price, with no hanges and good volume of business ransacted.

The Iron and Steel Market

PITTSBURGH, PA., Sept. 22, 1922.

Production of steel is now at between 60 and 65 per cent of capacity. The gain in the past week has been small relative to the gain which rather promptly followed settlement of the coal strike. Quickly a movement was re-established between mines owned by steel interests and their byproduct coke ovens and steel plants. Further increase would depend chiefly upon increased supplies of purchased coal or of coal or coke from the Connellsville region. The last weekly report of the Geological Survey expressed the opinion that the limit of coal production has been practically reached, having got up to the present transportation capacity of the railroads. Until conditions change, therefore, as for instance by the Lake coal shipping season ending or by the railroads becoming more efficient, little further increase in pig iron and steel production is to be expected, say beyond a 65 per cent operating rate.

CHANGES IN THE MARKET SITUATION

Market conditions, however, do not depict as great a scarcity of steel as appeared to exist a month ago. There have been some rather impressive changes in the market alignment. There is now very little demand for steel for late delivery, like December or the first quarter of the new year. Demand for early deliveries may be considered quite fair, for with the heavy buying that has marked the earlier portion of the year no very heavy tonnage of prompt steel should be expected as market demand at this time.

Since this is just the time of year when the steel market should stiffen if underlying conditions warrant a stiffening at all, the lightness of inquiry for forward delivery and the earlier deliveries obtainable at premium prices are significant. There seems to be a clear prospect that delivery premiums will disappear within the not distant future, perhaps in a month, leaving the whole market at the level now ruling for late delivery. For the greater part, this means simply the prices to which the Steel Corporation has lately adhered.

PROSPECTS FOR 1923

The common view is that there is a large volume of business to be done for 1923 delivery, industrial prospects being distinctly promising. Buyers and sellers of steel have never experienced difficulty in reaching a price basis when there was actual business to be done. With large business in prospect for 1923, a settling basis will no doubt be developed according to circumstances, either at present basis prices, ignoring delivery premiums now ruling, or at slightly lower prices. At the most, no great decline is to be expected. Present prices, for late delivery, average about $9 a ton above the market at its low point early in the year. Mills are unlikely to be willing again to go so near the cost line as at that time, while costs, on account of wage and fuel conditions, are up about $5 a ton.

According to delivery, price ranges in general are as follows: Bars, 1.90@2.25c.; shapes and plates, 2@2.25c.; sheets, 3.35@3.50c.; nails, $2.60@$2.75. Small lots of sheets seem to be bringing 3.75c. for very prompt shipment, but a good order for say 30 days' shipment could probably be placed at 3.50c. without difficulty.

Mills requiring box cars for shipping product have been short for some time, and a little steel has accumulated. Open top cars have now become scarce at some plants, resulting in slight accumulations of steel. Embargoes against shipment to one point or another are frequent and vexatious not simply to the consignee but also to the shipper.

PIG IRON MARKET

The pig iron market remains more or less stagnant. Only in an occasional instance has a merchant furnace been able to resume operations. A little Connellsville coke has been picked up, several brands having to be mixed, while the price is very high. In occasional instances furnaces are resuming on byproduct coke, but in general the increased supply of coal to byproduct ovens results simply in the operation of steel works furnaces.

Plainly pig iron prices are too high relative to the position of possible consumers, the result being a stagnant market, while attempts to buy large tonnages would merely send prices up. In basic iron there has been no defined market for some time, $30 valley being mentioned as a nominal quotation. It is doubted whether any steel works is in position to pay this price, while there are practically no offerings by merchant furnaces. There are some indications that steel works will offer basic iron in the market, on account of their steel orders not being able to absorb all their possible pig iron production. Bessemer remains quotable at $34 valley, and foundry on the basis of say $35 or $36 valley.

COKE AND COAL

Connellsville coke has stiffened in the week, being quotable now at $11@$12 for furnace and $13@$13.50 for foundry.

The Pittsburgh district coal market is a trifle easier. Indifferent grades of steam coal go at $4@$4.50, high-grade steam and gas coal being $4.50@$5. Good grades of domestic 1¼-in. lump stand at $5.25, this being the regular price of the Pittsburgh Coal Co.

STEEL SCRAP

Heavy melting steel scrap has undergone a sharp advance, having sold at $21.50, delivered in the Pittsburgh district, while it is thought that some Youngstown consumers have paid $22.50. Of late the Youngstown market has averaged nearly if not quite $1 above the Pittsburgh market. Demand is developing for cast scrap in charging box sizes. As high as $23.50 has been paid by foundries for cupola cast, and if steel works buy in such tonnages as would be natural the foundries will be confronted with higher prices still.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0 13½ – $0 13¾	14 – .14½
Acid, acetic, 28 per cent	100 lbs.	2 70 – 2 80	2 85 – 3 30
Acetic, 56 per cent	100 lbs.	5 35 – 5 40	5 45 – 5 75
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	11 00 – 11 25	11 50 – 12 00
Boric, crystals	lb.	11 – 11½	11¾ – .12
Boric, powder	lb.	11 – 11½	.11¾ – .12¾
Citric	lb.	..... –	.48½ – .49
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09¾ – .10	.10¼ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04¾ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06½	.06¾ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07¼
Oxalic, crystals	lb.	.17½ – .17¾	.17¾ – .18½
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	10 00 – 10 50	..... – .....
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15 00 – 16 00	..... – .....
Sulphuric, 66 deg., drums	ton	19 00 – 20 00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.31 – .31¼
Tartaric acid, imported, powdered	lb.	..... –	.31¼ – .31½
Tartaric acid, domestic	lb.	..... –	..... – .32
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.34 – .35
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.34 – .35
Alum, ammonia, lump	lb.	.03½ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03½ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1 65	1.70 – 2 25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	..... –	2.35 – 2.50
Arsenic, white, powdered	lb.	.08½ – 09	.09½ – .09½
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	70.00 – 71 00	71 50 – 73 00
Barium chloride	ton	97 00 –100 00	101.00 –105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04¾ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45 00 – 55.00	..... – .....
Bleaching powder	100 lb.	2 00 – 2 10	2.15 – 3 25
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2.40	2.45 – 2.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22 00 – 23 00	23 50 – 27 00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1 50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.83 – 85
Carbon bisulphide	lb.	.06¾ – .07	.07¼ – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2 10
Copperas	ton	20 00 – 22.00	23.00 – 30 00
Copper carbonate, green precipitate	lb.	20 – 20½	.20¾ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb	.09½ – .10	.10¼ – .10½
Fullers earth, f.o.b. mines	net ton	16 00 – 17.00	..... – .....
Fullers earth—imported powdered—net	ton	30 00 – 32.00	..... – .....
Fusel oil, ref	gal.	..... –	2.75 – 2 90
Fusel oil, crude	gal.	..... –	1.65 – 1 85
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.17¼ – .17¾
Iodine, resublimed	lb.	..... –	4 40 – 4 50
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.10½ – .11½
Lead arsenate, powd	lb.	.13 – .13½	.13¾ – .14½
Lead nitrate	lb.	..... –	15 – .20
Litharge	lb.	.07¼ – .08	.08¼ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07¼
Magnesium sulphate, U. S. P.	100 lb.	2 00 – 2.25	2 30 – 2 50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1 80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.12 – .12
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35¼
Potassium bichromate	lb.	.10½ – .10¾	.11 – .11
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb	.12 – .12¾	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05¼	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.07½ – .07¾	.08 – .08¼
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7 00
Potassium iodide	lb.	..... –	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.16 – .16¾	.16¾ – .17
Potassium prussiate, red	lb.	..... –	.95 – 1.00
Potassium prussiate, yellow	lb.	.37 – .37½	.37½ – .38
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06¾ – .07	.07¼ – .07¾
Salammoniac, gray, granular	lb.	.07¼ – .08	.08¼ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07¾	.08 – .08¾
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09½	.09¾ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02¾ – .03	.03¼ – .03¾
Sodium nitrite	lb.	.09¼ – .09½	.09¾ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03¾ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.24 – .24½	.24½ – .24¾
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04¼ – .04½	.04¾ – .05
Sodium sulphite, crystals	lb.	.03½ – .03¾	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	..... – .....
Talc—domestic powdered	ton	18 00 –25.00	..... – .....
Tin bichloride	lb.	.10 – .10½	.10¾ – .10¾
Tin oxide	lb.	..... –	.39 – .49
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran	lb.	.06 – .06¼	.06¾ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – 08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.20 — .22
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.35 — 1.50
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.55 — .60
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06¼ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15 —	$0.10
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.10 —	2.15
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.75 —	.77
Ortho-nitro-toluene	lb.	.10 —	.13
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1 60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.21 —	.22
Pyridine	gal.	1.75 —	2 75
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.25 —	.27
Salicylic acid, U. S. P	lb.	.29 —	.30
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12 —	.14
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Candellila, wax	lb.	.43 —	.45

Other Prices Remain Quotably Unchanged

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.50 —	$6.65
Rosin E-I	280 lb.	6.65 —	6.70
Rosin K-N	280 lb.	6.70 —	6.85
Rosin W. G.-W. W	280 lb.	7.85 —	8.40
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1 32 —	1.33
Wood turpentine, steam dist	gal.	1.15 —	....
Wood turpentine, dest. dist	gal.	1.12 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.38 —	....
Rosin oil, second run	gal.	.41 —	....
Rosin oil, third run	gal.	.48 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.75 —	3.80
Blood, dried, f.o.b., N. Y	unit	4.60 —	....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.40 —	2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

All Prices Same as Previous Report

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12½ —	.12¾
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¼ —	.08½
Cocoanut oil, Cochin grade, in bbls	lb.	.08¾ —	.09
Corn oil, crude, in bbls	lb.	.10 —	.10¼
Cottonseed oil, crude (f. o. b. mill)	lb.	.06¾ —	.07
Cottonseed oil, summer yellow	lb.	.09¼ —	.09½
Cottonseed oil, winter yellow	lb.	.10¼ —	.10¾
Linseed oil, raw, car lots (domestic)	gal.	.88 —	.88½
Linseed oil, raw, tank cars (domestic)	gal.	.83 —	.84
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.91
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.06¾ —	.07
Palm, Niger	lb.	.06 —	.06⅛
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¼ —	.08½
Peanut oil, refined, in bbls	lb.	.12 —	.12¼
Rapeseed oil, refined in bbls	gal.	.79 —	.80
Rapeseed oil, blown, in bbls	gal.	.86 —	.87
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11¾ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09⅞ —	....

FISH

Light pressed menhaden	gal.	$0.53 —	....
Yellow bleached menhaden	gal.	.54 —	.55
White bleached menhaden	gal.	.56 —	.57
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Prices remain quotably unchanged.

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	69.00 —	72.00
Spiegeleisen, 19-21% Mn	gross ton	38.00 —	39.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	1.85 —	2.00
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	60.00 —	62.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.65 —	.70
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19 00 —	20.00
Coke, foundry, f.o.b. ovens	net ton	12.50 —	13 00
Coke, furnace, f.o.b. ovens	net ton	11.00 —	11.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19 00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01⅛
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.29 —	....
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.50 —	.55
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	6.25 —	6.50
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	6.00 —	6.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent	19.00–19.50
Antimony, wholesale lots, Chinese and Japanese	7.00–7.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32 00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.25
Lead, New York, spot	6.10–6.25
Lead, E. St. Louis, spot	5.90–6.00
Zinc, spot, New York	7.00–7.10
Zinc, spot, E. St. Louis	6.70–6.75

OTHER METALS

Silver (commercial)	oz.	$0.69⅝
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.20
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$118.00
Iridium	oz.	2.75@3.00
Palladium	oz.	55 00
Mercury	75 lb.	67.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@ 8.75
Lead, heavy	4.50@ 4.75
Lead, tea	3.25@ 3.50
Brass, heavy	5.50@ 5.75
Brass, light	5.00@ 5.25
No. 1 yellow brass turnings	5.50@ 5.75
Zinc	2.25@ 2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	$2.90
Soft steel bars	2.80	2.80
Soft steel bar shapes	2.80	2.80
Soft steel bands	3.40	3.40
Plates, ¼ to 1 in. thick	2.90	2.90

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

DEMOPOLIS—The Gulf States Portland Cement Co. is planning for the erection of an addition to its plant at Spocari, Ala., to double, approximately, the present capacity of 1,200 bbl. per day. Plans will be prepared at an early date.

MONTGOMERY—The Excelsior Brick Co. is planning for the rebuilding of the portion of its plant, recently destroyed by fire with loss of about $35,000, including equipment.

Arkansas

GRAVETTE — The Spees Vinegar Co., Kansas City, Mo., is arranging a list of equipment for installation at its local plant, to include a hydraulic press, drying machinery and other primary apparatus. A new power house will be constructed at the mill.

Delaware

SOUTH WILMINGTON—The Wilmington Sugar Refining Co. is arranging for the early resumption of work on its new local refining plant, held in abeyance for a number of months past, and proposes to push the main works to completion. The plant will comprise a number of buildings, and is estimated to cost in excess of $750,000, including machinery. Armstrong & Latta, Land Title Bldg., Philadelphia, Pa., are engineers and contractors.

Florida

DADE CITY—M. F. Ackerman, Dade City, has preliminary plans under way for the organization of a company for the establishment and operation of a new plant for the manufacture of bricks and other burned clay products. A site for the proposed works has been selected.

Georgia

COLUMBUS — The Dixie Brick Co. has commenced the installation of new equipment at its plant for increased production in a number of departments. J. E. Minter is secretary and general manager.

COLUMBUS—James H. Palmer & Co., Inc., Columbus, Ga., has been incorporated with a capital of $10,000, to manufacture fertilizer products. The incorporators are A. Drane and James H. Palmer, Columbus. The last noted represents the company.

Indiana

HAMMOND—Fire, Sept. 7, destroyed a section of the local plant of the Inland Steel Co., with loss estimated at $50,000, including machinery. It is expected to rebuild at an early date.

INDIANAPOLIS—The Crown Chemical Co. has acquired the 4-story building at the northwest corner of Pennsylvania and Georgia Sts., known as the Hurst Bldg., 60x110 ft., and will occupy for a new plant. It was obtained for a consideration said to be $100,000. The company will remove its present works at 433-35 East South St., and will utilize the structures at the latter location as warehouses in the future. Arrangements have been made for a change of name to the Boncilla Laboratories. John M. Price is president and general manager; and J. S. Judy, vice-president and treasurer.

Louisiana

NEW ORLEANS—The Loyola University has plans in preparation for the erection of a new 4-story chemistry building, 60x200 ft., and plans to call for bids early in October. It is estimated to cost close to $250,000, including equipment.

NEW ORLEANS—The M. Augustin Paint & Glass Co. plans for the rebuilding of its plant at 612 Jerome St., recently destroyed by fire, with loss estimated at close to $200,000.

NAPOLEONVILLE—The Godchaux Sugars, Inc., 527 Canal St., New Orleans, has tentative plans under consideration for the rebuilding of the portion of its local sugar-refining plant, known as the Elm Hall Refinery, destroyed by fire, Sept. 5, with loss estimated in excess of $1,500,000, including machinery, buildings and stock.

Maryland

BALTIMORE—The United States Industrial Chemical Co., Fairfield Rd., has filed plans for the erection of a 1-story works addition, 21x35 ft.

BALTIMORE — The Security Cement & Lime Co., Equitable Bldg., is perfecting plans for the proposed enlargement of its cement mill at Security, Md., to increase the capacity from 950,000 to 1,400,000 bbl. per year. Additional buildings will be erected and machinery installed. To provide for the expansion, the company has disposed of a note issue of $300,000. Loring A. Cover is president.

BALTIMORE—The Baltimore Water Paint Co. has acquired the factory property of the Crown Cork & Seal Co., on Eastern Ave., between 11th and 12th Sts., for a consideration said to be $25,000. The property consists of three buildings, which will be remodeled and improved for a plant for the new owner. It is planned to install additional equipment to cost, with building improvements, about $30,000. The new works are expected to be ready for service early in December.

Massachusetts

NATICK—The Griess-Pfleger Tanning Co., 179 South St., Boston, has completed plans for the erection of a new 1-story leather tannery, 180x320 ft., on local site, recently acquired on Washington St. Work will be inaugurated at an early date. Haven & Hopkins, 40 Court St., Boston, are engineers.

CAMBRIDGE—The Boston Woven Hose & Rubber Co., Hampshire St., has awarded a contract to William T. Reed, 201 Devonshire St., Boston, for the erection of a 1-story plant addition 43x85 ft. The John O. DeWolf Co., 45 Bromfield St., Boston, is engineer.

Missouri

SPRINGFIELD—The Southwestern Tanning Co., 214 Holland Bldg., W. R. Wolfe, head, recently organized, has plans under way for the construction of a 1-story leather tanning pant, 100x135 ft., at 500 West Commercial St., estimated to cost about $16,000, exclusive of equipment. Earl Hawkins & Co., 400 McDanniel Bldg., are architects.

New Jersey

NEWARK—The Miner-Edgar Co., Blanchard St., manufacturer of chemical products, has filed plans for the erection of a new 2-story plant addition, 40x144 ft., estimated to cost approximately $40,000. Work will be placed in progress at once.

TRENTON—The Magnetic Pigment Co., 603-13 Cass St., has awarded a contract to the N. A. K. Bugbee Co., Trenton, for the erection of an addition to its plant for the manufacture of metallic pigments, estimated to cost approximately $50,000. It is planned to have the structure ready for equipment at an early date.

NEWARK—The American Tallow Co., Plum Point Lane, has filed plans for the construction of a 1-story plant addition, 35x60 ft.

HACKETTSTOWN—The Alphano Humus Co., manufacturer of fertilizer products, is reported to be planning for the rebuilding of the portion of its plant, destroyed by fire, Sept. 4, with loss estimated in excess of $50,000, including equipment and stock.

TRENTON—The Essex Rubber Co., Beakes and May Sts., manufacturer of general rubber specialties, has plans nearing completion and will soon take bids for the erection of a new 2-story addition. J. Osborne Hunt, 219 East Hanover St., is architect.

NEWARK—The Verona Chemical Co., 26 Verona Ave., is reported to be planning for the rebuilding of the portion of its plant, destroyed by fire recently with loss estimated in excess of $50,000.

CAMDEN—Fire, Sept. 9, destroyed a portion of the plant of the Keystone Leather Co., 17th and Carman Sts., with loss estimated at close to $50,000, including drying and other equipment. The two upper floors of a 4-story building were demolished.

New York

MINEOLA—George M. Murray, Garden City, L. I., has acquired property at the Merrick Rd. and the Long Island Railroad, for the erection of a new 1-story chemical works. Plans will be prepared at an early date.

North Carolina

WILMINGTON—The Southeastern Chemical Co., Charlotte, N. C., has acquired a local building for the establishment of a new branch plant for the manufacture of chemical specialties from pine byproducts. Machinery will be installed at an early date and operations inaugurated. Forrest A. Johnson heads the company.

Ohio

AKRON—The General Tire & Rubber Co. has preliminary plans in progress for enlargements in its plant to double, approximately, the present output of about 2,500 tires a day. It is proposed to have the extension equipped and ready for service by the first of the year.

ALLIANCE—The Crescent China Co., affiliated with the Sebring Pottery Co., Sebring, Ohio, has work under way on a new plant for the manufacture of fine chinaware, to comprise a main 1-story pottery and seven kilns. It is expected to have the plant ready for the equipment installation at an early date. The H. K. Ferguson Co., Euclid Ave., Cleveland, is architect and engineer. S. Morley is president and general manager.

Oklahoma

POTEAU — George F. Collins, Sapulpa, Okla., has acquired the local plant of the Hutton-Bates Glass Co., manufacturing bottles and other containers. The new owner will continue the operation of the plant and plans for a number of extensions and improvements, including the installation of additional equipment. Possession will be taken at once.

PONCA CITY — The Marland Refining Co. has plans in progress for extensions and improvements at its local oil refinery to increase the capacity from 6,000 to 14,000 bbl. of finished products per day. Additional machinery will be installed. It is also planned to construct an addition to the storage and distributing plant, including the installation of new steel tanks to bring the capacity to about 1,920,000 bbl. A new waterworks system will be installed to serve the plant property and vicinity. The expansion is estimated to cost close to $1,500,000.

PICHER — The Eagle-Picher Lead Co. is said to have plans under consideration for the rebuilding of the portion of its local works, destroyed by fire recently, with loss of about $25,000.

PAWHUSKA—The Chamber of Commerce is formulating plans for the establishment of a local plant for the manufacture of glass products. It is said that a company will be organized to operate the works.

Pennsylvania

BETHLEHEM—The Lehigh Valley Industrial Alcohol Co., recently organized under state laws, has plans under way for the erection of a new local plant for the manufacture of industrial alcohol, fusel oil, carbonic acid, potash and kindred specialties. The initial works will give employment to about 35 men. A site for the factory has been selected. Edward F. Reilly, Bethlehem, is treasurer; and Freeman H. Moyer, Allentown, vice-president.

CONSHOHOCKEN—The Ruth Glass Co. has work under way on the rebuilding of its mill, destroyed by fire a number of months ago. It is expected to resume operations at an early date.

READING—Samuel H. Bell, Reading, is selecting local property for the manufacture of inner tubes for automobile tire service and other rubber products. A similar plant now being operated in a neighboring locality will be removed to the new site, and the present equipment considerably increased.

PAXTONVILLE—The Paxton Brick Co. has tentative plans under consideration for the

rebuilding of the portion of its local plant, destroyed by fire, Sept. 11. Several kilns and buildings were demolished.

South Carolina

FLORENCE—The Florence Gas & Fuel Co., recently organized with a capital of $100,000, is planning for extensions and improvements in its local plant, lately acquired. New compressors, purifiers, boilers and other equipment will be installed, estimated to cost in excess of $30,000. M. D. Lucas is president.

South Dakota

RAPID CITY — The South Dakota State Cement Co., Pierre, S. D., has plans under way for the construction of a new plant at Rapid City, to include a number of mills, power plant and other operating buildings, estimated to cost close to $1,500,000, including machinery. J. C. Buckbee & Co., 38 South Dearborn St., Chicago, Ill., are engineers. A. C. Hunt is secretary and treasurer.

Tennessee

KNOXVILLE — W. J. Savage & Co,. 912 West Clinch Ave., manufacturer of brick and other burned clay products, are planning for the erection of an addition to their plant, to cost about $25,000. Additional equipment will be installed.

KINGSPORT—The Mead Fiber Co., manufacturer of pulp soda and kindred products, has preliminary plans under way for the erection of a new local plant for the manufacture of fiber and paper products. The initial works will consist of three brick and steel mills, equipped for an output of about 35 tons per day. The plant is estimated to cost close to $1,000,000. J. H. Thickens is general manager.

Texas

HOUSTON—The Great Lakes Western Refining Co., operating the plant of the Port Houston Refining Co., recently acquired, has plans under way for the construction of a new oil refinery, with initial capacity of about 3,500 bbl. per day. It is planned to commence work at an early date.

EL PASO—The Dodson Cement Products Co., Dallas, has tentative plans under consideration for the erection of a new plant at El Paso, on site recently selected, estimated to cost about $65,000.

BURKBURNETT—The Revere Oil Co., Fort Worth, is said to be planning for extensions and improvements in the oil-refining plant at Burkburnett, recently acquired from the Burk-Tex Production Co. The present refinery has a capacity of about 4,000 bbl. per day, and this will be increased.

DALLAS—The Trinity Paper Mills Corporation, operating a small mill at Commerce, Tex., is perfecting plans for the erection of a new paper mill in the vicinity of Dallas, for the manufacture of fine papers, using cotton linters as raw material. The plant is estimated to cost close to $400,000, including machinery. The company is capitalized at $6,000,000. J. V. Webb is president, and A. H. Davidson, treasurer.

Virginia

LEXINGTON — The board of directors of the Washington & Lee University will take bids early in October for the erection of the proposed new chemistry building at the institution, estimated to cost about $150,000. Flournoy & Flournoy, 306 St. Paul St., Baltimore, Md., are architects.

WINCHESTER—The Snapp Foundry, Inc., recently organized with a capital of $50,000, will take over the local foundry heretofore operated under the name of the Snapp Co. The new company will specialize in the manufacture of a general line of castings, and contemplates plant improvements. C. Arthur Robinson is secretary.

West Virginia

PARKERSBURG—The General Porcelain Co. is completing plans and will soon commence the erection of a new 1-story plant addition, 65x225 ft., estimated to cost about $25,000. It will be equipped for general production.

Wyoming

CHEYENNE—The Mammoth Oil Co., recently organized under Delaware laws with a capital of $200,500,000, as a subsidiary of the Sinclair Consolidated Oil Corp., 45 Nassau St., New York, N. Y., will operate in the Teapot Dome Fields, lately acquired from the government under lease. The new properties will be improved with refineries, storage and distributing plants, and constitute a total of about 9,000 acres.

Industrial Developments

PAPER—The International Paper Co., New York, is maintaining full production at its different mills in New York and Canada, and new plants, recently completed, are giving employment to a full working force at close to capacity.

The Eastern Mfg. Co., Bangor, Me., is operating at capacity at its pulp and paper mills. During the past few weeks orders for paper have been in excess of production, and pulp shipments have been the largest in many months past. An oil-burning system is being installed to insure continuous operation.

The Spanish River Pulp & Paper Co. and the Lake Superior Paper Co., affiliated, Toronto, Canada, are operating at close to normal at their mills, with regular working force. It is expected to maintain the present basis of production for an indefinite period.

RUBBER—The Goodyear Tire & Rubber Co., Akron, O., is running at full capacity at its Canadian mills, under a 3-shift schedule, 8 hours each. It is said that present orders will require the maintaining of 24-hour plant operation for an indefinite period.

New production records were established by rubber factories at Akron, O., during August, and September operations are being continued on the same basis. The Firestone Tire & Rubber Co. is running on a basis of 26,000 tires a day; the Goodyear Tire & Rubber Co. is maufacturing 22,000 tires daily; the Goodrich Tire & Rubber Co., the Mason Tire & Rubber Co. and the Miller Rubber Co. are all running full.

Owing to the expected curtailment in Ford automobile production, the Goodyear Tire & Rubber Co., Akron, O., has reduced operations at its Plant No. 2, devoted to tire manufacture for such cars, to a 4-day week schedule Heretofore the plant has been running three shifts per day on a 5½-day week.

GLASS — The Scott-Warner Glass Co., Stroudsburg, Pa., is completing the rebuilding of its local plant, destroyed by fire a number of months ago, and plans to place the factory in operation at an early date, giving employment to close to 100 men.

The Johnston Glass Co., Hartford City, Ind., is maintaining active production at its local plant, giving employment to a regular working force. The wage schedule has recently been advanced 25 per cent. The company specializes in window glass manufacture.

The Pittsburgh Glass Sand Co., Pittsburgh, Pa., is running full at its two plants at Mapleton, near Lewistown, Pa. A wage increase has been granted, effective Sept. 4, with common labor receiving $3.50 a day under the new schedule and corresponding increases in other departments. The Pennsylvania Glass Sand Co., operating in this same district, has also made similar wage increases at its plant.

The Owens Bottle Co., Toledo, O., has recently advanced production at its plant, following improvements made for this purpose. A large working force is being employed.

Glass plants at Pittsburgh, Kane and other points in western Pennsylvania are planning to advance production to a third shift working day, under full 24-hour operation before the close of the fall season, the increase being based on the volume of incoming orders.

OIL—The Pure Oil Co. has resumed operations at its refinery near Ardmore, Okla., following a shut-down of several months. It is expected to advance the output gradually to maximum, wken employment will be given to about 75 men.

The Mexican Petroleum Co, New York, N. Y., is increasing production at its Mexican plants. During August a total of 4,000,000 bbl. of oil was produced, as compared with 3,500,000 bbl. in the preceding month.

IRON AND STEEL—The Brier Hill Steel Co., Youngstown, O., has blown in another furnace at its plant, making the third unit now in blast.

The A. M. Byers Co., Girard, O., is planning for the early resumption of operations at its local blast furnace, which has been shut down for a number of weeks. The puddling mill has started up. About 1,200 men will be empoyed following the adoption of a full-capacity schedule.

The American Sheet & Tin Plate Co., a subsidiary of the United States Steel Corp., is arranging for the immediate resumption of eight hot mills at the local plant, following a month's shut-down due to fuel shortage.

The Eastern Rolling Mill Co., Baltimore, Md., specializing in the manufacture of steel sheets, is running at close to 100 per cent at its plant, giving employment to about 1,200 operatives, or approximately double the number at the works at the beginning of the year. The wages of common labor have been increased 20 per cent, or from 25 to 30 cents an hour, with 8-hour working day. It is said that orders on hand insure full capacity for many months to come.

The Republic Iron & Steel Co., Youngstown, O., has blown in another blast furnace at its mills, making the fourth unit on the active list. Other departments of the works are advancing production.

The Trumbull-Cliffs Iron Co., Youngstown, O, has blown in its blast furnace, following curtailment for a number of weeks due to coal and coke shortage.

The Youngstown Sheet & Tube Co., Youngstown, O., has lighted another blast furnace at its local plant and made additions in the working force. Further increases will be made at an early date.

MISCELLANEOUS — The New York & Pennsylvania Co., Johnsonburg, Pa., has resumed operations at its whiting plant and soda mill, following a suspension for about a month past on account of fuel shortage. Approximately 125 men are employed in the two mills.

The Standard Sanitary Mfg. Co., Tiffin, O., has been forced to curtail operations at its local pottery, due to a strike of about 100 men in protest against the employment of several non-union molders at the plant.

The Atlas Portland Cement Co., Northampton, Pa., is running full at its large mills in this district, and has recently announced a general wage increase affecting all employees. The Lehigh Portland Cement Co., Allentown and Coplay, Pa., has also advanced the wage schedule at its mills. Capacity output is being maintained at the latter plants.

The New Jersey Zinc Co., Palmerton, Pa., is giving employment to close to normal working force at its local plant, under full-time production. A general wage increase has recently been placed into effect.

The International Nickel Co., New York, has resumed operations at its plant at Coppercliff, Ont., following a suspension of 18 months. The initial production will be on a basis of about one-third of maximum output, giving employment to about 650 men under a two-shift operating schedule, 18 hours per day total. The company is also operating its refining plant at Port Colborne, and shipments are being made from the Creighton mines. All refined production is being sent to the new rolling mills at Huntington, W. Va.

New Companies

THE NATIONAL RUBBER CO., Los Angeles, Calif., has been incorporated with a capital of $100,000, to manufacture rubber products. The incorporators are E. J. Chambers and R. H. Watts, Long Beach, Calif., and Harry W. Mahan, Room 618, O. T. Johnson Bldg., Los Angeles. The last noted represents the company.

H. O. BOEHME, INC., New York, N. Y., care of P. C. Schnitzler, 35 Nassau St., representative, has been incorporated with a capital of $25,000, to manufacture metallic compounds and affiliated products. The incorporators are H. O. Boehme and K. Braun.

THE HOOSIER FERTILIZER CO., 1400 North Halsted St., Chicago, Ill., has been incorporated with a capital of $40,000, to manufacture fertilizer products. The incorporators are Maurice and Samuel L. Sarnatzky.

THE ARION STEEL CO., Boston, Mass., has been incorporated with a capital of 500 shares of stock, no par value, to manufacture steel products. Harry F. Arion, 83 Lawrence St., Medford, Mass., is president and treasurer.

THE ARROW CHEMICAL CO., Newark, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are Walter A. Beers, William A. and Edward A. Schilling, 763 Broad St. The last noted represents the company.

THE INDIANAPOLIS SOAP CO., Indianapolis, Ind., has been organized under state laws to manufacture soaps, washing powders, etc. The incorporators are Jesse M. and Sidney F. Daily, both of Indianapolis.

THE FALCONER PLATE GLASS CORP., Falconer, N. Y., care of Jackson, Manley & Herrick, attorneys, Jamestown, N. Y., representative, has been incorporated with a

capital of $150,000, to manufacture glass products. The incorporators are E. A. Peterson, B. H. Tefft and S. O. Merriman, Falconer.

THE M. E. FOLSOM FLOOR & WALL TILE Co., Union Hill, N. J., has been incorporated with a capital of $10,000, to manufacture and deal in ceramic floor and wall tile and affiliated products. The incorporators are M. E. Folsom, Frederick Brunning, Jr., and William Hinderks, 509 Gardner St., Union Hill. The last noted represents the company.

THE CALEDONIA OIL CORP., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $500,000, to manufacture petroleum products.

THE SHERMAN OIL MILL, INC., Sherman, Tex., has been incorporated with a capital of $175,000, to manufacture petroleum products. The incorporators are J. H. Wharton, Thomas Forbes and N. A. Birge, all of Sherman.

THE DETROIT TYLITE CO., Detroit, Mich., has been incorporated with a capital of $50,000, to manufacture composition tile and kindred building products. The incorporators are J. H. McIntyre, W. F. Rue and Frederick S. Beard, 2460 Central Ave., Detroit. The last noted represents the company.

THE INDEMAND PRODUCTS CORP., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del, representative, has been incorporated with a capital of $100,000, under state laws, to manufacture rubber products.

THE STAMFORD COTTON OIL CO., INC., Stamford, Tex., has been incorporated with a capital of $120,000, to manufacture cottonseed oil products. The incorporators are W. A. Bennett, L. W. and C. L. Jones, all of Stamford.

THE MILLIKEN BRICK CO., Pittsburgh, Pa., is being organized by Homer A. Milliken and John F. Baldwin, to manufacture brick and other burned clay products. Application for a state charter will be made on Oct. 2. The company is represented by R. A. McCrady, 1430 Park Bldg., Pittsburgh.

THE MEMPHIS COTTON HULL FIBRE CO., Memphis, Tenn., has been incorporated with a capital of $15,000, to manufacture fiber products. The incorporators are Walter Wolf, A. J. V. Ware and S. S. Dent, all of Memphis.

THE GLIDDEN OIL CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $1,000,000, to manufacture petroleum products.

THE YONKERS SOAP MFG. CO., care of D. Dorfinkel, attorney, Yonkers, representative, has been incorporated with a capital of $5,000, to manufacture soaps, washing powders, etc. The incorporators are H. Lerner, N. and D. J. Ressler, all of Yonkers.

THE SOUTH BEND GLASS WORKS, INC., South Bend, Ind., has been incorporated with a capital of $25,000, to manufacture glass products. The incorporators are Frank Haynes, Clarence K. and Herman H. Beyrer, all of South Bend.

THE DURATEX CO., 768 Frelinghuysen Ave., Newark, N. J., has been incorporated under state laws with a capital of $1,900,000, to manufacture imitation leather products. The incorporators are the officials of the company of the same name, now operating a plant at the location noted.

THE MERCER REFINING CO., Franklin, Pa., has been incorporated with a capital of $75,000, to manufacture refined oil products. W. C. Hastings, Franklin, is treasurer and representative.

THE CHEMICAL SPECIALTY CO., 380 Main St., Pawtucket, R. I., has filed notice of organization to manufacture chemicals and chemical byproducts. Richard Rouse heads the company.

THE LOUIS HUETWOHL BRASS FOUNDRY, INC., Brooklyn, N. Y., care of I. Phillips, 303 West 122nd St., New York, representative, has been incorporated with a capital of $20,000, to manufacture brass, bronze and other metal castings. The incorporators are G. and L. Schimper, and Louis Huetwohl.

THE SIMPLEX PETROLEUM CO., Long Beach, Calif., has been incorporated with a capital of $200,000, to manufacture petroleum products. The incorporators are Albert Stephens, H. Earl Hardy, and Vern Dumas, 1155 Burnett St., Long Beach. The last noted represents the company.

THE BROWN SOAP CO., Indianapolis, Ind., has been incorporated with a capital of $10,000, to manufacture soap products. The incorporators are Arthur B. Brown, A. L. Coburn and Gilbert McGaughey, all of Indianapolis.

THE BUTTERS MFG. CO., New York, N. Y., care of A. J. Lindsay, 43 Cedar St., representative, has been incorporated with a capital of $75,000, to manufacture chemicals and chemical byproducts. The incorporators are W. C. Findley and W. A. Levy.

THE ROONEY & ELY FERTILIZER CO., Jersey City, N. J., care of the Corporation Trust Co., 15 Exchange Place, Jersey City, representative, has been incorporated with a capital of $10,000, to manufacture fertilizer products. The incorporators are C. J. Skinner and W. J. Edelman.

THE JONES & LEIGH MFG. CO., New York, N. Y., care of L. I. Geber, 291 Broadway, representative, has been incorporated with a capital of $100,000, to manufacture paper products. The incorporators are G. L. Leigh, W. A. Simon and H. A. Jones.

THE MERION MAGNESIA CO., Port Kennedy, Pa., has been incorporated with a capital of $5,000, to manufacture magnesia products. Clayton Ullman, Phoenixville, Pa., is treasurer.

THE WALTER L. JOHNSON CO., Endicott, N. Y., has been incorporated with a capital of $12,500, to manufacture leather products. Walter L. Johnson, Endicott, heads the organization, and represents the company.

THE UNITED STATES PACKING & LUBRICATING CO., Philadelphia, Pa., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws, with capital of $600,000, to manufacture lubricants and kindred products. The incorporators are Alfred E. George, D. J. Mullins, Philadelphia; and Francis J. MacDonald, Ardmore, Pa.

Manufacturers' Catalogs

THE SCHUTTE & KOERTING CO., Philadelphia, Pa., describes in bulletin 8-G the new Schutte regrinding swing gate valve, which is a straightway closing valve designed for steam pressures up to 300 lb. per sq.in. and temperatures up to 750 deg. F. The company announces that this valve offers no obstruction to the steam flow or change of direction, and that the outstanding feature is that the valve disk is readily accessible for regrinding purposes without dismounting the valve.

THE W. W. SLY MFG. CO., Cleveland, O., is issuing a bulletin, S-90, entitled "Dust—A Loss and a Gain." It contains new and interesting matter concerning the collection of industrial dust.

THE BRISTOL CO., Waterbury, Conn., has ready for distribution a 68-page catalog (No. 1401) devoted to Bristol's pyrometers. The catalog is profusely illustrated and contains very valuable condensed information on this subject.

THE B. F. STURTEVANT CO. of Hyde Park, Boston, Mass., has just issued a new 72-page engineering bulletin on Pneumatic Collecting and Conveying. It contains 33 pages of pictures and diagrams, 17 pages of useful tables—how to find the size of fans, the suction, volume, r.p.m. and horsepower for any system, cubic feet of air handled per minute, size of pipe and ducts used, and various other valuable tables. Data are also given on dust collecting from grinding and polishing machines, tumbling barrels, sand blast machines, coal breakers, shoe machinery and the removal of fumes, gases, etc. In addition, there are parts on the conveying of pulverized coal, fibrous materials, coffee, ashes, wool, wood chips, etc. It is a most comprehensive treatise on pneumatic collecting and conveying systems.

THE RAYMOND BROS. ENGINEERING CO., Chicago, Ill., calls attention to a new catalog on "Rayco Pulverized Coal Systems—Their Design, Installation and Operation." This attractive catalog, which is well illustrated, has chapters on engineering service, fuel economy, essentials to successful results, records of results and savings, growth in use of powdered coal, combustion efficiency, character of powdered coal flame, variety of applications, plan of typical plant, crushing equipment, drying equipment, pulverizing equipment, distributing equipment, burners, tables of capacities, detail parts, individual unit, installations and data sheets.

THE ELECTRIC FURNACE CO., Salem, O., has issued a folder illustrating some of the types of electric enameling, annealing and heat-treating furnaces it has installed in the last few years. Another folder, on the "Baily Electric Furnaces" tells what nonferrous alloys the company is melting, and what products it is producing.

Industrial Notes

THE NORWALK IRON WORKS CO. announces that it has merged with it the Automatic Carbonic Machine Co. of Peoria, Ill., the plant and equipment of which company is being moved to South Norwalk, Conn.

C. E. Reese, editor of the *Gas Engineering & Appliance Catalog* and associate editor of the *Gas Age-Record*, has joined the stoker sales department of the Westinghouse Electric & Mfg. Co., at South Philadelphia. He was previously cadet engineer and combustion engineer with Henry L. Doherty & Co. and assistant engineer of the Illinois Public Utilities Commission. Mr. Reese will work with G. A. Sacchi, manager of the stoker sales department and R. R. Davis, manager of the department of publicity at East Pittsburgh.

THE U. S. ELECTRO GALVANIZING CO. announces change of name to the U. S. Galvanizing & Plating Equipment Corp., with main office and factory at 32 Stockton St., Brooklyn, N. Y.

THE MERRIMAC CHEMICAL CO., Boston, Mass., announces the following appointments: Sales manager, William M. Rand; chief engineer, J. B. Rutter, and designing engineer, M. S. Maxim.

L. J. Krom has established an office at 50 Church St., New York City, for the purpose of carrying on a consulting, metallurgical and engineering practice which will be devoted to the production and consumption of metals and alloys.

Coming Meetings and Events

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS is holding its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

AMERICAN WELDING SOCIETY will hold its fall meeting Oct. 2 to 5 at Chicago.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its fall meeting Oct. 9 and 10, at the Hotel Wolverine, Detroit, Mich.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, 52 East 41st St., New York City: Oct. 6—American Chemical Society, regular meeting Oct. 13—Société de Chimie Industrielle, regular meeting. Oct. 20—Society of Chemical Industry, Grasselli Medal. Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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An Engineering Investigation Of the Muscle Shoals Project

THE decision of the Federated American Engineering Societies to make an impartial engineering investigation of Muscle Shoals and recommend what it considers the best method of handling this moot project will meet with the approval of all who sincerely want to get a fair appraisal of the relative value of the several plans that have been proposed. Shall the government construct and operate this great power development? Shall it be leased to Mr. FORD? Shall it be turned over to a private concern like the Alabama Power Co. to be developed under the terms of the federal water power act? The changes have been rung on each of these proposals, with the result that partisan groups have arisen here and there who espouse their preferences without regard to the national welfare. Hearings have been held and investigations have been made in such number that it seems unlikely that any essential facts have been overlooked.

The great problem is to study and correlate the known data and to deduce therefrom a logical plan of procedure. This is the task to which the special committee of the Federated American Engineering Societies will devote itself. If, happily, the committee can reach a decision acceptable to the country, the Federation will have rendered a great national service. Further, it will have pointed the way to the solution of other great national problems before they have run the gantlet of Congressional committees and industrial promoters. In the case of Muscle Shoals it may put a damper on the aspirations of realty companies that are promoting town lots and holding out glittering hopes of fortune to those who follow their admonition to invest immediately, but this would be a calamity under which the country will endeavor to bear up if a solution can be found for the Muscle Shoals problem.

Reaching the Wrong Conclusion

SEVERAL YEARS AGO a large manufacturing concern bought, through the medium of a banking house, an option on a certain process. The corporation paid $10,000 for it. It was carefully worked out and ready for industrial operation. To adopt it would have involved the installation of some new equipment, but it promised material savings. Suddenly they declared that it was not what they wanted, charged up the sum paid for the option to profit and loss and would have nothing more to do with it. They would not even investigate adequately. They would not take as a gift an extension of the option; they were very drastic about it, and they "cut it out."

The process is in successful operation today, and they could easily have bought it outright and got all their money back from royalties without even using the process themselves, if they had wanted to do so.

Now in discussion lately with the banker who negotiated the sale, he said that the incident had been very instructive to him: that he had developed from it the slogan that even 100 per cent efficiency in a laboratory test means nothing in factory practice. Of course he assumed that the purchasing and refusing corporation had acted wisely; he thought they must know their business. But right there he was wrong. The corporation had no research establishment. Nobody on the board or among its executives had technical knowledge or a chemical background for their chemical business, and what really happened was that their advisory chemist was a sick man who condemned the process without more than a cursory glance at it. The process had already been carried out on a semi-commercial scale, and the only specific reason that we could discover why it was refused with such suddenness was that the consultant didn't like the idea and it meant changes in installation. There was nobody to check off the sick man, no one to argue with him. Consequently the manufacturers made a big mistake and the banker got the wrong slant on the whole subject.

The general reason why the process was not even critically examined and the corporation lost track of the whole thing was ignorance at the top. Nobody in authority knew enough chemistry in their chemical establishment to sense the principles which underlay the process. There are plenty more of just such chemical establishments in this country.

Our Knowledge Of Coal

TWO recent developments at the University of Illinois regarding our knowledge of the character and behavior of bituminous coal are worthy of special notice. Both of these developments have been made by Prof. S. W. PARR and his associates, who have not been content to follow the well-beaten paths of fuel research, but have gone exploring in virgin territory.

In one case the work has related to the structure of coal as affected by the oxygen content of the bituminic and cellulosic constituents. In this work PARR points out that the oxygen in the bituminic constituent apparently does not affect the binding power of that material for production of coke as one would expect, but that oxygen entering the cellulosic constituent does seem to affect the coke-forming power of the coal very materially. This information brings us one step closer to an understanding of what it is that causes some coals to form no coke, some to form only soft friable coke, others to form hard, strong coke of metallurgical value.

The other investigation has been carried out by LAYNG in association with Professor PARR. It is on

the softening point of coals and the point at which the plastic coal again hardens into a coke structure. It is too early as yet to forecast what this particular investigation will demonstrate, but the results promise to be very valuable in distinguishing between the oven performance of different fuel supplies.

These two investigations are noteworthy not alone because of the results which they have given or promise to give soon. They are conspicuous rather more because they represent a pioneer effort that has been all too long postponed. Coal is the most used raw material which nature provides to industry. Half a billion tons of it are used annually. Yet after generations of use we find ourselves still with practically no knowledge of the characteristics of coal constituents and without means for thoroughly intelligent discrimination between the coal from different sources. We have been content too long to use the approximate analysis which gives us only volatile, fixed carbon, ash and moisture, and the ultimate analysis which gives us the composition by the elements—carbon, hydrogen, oxygen, sulphur, nitrogen.

The heating value of the coal and the melting point of its ash have, to be sure, been used much by engineers to judge the value of the coal for boiler firing. But heretofore we have known nothing of the other significant characteristics, particularly with respect to the coking of a coal. It is to be hoped that Professor PARR and his associates will find opportunity rapidly to extend our knowledge in the fields which they have begun to till. But these fields are only a small fraction of the virgin territory that requires exploration and mapping. Other investigators will do well to consider the general scheme of investigation which PARR is following.

An Example of The Ruling Passion

THIS HAS TO DO with an able chemist who was installed as general superintendent of an important chemical works with permission to select his own staff. The concern bought in quantity only two raw materials which were obtained under contracts, so that two contracts per year were all that were needed. Nevertheless a purchasing agent was installed who had no technical knowledge whatever, and, while he was an agreeable young man, he could not be said to be of assistance or to earn his salary. It was necessary for him to ask questions about every requisition, and that took time. It did not save money.

During the nearly two years that our friend was in charge of the plant only one director ever visited it. All that the directors knew was what they got from monthly statements. When occasional inquiries came from them involving technical points, the superintendent dictated the replies, but they were made to appear as emanating from the vice-president in charge, who was not a technical man. This was a small affair, but it misrepresented the vice-president.

The concern had a hard and fast "system" about letters. In the early days the superintendent had considerable correspondence with the sales manager to meet specifications. The product was new, and selling required no little exposition that involved technical information. Individual salesmen, interested in their work, also wrote frequently to get points, and these were answered. In time all this was forbidden. All letters were to be addressed to the company, "attention of ——" at most, and were to be placed on the desk of the vice-president before they could go out, and directions were also sent to the salesmen not to communicate directly with the superintendent. This, of course, made the letters impersonal, and it cost the company the lively interest of the sales force.

Lately some new financial interests have come in. They want to be represented in the management as well as in the directorate. So a new general manager has been appointed to care for both the business and technological ends of the company's affairs. He has no technical training. The superintendent, after bringing on his family and purchasing a house, has been dropped for no other purpose, either intimated or even conceivable, than "economy." Of course that is not of general interest, but the concern is now blundering along making what are supposed to be pure chemicals without technical direction. That is of general interest. When will our bankers learn how foolish it is to put an unprepared and unskilled man in charge of complex scientific processes, because somebody who doesn't know anything about them has "sized him up and thinks he'll do"?

Chemistry in Agriculture In Great Britain

ELSEWHERE in this issue we tell of the development of turning cellulose into humus or farmyard manure worked out at the Rothamsted Agricultural Experiment Station at Harpenden, England. It was our privilege to spend a day there with Prof. H. E. ARMSTRONG of London, who has been for many years one of the trustees of the establishment, to walk over their fields with Sir E. JOHN RUSSELL, the director, and to spend some time in the laboratories with H. J. PAGE, the chief chemist, and others. The laboratory is divided into departments as follows, with a head for each, and assistants in number from one to six: Bacteriological, botanical, chemical, fermentation, antiseptics (with insecticides, etc.), physical, protozoological, statistical, entomological and mycological, Outside is the farm with experimental fields of about 350 acres under a manager and several assistants, and inside again is the library of 15,000 volumes, with librarian and secretarial staff.

The station was founded in 1843 by Sir J. B. LAWES, and Sir J. H. GILBERT was associated with him as director for nearly 60 years. LAWES died in 1900, GILBERT in 1901 and there succeeded them in the direction Sir A. D. HALL, who resigned in 1912, and Sir E. JOHN RUSSELL, who was appointed to succeed him.

The purpose of these notes is merely to indicate work in process. Of course, there are the famous fields of wheat, barley and roots, planted year after year with the same crops—for 81 years now with wheat—and subjected to varying treatments in the way of fertilizers. The old unfertilized field will scarcely give 10 bushels to the acre this year, but usually they get about 12. In their regular wheat fields, properly fertilized, they get, as the writer recalls, an average of about 45 bushels to the acre. Standard crops are grown, along with experiments to show farmers that they can get results as well as make experiments. The British farmer trusts his eye rather than statistics. We think we have met American farmers who showed that inclination also.

In the botanical laboratory Dr. BRENCHLEY and her assistants were working among other things on the

effect of boric acid on plant growth. Hearing of the misfortunes of American farmers who got borax along with their potash, the research began to see how much of this dread poison plants can stand. Working with "broad beans" (which we take to be field beans), the curious discovery was made that they must have it! Traces of borax are found in the beans and if they are grown in a medium from which borax is entirely absent, they develop part way both in branches and roots and then stop. Roots and stalks grow nubbly and cease to mature. One part in 2½ million is enough, but one part in 50,000 is endured. More than that is likely to act as poison. Barley, on the other hand, seems to thrive without borax. The research is not completed.

The unsatisfactory results from the use of phenol as an insecticide was ground for an investigation in the biological laboratory which brought out the remarkable fact that there is a species of micro-organism that thrives on phenol as its sole source of organic matter. Another thrives on benzene, another on toluene and still another on naphthalene.

Of course, work is in progress as to the wart disease in potatoes and another research has to do with the difference in fertilizing values of chloride and sulphate of potash respectively. The Germans furnish the sulphate and claim it is better. The French produce chloride and claim that it is as good. Differences in plant cultures are observed, but definite results have not yet been obtained.

Still another study has to do with the formation of humus in soil by green manuring. The statistical department is doing splendid work in making tables showing the effect of weather on crops under the same conditions, with records that go back for 80 years.

In the soil physics laboratory work is in process to determine water-holding qualities, shrinkage, expansion, cohesion and other physical properties under given conditions. Resistance determinations by means of a dynamometer attached to a plow and measuring the draw-bar pull of chalked and unchalked land showed an increase of 150 lb. and more on each plow when the soil was lacking in calcium carbonate. This is as pretty a note in colloid chemistry as we have come across for some time.

Mechanical Equipment And Human Contentment

IN HIS ARTICLE entitled "Increased Production Efficiency Means Good Material Handling" in our issue of August 30, J. G. HATMAN said: "Some of the effects of a well-designed, efficient handling system on the personnel of the manufacturing plants are . . . it enables the employee to work at his best, and hence command a high rate of pay. It takes the burden of physical labor from the laborer and makes him a brain-worker." This is the key to contentment at work, and contentment in work is the key to industrial progress. We have often said, and we expect to continue to preach the same gospel, that no amount of profits or dividends can atone for making men of wrath and misery out of a working staff. Of course there are large numbers of men who cannot work with their brains, but if an employer cannot bother to find out which men can and which cannot use their heads at work, he is himself incompetent and would better engage someone who knows more than he does to do the job.

We recall one large establishment which, before it was injured by high finance, was a veritable haven of contentment in which the competent manager put his stupid men into a yard gang. All that he required of them was to dig and push and pull under the direction of an intelligent foreman. That eliminated the unfit (for brain work) and yet did not throw them back on their relatives with all the distress such a procedure involves. This left him with a much higher average of intelligence for his labor staff within the works and provided that such hand workers could indeed be developed into brain workers. In order to prevent the exploitation of the unfit and the bringing down also of the fit to the same level, the labor unions have generally opposed any separation of this sort. But it is the only thing to do if highly developed workers are to be encouraged and a good esprit de corps maintained. A good man wants a chance to use his head and to improve his condition. The employer who cannot sense this and who can't provide for what the intelligent worker really needs is himself incompetent.

Productive and Unproductive Wealth

IN ROUND FIGURES the people of the United States are this year spending two billion dollars for new automobiles and three billion dollars for new dwelling houses and garages. The total of five billion is in the neighborhood of one-twelfth of the national income.

That this five billions of expenditure along these two lines is an important fact is proved very neatly by the amount of attention that has been given it. Everywhere it is being remarked that the automobile industry has had a wonderful revival; also that we are in "a great building boom." This constitutes proof that the condition is a remarkable one. Frequently the references are made for the purpose of proving a conclusion, as for instance that the country is very "prosperous." These ready-made conclusions are another matter. The point is that something big is going on.

The return for the five billions of expenditure represents actual wealth, except as it may depreciate from use or because the cost of replacement decreases. It is wealth this year just as the value of farm lands, or railroad cars, or carpets is wealth. All such items are in any proper inventory of the nation's physical wealth.

An important feature of this expenditure of one-twelfth of the national income is that it is upon property that has, in the last analysis, practically no earning power. Only to a relatively negligible extent will the automobile increase the productive power of their owners. Possibly the net result will be the other way, making the owners less disposed to work. As to the dwelling houses, their object is to increase comfort, not to increase production except as personal comfort and welfare affect production.

The great growth in the wealth of the United States has been due in large part to investment of savings in productive enterprises. The increase has been too rapid for it to represent a mere piling up of savings. The accumulation has been at something perhaps even better than compound interest. A compound interest accumulation would represent repeated investment of savings in productive enterprises.

When one-twelfth of the income is spent upon unproductive property, there is represented an abstraction from funds that would otherwise be invested in productive enterprises, in public service facilities, land reclamation, mine development and various other things. In view of this, one may well doubt whether the country is now in line to experience increases in total wealth in future comparable to the increases of the past.

Montreal Meeting American Electrochemical Society

Forty-second General Meeting Marked by Presentation and Discussion of Papers on Electrolytic Iron, Electrolytic Zinc and Electrolytic Nickel—Symposium on Industrial Heating by Electricity — Canadians Ideal Hosts

EDITORIAL STAFF REPORT

THE forty-second general meeting of the American Electrochemical Society was held at Montreal, Canada, Sept. 21, 22 and 23. The meeting was very well attended, over two hundred registering. The local committee, headed by H. W. Matheson and C. R. Hazen, spared no effort in making the electrochemists' visit one of the most entertaining and enjoyable in the annals of the society. A. R. M. MacLean headed the excursion committee and W. B. Woodland took care of the publicity. It was largely due to Mr. Woodland's efficient methods that the convention was so well advertised and in consequence well attended.

Besides the technical sessions, there were a number of social affairs which will always be remembered by those who participated. The outstanding social event was the visit at Shawinigan Falls, where R. A. Witherspoon and his committee were hosts. None but Witherspoon, with his irresistible humor and very efficient leadership, could have planned and conducted that luncheon and entertainment on the lawn of the Shawinigan Falls Inn.

Thursday Morning Sessions

The technical sessions were held at the Windsor Hotel. There was much animated discussion due to a strong representation by opposing factions. The manufacturers of apparatus claimed perfection in design and high efficiency in operation; the users of this apparatus, however, were all too anxious to point out what they considered inherent weaknesses of the product. The general impression gained was that even closer co-operation than practiced in the past was needed between designer and builder of electric ovens, furnaces and other apparatus on the one hand and the user or consumer of these on the other.

The first session, Thursday morning, was opened by President C. G. Schluederberg, of the Westinghouse company. He introduced Alderman Seyboldt, who welcomed the members of the society on behalf of the Mayor of Montreal and enumerated a few of the numerous attractions of the city. It was a surprise to many to learn that Montreal had the second largest harbor in North America, constructed at a cost of over $31,000,000. Prof. Robert Fulford Ruttan, of McGill University, past-president of the Society of Chemical Industry, extended a hearty greeting in the name of the chemists and engineers of Canada. "Your meeting in Canada," he said, "will help to emphasize the vast importance of the electrochemical industries to this country. As in the States so with us, many of the splendid researches undertaken during the course of the war have been abandoned and it requires a good deal of concerted effort to impress upon all parties concerned the absolute necessity of investigative work." Professor Ruttan's concluding remarks were: "I trust you will share with us in our good spirits."

The remainder of the morning session was devoted to papers and discussion on electrodeposition and the properties of the products.

ELECTROLYTIC IRON

Norman R. Pilling, of the Westinghouse research laboratory, gave an account of experiments he had carried out to ascertain in what way the properties of electroplated iron are subject to modification by simple heat-treatment. The initial effect of annealing is a very marked hardening, reaching a maximum at an annealing temperature of 300 to 400 deg. C. The corresponding scleroscope hardness number is 45. At the same time the initial brittleness is removed. Annealing at higher temperature results in progressive softening, consummated above the A_3 temperature (900 deg. C.). For complete and rapid softening, annealing at 900 deg. is necessary. The rate of decomposition of the unstable iron-hydrogen compound, which is assumed to be an essential component of electrolytic iron, was observed at different temperatures.

Mr. Pilling found that the compound is actively decomposing at a temperature as low as 90 deg. C. The maximum rate of decomposition occurs at about 200 deg., but complete decomposition and expulsion of hydrogen are not achieved until the A_3 temperature is exceeded. The increase in rate of evolution above 500 deg. appears to be due to a slow release of hydrogen, by diffusion from the interior of the larger particles or crystals, rather than due to a secondary reaction. The loss in weight due to the escaping hydrogen amounted to 0.11 per cent.

A series of microphotographs were shown indicating a close relationship between physical properties and structure. The original deposits are composed essentially of closely packed needle-like crystals, generally directed perpendicular to the surface of the cathode. As

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RIVER FRONT, MONTREAL

he annealing temperature is raised, a gradual change in tructure is discernible and at 900 deg. the well-known A_3 transformation occurs.

Discussion

Mr. Pilling's paper was discussed and commented pon at length. Henry Howard of Cleveland suggested hat it might be possible to determine the hardness of he iron-hydrogen compound. David B. Rushmore, of Schenectady, referred to the commercial development of lectrolytic iron in France and inquired as to possibilities of a similar development in America. H. M. Williams, of the General Motors Research Corporation, referred to experiments on carburizing electrolytic iron deposited on worn machine parts. J. D. Alley, of Pittsburgh, pointed out that such carburizing was generally not necessary, since the deposits could be made hard enough electrolytically. Colin G. Fink, of New York, questioned whether such deposits would not be too brittle, and William Blum referred to the brittle nickel deposits due to the presence of hydrogen. Eliminating he hydrogen produced a soft flexible nickel deposit.

Preparation and Mechanical Properties of Vacuum Fused Alloys of Electrolytic Iron With Carbon and Manganese

Robert P. Neville and John R. Cain, of the Bureau of Standards, Washington, next reported upon "The Preparation and the Mechanical Properties of Vacuum Fused Alloys of Electrolytic Iron With Carbon and Manganese." An extensive series of very pure alloys of electrolytic iron, carbon and manganese were prepared, the melting carried out in an Arsem vacuum furnace, thus eliminating as much as possible the influence of gases on the properties of the alloys. The ranges in chemical composition of the alloys were from 0.0 to 1.6 per cent carbon and from 0.0 to 1.6 per cent manganese. In amounts below approximately 1 per cent C the ultimate strengths of the alloys were increased by carbon, at an approximate average of 1,000 lb. per square inch for each 0.01 per cent carbon introduced. The increase in hardness due to carbon was from 1.8 to 2.6 Brinell numbers for each 0.01 per cent C, the rate being larger as the manganese contents increased. Reduction of area and elongation of pure iron were 82.5 and 40.5 per cent respectively. With the addition of carbon these values were rapidly and regularly decreased. Manganese increased the ultimate strengths of the alloys only slightly, particularly with small amounts of carbon present. Brinell hardness numbers were increased about 0.5 by each 0.01 per cent Mn when carbon was present. This rate was lower in the alloys of lower carbon contents. Manganese had very little effect on the ductility of the alloys. The effects of manganese and carbon on the mechanical properties of the alloys were each influenced by the other. The presence of C augmented the influence of Mn and *vice versa.*

Discussion

In the discussion of this splendid paper, Dr. Carl Hering, of Philadelphia, referred to the carbon content of electrolytic iron as deposited. William Blum, of Washington, pointed out that this small amount of carbon was very often mechanically occluded in the deposit coming probably from the anode. However, deposits from oxalate and citrate baths contained more carbon than deposits from sulphate baths. Answering

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BIRD'S-EYE VIEW OF MONTREAL

Mr. Rushmore, of the General Electric Co., who questioned the importance and value of electrolytic iron, Dr. Hering quoted Benjamin Franklin: "What's the use of a baby?"

Electrolytic Zinc

John T. Ellsworth, of Park City, Utah, showed some very remarkable photographs illustrating the "Effects of Impurities on the Electrodeposition of Zinc From Sulphate Solutions." When manganese is present in amounts higher than 1 gram per liter, small particles of manganese dioxide remain suspended in the electrolyte and a part of these become imbedded in the zinc deposit. As these particles are saturated with electrolyte, as soon as they are covered with zinc an individual cell is formed; holes develop in the cathode which enlarge with age of the deposit. Iron present as an impurity does not deposit, but uses up current in being alternately oxidized and reduced. About 0.05 gram per liter is the maximum amount permissible. When less than this amount of iron is present, the zinc deposit is particularly smooth and bright.

Copper in excess of 0.02 gram per liter causes the formation of needle-like sprouts; with greater amounts of copper the zinc becomes black and spongy. Cadmium up to certain limits is of distinct advantage. Most of the cadmium deposits with the zinc. However, if more than 0.50 gram of Cd is present, the zinc becomes rough and black. The limiting amount of cobalt is 0.012 gram per liter. The effect seems to be something like both the high manganese and iron. The photographs show large holes in the zinc. The effect of antimony is the most serious. Less than 1 mg. per liter is permissible. In amounts of 2 mg. per liter very distinctive tree-like sprouts are formed, the efficiency is poor and the deposit is soft and spongy and difficult to melt. In the presence of both manganese and antimony, as in the ordinary plant cell solution, the permissible amount of antimony is 0.7 gram per liter.

Walter G. Traub, of the University of Wisconsin, investigated the curious phenomenon brought to the attention of Prof. Charles F. Burgess some time ago. In at-

tempting to gold-plate some articles made of aluminum, Burgess first deposited a coating of zinc, and then covered this with a deposit of gold. After 3 months the gold deposit had entirely disappeared. Mr. Traub took a large number of zinc strips and plated these with various metals. The plated strips were then placed in an electric heater at a temperature of 70 deg. for a period of 2 weeks. The specimens were then examined and it was found that thin plates of copper, brass, gold and silver diffused into the zinc, thus accounting for the disappearance from the surface. The nickel plate, however, did not diffuse into the zinc perceptibly and furthermore a preliminary deposit of nickel would prevent gold, silver and copper from diffusing into the zinc base.

In commenting upon Mr. Traub's interesting results, Harry M. Williams, of Dayton, Ohio, related his experience with copper-plated and brass-plated zinc nameplates. After a very short time the plated metal apparently disappeared. Similarly, Amos G. Reeve, of Oneida Community Research Laboratory, told of the disappearance of gold deposits on tin. R. J. McKay, of the International Nickel Co., advanced the opinion that nickel probably diffused into zinc just as did silver and gold, only there was a difference in the rate of diffusion, the nickel diffusing so much slower. He added that copper diffuses into nickel very rapidly at cherry heat. Replying to William Blum's query as to how much alloying actually took place between deposited metal and base, it was pointed out that in plating tin on iron there was little if any alloying, whereas in the ordinary tinning process by the fire method there was considerable alloying between the tin and the iron. Dr. Fink suggested that it ought to be interesting to compare the diffusion velocity of the various plated metals with the fusion curves of the respective alloys.

De-zincification of Brass

"The De-zincification of Brass" was the title of a short paper by Ralph B. Abrams, of the University of Wisconsin. Experiments are recorded, the results of which indicate that the mechanism of de-zincification appears to be as follows: The first step is the dissolving of the brass as a whole. The copper in solution then redeposits, replacing brass as a unit. This redeposition will not take place unless there is some means of holding the dissolved copper in contact with the brass. This can be accomplished in two ways, one by the presence of a membrane, the other by having a large excess of dissolved copper present. Obviously this latter possibility is a remote one, especially so far as natural conditions are concerned. The membrane may be anything whatsoever, so long as it performs the function of keeping the dissolved copper in contact with the brass. Whether or not de-zincification shall take place can be controlled by merely supplying or taking away the membrane. Briefly, then, the de-zincification of brass is the dissolving of the brass as a whole, the holding of the dissolved copper in contact with the brass by a membrane and the subsequent redeposition of the copper.

Frank S. Weiser, of the Scovill Manufacturing Co., asked the author whether he had found any difference in de-zincification between yellow brass and red brass. Only the yellow brass had been studied. According to Mr. Weiser's experience different brasses and bronzes behave differently. Even in the low bronzes the remaining metal is all copper—no tin is left behind. Mr. McKay, of the International Nickel Co., pointed out that in the case of Monel metal only a mere film of copper is redeposited, protecting the alloy underneath. Answering Henry Howard as to what caused the disintegration of the Monel yacht Seacall, Mr. McKay stated that this was a case of electrolytic action with the salt water as electrolyte; the stem and stern of the yacht and likewise the bolts and rivets were made of iron.

Electrolytic Nickel

The Bureau of Standards at Washington investigated "The Effect of Impurities in Nickel Salts Used for Electrodeposition." The experiments were carried out by M. R. Thompson and C. T. Thomas, and they found that of the impurities likely to be present copper and zinc are especially objectionable. On the basis of their analyses of a large number of commercial salts the following specifications are recommended:

Zinc	not over 0.05 per cent
Copper	not over .02 per cent
Iron	not over .10 per cent
Free acid	not over .10 per cent

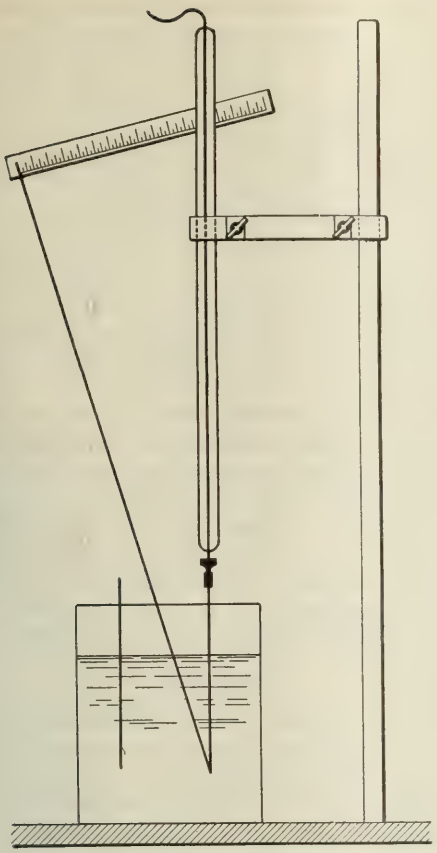
The nickel content is no criterion of the purity of the salts and is useful only in assuring that a definite amount of nickel is obtained. William Blum emphasized the fact that iron was nowhere near as objectionable as zinc and copper. R. J. McKay considered the specifications not stringent enough. In referring to the presence of magnesium in some nickel baths, Prof. Wilder D. Bancroft suggested that this impurity might well be present in the original salt.

Application of the Contractometer to the Study of Nickel Deposition

The last paper of the Thursday morning session was that of Ernest A. Vuilleumier on "The Application of the Contractometer to the Study of Nickel Deposition." The contractometer blade is a piece of sheet platinum, 6x2 cm. by 0.1 mm. thick. A narrow platinum strip is welded to the center of the bottom edge of this foil. This strip is twisted around a thin glass thread serving as pointer. The side of the foil away from the pointer is insulated by painting with vaseline. A millimeter scale, some distance above the cell, is adjusted so that the end of the glass pointer will move freely along its length (see figure). The platinum foil is immersed 3 cm.; the area plated is thereafter 6 sq.cm.

When this platinum foil is made the cathode in a nickel bath and the circuit is closed, the pointer at once begins to move toward the right. When the current is broken the pointer ordinarily stands still at once. After each measurement the nickel is dissolved in warm concentrated nitric acid, the insulation is burned off, and the apparatus is ready for a new contractometric measurement. The degree of contraction decreases when the deposit becomes more coarsely crystalline. Hydrogen, when and while electrolytically deposited, causes the nickel to expand. The contraction of the nickel is evidently a function of the size of the crystalline grains, etc., and the consequent amount of internal stress in the deposit. There are a number of factors influencing the structure of the deposit, such as metal-ion concentration, hydrogen-ion concentration, current density, temperature, etc.

In the discussion of Mr. Vuilleumier's paper William Blum agreed that it was more likely to be the crystal size of the deposit than the occluded hydrogen that de-



CONTRACTOMETER

termines the contraction. What we need now is a reliable method and apparatus to determine the degree of adhesion of electrodeposited metals. Professor Bancroft referred to his experience with platinum black used in contact catalysis. If the black is heated high enough to drive out gases, it will contract very appreciably and thereafter present a much smaller surface. However, if the platinum is precipitated on asbestos and heated, the surface exposed does not change very appreciably—the platinum particles not being in direct contact—and it is easy to obtain good reproducible results in catalytic work. The contraction of porous metals is a big problem and very little is known to date. Mr. Alley, of the Westinghouse company, emphasized the importance of absolute cleanliness in electrodeposition. If this is observed, he mentioned that he had plated rods that could be drawn through a die or forged without any apparent tendency for the deposit to peel. The plated rods were put into a pipe and bent at right angles and back again without any loosening of the deposit discernible. Heating the rods after plating the microscope did not reveal any definite line between deposit and base.

Industrial Heating by Electricity

The entire Thursday afternoon session and the Friday morning session were devoted to a discussion of the principles and practice of industrial heating by electricity. Of particular merit were the papers submitted by the General Electric Co. and the Westinghouse company. In introducing the subject E. F. Collins, of Schenectady, discoursed on "Electric Heat, Its Generation, Propagation and Application to Industrial Processes." The paper is one of the very best ever prepared on this so important subject and was received with much applause. (We expect shortly to reproduce the greater part of Mr. Collins' paper in our columns.) The successful application of electric heat to the varied processes met in the manufacturing world involves not only a knowledge of the particular characteristics, both physical and chemical, of the process involved, but the heating device in question should be of such design as to take account of at least the laws governing the following outlined conditions, tempered with good judgment, resulting from experience:

(1) Chemical laws: (*a*) Chemical reactions at low and high temperatures; (*b*) oxidation, decarbonization at high temperature; (*c*) fluxing of refractories. Effect of furnace atmosphere.

(2) Mechanical laws: (*a*) Expansion and contraction with heat; (*b*) physical strength at low and high temperature; (*c*) crystal growth, with temperature; (*d*) abrasion of refractories when heated; (*e*) mechanical methods of construction.

(3) Physical laws: (*a*) Heat generation; (*b*) conservation; (*c*) transmission; (*d*) absorption; (*e*) distribution; (*f*) storage; (*g*) equalization; (*h*) emissivity; (*i*) potential; (*j*) diffusion; (*k*) quantity; (*l*) temperature gradients; (*m*) control of temperatures through control of heat flow.

(4) Laws of environment and psychology: (*a*) Complete knowledge of the heating process involved; (*b*) more or less complete knowledge of shop methods and individuals who will use the device; (*c*) peculiarities associated with the product to be treated or methods of manufacture should be appreciated; (*d*) What is the frame of mind of the operator? Will he support or antagonize a given design? (*e*) Do executives realize the importance of correct furnace design, and how far will they modify methods to take the fullest advantage of new and progressive equipment offered? (*f*) Does equipment afford better working conditions for the operator?

(5) Economic laws: (*a*) Covering first cost of heating equipment; (*b*) covering operation and operating cost of furnace; (*c*) covering reduction of cost of product and retaining the same quality; (*d*) covering increase in uniformity and quality of product and retaining the same cost; (*e*) greater output for same floor space; (*f*) reduction of labor; (*g*) location of equipment in the line of production, etc.

Discussion

Mr. Collins' paper drew forth considerable discussion. Dwight Miller dwelt at length upon the persistent prejudice against electric heating as against gas heating due to a biased idea of cost of operation and quality of product. The user is apt to lay too much stress upon the relatively higher cost of electric power as against gas or other fuel, overlooking entirely the great improvement in quality and the increase in production. Wirt S. Scott laid stress upon the proper design of apparatus. L. E. Saunders described briefly electrical heating employed by the Norton Co.

F. A. Lidbury, of the Oldbury Electrochemical Co., deplored the lack of sufficient detailed information on the part of the manufacturer of apparatus as to the processes to be carried out in the electric heater or oven. The direct energy cost is not sufficient comparison; we must also take into account the first cost of apparatus and the maintenance cost. Too much importance has been laid by apparatus manufacturers on the efficiency of the apparatus. Often simplicity of design is much more important. For example, there are emulsion heaters sold today that are so illiberally designed that a small increase of temperature of resistor causes breakdown of the apparatus. Frederick J. Ryan, of Philadelphia, said that he had been in the business for twelve years and agreed with Mr. Lidbury that altogether too small attention has been paid to the demands and wants of the consumer. About 90 per cent of the electrical heating apparatus has been turned over to the

user for him to determine whether or not it was properly designed and suitable for his process. The consumer, and not the apparatus manufacturer, deserves the greater part of the credit in the development of electrical heating apparatus. Dwight Miller added that consumer's specifications are usually based on fuel heating practice. The consumer does not always appreciate the uniform heating with electricity as against intermittent heating with fuel. Seldom, too, has the consumer any accurate knowledge as to actual manufacturing costs. Mr. Collins agreed that it was very essential to try out the apparatus and get detailed data before approaching the consumer. Unless you can really show an ultimate economy, it is not fair to go to the consumer.

Principles of High-Temperature Furnace Design

"Principles of High-Temperature Furnace Design" was the title of the next paper, by E. L. Smalley, manager of the Electric Heating Apparatus Co. On the basis of Mr. Smalley's experience the best electric furnaces, judged from the viewpoints of highest quality of products, lowest cost of operation and maintenance and greatest safety in operation at high temperatures, must have these attributes: Muffled type where best suited to the process. Exposed element or radiant form only when best adapted to a process. Elements of sufficient number for cheap renewal. Elements readily and easily renewable. Coils fully supported, and yet free for expansion. Refractory parts thoroughly supported, but free for expansion. No internal connections of coils should be tolerated. Terminal sizes should be larger than the element size. Source of heat must be uniformly distributed. Size of furnace must be governed by the charge. Placement of elements should not control the furnace size. Thermal efficiency should be a controlling feature in decision. Transverse section of heating elements should be round. Exposed elements preferably in corrugated grooves. Elements not chosen to suit a voltage. Total weight of heating element should be high in proportion to the weight of the charge. Efficiency of heat insulation must be adapted to the work to be performed. All of these characteristics, when properly combined with one another, will make the furnace most successful.

Advantages of Industrial Electric Heating

Wirt S. Scott, manager of the industrial heating section of the Westinghouse company, contributed a splendid résumé of the "Advantages of Industrial Electric Heating." He pointed out among other things the following specific points of advantage: (1) With electric heating no products of combustion are produced that might impair the quality of the product. (2) Automatic temperature control. (3) An easier and better temperature distribution, possessing a flexibility of installation and operation not obtainable with any other form of heat. (4) Danger of gas explosions is eliminated. (5) Electric heaters respond quickly when the current is turned on and have a sufficient temperature head to force the heat quickly into the work.

In complimenting Mr. Scott upon his paper President Schluederberg referred to the distinct progress made in industrial heating due to the introduction of the electric apparatus. It is necessary only to see once the large enameling ovens in Detroit to appreciate what wonderful possibilities have been opened by electric heating as compared with fuel heating.

Some Electrical Properties of Alloys at High Temperatures

Another paper of distinct merit was that of Prof. Matthew A. Hunter, director of research of the Driver Harris Co., and his associate, Dr. A. Jones, of Rensselaer Polytechnic Institute, on "Some Electrical Properties of Alloys at High Temperatures." The alloys discussed are those most commonly used in electrical ovens and heating appliances. The specific resistance was determined over the range from room temperature to 1,000 deg. C. The resistance of nickel can be readily raised by the addition of metals which form solid solutions with it—e.g., iron or copper. While the specific resistances and temperature coefficients at room temperature of the nickel-chromium and nickel-chromium-iron alloys have been known for a long time, no exact information on their specific resistances and temperature coefficients at high temperatures has been previously published. With the new data supplied by Messrs. Hunter and Jones, it is possible to calculate the specific resistance of the commercially important materials at any operating temperature. We intend to publish this paper at length in an early issue.

Discussion

In discussing the paper Colin G. Fink referred to the present limiting percentages of chromium in the two types of nichrome wires due to the difficulty of rolling and drawing alloys with higher percentages. As our knowledge of the cause of brittleness is gained, it seems safe to predict that sooner or later we may be able to produce resistance wires with as much as 40 or even 60 per cent of chromium present. The influence of other elements, such as carbon, silicon, etc., although investigated from time to time, is not yet fully appreciated. On the other hand, it was pointed out by Professor Hunter and Frank S. Weiser that nichrome brought into contact with asbestos, mica or other silicates at high temperatures will produce brittleness at the point of contact. E. F. Collins discussed the relative merits of nichrome ribbon as against nichrome wire. He considered the ribbon better for most purposes.

Resistivities of Some Granular Resistor Carbons

Clyde E. Williams, of the Bureau of Mines, and Gordon R. Shuck, professor of electrical engineering, University of Washington, Seattle, reported their determinations of the "Resistivities of Some Granular Resistor Carbons." Granular resistor materials are used in the heating elements of some types of electric furnaces. The important requirements of a satisfactory resistor material are: Small change in resistivity with different temperatures in order to avoid too much regulation of current; a low ash content to obviate too frequent renewing of heating element; high resistance to oxidation; sufficient density, physical strength and hardness to withstand mechanical forces tending to break up particles. Williams and Shuck find that at 1,000 to 1,200 deg. C. the difference in resistivities of the various types and sizes of carbon resistors is not very large. The temperature coefficient of resistivity is negative for all the forms of carbon tested up to 1,000 or 1,200 deg. C., at which temperature it approaches zero and then becomes positive as the temperature increases further. This change was more pronounced in graphite than in the other forms of carbon.

The resistivity increases as the size of the particle decreases. High resistivities are caused by the presence of volatile matter in the resistor material, the resistivity and volatile matter bearing a direct relation for the same material. Ash contained within the particle of carbon increases the contact resistivity and the thermal coefficient somewhat, but the effect is not nearly so large as is that of contained volatile matter. Extraneous ash or foreign matter of high resistivity increases the resistivity and the thermal coefficient to a very marked extent.

The paper was briefly discussed by Dwight Miller, who recounted his experiences with the Baily furnace, the heating element of which is of the granular type.

Heat-Insulation Materials for Electric Heating Apparatus

A subject of fundamental importance is the proper selection and application of "Heat-Insulating Materials for Electric Heating Apparatus." J. C. Woodson, of the Westinghouse company, has studied this subject for many years and presented to the meeting a detailed report, including numerous curves and photographs. Although the insulation materials available for low temperatures are more or less numerous, there are few satisfactory products on the market today for high temperatures.

Discussing Mr. Woodson's paper, Carl Hering, of Philadelphia, mentioned his experience of whitewashing the outside of his furnace and thus very perceptibly improving the heat insulation. Upon compressing a porous insulating material, the heat flow through the material at first decreases, but upon further compression the heat insulation value drops off rapidly. Dr. Hering strongly recommended the use of the thermal ohm, as it saves a good deal of calculation. Prof. Alfred Stansfield of McGill University emphasized the importance of avoiding too thick a layer of outside insulating materials, such as Sil-o-cel, especially in high-temperature furnaces. The melting point of Sil-o-cel and similar materials is comparatively low and if all the heat is trapped, it soon accumulates in the inner layers, a temperature approaching that of the bath is attained and the Sil-o-cel melts. Similarly it does not pay to make the roof of the electric steel furnace too thick. Frank W. Brooke, of the Electric Furnace Construction Co., mentioned the case of using 4½-in. Sil-o-cel as outside insulation which started to fuse after ten heats. Replying to Henry Howard of the Graselli company as to the advantages of using air spaces at definite intervals between the layers of brick or asbestos, Mr. Woodson said that above 300 deg. C. air spaces are of no advantage on account of the convection currents. There undoubtedly would be some advantage were these spaces evacuated.

Firing of Ceramics in Electric Furnaces

E. L. Smalley discussed the "Firing of Ceramics in Electric Furnaces." The cleanliness of atmosphere, the uniformity of temperature control and the ease of duplication of temperatures have made the electric furnace very adaptable to the china and glass industries. L. E. Saunders, of the Norton Co., pointed out that a commercial process for the electric firing of grinding wheels has not yet been worked out. Organic binders for these wheels require but 100 to 200 deg. C. and wheels with the sodium silicate binder are not heated above 250 deg. C. Professor Bancroft considered a small high-temperature electric furnace for porcelain firing a very desirable and welcome piece of apparatus. Artists could then fire their own china and thus we would encourage the development of artistic decorative china. The art would no doubt develop to heights never attained before. Frank W. Brooke and F. A. J. FitzGerald agreed that there are wonderful possibilities along this line of porcelain firing, but who is to pay for the development of such a small electric firing furnace especially designed for artists' use?

Other Papers

With the aid of an interesting set of slides Frank W. Brooke described in detail "Methods of Economically Handling Materials in Electric Furnaces." In some instances the work was carried through the furnaces on cars, in others the work was attached to an endless chain, and in all cases provisions were made to conserve as much of the heat as possible.

Wirt S. Scott gave a detailed account of the "Development of Industrial Electric Heating for Low-Temperature Enameling" and described the enameling ovens used in the automotive and typewriter industries.

The concluding paper of the symposium on industrial heating was presented by C. B. Gibson, of Pittsburgh, on the "Electric Annealing of Malleable Iron." Very little has been done along this line and developments are very much in the experimental stage. There are many advantages of electric annealing as against annealing in fuel-fired furnaces. Among others there is the elimination the packing pots, stacks, flues, stokers, etc., and considerable saving in labor.

Simple Electric Crucible Furnace for Melting Aluminum

The final paper of the Friday morning session was a short report on the construction and operation of an electric crucible furnace, by Prof. A. Glynne Lobley, director of the electrochemical laboratories, Victoria University of Manchester. The crucible, which will hold 40 kg. of aluminum, is heated by means of a resistor of nichrome ribbon 6.3 mm. wide and 1 mm. thick. An aluminum alloy containing 8 per cent of copper was melted in the crucible, and in an average week 465 lb. was melted with an energy consumption of 363 kw.-hr. The voltage across terminals was 200. Full details of construction were given.

Electric Steam Generators

P. S. Gregory, of the Shawinigan Water & Power Co., described the improved type of electric steam generator developed by F. T. Kaelin, chief engineer of the company. The water-resistance electric steam generator consists essentially of a closed pressure vessel to which is connected a source of water supply and from which water may be drawn off at the bottom and steam at the top. In this vessel electric energy is made to flow through the water from an electrode in the form of a plate or tube, to the shell of the vessel, or to the metallic inner lining. Alternating current energy is used at a pressure varying from 110 up to 12,000 volts. The generators are constructed for the use of three-phase power, either by employing three electrodes in one vessel or by the use of three vessels with one electrode in each, in which case the outer shells are connected together in star. In this type of generator there is no

heating surface, the generation of steam taking place throughout the water, and as a consequence no portion of the apparatus is at a higher temperature than the temperature of the steam. This is a most important feature from the viewpoint of safety and continuity of operation, as can be readily appreciated.

The chief advantages of the water-resistance type of steam generator over the metallic resistance type are freedom from electrical and mechanical troubles, ease of regulation and cheapness.

There are in operation in Canada and in the United States at the present time installations of electric steam generators totaling about 150,000 kw., which are for the most part installed in paper plants.

DISCUSSION

Mr. Gregory's paper drew forth a long, animated discussion. F. A. Lidbury, of Niagara Falls, who has had considerable experience with the electric steam generators, commented upon the importance of studying the conditions and requirements of each individul mill or plant. The rising coal prices have done much in popularizing electric steam. Dwight Miller referred to successful installations in various paper mills. Eric A. Lof, recently returned from a trip to Sweden, reported that hundreds of electric steam boilers are in daily use in Europe, largely operated on surplus power. Why not do away with many of the coal-fired steam boilers in this country and introduce the electric steam accumulators? In Europe there are forty-two successful installations of that kind. Dr. Carl Hering inquired whether any appreciable decomposition of the water were discernable, due to electrolysis. Philip H. Falter, of the Canadian Electro Products Co., replied that very little is known regarding any electrolytic effects, but it has been observed that electrodes wear out entirely out of proportion to the energy consumed. Furthermore, with twenty-five-cycle current there is greater electrode wear than at sixty cycles. Mr. Lof cited a Swiss case where very low cycle current was used and dissociation of the water took place. Others who participated in the discussion were Duncan MacRae, of the Westinghouse company, Acheson Smith, of the Acheson Graphite Co., and Wilder D. Bancroft, of Cornell University.

A New Induction Furnace

J. Murray Weed, of the General Electric Co., gave a detailed account of a new induction furnace. In this furnace, as in other induction furnaces, the heat is produced by an electric current induced by transformer action in a looped portion of the molten charge, which we will call the secondary. This secondary is distinct from the melting chamber pot, in which the cold charge is received, melted and held for refining and pouring. The success of the furnace depends upon a continuous, automatic circulation of the molten metal between the secondary and the melting pot, to prevent overheating in the former and to deliver the heat to the cold metal in the latter. It is in the form of the secondary, and in the character of the circulation and the method of producing it, that the new fundamental features of this furnace are found.

The circulation in this furnace is effected by the force of electromagnetic repulsion, set up through the medium of the magnetic leakage field, which exists between primary and secondary in any transformer. This force is proportional to the square of the current flowing, and is familiar to all transformer engineers as having caused much trouble in the wrecking of transformers when the windings were not held with sufficient rigidity to withstand the enormous forces of this nature which are set up when short circuits occur.

The induction furnace is, in fact, a special case of a short-circuited transformer, in which the internal impedance is comparable with the total full load impedance of the secondary circuit of the ordinary transformer. The repulsive force in this furnace, therefore, is not excessive, as in ordinary transformers when short-circuited, but only such as exists in ordinary transformers when normally loaded.

DISCUSSION

Oscar Brophy, of the Ajax Metal Co., referring to the circulation of metal in the Weed furnace, said that the method of producing this circulation is not new, because it was described by him in the U. S. Patent 1,296,752 granted March 11, 1919. He felt that the flow of metal in the Weed furnace depended upon two facts: (1) There is an electrodynamic force of repulsion between the primary and secondary as their currents are in opposite directions. (2) This force is given an axial direction, so as to cause the metal to flow up into the bath, by means of the axial displacement of the primary. Dr. Hering likewise felt that there was no new principle involved in the furnace described by Weed. John A. Seede, associated with Mr. Weed, considered the furnace a radical departure. Mr. Weed added that the furnace is still in the experimental stage.

Carbon Bisulphide

George A. Richter, of the research laboratories of the Brown company, has carried out a detailed investigation of the electrical production of carbon bisulphide. We expect to publish this paper shortly in full.

Preparation of Perchlorates by Heating Chlorates

Frank C. Mathers and J. W. H. Aldred carried out experiments seeking to increase the yield of perchlorate by heating chlorates. But no variation in the conditions of heating chlorates and no catalysts were found whereby the yield could be increased. A maximum yield of about 55 per cent perchlorate was obtained by heating 1 to 50 grams potassium chlorate for 30 to 60 minutes at 480 to 540 deg. C. Most substances, when added, decreased the yield. The sodium chlorate gave a smaller yield. There seems no possibility that the chemical preparation of perchlorate from chlorate can equal the electrolytic method.

Electrosmosis and Electrophoresis

Oliver C. Ralston, in his paper, proposed the terms "electrosmosis," "electrophoresis," "cathodophoresis" and "anodophoresis" (1) to replace a large number of other words, some of which are incorrectly used and all of which are awkward; (2) to gain uniformity of nomenclature in conformity with the two words "electrolysis" and "electrostenolysis," and (3) to provide single descriptive nouns, which when properly modified can be used as verbs, adjectives or participles that easily displace present clumsy phrases.

Electrolytic Oxidation of Isoeugenol

Prof. Alexander Lowy, of the University of Pittsburgh, is an ardent enthusiast for the electrolytic preparation of organic chemicals, and at the Montreal

leeting he reported upon one of his latest researches, iat on isoeugenol, which he had carried out jointly ith Miss C. M. Moore. The first part of the investigaion here reported dealt with the method for the prepiration of vanillin as described in the German patent .R.P. 92,007. It was found that the specifications of he patent are not exact, in spite of statements to the ontrary appearing in many textbooks. Repeated tests ave rise to no appreciable amounts of vanillin—a esinous substance being obtained instead. Perhaps erivations of isoeugenol, such as the acetyl or benzoyl, ould be used to produce the desired results. Further nvestigation is desirable.

Insulating Compounds

The two concluding papers of the Friday afternoon ession dealt with insulating compounds. The first of hese was by Dr. H. C. P. Weber, of the Westinghouse ompany, on the "Changes in the Electrical Conducivity of Varnishes During Drying" and the second by Dr. C. J. Rodman on "Arc Action on Some Liquid Insulating Compounds." Both subjects are of great importance. There are many intricate problems presented in the study of insulating compounds and it akes the closest co-operation of chemist and electrical engineer to hasten a solution of these problems.

Social Features

So much had been planned by the local committee in social entertainments that it was difficult to find time to take in even a small fraction of these. Thursday evening was spent at McGill University and the members had the pleasure of listening to a scholarly discourse on "The New Philosophy of Physics" by Dr. A. S. Eve, a physicist of world-wide repute. The experiments were exceptionally well planned and carried out. Golf enthusiasts spent a number of delightful hours at the Kanawaki and Royal Montreal Golf Clubs. All of the outings arranged for the ladies were carried through to perfection under the able and clever guidance of Mrs. C. R. Hazen. There were automobile and coach sightseeing tours; a very sumptuous tea on the lawns of the Royal St. Lawrence Yacht Club; an equally enjoyable gathering at the Engineers' Club; a theatre party; and finally the ladies joined in the excursion to Shawinigan Falls.

Shawinigan Falls

An exceptionally attractive and enjoyable feature in the program was the all-day outing to Shawinigan Falls. Special coaches reserved for the society were attached to the midnight train, arriving at the Falls early Saturday morning. The local members, under the most able leadership of R. A. Witherspoon, gave the visitors a cordial reception. Automobiles were in readiness to take the party to various plants of interest. At the Shawinigan Water & Power Co.'s plant opportunity was afforded to inspect a new horizontal unit in the process of installation. As F. T. Kaelin had pointed out, Shawinigan Falls is an ideal place for water-power development and the manufacture of electrochemical products. Not only is there an available high head and a large quantity of water with fairly constant flow, but the St. Maurice River widens into a lake just above the falls, and after making a sharp bend forms a second lake 145 ft. below. This brings the upper and lower water levels within a short distance of each other, thus

POWER DEVELOPMENT AT SHAWINIGAN FALLS

providing an extremely economical location for the power plant at the bottom of the slope between them. Part of the power used at the Falls for the manufacture of carbide, carborundum, aluminum, electrodes, acetic acid, paper and other products; a large portion of the power is transmitted to Montreal.

Canada Carbide Co.

At the Canada Caribe Co.'s plant the visiting electrochemists saw the large 6,000-kw. carbide furnaces in operation. These furnaces are about 10 ft. high with a base about 10x10. The two electrodes are 48 in. wide, 16 in. thick and about 7 ft. high. They are built up of three electrodes each, 16x16 in. square, the seams being carefully luted. The voltage of the carbide furnaces is kept constant at 125 to 130 volts and the amperage is about 30,000 per phase. The electrodes have a life of about 10 to 12 days, operating 24 hours a day. The feed consists of two parts of limestone to one of coke; the carbide is tapped at intervals, the tapping temperature being about 1,000 deg. C.

Belgo Paper Co.

At the Belgo Paper Co.'s mill one of the novel features was a 25,000-kw. electric steam generator. There are three iron cylindrical units, star-connected and operating at 6,600 volts. An iron cylinder next to the shell forms the one electrode and a cast-iron perforated pot about 18 in. in diameter and 16 in. high is concentrically suspended and forms the second electrode. Kaelin electric steam generators are also installed at the Laurentide Pulp & Paper Co.'s mills. These have a maximum capacity of 70,000 kw., or 7,000 boiler horse-power.

A complimentary buffet luncheon was served on the lawn of the inn. This luncheon was the outstanding social event of the meeting. How much it was enjoyed and appreciated by the members and guests is difficult to realize. A most generous and entertaining host, with a capacity for efficiency seldom equaled saw to it that a delicious and spirited luncheon was served with remarkable dispatch and comfort to all. The good humor and cordiality of hosts and guests alike, made for an abundance of good will and happiness. Robert Turnbull, A. T. Hinckley, Howard C. Parmelee and R. A. Witherspoon took turns as song leaders, introducing new verses and variations in many of the electrothermic ballads and electrocomical ditties so familiar to all members of the society. This closing event of the Montreal convention seemed more like a happy family reunion than a staid convention of learned men. The members returned in a body to Montreal, and soon after all were on their way home.

Electrolytic Iron From Sulphide Ores

Iron of Extraordinary Purity Is Made From Pyrite, Recovering Sulphur as a Byproduct—Costs Will Be Low Enough Not to Handicap Wide Use of the Metal

AN ESTIMATION of the commercial possibilities of electrolytic iron in America was given by F. A. Eustis in a paper read Sept. 27 before the Mining and Metallurgical Society of America. He recounted briefly the various laboratory investigations which have been published during the last 50 years, and described the experiments he and his associate Charles P. Perin have been making.

Commercial Operations in France

Their interest was revived by the use of electrodeposition to build up worn steel parts[1] (a process adopted by the allied armies) and the undoubted commercial success of the Société le Fer at Grenoble and two or three other localities in France.[2] Founders of the latter enterprise took out their first patents in 1910. As is perhaps well known, their product is iron boiler tubing, deposited on a rotating cathode, 4 m. long. Soluble cast-iron cathodes are used, the current density is in the neighborhood of 100 amp. per sq.ft., led in through the rotating mechanism. Their tanks are located somewhat above the floor; electrolyte is distributed through an overhead pipe and rubber hose connections. It overflows to a sump, from which it is pumped to a tank containg iron turnings. This performs a double purpose: it keeps the solution both reduced and filtered. Air is blown into the electrolyte to absorb hydrogen—as deposited the iron is somewhat brittle from hydrogen, but a gentle annealing drives off the gas and renders the metal extremely ductile. A high speed of rotation of the cathode was thought to be very important—it was maintained at a correct rate by observing a pilot electrode consisting of a cone rotating at known speed.

The Grenoble plant produces about 1½ tons of boiler tubes per day, ready for the market after stripping from the cathode, cutting to length and slight annealing. Variation in gage amounts to no more than 0.002 in., plus or minus. The iron is very pure; it is quite soft so that it is easily expanded into its connections. Its superior thermal conductivity increases the efficiency of the boiler, and its resistance to corrosion enables it to resist the pitting action of many waters.

Some Iron Is Made in Illinois

Only one American firm is now making electrolytic iron in commercial quantities: the Western Electric Co. has a plant at Hawthorn, Ill., producing about 2 tons per day.[3] Its tank house looks much like a copper refinery. Brittleness of the deposit is here a virtue; the iron is knocked off the polished steel cathode, ground in a ball mill and tumbled with zinc dust (thus coating each particle). The powder is then compressed and made into cores for loading coils for telephone installations, for which it has been found to be peculiarly advantageous.

In experimenting with some complex Cuban iron ores[4], Perin and the author decided to use SO_2 from pyrite as a reducing agent for their chloride solutions, but it was found that the pyrite residue contained as much iron as was recovered from the process. Consequently it seemed logical to use a sulphide ore not only as a reducer but also as an ore. As a matter of fact, pyrrhotite (the monosulphide of iron) dissolves easily in ferric chloride, giving an astonishingly complete reduction:

$$2FeCl_3 + FeS = 3FeCl_2 + S.$$

This reaction is exothermic, producing about 700 B.t.u. per lb. of iron dissolved—an important advantage, since successful electrolysis appears to demand hot solutions.

Ground pyrite (FeS_2) is not as good a reducer as pyrrhotite, only 60 per cent of the metal going into solution before the residue is insulated by a sulphur deposit. Pyrite may be easily changed to pyrrhotite by a reducing roast; flowers of sulphur or brimstone is a byproduct of more value (at present market prices) than the cost of the operation. In view of the tremendous amount of nearly pure iron sulphide (one Spanish mine alone has 100,000,000 tons developed) to say nothing of the vast tonnages of complex sulphides carrying attractive amounts of gold and silver, it appears to Mr. Eustis that the most of our future electrolytic iron will come from these sources, and this idea forms the basis of his patented processes.

Purification of Electrolyte

The process, as is now in operation in their experimental mill at Milford, Conn., consists of grinding the sulphide and agitating the pulp with spent electrolyte (containing $FeCl_3$ and $FeCl_2$ in equal molecular proportions). Sulphur and other insolubles are filtered.

Any copper in the ore goes into solution, but it is precipitated very cleanly and easily on metallic iron. (In passing it may be remarked that this may prove to be a more economical process for the recovery of copper from lean pyritic ores than the present methods of selective concentration and smelting, wasting all the iron, either in a mill tailing or in a blast-furnace slag.) Zinc and cadmium may be taken out of solution as a sulphide, precipitated either by H_2S or a soluble alkaline sulphide. (After about 9 months' experimentation, the Consolidated Mining & Smelting Co. at Trail, B.C., has been able to make iron sheets of most excellent quality, and containing 0.04 Zn, from a zincy pyrrhotite tailing.) Other impurities are not expected to give much trouble, since we have learned how to make solutions of extraordinary purity in our struggles with electrolytic zinc. Iron solutions do not appear to require such extreme purity. Furthermore, iron sulphide is so widespread that if one ore gives trouble, another could usually be substituted. In large-scale work, the operator would doubtless bleed a moderate amount of solution from the circuit in order to keep certain accumulating impurities within bounds. This would involve a loss of its chlorine,

[1] "Building Up Worn Metal Parts by Electrodeposition," by W. E. Hughes. *Chem. & Met.*, vol. 26, p. 267 (Feb. 8, 1922).

[2] Jean Escard, *Le Génie Civil*, Aug. 23, 1919.

[3] *J. Am. Inst. Elec. Engrs.*, July, 1921, p. 598.

[4] Some of this work was described by Carle R. Hayward, in *Chem. & Met.*, vol. 26, p. 261 (Feb. 8, 1922).

but it would probably be replaced with gas made on the spot, given cheap power and salt.

Details of Deposition

The diaphragm cell used is much like a caustic soda cell. It contains graphite anodes. As iron is deposited from $FeCl_2$ in the cathode compartment, the chloride migrates through the diaphragm to the anode and oxidizes two molecules of ferrous chloride. The solution in this compartment is circulated so that it never reaches a greater concentration than 70 grams per liter of $FeCl_3$ (and about the same of $FeCl_2$). This prevents free chlorine from giving trouble in the solutions and atmosphere, and from lowering the electrical efficiency.

When conditions are right, iron is deposited at high current efficiency, exceeding 95 per cent. That is to say, 1 gram of iron may be had per ampere-hour. The amount per kilowatt-hour depends of course on the resistance of the cell, which in turn depends upon the composition and temperature of the electrolyte, but most especially on the current density. For instance, other conditions being equal, a current density of 20 amperes per square foot requires 1 volt, 40 amperes 2 volts, and 160 amperes 4 volts. Therefore if a plant can operate 90 per cent of the time, and power costs $20 per kilowatt-year (a figure at which large blocks have been offered), one ton of iron can be produced for $2.40 worth of current at 1 volt, $4.90 at 2 volts and $9.80 at 4 volts. Part of the saving in power when operating at low voltages would be offset by higher overhead charges on account of the more extensive plant needed. Power costs of not more than $5 per ton compare favorably with the cost of coke for blast-furnace iron.

Many difficulties must be met before ferric chloride solutions can be handled in large volume. Most of the equipment at Grenoble was made of wood, it being quite resistant and easy to change. They are now rebuilding permanently in concrete—probably of a special nature. Sulphur resists hot $FeCl_3$ very well indeed, and it will doubtless be used to a great extent, either pure or as a cement for silica sand. Pumps may be located in the reduced portion of the cycle. Stoneware pumps will doubtless give very good results—rubber-lined pumps also have possibilities.

Commercial Possibilities

Physical properties of the deposited iron have been summarized by Bradley Stoughton[5]. Its purity, ductility, rust-resisting properties and high thermal and electrical conductivity fit it for a number of special uses, to which it will be welcomed and which will furnish the early market. Thin boiler tubes, fine iron wire, deep stamping stock, cold-worked parts of precise shape and electrical or magnetic specialties are attractive possibilities. Such uses might easily absorb ¼ million tons of iron a year. A similar or even greater tonnage will undoubtedly be absorbed by the manufacturers of crucible and superfine electric steels for tools and high-strength alloys, if the cost could be kept somewhat below that of Swedish iron, or the price of selected scrap plus the necessary refining costs.

Estimates of Costs

All these possibilities depend upon the cost of the iron. Certainly the ore will not be a limiting factor. As indicated above, there is a great wealth of pyrrhotite available, which can be had, ground, for $5 or $6 per ton. These ores are of such a nature that no costly difficulties from impure solutions need be expected. At present market prices, the sulphur recovered is worth more than the ore will cost, so for the time being the raw iron will be free. Of course a great tonnage of electrolytic iron from this source will glut the sulphur market. (The United States' annual consumption is now not more than 1,500,000 tons of sulphur, which would be produced as a byproduct from 3,000,000 tons of iron. New uses of sulphur may be found, but any important tonnage, such as for concrete, could carry only a very low price.)

Labor and supplies are quite high in plants now operating. This is due in great measure to the small scale of the operations and the semi-experimental nature of the work. As a matter of fact, Mr. Eustis sees no factor which would demand permanently high costs for labor and supplies. The electrolytes must be kept hot, but careful calculations show that this is a problem of insulation, since both the reducing and the deposition reactions generate quite large amounts of heat.

Electric power in this country from water or coal is unlimited, its development only awaiting a market. Certainly the cost for electricity will always compare favorably with the fuel cost in a blast furnace. Operating voltages are very low, and all the electrical details for an electrolytic refinery have long since been worked out.

Capital cost may be balanced against the power cost. An expensive large plant may operate on little power at low voltage, or a smaller plant can get the same output with greater power. Mr. Eustis thinks, however, that capital charges may fall within $8 to $12 per ton of iron produced.

In closing, the speaker gave the opinion that the possibilities of the process are great, although the road ahead is far from easy.

[5] *The Iron Age*, Jan. 5, 1922; *Chem. & Met.*, vol. 26, p. 128, Jan. 18, 1922.

Corrosion of Rifles

A source of great loss, not only to the national defenses but to every owner of a firearm, is the slow corrosion which gradually destroys the accuracy of fire, even when every effort is made to protect the rifling by cleaning the barrel and keeping it well oiled. This "after-corrosion" under an oil film has been studied by the Bureau of Mines. The experiments were performed on the U. S. Infantry rifles and ammunition, using the high-pressure smokeless cartridge primed with typical fulminate, sulphocyanide and sulphur compositions.

Smokeless powder leaves behind no nitrocellulose residue (except when the pressure developed is relatively low, as in firing blank cartridges), nor does it leave a corrosive acid residue. After-corrosion in this instance is due to a water-soluble salt (KCl) from the decomposition of the chlorate in the primer. This salt is retained in pits or minute chatter marks in the bore, from which it cannot be removed by wiping. However, the salts easily dissolve in water, even condensing it from the atmosphere below the dew point, and corrosion proceeds by reaction with atmospheric oxygen. The trouble will disappear when a primer containing no chlorate may be developed.

Meantime, after-corrosion may be suppressed by washing in naphtha and then in hot water, carefully drying, oiling and then keeping both ends of the bore tightly corked. Many non-aqueous compositions recommended for cleaning firearms possess little or no value.

The Air Bleaching of Nitric Acid*

An Experimental Study of the Bleaching of Nitric Acid With Air—Effect of Temperature, Air Velocity, Etc., Discussed and Analyzed—A Formula Is Derived for Calculating the Bleaching Coefficient Which Is Checked by Experiment

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THE problem of bleaching nitric acid to be used in the manufacture of mixed acid has assumed greater importance as the specifications on lower oxide content have become more rigid. This has stimulated the development of better methods of operating and controlling the bleaching process which is necessary in the older types of plants. This paper presents the results of experimental work on bleaching nitric acid at varying temperatures and air rates, and develops a theory and an equation whereby these results can be applied to industrial practice.

Removal of Lower Oxides. The process of bleaching strong nitric acid with air consists essentially of volatilizing the lower oxides present and removing them by the current of air. There are, therefore, three important factors involved. In the first place, the vapor pressure of the lower oxides, determined by their concentration and the temperature of the solution, is a direct measure of their tendency to volatilize. Next, a source of heat is necessary to supply the heat of vaporization. Finally, the volatilized oxides must be removed from the system—a process which is effected in this case by a current of air. These three factors will be discussed separately.

First Factor: Vapor Pressure of Lower Oxides. Owing to the relatively low concentration, the vapor pressure of the lower oxides at any given temperature may be assumed to be directly proportional to their concentration in the solution (Henry's Law)—i.e., $p = \alpha N$ where p = the partial pressure of lower oxides, N = the concentration of lower oxides in the solution (expressed as per cent N_2O_3) and α = the proportionality constant. It is obvious that α will vary with the temperature of the solution, and, by analogy with other cases, an exponential function may be predicted.

Second Factor: Heat of Volatilization. The major source of heat is the solution itself, which cools during the bleaching process. It is, of course, possible to supply heat externally and prevent cooling, but this does not alter the concept. It is impracticable to supply much heat in the air used for bleaching, since the sensible heat of the air stream is necessarily small compared to the total heat required for evaporation.

Third Factor: Mechanical Removal of Vaporized Oxides. The air used to remove the volatilized products could theoretically become saturated in an ideal bleaching pot. Actually, this condition is nearly realized, so that an approximation that the air reaches the same percentage saturation under different conditions of temperature and velocity is justified. The oxide removal should, therefore, be nearly proportional to the air rate, varying only by slight differences in the saturation of lower oxides at different air velocities.

The bleaching formula derived from these considerations is as follows:

$$-\frac{dN}{d\theta} = \beta N$$

Where N = per cent N_2O_3 in solution
θ = time in minutes
β = the bleaching coefficient, defined as the drop in per cent lower oxides per minute in a 1 per cent solution.

$-\frac{dN}{d\theta}$ = the instantaneous rate of bleaching.

The above equation states that the rate of removal of the lower oxides is a function of the amount of oxides present. This equation integrates to the form

$$\log_e N = -\beta\theta + \text{constant}$$

or, between the limits of an initial concentration N_1 and a final concentration N_2

$$\log_e \frac{N_2}{N_1} = -\beta(\theta_2 - \theta_1)$$

The coefficient β is not a constant, but varies with the temperature of the solution and the air rate, and should be nearly proportional to the latter. All laboratory runs were made with constant temperature and air rate, so that β was itself constant for any one run. It is obvious that the validity of the theory and assumptions given above must be demonstrated by comparing the equation to actual data obtained in bleaching runs.

The absence of data on the vapor pressure of lower oxides has made it impossible previously to calculate the rate of bleaching. In this work it has been considered that the actual vapor pressure obtained from laboratory bleaching runs is the vapor pressure of oxides above the solution. This is not strictly true, since, as noted previously, the air does not become saturated. However, the approximation that the same degree of saturation is reached in all cases permits this assumption and, furthermore, such vapor pressure data are applicable to other bleaching runs in which complete saturation is again unattainable.

Loss of Nitric Acid. During the removal of lower oxides, nitric acid will itself be volatilized, but the problem is somewhat simplified in that the vapor pressure of nitric acid remains constant during a run at any one temperature, since the amount vaporized is so small. Although data on the vapor pressures of HNO_3 in concentrated solutions at higher temperatures are a little uncertain, it is possible to calculate the values from data at lower temperatures using the Clapeyron equation. These values may be compared with observed values.

The experimental work consisted in bleaching nitric acid on a laboratory scale under various conditions of temperature and air rate. Compressed air was passed through a calibrated flow meter and then to a 2-liter bleaching flask, where it was distributed in the acid by

*Paper presented at the meeting of the American Institute of Chemical Engineers, Niagara Falls, N. Y., June 19, 1922.
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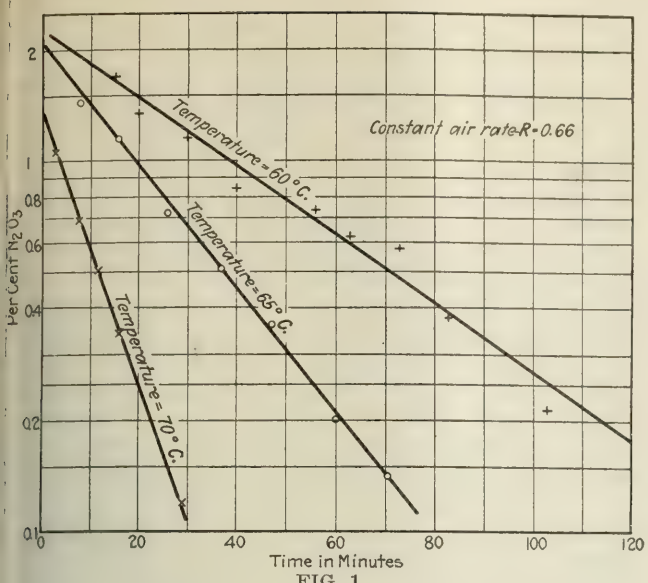

FIG. 1

a perforated glass coil. The flask was equipped with a thermometer, a gas burner for heating and an exhaust tube for the gases, which also acted as an air-cooled condenser. The amount of nitric acid lost during the process by evaporation was measured by collecting the condensate.

Each test consisted of bleaching 1.5 liters of raw acid (93 per cent HNO_3) at a definite temperature and air rate. At intervals during the bleach acid samples were siphoned from the flask and analyzed for dissolved lower oxides of nitrogen by titrating a diluted sample with tenth normal $KMnO_4$; the oxides being expressed as N_2O_3. Approximately 200 c.c. of the acid was removed as samples, giving an average volume of 1.4 liters.

The first set of three runs was made at constant air rate, equal to 0.66 liter air per minute per liter of acid, and temperatures of 60, 65 and 70 deg. C. respectively. Air rate is expressed as the ratio of air volume per minute per unit volume of acid, so that the results would be comparable with plant practice. The second set of three runs was made at constant temperature—namely, 70 deg. C., and air rates of 0.51, 0.66 and 0.75 liter per minute per liter of HNO_3 respectively.

If the original equation $\log_e N = -\beta\theta +$ constant is true, then ploting $\log_e N$ against β should give a straight line whose slope equals $-\beta$.

Fig. 1 shows log of the lower oxide concentration plotted against the time of bleaching for runs at three different temperatures, but at a constant air rate. The points for a given run all fall close to a straight line,

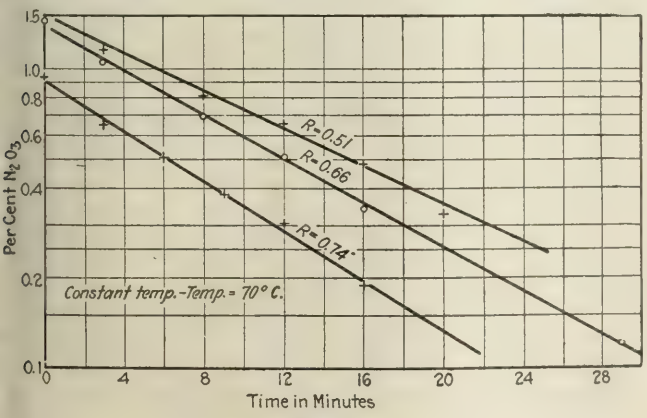

FIG. 2

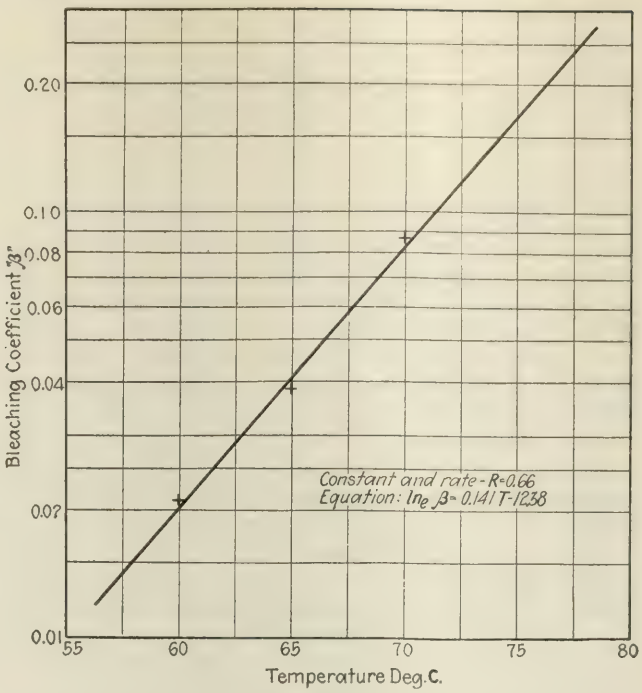

FIG. 3

thus verifying the original law for rate of bleaching. Fig. 2 shows the log of the lower oxide concentration also plotted against time of bleaching for runs at three different air rates, but at a constant temperature. These points for a given run, all falling close to a straight line, again verify the original equation.

The slope of each line on Figs. 1 and 2 equal the bleaching coefficient, $-\beta$, for that specific temperature and air rate, as seen from the equation above.

The variation of β with temperature at constant air rate, Fig. 3, is represented by an exponential function as predicted, since the vapor pressure vs. temperature relation in general is exponential. An inspection of Fig. 3 shows that the log of β when plotted against temperature gives a straight line and that the rate of bleaching doubles every 5 deg. C. The equation showing the value of β with variation in temperatures is $\log_e \beta = 0.141\ T - 12.38$.

The rate of bleaching is nearly proportional to the amount of air used, Fig. 4, the line failing to pass through zero due to incomplete saturation of the air at the velocities in question. The equation showing the variation of β with air rate is $\beta = 0.0122 + 0.112\,R$. Fig. 5, showing the combined effect of temperature and air rate on the rate of bleaching, is self-explanatory.

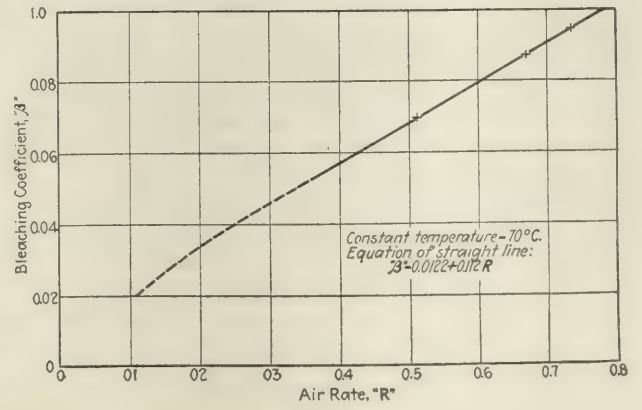

FIG. 4

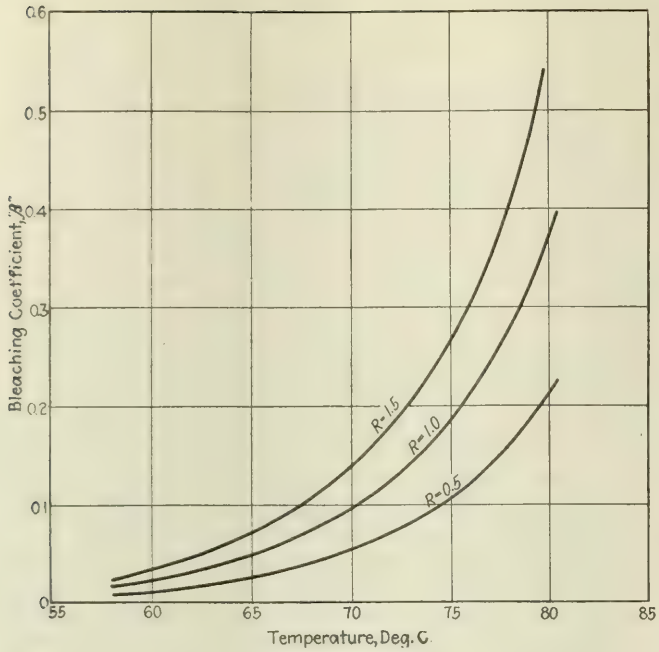

FIG. 5

Fig. 6 shows vapor pressures of nitric acid and lower oxides above 93 per cent nitric where the lower oxide concentration is 1 per cent. The values calculated by extrapolating data[1] by means of the Clapeyron equation and those experimentally determined points are compared with data by Pascal[2] and Creighton and Githens.[3] The lower oxide vapor pressures are admittedly low, due to incomplete saturation of the air, as already noted. This plot shows the lower oxide pressure for a 1 per cent solution, and Henry's law may be used to calculate the pressure above a solution of any other concentration.

These results indicate the advantages to be gained by using a high temperature. An inspection of the integrated equation, $\log_e \frac{N_1}{N_2} = \beta(\theta_2 - \theta_1)$, shows that bleaching between any two concentrations N_1 and N_2 requires a time inversely proportional to β, the bleaching coefficient. Since β doubles with a 5 deg. C. rise in temperature, bleaching time at 40 deg. C. therefore would be sixty-four times as long as at 70 deg. C. The effect of air rate may be simplified to the statement that bleaching time is inversely proportional to the air rate employed.

In plant bleaching, the temperature of the acid drops during the process due to evaporation of lower oxides and nitric acid. This fact must be allowed for in applying the constants obtained from laboratory runs. For example, a laboratory bleaching from 0.26 to 0.06 per cent at 70 deg. C. and 0.66 R would require 18 minutes, while a plant bleach with the same air rate, starting at the same temperature but finishing at 64 deg. C. would take 32 minutes. For accurate calculation of a plant run, it is necessary to obtain temperatures during the bleaching period, look up the corresponding values of β, plot these against the time, and get an average β from the area under the curve. The application of this method gave checks on the lower oxide removal of better than 10 per cent in all cases. The value of β to be used for this plant run was found at 66 deg. C.—i.e., two-thirds of the difference between 70 and 64 deg. C. subtracted from the higher temperature. This latter rule gives a fairly close approximation in all cases, so that it is unnecessary to use the accurate method mentioned above. Thus, in bleaching an acid high in lower oxides dropping from 70 to 55 deg. C., the average value of β would be 60 deg. C.

Bleaching may be effected by merely heating the acid providing the vapors have opportunity to escape from the system. It is possible to raise the acid to such a temperature that the lower oxides boil off, the boiling point rising as the oxide content decreases. Some work has been done along this line with the object of determining the optimum combination of heating and air blowing to give the desired bleaching, having in mind the loss of nitric acid, the heat requirements and the time necessary. The results of this work will be published at a later date.

The loss of nitric acid incurred in bleaching has been calculated from the vapor pressure data shown by the line on Fig. 6. While the results are not strictly quantitative, it can be stated that, in bleaching to a fixed concentration, less nitric acid is lost at the higher temperatures. This statement is corroborated by Fig. 6, where the lower oxide vapor pressure increases with temperature much more rapidly than the nitric acid pressure.

[1]Thorpe, vol. 3, p. 692.
[2]Paul Pascal, *Ann. Chim.*, vol. 15, pp. 253-90 (1921).
[3]H. J. M. Creighton and J. H. Githens, *J. Frank. Inst.*, vol. 179, pp. 161-9 (1915).

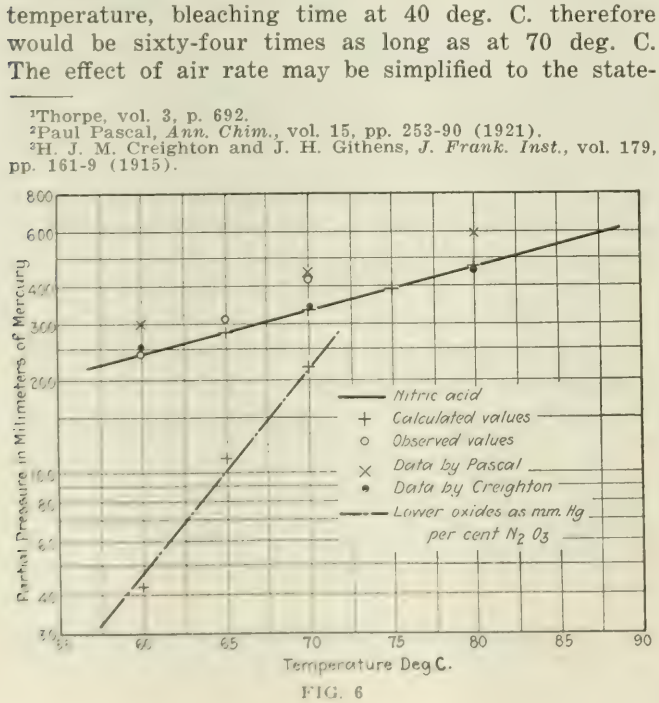

FIG. 6

Summary

(1) From theoretical considerations, the equation for the rate of bleaching of nitric acid by air is shown to be $\log_e \frac{N_2}{N_1} = -\beta(\theta_2 - \theta_1)$

(2) Three runs at constant air rate but varying temperatures and three runs at constant temperature but varying air rates proved this law.

(3) The rate of bleaching was found to be proportional to the rate of air flow and to double with each 5 deg. C. rise in temperature.

(4) The coefficients obtained in the above laboratory runs give calculated rates of bleaching which check observed rates in the plant with an accuracy of better than 10 per cent.

(5) The approximate vapor pressures of the lower oxides of nitrogen in nitric acid solution were determined for a 1 per cent solution.

(6) In bleaching nitric acid to a fixed concentration of lower oxides less nitric acid is lost at the higher temperatures, since the vapor pressure of the lower nitrogen oxides increases more rapidly with an increase in temperature than does the vapor pressure of HNO_3.

War Explosives in France

The Problems That Confronted French Chemists During the World War and a Review of Their Work in Developing New Explosives

By J. Cavalier
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FRANCE was handicapped in her war manufacturing by the situation in her chemical industry. It has been said that she had no great chemical industries and that she depended on other countries for her chemical products. This statement is not strictly correct, for France was independent in many instances, manufacturing an abundance of dilute sulphuric acid and even exporting a number of important products such as carbonate of soda, chlorides, chlorates, mineral coloring materials, superphosphates, essence of turpentine, tanning extracts, soaps, glycerines, etc.

The fact is that a real division of work between the countries had become established and in this distribution the industries based on organic synthesis were practically monopolized by Germany. Particularly was this true with respect to the aromatic compounds, especially dyes, for which, like most other nations, France was tributary to Germany.

Now it happens that the industry of coloring materials is closely related to that of nitro-explosives. A country which is fitted out to make the first is fitted out to make the second, for it has available the aromatic hydrocarbons, raw materials common to both industries. In France the production of coal was never above the immediate need of the country and consequently relatively few coke ovens were operated and many of these were not of the byproduct type. Therefore the production of benzene and toluene at the beginning of the war was altogether insufficient for the demand.

Regulation Explosives at Outbreak of War

At the time war was declared the regulation high explosives used in France for charging artillery projectiles were TNT, picric acid and trinitrometacresol. As the war went on, new projectiles came into use, such as hand grenades, trench mortar bombs, airplane bombs, etc., so that the demand rose from about 40 tons a day at the beginning to 1,064 tons. The raw materials for such large-scale production were lacking; it was necessary to find, study and use other explosives that could be substituted for these.

Solving the Problem

The situation called for relief either by increasing the development of natural resources, by the utilization of new raw materials or by the development and use of new types of explosives. Following the first two expedients, strenuous efforts were made to increase the national production of essential materials. New coke ovens were constructed in connection with the blast furnaces, which utilized the new iron ore of Normandy; byproduct recovery systems were installed in all the old and new coke plants and benzene was recovered from illuminating gas. In addition, the rectification of the so-called oils of Borneo was developed. These oils are complex mixtures containing hydrocarbons of the aliphatic series, analogous to those of ordinary petroleum and not nitratable, and aromatic hydrocarbons, including benzene, toluene and xylene. Their composition is variable, but it may be approximately expressed as benzene 5 per cent, toluene 13 per cent and xylene 7 per cent. The extraction of these substances in a pure state is not commercially feasible, but by successive rectifications the aromatic hydrocarbons are enriched and fractions are separated, each of which contains a single nitratable hydrocarbon mixed with non-nitratable aliphatic hydrocarbons of about the same volatility. By treating these fractions with nitric acid, a mono-nitro derivative is formed which may be easily separated by distillation. The mononitrotoluene thus separated is used as raw material for making TNT. The mononitrobenzene was used in the production of aniline, dyes and diphenylamine, the well-known stabilizer for smokeless powder. The mononitroxylene can be trinitrated in the same way as toluene to form xylite and although this explosive is less powerful than TNT, its utilization was considered and studied.

Another hydrocarbon which had not been used in France up to this time for war explosives, and of which notable quantities could be obtained, was naphthalene, $C_{10}H_8$. The mono-, di- and tri-nitro derivatives were prepared, each of them, as a matter of fact, being a mixture of isomers rather than a definite chemical compound.

Picric acid, the second-mentioned regulation explosive, is the trinitro derivative of phenol. Some work was done in the early days of the war in preparing the dinitro derivative directly from benzene without the intermediate phenol stage. Benzene is transformed into a mono-chlor substitution derivative by passing a stream of chlorine through it in the presence of iron filings, which act as a catalyst. By nitration, dinitro chlorbenzene is obtained; the chlorine is relatively mobile and the OH group can be easily substituted for it by saponification with caustic soda, which gives the dinitrophenol.

$$C_6H_6 \rightarrow C_6H_5Cl \rightarrow C_6H_3\begin{cases}Cl\\(NO_2)_2\end{cases} \rightarrow C_6H_3\begin{cases}OH\\(NO_2)_2\end{cases}$$

The dinitrophenol obtained was then by a further nitration to be transformed into picric acid. However, as it was possible to procure the necessary phenol elsewhere, the latter part of the operation was abandoned and the dinitrophenol was employed directly in the mixtures.

As for metacresol, which is necessary in making one of the three regulation explosives, it was not possible to increase the stock on hand; even by uniting the resources of the allied countries scarcely more than a few tons a day could be obtained, and this was absolutely insufficient. Trinitrometacresol is used mixed with melinite for the purpose, as will be described later, of lowering the fusion point. The same rôle can be played by other substances, especially dinitrophenol, so the latter was developed to some extent.

Thus, besides the raw materials formerly used—benzene or phenol, metacresol and toluene—it was possible to utilize two new ones, naphthalene and xylene; and to the three usual nitro-explosives—picric acid,

TNT or tolite, and trinitrocresol—were added xylite, mono-, di-, and tri-nitronaphthalene and dinitrophenol. The study of certain derivatives which had been investigated and proposed for certain purposes was also resumed: trinitro-anisol, trinitrophenetol, tetranitromethylaniline and hexanitrodiphenylamine.

All these derivatives involved about the same raw materials and hence did not increase the sum total of the country's resources. Moreover, their explosive properties were not such as to warrant undertaking new and complicated methods of manufacture. Hence they were not extensively developed. Instead, attention was directed to two other types of explosives, the nitrates and the chlorates. Considerable quantities of ammonium nitrate were available from the synthetic plants of Norway, and Chilean nitrate was also being imported. The manufacture of chlorates, especially sodium chlorate and ammonium perchlorate, presented no difficulties.

The third-mentioned expedient for relieving the chemical situation—that of developing and using new types of explosives—therefore followed these lines. A large number of available mixtures can be made by mixing the various substances mentioned above, the nitro derivatives, nitrates and chlorates. The problem would have been relatively simple had there been only the questions of resources and production methods with which to cope. But there were other factors to reckon with. While almost any of the combinations can be applied indiscriminately for explosives used in mining operations, this is not true for those employed in charging shells, where the safety factor is of such great importance. Besides, the effect to be produced must not be overlooked, as a different type of shell is required for use against troops than that used to break up trenches or to destroy barbed wire entanglements. Again, the method of charging and the available apparatus for this operation had to be kept in view.

Fundamental Properties of Explosives

In developing a new explosive the essential properties to be considered are its potential energy, its force, its sensitiveness and the speed of detonation.

The potential is the total amount of heat evolved by the reaction in a closed vessel; it is measured by means of a calorimetric bomb.

The force, or power, is determined by the maximum pressure developed by the explosion in a closed vessel, and is measured by means of a pressure bomb, a strong hollow cylinder of steel closed at one end by an electric firing device and at the other by a "crusher" gage. The pressure developed is transmitted to a copper cylinder and is measured by the amount of compression sustained by the cylinder.

For a given explosive, the pressure evidently increases with the "density of the charge"—that is, the weight of explosive per unit of volume. It is not proportional to this density, for it must become infinite when the volume occupied corresponds to the smallest volume which the products of decomposition (gases and solids, if such are formed) can have, however great the compression to which they may be subjected. This smallest volume per unit of weight is called the "co-volume"; it is the volume below which the decomposition products of 1 kg. of the explosive are not compressible.

Let α be the co-volume.
π the weight of the explosive charge.
V the volume occupied.

The pressure P is related to the charge by the equation:

$$P = \frac{f\pi}{V - \alpha\pi} \qquad (1)$$

or, substituting the density of the charge $\Delta = \frac{\pi}{V}$

$$P = \frac{f\Delta}{1 - \alpha\Delta} \qquad (2)$$

f is a constant for each explosive and characteristic of the force. It is the pressure produced by 1 kg. of explosive decomposing in a closed space equal to 1 cu.dm. plus the co-volume. In fact, if we put $\pi = 1$

and $V = 1 + \alpha$

in formula 1, we find $P = f$

With powerful explosives this force is of the order of 7 to 10,000 kg. per square centimeter. It depends on the quantity of heat and the amount of gas furnished by the decomposition.

Certain nitro- or nitrated explosives contain sufficient oxygen to transform all their carbon into carbon dioxide and all their hydrogen into water. The nitrogen is supposed to remain in the free state. Such explosives are said to be completely combustible. Nitroglycerine, with an excess of oxygen, is an example.

$$2C_3H_5O_3(NO_2)_3 \rightarrow 6CO_2 + 5H_2O + O + 6N$$

Such also is the case with ammonium nitrate explosives, such as schneiderite; the quantity of dinitronaphthalene has been adjusted so as to be completely burned by the oxygen of the nitrate.

$$(NH)_4NO_3 \rightarrow N_2 + 2H_2O + O$$

This does not apply to all explosives, however. Nitrocellulose has approximately the formula $C_{12}H_{14}O_{10}(NO_2)_6$ or $C_{12}H_{14}N_6O_{22}$. To give $12CO_2 + 7H_2O$ it would require 24 + 7, or 31O, whereas we have but 22. Picric acid is $C_6H_3N_3O_7$. The molecule contains 7O, while complete combustion would demand 12 plus 3/2.

Hence, when these compounds decompose, considerable amounts of carbon monoxide are formed which can poison the air in the dugouts. With picric acid there may be a considerable amount of carbon liberated, producing a black smoke. However, the completely combustible compounds are not always the most efficacious. For example, the nitro derivatives of the picric acid class, far as they are from complete combustion, are generally more powerful than the mixtures of the schneiderite type. In the new mixtures studied during the war it was those which by incomplete combustion would yield carbon monoxide that were chiefly sought.

For nitro derivatives of the same type, the power increases as the ratio of the number of nitro groups to the number of carbon atoms in the molecule. Thus, trinitrotoluene, $C_6H_2(CH_3)(NO_2)_3$, is more powerful than the dinitro compound and more powerful than trinitroxylene, $C_6H(CH_3)_2(NO_2)_3$.

Sensitiveness

The greater or less ease with which an explosive substance detonates when subjected to friction or shock is its sensitiveness, a quality of capital importance which merits consideration, not only in regard to use of the explosive but also for handling it during the process of manufacture and in transportation. A very simple experiment will give a clear conception of its nature. A metallic weight is permitted to fall from various heights on a small quantity of the explosive in a capsule. The minimum distance through which the weight may be

dropped and still produce detonation is a measure of the sensitiveness of the explosive. Fulminate of mercury is extremely sensitive, while ammonium nitrate mixtures and picric acid are much more resistant to shock and friction. The salts of picric acid, however, particularly the alkali picrates and lead picrate, are extremely sensitive.

For a given explosive, the sensitiveness depends to a certain degree on its physical condition. It is greater in a mass of crystals which can rub against one another and it is diminished by making the mass more compact, especially by fusing and hindering the formation of larger crystals during subsequent cooling. It is also lessened by imbedding the crystals in a plastic substance which separates them. Thus melinite is imbedded in paraffine to render it less sensitive to rough handling.

Velocity of Detonation

Certain more sensitive substances detonate on being lighted. Such is always the case with lead picrate and mercury fulminate. The latter is used as a primer; the explosion wave produced by the detonation of a very small quantity of fulminate (about 2 grams) is transmitted to the explosive to be detonated. If this should not suffice, as in the case of resistant explosives, a relay is employed which consists of a certain quantity of explosive of medium sensitivity. The detonation must spread throughout the whole mass of the explosive.

The speed with which the detonation spreads through a given explosive is not a constant; it varies with the amount of tamping. A very simple method due to a French engineer, Dautriche, enables us to determine the relative velocity of detonation as compared with a standard velocity, that of a rod or string of melinite. The explosive under investigation is placed in a metallic tube T about 10 cm. long. At two well-defined points B and C are the ends of a strip or cord of picric acid, BCD. Each of these ends is provided with a charge of fulminate. The explosion is initiated by a third fulminate charge at A. The wave travels to B and then to C. The strip of explosive is laid out on a plate of lead; the two explosion waves originating at and traveling from B and C move in opposite directions through the strip and at the point where they meet produce a transverse furrow at E.

If the two fulminate caps B and C were discharged at the same time, the furrow would be made at the midpoint D of the strip, a point which is marked exactly at the beginning of the experiment. A slight lag between the detonation of B and C, however, will cause a displacement of the furrow to E. This displacement, DE, is measured carefully and will be represented by e. The distance between the two caps B and C is also measured and called l.

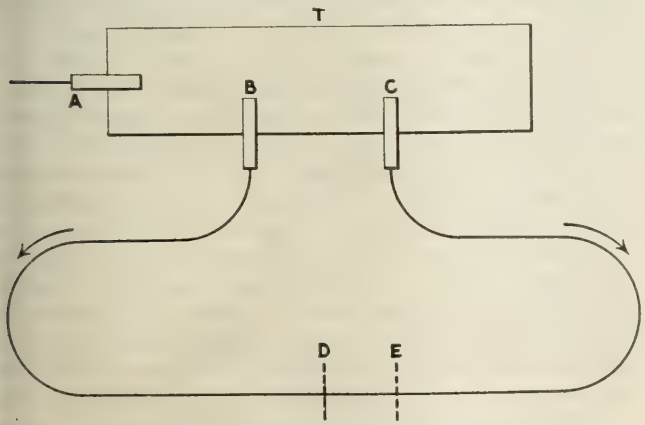

DIAGRAM OF APPARATUS FOR TESTING VELOCITY OF DETONATION

Let L = length of strip BD.
v = the velocity of the detonation to be measured.
V = the velocity of detonation in the strip.

The times of travel of the two explosion waves BDE and DCE are equal. Therefore,

$$\frac{L+e}{V} = \frac{l}{v} + \frac{L-e}{V}$$

or

$$\frac{2e}{V} = \frac{l}{v}$$

Whence

$$\frac{v}{V} = \frac{l}{2e}$$

The velocity V in the cord of melinite as measured by a direct method is about 7,000 meters per second. The maximum velocity of detonation of nitro explosives lies between 6,000 and 7,500 meters per second; that of schneiderite and other nitrate explosives between 5,000 and 6,000 meters; that of chlorate explosives between 3,500 and 5,000 meters.

Density Limit

Let us study a nitrate or chlorate explosive under different degrees of tamping or compression. Untamped, the material has generally but a low velocity of detonation: it increases with tamping and hence with the density up to a certain degree of compression, beyond which it diminishes rapidly and the detonation is no longer transmitted. The density corresponding to the maximum velocity is called the "density limit" under the conditions of the experiment. This point is of great importance, for if, in charging, this limit is overstepped, the explosive could not be detonated.

The density limit has not a fixed value for a definite explosive; it increases with the dimensions of the receptacle and the resistance of the containing walls. Thus, in the open air, schneiderite will not detonate unless its density be somewhat greater than 1; in a tube of copper, 2 cm. in diameter and with a wall-thickness of 1 mm. similar to those used in the method of Dautriche, the density limit is 1.45 to 1.50; it is over 1.50 in a 75-mm. shell and 1.6 in a 155-mm. shell.

Nitro explosives (picric acid, tolite, etc.) have, so to speak, no density limit; the velocity of detonation only becomes irregular as a result of great compression—4,000 kg. per square centimeter (density 1.7).

The properties and determinations described form the basis for the choice of explosives for producing any desired effect. For shells to be used against troops the charge should break the envelope into a large number of fragments which will act as so many separate projectiles. Therefore a very powerful explosive is required and a very sudden detonation. The nitro explosives fill this requirement admirably.

On the other hand, there is no need of great velocity of detonation to destroy trenches, power and potential energy being the qualities desired. Nitrate explosives which are slower, and some of which evolve more heat, will often do more effective work on the ground than nitro explosives.

For mining operations a great variety of formulas may be used. It is quite feasible to control the charging density to give the desired detonation.

The use of explosives in projectiles, especially in projectiles for artillery of high initial speed, presents other important problems. The velocity of such a projectile rises from 0 to 500 meters per second in about 0.01 second. Besides, it generally takes a rotary motion. The effect of inertia on the explosive contained in the shell will have a tendency to produce friction between the particles and consequently ignition and premature explosion followed by rupture of the gun or at least serious damage.

For use in projectiles the charge mass must be stable and free from any tendency to shift or become displaced. To this end it is necessary that the material be compact, without open spaces after the charging, and have no tendency to form them at the firing of the shot. At that instant, the interior charge is pressed against the base of the shell with a force that can readily be conceived. The phenomenon is called the set-back.

If S be the exterior surface of the base of the shell, P the maximum pressure produced by combustion of the powder, the force acting on the shell is PS.

Let M be the mass of the shell, G its acceleration.

Then $PS = MG$.

Let p be the weight of the shell and g the acceleration due to gravity.

Then $p = Mg$

Whence $$PS = p\frac{G}{g}$$

$$G = g \times \frac{PS}{p}$$

Calculation shows that the acceleration G of the projectile is greater the smaller the caliber. For a 75-mm. shell, G equals 17,000 g. That means that the charge, as well as each part of the shell, at the moment of starting, weighs about 17,000 times its ordinary weight. By multiplying the acceleration by the total weight of explosive and dividing by the cross-section of the interior, we obtain approximately the pressure to which the layer of explosive on the base is subjected. This is called the pressure due to the set-back. In the 75-cm. shells its maximum value is about 900 kg. per sq.cm. Under this pressure the explosive material is compressed to a density which we may determine by subjecting a small portion of the explosive to the same pressure in a cylindrical mold and measuring the density of the compressed mass. The preliminary tests must necessarily be verified by density measurements made on charged, but unprimed, projectiles that are actually fired. A surcharge of propellant is employed to give the desired margin of safety. The unexploded shell is recovered, opened and the density of the charge at the base is measured.

This is the density that must be reached in charging. If not, it will be reached in firing the backward displacement of the charge toward the base which, as we have said, might cause a premature explosion. The density thus determined and which must be realized in charging is then compared with the "density limit" of the explosive—that is, the density beyond which the detonation is no longer transmitted. If the "density limit" has been overstepped, the explosive under investigation must be abandoned for the caliber intended.

To realize these necessary conditions—low sensitiveness, compactness, sufficient density—two methods of charging are employed: Compression and fusion.

The shell is filled with the powdered explosive and rammed down by hydraulic pressure. This process produces compact charges, but is too slow for intensive production. Picric acid shells were loaded this way, a mixture of 88:12 picric acid:paraffine being used. The paraffine incloses the crystals reducing the sensitiveness and gives the necessary plasticity for the compression without hindering the detonation, the latter being accompanied by a fulminate primer and a relay of picric acid crystals properly tamped. This combination was used for shells of medium and large caliber.

Ammonium Nitrate Explosives

Since 1888, the Service des Poudres had manufactured an explosive composed of 87.5 per cent of ammonium nitrate and 12.5 per cent of dinitronaphthalene for use in mining operations. This explosive, on complete combustion and sudden decomposition, yields a large volume of gas, the final temperature of which is not very high so it is a safe explosive for use in mines where firedamp prevails. It was not employed by the French artillery, but had been utilized by the Schneider company to charge projectiles which it sold to foreign countries and which were used especially in the Balkan war. Hence the name "schneiderite," by which it is known. Thus it was an explosive that had been studied, had been tested for war purposes and had given satisfaction. One of its drawbacks was the fact that ammonium nitrate is hygroscopic and the explosive must be protected from moisture.

An analogous but more powerful mixture consisting of 77 per cent ammonium nitrate with 23 per cent xylite was also used. Sodium nitrate may be substituted for the ammonium salt, although it produces a smaller volume of gas and forms an explosive with less shattering power than schneiderite; but for large caliber shells and for clearing ground it gives satisfactory results.

TABLE I—COMPOSITION OF PROJECTILE EXPLOSIVES

Constituent	Per Cent									
NH_4NO_3	87.5	77	70	80	85	50	50	50	50	50
$NaNO_3$	....	..	..	..	..	30	30	30	30	30
Dinitronaphthalene	1.25	..	..	..	10	..	..	..	..	..
Trinitronaphthalene	....	..	..	20	..	20	..	..	15	15
Xylite	....	23	..	..	..	..	20	..	5	..
TNT	....	..	30	..	5	..	..	20	..	5

Of the new combinations tried and tested, a number were considered satisfactory and held in reserve. These formulas are summarized in Table I.

Charging in Fused State

Most of the explosives charged in this way are nitro compounds either alone or in mixture. The explosive is melted in a bath of boiling water or glycerine and is poured directly into the shell. These melted explosives, after solidification, usually have a greater density than would be needed to prevent displacement on firing of the shell. Thus one of the essential conditions of proper charging is attained. It is necessary only to avoid free spaces and hollows which may form by contraction when the material solidifies, especially in the upper portions.

As before mentioned, an explosive fused into a compact homogeneous mass is generally less sensitive to shock than when in the powdered condition. That is an advantage, but care must be taken to prevent the formation of crystals during the solidification. To this end the material is stirred with a wooden ladle after solidification begins, so as to interfere with crystal formation. This operation is called "touillage" (stirring). Single compounds used alone, such as picric

id and TNT, have a tendency to form large crystals, ndering the process quite risky. On the contrary the ndency to crystal formation is much less marked in ixtures, especially eutectic mixtures.

Xylite, or TNX, melts at 170 deg. C. and cannot be ed alone for charging in the fused state. Mixing ith other substances not only lowers the boiling point t brings about a particularly fine and homogeneous ructure, favorable to safety. It is not always possible use a eutectic mixture, however, for the melting point ay be brought below that prevailing in munition pots.

Table II gives the proportions of some fused explo- ves which have been studied and pressed into service could have been used if the need had developed.

ABLE II—PROJECTILE EXPLOSIVES CHARGED IN FUSED STATE

	Composition—Per Cent													
cric acid	100		40	80	60	70	55	55	50	80	60		50	60
initrocresol			60				10	10						
initrophenol					40		35				10	90		30
NT		100						35			30	10	40	
ylite										20			10	10
ononitronaphthalene						30			50					
initronaphthalene				20										

Ammonium nitrate melts at 166 deg. C., at which emperature it also starts to decompose. The melting oint is lowered by mixing with sodium nitrate or am- ionium thiocyanate, NH_4SCN, which also aids combus- on. The formula used was:

Ammonium nitrate	71 per cent
Sodium nitrate	5 per cent
Ammonium thiocyanate	11 per cent
Powdered aluminum	13 per cent

The mixture of salts is first fused alone and then the luminum is mixed in by simple stirring. This explo- ive may be poured at temperatures below 130 deg. C. nd is used in shells of large caliber.

Chlorate Explosives

The alkali chlorates and perchlorates are explosive ompounds, but on account of their sensitiveness the anger of handling them is great, and this stood in the ay of large-scale production for a long time. It is nly within the last 20 years that the problem has been olved by incorporating the salts in a combustible mate- ial of plastic nature. This material is melted, the hlorate mixed in by processes involving a minimum mount of friction and the mixture is then cooled. The lastic material may be a solution of nitrated hydro- arbons in castor oil, or simply paraffine or vaseline, ats, or a mixture of such substances. The use of this lass of explosives for war needs had a peculiar interest or France.

The preparation of chlorates and perchlorates is rela- ively simple. It involves none of the materials needed or other explosives; no hydrocarbons or nitrates; no oncentrated nitric or sulphuric acids. The essential aw material is sodium chloride, which France pro- uces in abundance from salt marshes and mines. An- ther requisite is electric energy. France is well sup- lied with water power, which was in great demand for umerous other war products—chlorine, calcium car- ide, aluminum, ferro-alloys, chromium, manganese, pecial steels. It was possible, however, to divert a ufficient amount for chlorate manufacture.

Unfortunately, however, the chlorates are more sensi- ive to shock and friction than the other two classes (nitro-compounds and nitrates) and for this reason could not be employed in projectiles of high initial velocity in which the charge undergoes a sudden and violent compression at the instant of departure from the gun. Hence this class of explosives was reserved for mine opertions and for projectiles of low initial velocity—for instance, in hand grenades, aviation bombs and trench mortar shells.

Conclusion

Such were the problems that confronted the French chemists at the beginning of the war and such were the steps taken to solve them. It has been shown in a general way how much preliminary work is necessary to develop a new explosive. A long series of preliminary investigations is necessary; first of all in the laboratory, to determine the characteristic properties, heat evolved, pressure developed, sensitiveness, velocity of detonation, melting point and other empirical tests approximating the conditions in practice, such as the enlargement produced in a hollow block of lead or in the earth, or the crushing of a lead cylinder. Then the investigation must be carried over to actual use; charging shells, safety test by actual firing, proper charging density by examination of material in re- covered shell, fragmentation, volume of shell holes pro- duced, etc. The results of this work were such that the French army was able to meet all contingencies, as far as ammunition was concerned.

Acetone as a Solvent for Varnish-Gums, Resins and Shellacs

A critical examination of the solvent properties of acetone, produced by the destructive distillation of cal- cium acetate, is being conducted at the Mellon Institute of Industrial Research of the University of Pittsburgh, Pittsburgh, Pa., in order to ascertain its value as a commercial solvent.

In the course of the work on the solvent properties of acetone, a number of gums, shellacs and natural and artificial resins have been investigated. The percentage of acetone-soluble material in water-gums was found to be considerably less than in copal resins. The former contained from 7 to 17 per cent of acetone-soluble material, while the solubility of the latter class of gums varied from 30 to 100 per cent in the same solvent. The solubility of water-gums at room temperature was found to be quite low, while the copal resins tested were either miscible in all proportions or in a concentrated solution with a separation on dilution. The solubility of shellacs and resins varies somewhat with the grade of product. The WW grade resin is entirely soluble and miscible in all proportions, while inferior grades contain different amounts of insoluble material: the part soluble, however, is miscible in all proportions at 25 deg. C.

It was noted that the addition of another solvent, as methanol, to acetone greatly increased its solvent prop- erties. Acetone was found to be miscible in all pro- portions with all the ordinary commercial solvents tested, thus permitting composite solvents to be had, the solvent power of which greatly exceeds that of the individual solvents.

The present grade of acetone obtained from calcium acetate is of excellent homogeneity and uniformity. Its low specific gravity gives it a larger volume per pound and thus lowers its price per gallon when compared with a number of ordinary commercial solvents.

Mechanical Properties Of Commercial Iron

Definitions of Various Terms Used in the Art of Testing Materials, and a Discussion of How Various Circumstances Surrounding the Test Affect the Results on Annealed Bars of Common Structural Metals

By Zay Jeffries and R. S. Archer

BROADLY speaking, the mechanical properties of metals are those properties which describe the behavior of metals in the mechanical arts. The conditions to which metals are subjected, both in service and in the fabricating processes which precede service, are of unending variety, so the engineer is confronted with the problem of determining the suitability of metals for the various conditions of fabrication and of service. It is to meet this problem that the science of mechanical testing has been developed.

The most certain evidence of the behavior of a metal under a given set of working conditions consists in the accumulated results of many trials under those conditions. Actual working conditions are often very complex, however, and the accumulation of such evidence is a long, slow and costly process. It is, therefore, desirable to analyze the complex conditions into a relatively small number of more simple elements. The common tests of metals, such as the tensile test, are designed to determine these more elementary properties.

Complexity of "Simple" Properties

A mechanical test is merely a mechanical operation in which the variables are controlled and the results quantitatively measured. The smaller the number of independent variables the more easily are they controlled and hence the greater the accuracy of the test and the more fundamental the nature of the property disclosed. Considering our "simple" mechanical properties of metals in this light, we find that they are quite complex in comparison with the properties regarded as fundamental physical constants. The melting point, for example, of a metallic element is sufficiently fixed for practical purposes to be regarded as absolute. Pressure and grain size exert a slight but negligible influence. The tensile strength, on the other hand, cannot be stated with satisfactory accuracy even for a pure metal without defining the temperature, structure of the metal, form and size of test piece, and rate of loading.

There is, therefore, a need for still further simplification in testing—that is, for further analysis of the common mechanical properties and the defining of properties of a more fundamental nature. Such an analysis must be made with the assistance of all the knowledge afforded by metallography of the structure of metals, and the effects of deformation and temperature on structure. Attempts have been made and are unfortunately still being made to solve these problems by pure mathematics.

The analytical method is of course limited. Even if it were possible to define all of the fundamental constants upon which the mechanical properties of metals depend, and to determine them, the synthesis of these elements into results of direct utility would undoubtedly present such difficulties that in many cases the empirical method of attack would be more easy and more certain. Such a knowledge of fundamentals would be invaluable, however, in classifying empirical information and in pointing the way to new knowledge.

It is almost needless to say that a fundamental study of the properties of metals and alloys should begin with the pure metals. There has nevertheless been some tendency to give the properties of the pure metals less attention than they deserve, perhaps because of failure to recognize their true complexity. While it is true that metals are most widely used in alloyed form, it is also true that a fundamental understanding of the properties of the alloys requires an understanding of the properties of the pure metals upon which they are based.

Classification of Properties

All of the mechanical tests consist in observing quantitatively the behavior of metals under stress, the various tests being differentiated by the type of specimen and the manner and rate of application of stress. According to the rate of application of load, tests are often divided into two classes, called "static" and "dynamic." The so-called static tests include the ordinary tension, compression, torsion and transverse tests, as well as the Brinell hardness test. The Shore scleroscope test for hardness would also probably be classified as a static test. The dynamic tests include the various types of alternating stress or fatigue tests and the single and repeated blow impact tests. (Another division is sometimes made into static tests, repeated stress tests and impact tests.)

The effects of stress are deformation and rupture. The mechanical properties of metals may be classified in a general way in three groups, describing (1) *resistance* to deformation and rupture; (2) *capacity* for deformation without rupture; and (3) *work* of deformation or rupture.

In the first group, which may be designated by the general term *hardness*, are included the elastic limits, elastic moduli, tensile strength, transverse strength, shearing strength, endurance limit under repeated stresses, Brinell hardness, scleroscope hardness, etc.

The second group may be covered by the term *plasticity*, and includes the elongation and reduction of area in the tensile test, the relative compression without rupture in the compression test, the angle of twist in the torsion test, the deflection at failure in the transverse test, angle of bend in the bend test, as well as the general properties denoted by the terms ductility and malleability.

The work of deformation and rupture is the product of the resistance to deformation by the amount of deformation, and can be calculated from the complete data of any test in which both load and deformation are observed continuously or at close intervals. It is represented by the area under the stress-strain curve. The only common test in which the work is measured directly is the single-blow impact test.

In a test specimen subjected to simple stress, as ten

on or compression, the energy of deformation is applied uniformly to all of the metal under test, as long as the deformation is elastic. The energy is stored as elastic energy, recoverable on removal of the load, and is called *resilience*. The work expended in deforming unit volume of a material to its elastic limit is the modulus of resilience.

When the elastic limit is exceeded, plastic deformation may take place in a fairly uniform manner, as when a tensile specimen draws out evenly without necking. The work of permanent deformation may then be calculated per unit volume of the metal. When the deformation ceases to be uniform, as when necking occurs, it is no longer possible to refer the energy to a definite volume of metal. Supposing the stress-strain diagrams of two tensile test-bars to show the same total work of rupture, the maximum energy absorbed per unit volume of metal will be in the bar having the greater reduction of area.

Cause of Hardness and Strength

Metals owe their resistance to deformation to the forces between the atoms. These forces are both attractive and repulsive, and are directional. The repulsive forces are manifested by the resistance of metals to hydrostatic pressure by which the atoms are forced closer together in all directions. Under ordinary compression loading, the atoms are forced together in the direction of the compression but apart in the direction of the secondary tensile stresses. Under direct tension the distances between atoms are increased in the direction of the load and decreased in the direction—at right angles—of the secondary compressive stresses. There is no condition of loading corresponding to a negative hydrostatic pressure, under which the interatomic distances would be increased in all directions.

Any permanent deformation of a metal involves changes in the relative positions of some of the atoms, and, therefore, the breaking, temporarily at least, of some interatomic "bonds." The rupture of any material, whether with or without permanent deformation, also involves the breaking of interatomic bonds. The greatest possible resistance that a material can offer to deformation or rupture is the summation of all the interatomic bonds on a plane through the specimen normal to the stress, a summation which may for convenience be termed the "absolute cohesion" of the material. Actually such a summation of forces is never realized, because rupture always takes place by degrees, and the breaking of atomic bonds is not simultaneous. The tensile strength of a material merely represents the maximum number of atomic bonds that come into play simultaneously during the test.

Absolute cohesions of metals are far in excess of the values obtained for tensile strength. A qualitative illustration of this fact may be found in a consideration of some properties of pure iron. The tensile strength, after hot-rolling, is about 40,000 lb. per sq.in., a value representing as usual the maximum load divided by original cross-section. If the actual reduced area of the test-piece is measured throughout the progress of the test and the stress computed on this basis, a value will be found for the maximum stress which is much higher than the tensile strength. The maximum stress will then be about 80,000 lb. per sq.in. Severely cold-worked iron may show a tensile strength of 150,000 lb. per sq.in. The maximum actual stress is again somewhat higher (165,000), but not in so large a ratio as in the case of the hot-rolled iron. Even in the cold-worked iron, rupture still takes place by degrees—that is, by a kind of tearing action—so that the highest of these figures still does not represent the inherent absolute cohesion.

Some very interesting tests of glass have been reported by Griffith[1]. In ordinary fibers of 0.040 in. diameter the material had a tensile strength of about 25,000 lb. per sq.in. The tensile strength was found to increase as the diameter of the fibers decreased, and in very fine fibers, carefully prepared, surprisingly high values were obtained. The maximum strength recorded was 498,000 lb. per sq.in. at a diameter of 0.00016 in. Plotting the reciprocal of the tensile strength against the diameter of the fiber and extrapolating to zero diameter, Griffith found a value of 1,600,000 lb. per sq.in., representing the theoretical "absolute cohesion" of the glass.

Calculations based on the energy required to separate the atoms of metals by vaporization give values up to about 5,000,000 lb. per sq.in. for the "intrinsic pressure," a quantity which is theoretically of the same order of magnitude as the absolute cohesion.

The accuracy of Griffith's extrapolation and of values for cohesion derived from the heat of vaporization may be questioned. The actual numerical values reached are of little significance. The important thing is that metals possess very great inherent cohesion, greater probably than is ever realized in tensile tests of the pure metals or their strongest alloys. Looked at from this point of view, the problem of the hardening and strengthening of metals by various means becomes more simple. Instead of inquiring why metals are so strong, we may better ask why metals are so weak.

Nature of Plasticity

Permanent deformation of any material involves displacements within the material, during which the cohesion is overcome between the parts undergoing relative displacement. The property of plasticity depends upon the ability of such displaced parts to re-establish cohesion in their new positions. This ability is a conspicuous characteristic of liquids, and the plasticity of many materials depends on the possession of a structure like that of liquids, or on the presence of some liquid, to preserve continuity during deformation. Glass is a typical example of undercooled liquid which at certain temperatures is distinctly plastic. Even after cooling to temperatures of great rigidity its structure is still that of a liquid, in the random arrangement of molecules. Clay, on the other hand, owes its plasticity to the presence of a continuous matrix of water which holds together the fine particles of non-plastic solid matter.

According to the amorphous metal hypothesis of Beilby, metals preserve their continuity during plastic deformation by the generation of fluid amorphous films on the surfaces of slip. On this basis the plasticity of crystalline materials depends on their ability to generate such amorphous films. It is quite conceivable, however, that crystalline fragments might adhere to each other without the intervention of a layer of undercooled liquid or vitreous amorphous material.

Complexity of structure is opposed to plasticity. The molecules of a liquid establish cohesion bonds with each other easily without the necessity of any particular arrangement. Hence two bodies of a given liquid unite with each other on contact. When contact is brought about between two solids whose rigidity depends upon a highly organized structure, the establishment of cohesion is not so easy. When a piece of wood, for example, is broken in two, it is practically impossible to replace the parts either in their original positions or in any other positions in which cohesion is re-

[1] "The Phenomena of Rupture and Flow in Solids," A. A. Griffith, *Phil. Trans.*, Series A, vol. 221, pp. 163-198.

established. In metals the structure, though crystalline, is relatively very simple. It is easily imagined that the fragments of a metallic crystal broken along a crystallographic plane might be brought into contact on this plane in perfect registry so that the original space lattice, and hence cohesion, might be re-established. Probably plastic deformation of metals involves both this type of junction and junction by more or less disorganized or amorphous metal. The monatomic condition of aggregation of the metals and their simplicity of crystalline structure favor both mechanisms.

Common Properties of Commercial Iron

In Table I are given the common mechanical properties of a very pure grade of iron, in the annealed condition after working. The tests were all made at ordinary temperatures and under usual conditions. Besides giving useful information about this most important metal, these figures will serve to illustrate a brief discussion of some of the mechanical properties.

The elastic and proportional limits are practically identical. Difference in the values given reflects chiefly the difficulty of an accurate determination: the actual results obtained depend on the sensitivity of the measurements of extension. When metals are tested at temperatures well below that of recrystallization, the passing of the elastic limit represents the beginning of plastic deformation by transcrystalline slip. At temperatures near or above the recrystallization temperature, intergranular flow may take place and mark the elastic limit; the stress required varies greatly with the time of application.

The yield point is well marked in iron and mild steel, representing a considerable extension at nearly constant stress. During this stage the formation of slip-bands is general throughout the specimen; the effect is visible on the machined surface of a test-bar, which becomes dull. In non-ferrous metals the yield point is not nearly so well marked and can be defined only as the stress at which some arbitrarily selected extension occurs.

Up to the elastic limit the metal is unaffected by the application of the test load. Beyond this point, however, the deformation incident to the test alters

TABLE I—PROPERTIES OF ANNEALED ARMCO IRON

Property	Value	Remarks
Elastic limit in tension, lb. per sq.in.	14,400	
Proportional limit in tension, lb. per sq.in.	16,100	
Yield tension, lb. per sq.in.	19,000	
Ultimate tensile, lb. per sq.in.	42,400	½ in. diameter specimen
Ultimate tensile*, lb. per sq.in.	48,200	0.025 in. diameter specimen
Per cent elongation in 2 in.	48.3	½ in. diameter specimen
Per cent elongation in 2 in.*	23.7	0.025 in. diameter specimen
Per cent reduction in area	76.2	½ in. diameter specimen
Per cent reduction in area*	76.0	0.025 in. diameter specimen
Elastic limit in compression, lb. per sq.in.	19,400	
Proportional limit in compression, lb. per sq.in.	19,200	
Yield point in compression, lb. per sq.in.	20,600	
Ultimate in compression, lb. per sq.in.	31,200	
Elastic limit in torsion, lb. per sq.in.	12,400	
Proportional limit in torsion, lb. per sq.in.	12,500	
Yield point in torsion, lb. per sq.in.	13,600	
Modulus of elasticity in torsion, lb. per sq.in.	11,770,000	
Young's modulus in tension and compression*, lb. per sq.in.	30,000,000	
Endurance limit, Farmer rotating beam, lb. per sq.in.	26,000	
Endurance limit, Olsen-Foster reversed torsion, lb. per sq.in.	12,500	
Brinell hardness number*	75	
Shore scleroscope hardness	18	
Energy of rupture on impact, ft.-lb.	19.3	Specimen 0.394 in. square, notched to ¼ depth, bottom of notch 0.04 in. radius.

* With the exception of the properties marked with asterisk, the results given in this table were reported by H. F. Moore, Eng. Exp. Sta., Univ. of Ill.

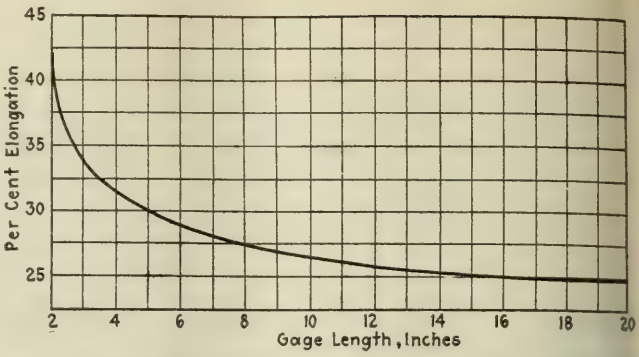

FIG. 1—EFFECT OF GAGE LENGTH ON ELONGATION OF SOFT STEEL
Test piece 0.688 in. diameter

the structure and properties of the metal. Elongation, reduction of area and tensile strength therefore depend not only on the original condition of the metal but also upon the effect of the testing operation itself. The mechanism and effects of plastic deformation must be considered in interpreting the results of tests in which the metal is plastically deformed.

General and Localized Elongation

Most of the ductile metals draw down at the point of fracture so that the relative elongation at this point is greater than the general relative elongation along the bar. Total elongation as measured is, therefore, made up of two parts, one a general elongation approximately uniform along the bar and the other a variable local stretch where the bar necks down. The maximum local stretch can be calculated from the reduction of area on the assumption that the volume of the metal remains constant (which is practically true). When the reduction of area is high the per cent elongation on the constricted portion of the bar may be several times the per cent general elongation. Hence on bars of the same cross-section, the per cent elongation, measured so as to include the fracture, is greater the shorter the gage length. (See Fig. 1.) If the gage length remains constant but the test-bars differ in cross-section, then the per cent elongation is greater on the larger bar, as illustrated by the values given in Table I. The gage length is 2 in. in each case. On the ½-in. test-bar the per cent elongation was 48.3, made up largely of the local stretch at the fracture. Wire of 0.025 in. diameter showed elongation of 23.7 per cent, representing almost solely the general elongation—since the contribution of the small local stretch is in this case negligible.

Reduction of area in tension is characteristic both of the metal and the conditions of test. General elongation is to a similar extent characteristic of the metal; elongation as commonly measured, however, includes a factor which is proportional to reduction of area. Reduction of area and general elongation are not affected in the same way by changes in temperature and other variables. Since the measured elongation includes both factors, it will be found that the effect of temperature and other conditions depends largely on the ratio of gage length to cross-section. The relative elongation found by the tensile test is the most common criterion of ductility, the general elongation being probably a better indication than the total elongation measured over a short gage length.

Ductility and Malleability

Ductility is capacity for being drawn out, or plastically deformed, by direct tensile load without rupture.

is a property which requires both plasticity and tensile strength, and does not, therefore, necessarily reach a maximum value when plasticity is at a maximum—most metals have the greatest plasticity above the recrystallization temperature, but greatest ductility below the recrystallization temperature; they have not sufficient tensile strength above the recrystallization temperature to sustain the loads necessary to draw them out. Malleability is capacity for plastic deformation without rupture by hammering. It does not require as much resistance to tension as does ductility, since the metal is not subjected to the entire deforming load in direct tension. Secondary tensile stresses are developed, however, of greater or less magnitude depending on such factors as the manner of hammering and shape of dies. Some strength is therefore required, in the absence of which the metal is said to be "tender." The process of drawing out by swaging in confined dies is less exacting on the strength of the metal than are most forms of hammering, and can often be carried out when successful working by hammering is not possible.

There are no fixed standards of plasticity, ductility and malleability. In fact, these properties are so loosely defined that they cannot be expressed accurately even in relative terms. While the term plasticity refers chiefly to *capacity* for deformation, it also carries some implication of *ease* of deformation. Consider iron, for example, at the temperatures 1,000 and 1,100 deg. C. At either temperature it can be plastically deformed to an almost unlimited extent. It is softer at the higher temperature, however, and would commonly be considered more plastic. Since it can be deformed more easily by hammering or rolling at the higher temperature, it would also be generally considered more malleable. Ductility refers more definitely to capacity for deformation by drawing, but there are various ways of estimating such capacity. Some of the older tables in which the metals are arranged in the order of ductility are based on the fineness of the wire which can, or rather has, been drawn, just as the tables of malleability are based largely on the thinness of the sheet or foil that can be beaten. Another criterion is the total reduction in section, or extension in length, possible by drawing without intermediate annealing; on this basis copper is much more ductile than iron at room temperatures. Relative ductility is also sometimes measured by the maximum reduction possible in the first die or the first few dies. In this respect iron is more ductile than copper.

It will be noted in Table I that the tensile strength of the iron wire is about 14 per cent higher than that of the ½-in. test-bar. Presumably the two materials are similar as to structure, and the difference in strength is in accordance with the general observation that tensile strength increases as the diameter of the material decreases. This has been recognized in standard specifications for wire.

It is remarkable that this material showed an endurance limit under repeated stress about 60 per cent higher than its elastic limit in tension. Although there is no general law connecting endurance limit with the static properties, the endurance limit is usually less than the elastic limit in tension. It may be remarked in passing that the endurance stress of 26,000 lb. per sq.in. given in the table was calculated from the formula for a transversely loaded beam, which depends upon the assumption of perfect elasticity, yet the calculated stress is well above the known initial elastic limit of the metal.

Rate of Loading

Time plays an important part in the behavior of metals under stress. Thurston[2] divided metals and alloys into two classes according to whether or not they exhibited flow under prolonged application of stress. At ordinary temperatures, iron will sustain indefinitely any load which it will sustain for a short time. Many of the non-ferrous metals, however, especially the softer metals, like lead, tin and zinc, yield gradually under constant load; in the course of years, lead roofing will creep under its own weight.

Variations in the rate of applying load in the ordinary tensile test have a marked effect on both tensile strength and elongation of soft metals, which are as a rule increased by increasing the rate of loading. Ordinary variations in the rate of testing have practically no effect on the tensile properties of iron and steel. Under extremely rapid loading the elongation may be increased. Some tests have been reported by Maitland[3] on a steel which had a tensile strength of 58,000 lb. per sq.in. with an elongation of 27 per cent in 2 in. when broken in the usual manner. A specimen was screwed in blocks arranged so as to fall vertically in a slide for a certain distance, when the top block was arrested by stops and the specimen was broken by the momentum of the lower block. Broken in this manner the elongation was 47 per cent. The rate of loading was still further increased by driving the ends of the test-bar apart by exploding gunpowder or guncotton. Under these circumstances the elongation was up to 62 per cent. Such increases by rapid loading are not always obtained.

Instead of causing failure at a low stress, extremely slow loading of iron causes a considerable increase in tensile strength. Wires broken after a gradual application of load during about 2 months gave a tensile strength about 25 per cent higher than that obtained in a quick test. This behavior, which is peculiar to iron in its magnitude, will be discussed later and correlated with other properties.

Time plays an unimportant role in causing fatigue, especially in iron and steel. Thus the metal can be subjected without failure to a static load much greater than its endurance limit under repeated stresses for a period of time greater than that required in the fatigue test. It is the reversal of deformation rather than the prolonged application of load that does the damage.

There has long been a rather general belief that metals, particularly iron and steel, break more easily under suddenly applied load—i.e., shock or impact—than under slowly applied load. Impact tests have been made on rails and axles as a matter of routine inspection, to determine their susceptibility to easy fracture by shock. Several types of impact testing machine have been developed; the most common one breaks a notched bar by a single blow and measures the energy of rupture. It has been shown that for many kinds of steel the energy absorbed is practically the same whether the bar is broken in the impact machine or by slow bending. In other words, the test is merely a bend test of a notched bar. Some steels, however, appear to break much more easily by rapid than by slow bending.

[2] Thurston's "Materials of Engineering, Part 3, Alloys, Brasses and Bronzes," p. 489. John Wiley & Sons, Inc.

[3] "The Treatment of Gun Steel," *Proc. Inst. Civil Engrs.*, vol. 89, p. 120.

Legal Notes

By Wellington Gustin

Leasing of Equipment to Dealers Not Unfair Competition—Court Discusses Competition

In the case of the Sinclair Refining Co. against the Federal Trade Commission, the Circuit Court of Appeals set aside the order made by the commission against the Refining company and an appeal by certiorari was made to the United States Supreme Court. (42 Sup. Ct., 183.)

Complaint by Federal Trade Commission

The substance of the complaint against the Refining company was that it leased for a nominal consideration its oil pumps, storage tanks and containers and their equipment to persons who purchased oil from it with the understanding that same should not be used by the lessees to hold or pump the oil of any competitor. It was also charged that the leases were made on consideration that lessees should not purchase or deal in the products of a competitor.

The question presented was whether, under the terms of the contract between the Refining company and its customer, the leasing of containers and pumps is an "unfair method of competition" as these words are used in section 5 of the Federal Trade Commission act of Sept. 26, 1914, or whether the effect of such leasing be substantially to lessen competition and tend to create for the company a monopoly in the business of selling its products in violation of section 3 of the Clayton act.

The Court of Appeals says that neither of these sections gives the Federal Trade Commission power to regulate trade generally. And jurisdiction under section 5 exists only where there are practices that amount to a fraud in regard to some public or private right, otherwise they do not amount to an unfair method of competition. This court was of the further opinion that the company had the undoubted right to furnish any and every purchaser of its products such containers and conveniences to aid him in delivering such products into the possession of the consumer as it might see fit, and at such charges as it might see fit. The right to fix prices is not given to the Federal Trade Commission, it says, and the only cases where the question of prices has come into consideration have been those wherein the making of a price—in some cases high, in others low—has been used as an element in some fraudulent scheme of oppression. The price which one may put upon that which he has to sell or lease is a matter wholly his own.

Legitimate Weapons of Competition

Turning its discussion to competition, the court says this is not an unmixed good. "It is a battle for something that only one can get; one competitor must necessarily lose. The weapons in competition are various. Superior energy, more extensive advertising, better articles, better terms as to time of delivery, place of delivery, time of credit, interest or no interest, freights, methods of packing, lower prices, more attractive and more convenient packages, superior service and many others are and always have been considered proper weapons. Expense attending the use of any weapon, the foolishness of it, the fact that a method is uneconomical or that the competitor cannot meet any method or scheme of competition because it will be ruinous to him to do so have not, nor has either of them, ever been held unfair. Such things are a part of the strife inherent in competition."

The fact that the company loaned an expensive pump and container, more than its competitors did for the customer, does not make the transaction unfair, says the court further. If it does, then the law must mean that the Trade Commission is set as a watch on competitors, with the duty and the power to judge what is too fast a pace for some and to compel others to slow up; in other words, to destroy all competition except that which is easy.

Right of Customers to Handle Competitors' Products Not Limited

Further, this court was of opinion the company had not violated section 3 of the Clayton act. The complaint under this section against monopolizing the business is that the company made leases for the container and pump and fixed the price therefor "on the condition, understanding and agreement that the lessees thereof shall not purchase or deal in the products of a competitor or competitors of the company." But the contract showed a limitation only that the equipment should be used for the sole purpose of storing and hauling the lessor's products. There was no further agreement attempting to limit the right of customers to handle the products of competitors. Still the finding of the commission indicated the real trouble which it desired to reach to be that of leasing out costly equipment at a nominal rental far below the cost of purchasing and leasing, the effect of leasing in this manner, which smaller competitors could not meet, and by contract restricting the use of the equipment to the company's products tending to lessen competition.

Trade Commission Not Empowered to Fix Rentals

The necessary conclusion from the findings and order of the Trade Commission is, as put by the court: "First, that the commission deemed it lawful and proper for it to condemn certain rentals and also to fix and regulate the rentals on the equipment because the furnishing of such equipment required a large capital investment and because many competitors were financially unable to do that sort of thing." But the court points out that Congress did not bestow upon the commission such power.

Now section 3 does make it unlawful to make sales or leases on the condition, agreement or understanding that the lessee or purchaser thereof shall not use or deal in goods, etc., of a competitor where the effect of such lease, condition, agreement or understanding may be substantially to lessen competition, etc. But the company's contract with its customer does not prevent him from also dealing in products of its competitors; only its leased equipment shall be used exclusively in handling its own products. The court was of opinion that section 3 could not be construed as preventing the company, under the facts of this case, from putting such a limitation upon the use of the thing leased.

If anything further need be considered, the court points out that the effect of the orders of the Federal Trade Commission in this case would seem to be to terminate and destroy the contractual rights of persons (the customers) not parties to the proceeding.

The Oxidation of Ammonia—The Work of the Sheffield Experiment Station

A Study of the Fundamental Conditions Involved in the Catalytic Oxidation of Ammonia and a Résumé of the Important Unsolved Problems

By Harry A. Curtis

DURING the war the Nitrate Division of Ordnance maintained a number of experiment stations at which research on various phases of the fixed nitrogen problem was conducted. While the building of the nitrate plants absorbed the attention of most of the Nitrate Division staff, the experiment stations accumulated a considerable amount of experimental data, and but little of this has been published.

The Sheffield Experiment Station, Sheffield, Ala., of which the writer was director, was given over, for the most part, to work on the catalytic oxidation of ammonia and the production of nitric acid from the resulting oxides. During the early part of 1918 an experimental ammonia oxidation plant, having a capacity of about 500 lb. of nitric acid per day, was constructed at this station. This small plant was put in operation in May, 1918, and was run on a 24-hour basis until January, 1919. During these several months of experimenting a great deal of data was obtained. While it is not profitable to publish much of this, the results obtained in certain cases are of sufficient interest to merit permanent record.

Since, with but few exceptions, names of the men connected with the Sheffield Experiment Station are not mentioned, the writer would have it understood that the results recorded here were obtained with the hearty co-operation of all the men assigned to this work.

The Experimental Plant

The experimental ammonia oxidation plant included the following:

(*a*) A 10,000-gal. storage tank for aqua ammonia. This was set alongside a railroad spur and served from a tank car. The aqua ammonia was drawn from this tank as needed into a small blow-tank and forced by air pressure to a constant head tank at the top of the ammonia still.

(*b*) An ammonia stripping still for obtaining an air-ammonia mixture of any desired ammonia concentration. This was built of standard cast-iron flanged pipe, 12 in. diameter by 18 ft. high. Aqua ammonia was fed in at the top through a flow meter, and air from a blower was passed up through the column, the pipe being packed with coke. A little steam was blown in at the bottom to insure complete removal of the ammonia.

(*c*) A catalyst chamber about 20 in. high and 1 sq.ft. cross-section. This was built of cast iron and lined with enameled terra cotta blocks. The air-ammonia mixture entered at the top through aluminum piping, and a platinum gauze was stretched across the bottom. The platinum gauze was clamped in a nickel frame and could be removed fairly readily. This catalyst chamber or "oxidizer" was designed by Captain Perley of the Nitrate Division. It gave good service, but was rather big and heavy for its capacity. One interesting item was that this oxidizer never "howled" during operation, as many other types of oxidizers did. The oxidizer was originally designed without electrical connections, but these were later added to the apparatus and means provided for supplying electrical current up to 350 amperes.

(*d*) Coolers. The hot nitrous gases from the oxidizer were first cooled in cast-iron pipe and finally in Duriron, entering the absorbing towers at practically room temperature.

(*e*) Six stoneware towers 30 in. in diameter by 18 ft. high for absorbing the nitrogen oxides. The acid circulating system included six air-lifts made of aluminum piping and Duriron fittings.

(*f*) A chemical laboratory, office and library.

Loss of Fixed Nitrogen at the Gauze

The catalytic oxidation of ammonia on anything approaching a commercial scale was a comparatively new art in the United States when we entered the war. Two or three experimental plants had been in operation for a short time.[1] Judging from the results obtained at these small plants, it was apparent that in commercial plants, under favorable operating conditions, an oxidation efficiency in the neighborhood of 90 per cent might be expected. It was explained to the writer at that time that the remaining 10 per cent of fixed nitrogen passed through the gauze as unoxidized ammonia, and that this ammonia would eventually form ammonium nitrate, and would, therefore, be recovered in a plant where the final product was ammonium nitrate. It is now known that but little ammonium nitrate or nitrate is formed beyond the gauze, even when the oxidation efficiency is low. Further, it has been found that even if ammonium nitrate were so formed it would be decomposed in the absorption towers. These facts make several United States and foreign patents valueless.

In Table I the oxidation efficiencies obtained with several different rates of air flow are compared with the amounts of ammonium salts formed beyond the gauze. The gauze used was 12x12 in., woven 80 mesh per inch, with wire 0.003 in. diameter.

[1] Semet-Solvay Co. at Syracuse, N. Y.; American Cyanamid Co. at Warners, N. J.; General Chemical Co., at Laurel Hill, L. I.

TABLE I—OXIDATION EFFICIENCIES AND AMOUNTS OF AMMONIUM SALTS FORMED

Date	Duration of Test, Hours	Number of Samples Analyzed	Rate of Air Flow to Gauze Cu.Ft. Per Min.	Average Per Cent NH_3 in Gas to Gauze	Av. Oxidation Efficiency, Per Cent	Av. Fraction of the NH_3 Converted to Ammonium Salts
7/ 9/18	8	10	15	11.45	93.1	0.016
7/10/18	5¾	5	20	9.35	86.4	0.019
7/11/18	10½	9	25	11.0	86.0	0.021
7/12/18	10½	10	30	10.75	83.2	0.028
7/17/18	14	11	40	11.2	81.7	0.026
7/18/18	8½	8	50	10.6	76.1	0.035
7/19/18	12½	12	60	10.3	71.4	0.044

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If the average values for the ammonia oxidation efficiencies and for the percentages of ammonia converted to ammonium salts be plotted against the rates of air flow, the graphs of Fig. 1 are obtained. It will be seen that even when only 71.4 per cent of the ammonia was oxidized to nitric oxide at the gauze, but 4.4 per cent appears below the gauze as ammonium salts.

Effect of Small Percentages of Iridium in the Platinum Gauze

It was thought at one time that the platinum used in making up a platinum gauze catalyst had to be free from iridium. This was rather an important point because of the fact that it is difficult to draw fine wire of pure platinum, whereas the addition of a little iridium, even a fraction of a per cent, gives a metal much more easily handled and from which a finer wire can be drawn if desired.

A study of the oxidation efficiency of a gauze woven from an alloy of 99 per cent platinum and 1 per cent iridium at the Sheffield Experiment Station showed that the iridium had no measurable effect. The alloy for this gauze was made by the U. S. Assay Office of New York and the gauze by the Newark Wire Cloth Co. The wire was 0.0026 diameter and the mesh 80 per inch.

In Table II the average results for various rates of gas flow for a pure platinum gauze are compared with those obtained under parallel conditions with the platinum-iridium gauze, and the data are plotted in Fig. 2.

Electrical Heating of Platinum Gauze

During the construction of the nitrate plants there was considerable discussion as to whether it were possible to avoid electrical heating of the platinum gauze catalyst. The oxidation of ammonia is an exothermic reaction, and it may be calculated that the heat of the reaction, when 10 per cent of ammonia is present in the air-ammonia mix, is sufficient to raise the temperature of the gaseous products of reaction to about 800 deg. C. It was thought at one time that the optimum gauze temperature was in the neighborhood of 600 deg. C. and it was argued that but little if any additional heat was required in the gauze.

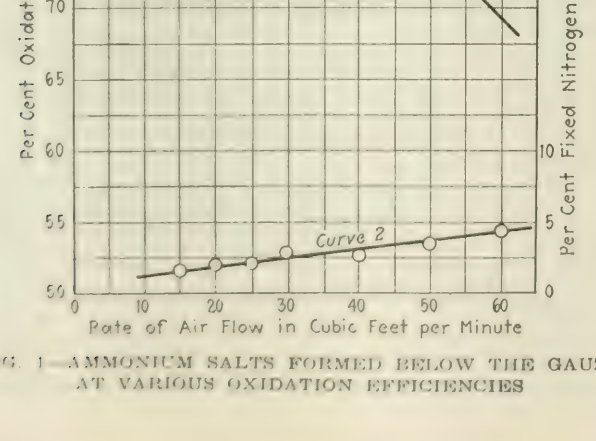
Per Cent Oxidation Efficiency, Curve 1
Per Cent Fixed Nitrogen Converted to NH_4 Salts, Curve 2
Curve 1
Curve 2
Rate of Air Flow in Cubic Feet per Minute

FIG. 1—AMMONIUM SALTS FORMED BELOW THE GAUZE AT VARIOUS OXIDATION EFFICIENCIES

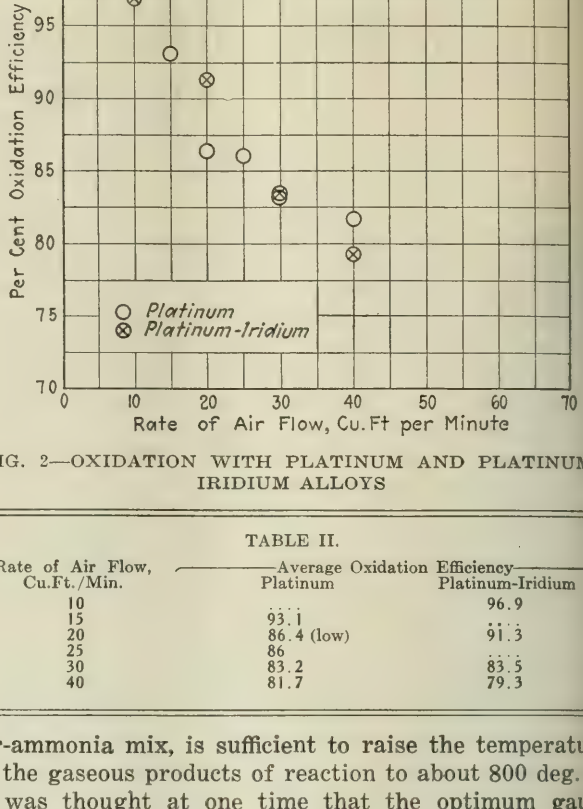

FIG. 2—OXIDATION WITH PLATINUM AND PLATINUM-IRIDIUM ALLOYS

TABLE II.

Rate of Air Flow, Cu.Ft./Min.	Average Oxidation Efficiency—Platinum	Platinum-Iridium
10	....	96.9
15	93.1	....
20	86.4 (low)	91.3
25	86	....
30	83.2	83.5
40	81.7	79.3

In order to study the effect of changing the temperature of the gauze when the various percentages of ammonia were being used, the following procedure was adopted: The experimental plant was operated under given conditions until it became stabilized. Samples above and below the gauze were then taken and immediately after this the electric current to the gauze was cut down so as to give a marked lowering of the gauze temperature. After a few minutes, samples were again taken. Since the plant was operating steadily the analytical results obtained from the samples represent only the temperature effect at the gauze. This procedure was repeated for several different concentrations of ammonia. The results are given in Table III and expressed graphically in Fig. 3. They show beyond question that the gauze was in every case operating below its optimum temperature, even with the high electric current consumption (about 3.3 kva.).

The temperatures which are recorded in Table III were taken with an optical pyrometer and are approximately 100 deg. lower than the actual temperatures which obtained.

When using a single flat gauze in any such apparatus as the one employed, there is little preheating of the gas mixture and the addition of heat to the gauze by electrical means is advantageous. It must also be remembered that the electric current has a very valuable stabilizing effect, for the electrical conductivity of platinum increases as the temperature is lowered, and if, for any reason, the heat supplied by the reaction itself falls off, the electric current automatically increases and keeps the gauze hot until normal conditions are again established.

TABLE III—EFFECT OF TEMPERATURE CHANGE IN A SINGLE FLAT GAUZE CATALYST

Time Between Sampling, Min.	Per Cent NH_3 by Volume, Per Cent	Temperature of Gauze, Deg. C.	Oxidation Efficiency, Per Cent
3	8.8	693	90.3
		too low to read	87.2
5	10.1	715	90.1
		673	87.4
5	11.3	765	90.9
		687	87.1
5	12.2	781	90.6
		733	87.0
5	12.2	781	90.6
		733	86.0
5	13.4	816	86.1
		760	80.9
5	13.8	831	73.9
		775	70.7
2	15.6	914	56.7
		876	51.8

Since, however, the reaction involved is highly exothermic, it appears that a system of heat interchangers might well be employed to heat the gas mixture ahead of the gauze and so eliminate the electric heating. In 1917 the Bureau of Mines, in co-operation with the Semet-Solvay Co., designed and constructed a cylindrical gauze oxidizer[2] in which a slight degree of preheating is secured. This cylindrical gauze oxidizer was modified by Captain Perley of the Nitrate Division and installed at U. S. Nitrate Plant No. 1. Using byproduct coke-oven ammonia, the modified apparatus did not give a satisfactory efficiency. It also failed in trial runs with ammonia from cyanamide. Later, however, by installation of a heat interchanger for the air ahead of the gauze, the oxidizers at Plant No. 1 gave good results[3] on short runs. It is unfortunate that these experiments could not be continued and the new apparatus tried on cyanamide ammonia.

Ammonia Oxidation With Double Gauzes

It had been shown that the oxidation efficiency of a single flat gauze is increased by use of electrical heat in the gauze. It was also known that where no electrical heat is added, a double layer flat gauze gives a little higher efficiency per unit weight of gauze. This increase in efficiency may result both from the somewhat higher temperature at which the double layer gauze operates and to the reduction in effective gauze mesh. The idea naturally occurs to use two gauzes electrically insulated from each other, applying electrical heat only to the up-stream gauze. This idea was put into effect at the Sheffield Experiment Station in December, 1918. It was later learned that the same scheme was tried in England.

The results obtained at Sheffield were excellent, as will be seen in the data tabulated in Table IV. The two gauzes were clamped in the same nickel holder, but electrically insulated from each other by asbestos board around the edges and by some very pure asbestos fiber packed loosely between the gauzes where exposed to the gas stream. The gauzes were separated by a distance varying between $\frac{3}{8}$ in. and $\frac{1}{2}$ in. In the particular

[2]See U. S. Pat. 1,321,376.
[3]G. A. Perley, *Chem. & Met. Eng.*, vol. 22, p. 125 (1920).

TABLE IV.

Date	Duration of Test Period Hr.	Min.	No. of Samples	Cu.Ft. Air Per Minute	Average Per Cent NH_3 by Volume	Average Oxidation Efficiency, Per Cent
12/12/18	10	20	11	20	8.5	93.7
12/13/18	3	40	6	40	10.4	95.4
12/13/18 to 12/14/18	17	52	8	60	9.3	92.4
12/14/18	2	40	4	78	9.9	89.0

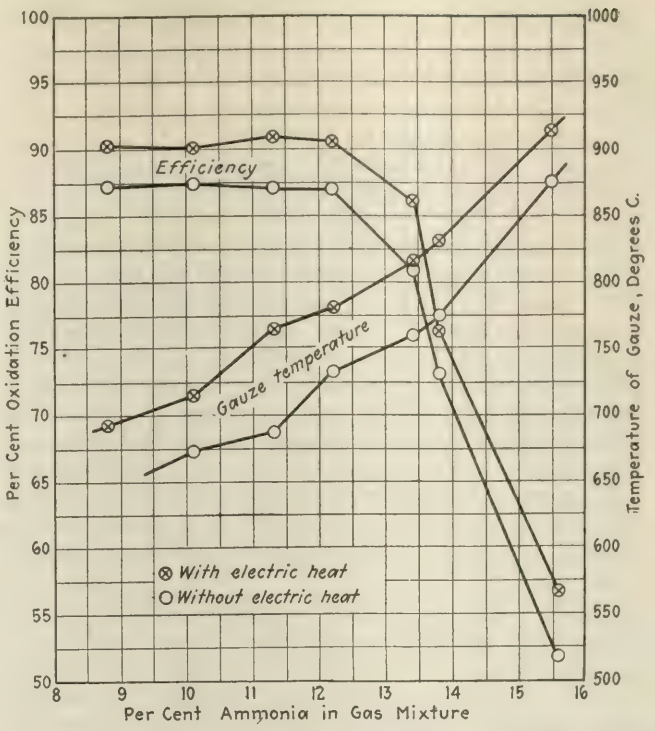

FIG. 3—EFFECT OF GAUZE TEMPERATURE ON OXIDATION EFFICIENCY FOR VARIOUS PERCENTAGES OF AMMONIA

experiment referring to the data given in Table IV, the upper gauze was of pure platinum and the lower one of an alloy of 90 per cent platinum and 10 per cent palladium, but the use of the alloy had no bearing on the experiment. Both gauzes had been activated in earlier runs.

It was then decided to try the same arrangement of gauzes, but with a base metal gauze replacing the lower down-stream platinum gauze. The purpose of this experiment was to test the idea that possibly the lower gauze, and the asbestos fiber between the gauzes, served only as a heat insulator with possibly the added effect of diminishing eddy currents in the neighborhood of the gauze. If such were the case, a base metal gauze on the down-stream side would serve as well as a platinum gauze. The results, given in Table V, are perhaps not quite conclusive, but so far as they go indicate that the beneficial results of a double gauze are due partly, but not entirely, to heat conservation and effects other than gauze activity.

TABLE V.

Date	Duration of Test Period Hr.	Min.	No. of Samples	Cu.Ft. of Air Per Min.	Av. Per Cent NH_3 by Volume	Av. Oxidation Efficiency, Per Cent
12/17/18	8	..	11	20	8.5	97.1
12/18/18	16	10	8	40	8.4	91.9
12/18/18	5	20	6	60	10.8	88.1
12/19/18	1	..	2	80	9.0	85.0

Use of Ammonium Nitrate Solution in Absorption Towers

Since the use of air as an oxidizing agent for ammonia automatically sets rather a low limit to the concentration of nitric acid which can be obtained in the absorption towers, it is obvious that it would be very advantageous to circulate a fairly strong solution of ammonium nitrate in the towers, so that on subsequent neutralization of the nitric acid the excess ammonium nitrate would crystallize out. It was first demonstrated

that an ammonium nitrate solution was practically as good an absorbent for nitrogen oxides as is water. Unfortunately, however, the ammonium nitrate solution is rapidly decomposed in the towers and the whole scheme thereby rendered valueless.

Catalysis of the Reaction Between Nitric Oxide and Oxygen by Activated Carbon

One of the factors which make it necessary to provide a very large absorption system for the nitrogen oxides resulting from ammonia oxidation (or from arc process) is that the reaction between nitric oxide and oxygen to form nitrogen peroxide is relatively slow. Dr. C. L. Burdick had studied the catalytic effect of activated carbon on this reaction, working with small samples of carbon in the laboratories at Massachusetts Institute of Technology, and had obtained very promising results. In June, 1918, Dr. Burdick was assigned to the Sheffield Experiment Station, where facilities were available for trying the reaction on a semi-commercial scale.

An apparatus was set up using about 125 lb. of carbon catalyst for handling the gases from a square foot of platinum gauze oxidizer and a considerable number of tests carried out. Possibly Dr. Burdick will at some time report the details of these tests. In the present article there is space available for mention only of the general results obtained.

The first difficulty encountered with the large-scale apparatus was the discovery that with a gas containing as much as 10 per cent of nitric oxide initially, the catalyst would promptly burn up. This factor had not been disclosed by the laboratory tests. A variety of experiments were then carried out in attempting to eliminate this difficulty, but it was finally decided to put the first catalyst chamber after the first or second absorption tower, where the nitric oxide content of the gas would be lower. This proved satisfactory, but another difficulty arose in that the bed of catalyst removed so much of the fog from the gas stream that it soon became soaked with weak nitric acid solution and, of course, became inactive. This difficulty was eventually overcome by keeping the gas in the catalyst chamber well above the dew point (about 75 deg. C.) and fairly satisfactory results were finally obtained. It was found that with a total nitrogen oxide content in the gas from 1.5 to 2 per cent, under the conditions of the test, the rate of oxidation with the catalyst was, on the average, about fourteen times as great as when no catalyst was present. There is no doubt that the scheme has commercial possibilities, but there are some engineering features to be worked out in its practical application.

A Few of the Unsolved Problems Connected With the Catalytic Oxidation of Ammonia

1. *More Economical Use of Platinum Catalyst.* While platinum gauzes have been the most successful form in which platinum has been utilized as an ammonia catalyst, at least in this country, it is very likely that the present practice is not the most economical way in which platinum can be used as ammonia oxidation catalyst. The matter of wire diameter and gauze mesh has not been placed on a scientific foundation. It has been largely a case of one plant copying what has been successfully used elsewhere. At the present time, commercial practice is settled on a wire diameter somewhere in the neighborhood of 0.003 in. and a mesh of about 80. There are ample reasons for believing that this does not represent the best wire diameter and mesh. The matter of wire diameter has been somewhat fixed by the fact that it is not easy to draw pure platinum into wire finer than 0.003 in. diameter. At one time the erroneous idea prevailed that the platinum must be iridium free. This idea has been dispelled, and with the use of a little iridium in the wire it is possible to draw the platinum considerably finer. There is considerable leeway possible in the matter of gauze mesh.

Aside from the use of platinum in the form of a gauze, European investigators and possibly a few in America have tried perforated platinum foil, corrugated platinum and various other forms. None of these, so far as is known, has any advantage over the platinum gauze. It must be remembered, however, that in a gauze woven of platinum wires a considerable amount of the platinum in the interior of the wires is not active. The formation of a mossy surface on the wires very greatly increases the effective surface of the platinum, but a microscopic examination of the wires, even after they have been in use for several months, revealed a solid core of platinum in each wire which is obviously not effective in the ammonia oxidation. Numerous attempts have been made, both in this country and in Europe, to use platinum deposited on either base metal wire or on refractories such as aluminum, quartz, etc. So far as is known, none of these catalysts has been used commercially, but there is no reason to believe that success will not ultimately attend these efforts, and certainly the use of a very thin layer of platinum deposited on the surface of some refractory material which does not decompose ammonia would appear to be a better way of utilizing platinum than the ordinary gauze.

2. *Non-Platinum Catalyst.* It is well known that platinum is not the only material which will bring about the catalytic oxidation of ammonia to nitric oxide, and numerous attempts have been made to substitute cheaper materials for the costly platinum. A number of the base metals will oxidize ammonia to nitric oxide with an efficiency of, say, 70 per cent. There are also a number of oxides such as nickel, cobalt, chromium, etc., which are fairly effective in the catalytic oxidation of ammonia. The General Chemical Co. claims to have a non-platinum catalyst which operates at an efficiency of 92 per cent in an experimental plant. However, the fact remains that none of these non-platinum catalysts has been operated successfully on a commercial scale, and it is to be said of most of the experimental work that the oxidation efficiencies obtained have been hopelessly low. It must be remembered, however, that when platinum itself was first used as an ammonia oxidation catalyst, the efficiencies obtained were rather low. Even at the time the United States entered the war the oxidation efficiency actually obtained by platinum gauzes in daily use was not above 80 per cent, and there is no reason for believing that the efficiency of non-platinum catalysts could not also be increased by a further study of such catalysts.

3. *Use of Multiple Gauzes.* During the course of the experimental work carried out at this station it was shown that if two platinum gauzes be mounted in the converter at a distance of about ¼ in. from each other, but insulated from each other by a loose layer of pure asbestos fiber, there was thus obtained an ammonia oxidation apparatus which was much more efficient than

the ordinary flat gauze type. With this arrangement it was necessary to heat only the upper, or up-stream, gauze. The capacity per square foot of platinum was more than 50 per cent greater than for the platinum used in the ordinary flat gauze and, moreover, the oxidation efficiency was also raised. It was found further that if a base metal gauze were substituted for the lower platinum gauze the apparatus still had considerably greater capacity and higher oxidation efficiency than the single platinum gauze ordinarily used. The success of these experiments certainly warrants further research in the matter of using combinations of gauzes with electrical heat only on the up-stream gauze, the assumption being that the heat of the reaction is sufficient to maintain the other layers of gauze at operating temperature. It should be mentioued, of course, that with a double gauze combination, electrically heated on only one gauze, the electrical power consumption is only half as great as would ordinarily be used for the same area of platinum. There is a further possibility that a combination of platinum gauze with a non-platinum catalyst could be successfully used. For example, if the lower gauze in the above combination should be replaced by a non-platinum catalyst, it is quite possible that the non-platinum catalyst would be efficient enough to clean up any ammonia passing through the platinum gauze.

4. *Relation of the Factors: Ammonia Content of Gas, Gauze Temperature, Rate of Gas Flow Through Gauze, and Ammonia Oxidation Efficiency.* The Sheffield Experiment Station contemplated a complete study of the relation which exists between the factors listed above. However, the press of other experiments did not give sufficient time to complete the investigation. It was shown that regardless of the ammonia content of the gas, the heat developed by a single flat gauze, operated without electrical heat, is not sufficient to maintain the gauze at the optimum operating temperature. In spite of all the experimental work which has been done on ammonia oxidation by means of platinum gauze, it is the belief of the writer that the relation between the above factors has not been established on anything like a scientific basis. It is rather difficult to maintain a sufficient number of factors constant in studying the problem, and this difficulty increases somewhat in proportion to the area of the gauze used. It is thought that the problem should be attacked on a laboratory scale with a gauze measuring, say, 3x6 in. and with sufficient provision for heating the gauze electrically up to its melting point, with means for providing a very steady flow of gas and for controlling the ammonia content accurately. It is thought that the result of such experiments would throw considerable light on the actual behavior of platinum as an ammonia catalyst.

5. *Increasing the Oxygen Content of the Gas Mixture Ahead of the Gauze.* It has been frequently suggested that in place of using air and ammonia, it would be an improvement to use an air-ammonia mixture enriched with oxygen. This point is particularly well taken in view of the fact that ammonia oxidation may very likely be carried out in connection with plants where waste oxygen is available as, for example, in a cyanamide plant. There is, of course, a limit to the amount of oxygen which can be introduced because of the fact that ultimately the mixture becomes explosive. Attempts have been made to pass beyond this lower limit of explosibility by adding steam to the mixture. The obvious step would be to eliminate the nitrogen entirely and use an ammonia-oxygen mixture in the exact proportions to form either nitric oxide or nitrogen dioxide, preferably the former. The explosion which would ordinarily occur could then be damped out by means of steam, the steam being condensed beyond the gauze, leaving the pure nitric oxide, which could then be enriched with enough oxygen to form ultimately only nitric acid in the absorption towers. This would entirely avoid the dilution of the nitrogen oxides by the nitrogen and the tower losses would certainly be reduced, since this dilution by nitrogen is one of the factors which renders the absorption of the nitrous gases in the towers difficult. This scheme of using oxygen, ammonia and steam has, it is understood, been suggested in Europe and some experiments along this line have been made. Complete data are lacking.

6. *Apparatus for Continuous Analysis of Gas Mixtures.* Instruments for continuously recording the ammonia content of the air-ammonia mix passing to the catalyst and the nitric oxide content of the gas leaving the catalyst chamber would be very desirable in a plant. The ammonia analysis instrument should be fairly easy to devise.

7. *Catalysis of the Oxidation of Nitric Oxide to Nitrogen Peroxide.* The principal reason for the difficulty encountered in the absorption of nitrous gases by water is the fact that the oxidation of nitric oxide to nitrogen peroxide is a rather slow process. The absorption of nitrogen dioxide by water results eventually in the liberation of more nitric oxide. This fact results in the liberation of nitric oxide all the way through the tower system, so that obviously 100 per cent absorption is theoretically impossible, although it may be approached sufficiently near by making the absorption train large. This nitric oxide which is liberated must be oxidized again to nitrogen dioxide before it can react further with water, and obviously the slow rate of oxidation of nitric oxide to dioxide, while the gas is meanwhile being swept through the tower system, necessitates the building of a very large absorption system in order to get a reasonable recovery of the fixed nitrogen.

The use of activated carbon for catalyzing this reaction has already been described. On account of the inherent disadvantages of this carbon, however, it would be well to develop other catalysts.

Iron Ore Production in France

During the year 1921 14,106,068 metric tons of iron ore was mined in France, as compared with 13,846,122 metric tons in 1920, an increase of 259,946 metric tons, or 1.8 per cent. In 1913 French iron ore production amounted to 21,917,870 metric tons, to which amount should be added 21,136,265 metric tons produced in the Metz-Thionville basin, which was German at the time. The 1921 output represents only about one-third of the production realized in 1913 within the present boundaries of France.

Statistics of production show a noticeable decrease in the monthly tonnage per man. Previous to the war the monthly production of a French miner was 71.6 metric tons in 1920, an increase of 259,946 metric tons. In 1913 the German miner in the Metz-Thionville basin was credited with a monthly average of 109.7 tons.

Metallic Tantalum Now Commercially Available

AS A RESULT of research extending over a period of 6 years, the Fansteel Products Co. of North Chicago, Ill., has developed a process for the production of metallic tantalum. It was felt that certain characteristic properties of this element—particularly the combination of its softness and workability with its extreme resistance to wet corrosion—would make it a valuable material in American technology. The following information regarding this interesting new commercial metal will supplement the brief reference made in *Chem. & Met.* for June 14, 1922, p. 1141.

No tonnage uses of the material can ever be expected, as it must be manufactured in an atmosphere free from oxygen, hydrogen, nitrogen and other common gases. It is, as a matter of fact, made *in vacuo*, which, of course, will make its price excessive for use as an ordinary metal.

Resistance to Wet Corrosion

Its resistance to wet corrosion is its most obvious characteristic. It is unattacked by any acid or alkali solution even at boiling temperatures, excepting hydrofluoric acid and its mixtures with other acids. It is unattacked by aqua regia.

Electrically also it has some interesting properties, the most novel of which is its valve action in electrolytic cells, a property which it holds in common with aluminum. A dielectric oxide is readily formed on its surface, which makes it useless as an anode in electrolysis, as no direct current will pass. This property, however, permits its use in electrolytic rectifiers for alternating current, where it has the apparent advantage over aluminum of its extreme chemical resistivity, which permits a wide choice of electrolytes.

Combines With Gases at High Temperatures

Its high melting point, about 2,850 deg. C., is of no commercial advantage, except where the atmosphere may be made to exclude the gases which will combine readily with it. In its combination with gases at elevated temperatures it forms stable compounds which are not readily dissociated into the gas and pure metal below the melting point. No very close study of its action in gases has been made and it is impossible to say at the present time if it is selective in its action or whether it continues to take up gas at all temperatures to its melting point, or whether it will release certain gases at high temperatures *in vacuo*.

Tantalum has not been available in the United States since 1914, when the German source was cut off. The possibilities of its utility will now be very much greater than they were in 1914, as the various electrical arts, particularly those requiring high melting point materials and use *in vacuo*, have been very largely developed since that date.

Properties to Be Studied Fully

No very reliable list of all of the properties of tantalum has been compiled to the present writing, but steps are being taken to make a complete scientific investigation of the properties of the pure material.

All of the work in the development of a commercial process for the manufacture of pure American tantalum has been done for the Fansteel company by Dr. Clarence W. Balke, the company's research director. Dr. Balke has always been interested in tantalum and its sister metal columbium, since he determined the atomic weights of these materials, working under Dr. Edgar F. Smith at the University of Pennsylvania. These determinations, made about 10 years ago, are still accepted in the international table of atomic weights.

Work on Columbium Under Way

Further research work is being conducted by the Fansteel company on columbium with a view to determining what commercial advantages this material may have.

The sources of raw material occur in the United States chiefly in the form of columbite, although a certain amount of tantalite is available. Hitherto stocks of the material have come from Australia, where excellent grades of ore are still obtainable.

Volatilization of Copper at Low Temperatures

In a recent research on decarbonization of steels[1] a piece of medium-carbon steel was fixed to a copper support by a pure iron wire and heated for 4 days in a stream of dry hydrogen at about 800 deg. C. When the furnace was opened, the steel was tightly welded to the copper, and everything was covered with a bright copper plate. A microscopic view showing the wire binding is shown in Fig. 1. Evidently the iron wire

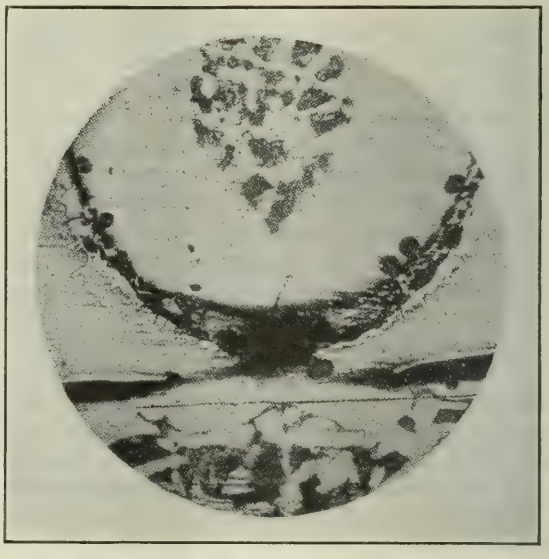

FIG. 1—MIGRATION OF CARBON AND COPPER IN HYDROGEN AT 800 DEG. C. (× 100)

had first been carbonized throughout to approximately the carbon content of the steel sample, whereupon the decarbonization of both steel and its fixture ensued. Meanwhile a thin film of copper had deposited (vaporized from the copper support) and alloyed, the alloy later being covered by a layer of substantially pure copper.

Small Cottrell Precipitator

The Research Corporation has designed a new so-called "BL" unit type of precipitator, applicable to dust recovery. It is lighter, smaller, more compact and simpler to install than the old type, and is available in capacities up to 25,000 cu.ft. per minute. It is shipped ready to set up.

[1] "Hydrogen Decarburisation of Carbon Steels, With Considerations on Related Phenomena," Charles R. Austin; British Iron & Steel Institute (1922).

Synopsis of Recent Chemical & Metallurgical Literature

Surface-Coated, Photographic, Cigarette and Miscellaneous Papers

The United States Tariff Commission has just issued a report entitled "Surface-Coated, Photographic, Cigarette and Miscellaneous Papers." This report is one of a series to be published by the commission dealing with different kinds of paper. In structure it follows the general outline of all the tariff information surveys prepared by the commission, the aim of which is to present to Congress in detail sifted data that may serve as a guide in framing scientific tariff legislation. These data relate to description of the different varieties of paper, raw materials used, processes of manufacture, volume and value of production, imports, exports, prices, tariff history, nature of competition with foreign countries, customs decisions, etc. The papers considered are surface-coated, waxed, gummed, decalcomania and decorated paper; cloth-lined or reinforced paper; photographic and blueprint paper; cigarette paper; papier-mâché; paper not specially provided for in the tariff law; miscellaneous manufactures of paper, such as bags and boxes; and paper stock.

Electrodeposition of Iron

A 50-page bulletin has been written for the British Department of Scientific and Industrial Research on "Electrodeposition of Iron," by W. E. Hughes[1]. In it he describes eight different types of deposits—viz., normal, columnar, mosaic, poplar-tree, fibrous, fan, cauliflower and fountain. Most of these names are self-descriptive and applicable to various electrodeposited metals. Normal deposit is most frequent; in it many prominent grains have a V shape, pointed inward toward the cathode.

Using a current density of 120 amp. per sq.ft., a 2½-gal. bath of neutral ferrous chloride[2], depositing for 2 hours on a cleaned copper rod, the effect of varying temperature from 70 to 116 deg. C. is as follows: As temperature increases the surface becomes rougher and the grain becomes coarser, the deposit softer and less brittle. (It is a quite general rule that the more coarsely crystalline the surface is the larger the grain size of the metallic deposit.)

Maintaining the temperature at 110 deg. C. and varying the current density from 60 to 240 amp. per sq.ft. gave results indicating that a maximum grain size is reached at about 120 amp. per sq.ft. and a minimum exists at about 200. Heavier densities again coarsen the grain. As before, coarse grain is associated with softness and lack of brittleness; the metal can be safely hammered while cold.

A great and striking difference exists between two deposits made under like conditions except that one contains a rotating cathode. The latter surface is extremely smooth and the metal is very much finer in grain, often approaching a fibrous structure when sectioned and examined under the microscope. It is also characteristically hard and brittle.

Adhesion of the deposit depends upon absolute cleanliness of the cathode. This involves boiling in an alkaline cleanser, treatment by an electro-cleaner, and dipping in 10 per cent HCl, with appropriate scrubbing and rinsing between.

A small quantity of free acid will generally cause an iron deposit to be fine grained to fibrous, even if made at low current density. Furthermore, the solutions must not become materially depleted in iron content if thick, uniform deposits are desired.

[1] Published by His Majesty's Stationery Office, London, Price 6s. 8½d.

[2] Concentration not noted; possibly Merck's solution (100 kg. $FeCl_2$ to 100 liters water.)

Use of Rubber in Paper Making

Engineering, London, for Sept. 8, 1922, comments editorially on the interest which is being taken in the research work of S. Kaye on the addition of rubber latex to paper stock during the beating operation for the purpose of improving the strength and quality of the paper. Representatives both of the rubber industry and the paper manufacturers were present at a recent meeting of the Rubber Institution, when Mr. Kaye read a paper entitled "Rubber Latex in Paper Making." The amount of rubber which actually enters into the constitution of the paper is very small indeed, but in some unexplained way the addition of the latex appears to assist the hydration of the cellulose fibers, with a consequent reduction in the time required for beating and the power consumed.

The article emphasizes a point brought out during the discussion by a speaker who suggested that since the beneficial effect of the rubber is not due to its rubbery nature but to the colloidal properties of the latex, further investigation might disclose some more easily procurable colloid which would have the same effect. This, of course, is merely speculation, as the mechanism of the acceleration of the hydration of the fiber by the latex is not understood. Several possible developments of the process were indicated at the meeting, such as the production of waterproof containers for packing liquid and semi-liquid substances. The dyeing of rubber-treated paper has not been found difficult, even when the rubber content amounted to as much as 30 per cent. Rubber-treated paper bears up well under rigid tests for durability. It was also suggested that where a rubber content of 5 per cent or more was used, it might be found advantageous to vulcanize it, as the paper would be rendered stiffer and stronger.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Cellulose Ester Solvent — Carbon tetrachloride as a solvent for cellulose ethers for film base is covered by a patent assigned to the Eastman Kodak Co. by William R. Wibb, of Rochester, N. Y. It is claimed that a solution of the proper viscosity for casting may be obtained by using a mixture of tetrachloride and ethyl alcohol. The specification covers solvent mixtures ranging from 5 to 95 parts of carbon tetrachloride and 95 to 5 parts by weight of ethyl alcohol, although the ratio 60:40 tetrachloride:alcohol is mentioned specifically. (1,418,413. June 6, 1922.)

Greaseproof Paper—The use of sugar as a coating for paper containers to render them greaseproof is covered by a patent taken out by Wilbur L. Wright, of Fulton, N. Y., and assigned to the Sealright Co. The idea is based on the fact that various compounds included under the general term sugar are harmless commercial products, cheap and not appreciably soluble in oils and other greases, particularly food products, and that hence if paper can be coated with an unbroken or impervious coating of sugar, or if the fibers and body of the paper can be completely filled or impregnated with sugar, this treatment will constitute a barrier against the passage of grease. Gelatine is used as a medium for the sugar, and a hygroscopic ingredient such as glycerine and a hardener, such as alum, are also added to the treating solution. It is claimed that paper covered with this material dries quickly, producing a bright smooth surface that is hard and not sticky, that is flexible and more or less elastic, is tasteless, odorless, colorless, and does not cause harmful action in food products put up in such packages. (1,417,708. May 30, 1922.)

Naval Stores—An apparatus for the extraction of turpentine and rosin from pine stumps is covered by a patent taken out by Jerry M. Jordan, of Crestview, Fla. The apparatus is merely a closed retort surrounded by a water jacket. A firebox is provided which boils the water in the jacket and keeps the retort surrounded by steam. The inventor claims that it is possible by the use of this apparatus to obtain turpentine from waste pieces of wood, slashings, dead wood, etc., and that a large amount of turpentine can be obtained cheaply from tracts of timber where the turpentine has been extracted in the usual fashion and which would otherwise be worthless. (1,424,248. Aug. 1, 1922.)

The Vulcanization of Rubber—Paranitroso-di-methyl-aniline is a poison

and because of this fact its properties of accelerating the vulcanization of rubber are not extensively used. Bedford and Sibley, of Akron, Ohio, have discovered that this compound will react in an organic solvent with hydrogen sulphide to produce a substance with strong basic properties. This substance has the same accelerator effect on rubber that paranitroso-di-methylaniline has. It is quite odorless and can be stored for a long period of time without danger of poisoning those in the vicinity. (U. S. Pat. 1,418,771.)

Available Potash From Leucitic Rock—Dr. Blanc and N. Felix Gourdan, of Rome and Paris respectively, have taken out a patent to render the potash in leucitic rock available at considerably less cost than the present process. At present, it is necessary to grind the rocks and treat them with strong mineral acids such as hydrochloric acid, but when large quantities of material are employed, the process becomes extremely expensive. The potash in leucitic rock is combined in such a way as to be rather readily separated from its silicic acid component. By grinding the rock to an impalpable powder, the authors declare that not only strong acid but weak mineral acid and even organic acid will attack the potash and make it soluble. It is actually accomplished by means of carbonic acid (CO_2). The potassium carbonate thus formed can be readily washed from the insoluble material, or the leucitic rock can even be used as a fertilizer ingredient directly without lixiviation. In order to accomplish more easily the breaking up of the leucite, the rock is first calcined in the presence of steam or with quicklime magnesia, etc. The calcined material is then introduced after grinding into the treating apparatus. It is extremely interesting that fine grinding has made weak acid effective in breaking down the leucitic rock. (U. S. Pat. 1,418,356.)

Method of Purifying Carbon—Victor Lenher, of Madison, Wis., and Frank M. Dorsey, of Cleveland, Ohio, are the coauthors of this extremely interesting patent. A much more porous and much purer charcoal is obtained by this process than is possible by a simple activation. The activation process, of course, consists in heating charcoal in the presence of superheated steam to from 700 to 1,100 deg. C. This produces a porous structure, but is not nearly as desirable an article as the product which is prepared by this new method.

The carbon first is heated with selenium oxychloride. Selenium oxychloride at room temperature or as high as 50 to 100 deg. C. is first used and this dissolves many of the impurities and forms a very porous structure of very pure carbon. The selenium oxychloride must be removed, however, and this is accomplished with either carbon tetrachloride or chloroform. (In fact, it is found desirable to dilute the selenium oxychloride in the first place with about 25 per cent of carbon tetrachloride.) The residue of carbon tetrachloride is then distilled out of the carbon and recovered. (1,423,231; assigned to the General Electric Co., New York. July 18, 1922.)

Rubber Accelerator — Benjamin D. Porritt, of Edinburgh, has taken out a patent for the use of monohydroxy nuclear substances, such as phenol or its analogs. In other words, he takes about 2 per cent sodium phenate with ninety parts of rubber and ten parts of sulphur. This addition reduces the vulcanization time more than 75 per cent. (U. S. Pat. 1,418,166.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Tanning—Hides and skins are tanned by means of soluble magnesium salts and soluble carbonic acid salts of other bases in the presence of water. A mixture of the dry salts may be introduced into a drum containing the wet hides, the moisture being sufficient to dissolve the salts and render them active, or the hides or skins may be drummed successively in separate solutions of the salts. The process may be applied to partly tanned hides, or may be combined with other processes such as tanning or treatment by cellulose sulphite liquors, formaldehyde, chrome, iron or other mineral tanning agents, or vegetable tanning agents, used in admixture or separately. In an example, 100 kg. of unhaired hides is drummed for 4 to 6 hours or longer in a concentrated solution containing 21 to 22 kg. of magnesium sulphate and 7 kg. of sodium bicarbonate or 9 kg. of sodium carbonate, or the hides may be first drummed in a solution of one of the salts, the other salt being added subsequently. This treatment may be followed by rinsing and oiling or by treatment with fat, grease, etc., to which formaldehyde has been added, or the hides may be pressed out or exposed to the air, then coated or brushed over with cellulose sulphite liquor and afterwards rolled and greased. Alternatively the cellulose extract may be aded to the tanning mixture. Formaldehyde, chrome alum or salts of iron, zinc or barium or small quantities of vegetable tanning materials such as oak extract may be added to the tanning mixture described in the example or may be employed in separate solutions for subsequent treatment. In a further example the hides, after treatment with the mixed salts and formaldehyde, are steeped in milk of lime and then further treated as in the first example. The various processes are stated to produce heat-resisting qualities, durable graining or embossing, etc., firm or soft texture as required. (Br. Pat. 180,758; J. Hell, Wurttemberg. July 26, 1922.)

Lead Chromate Pigment—Lead chromate for use as a pigment is obtained by treating lead sulphate, preferably freshly precipitated, with an equivalent quantity of a soluble normal chromate such as sodium or ammonium chromate. Paler yellow pigments are obtained by using smaller quantities of the soluble chromate, products of the composition $PbCrO_4.PbSO_4$ and $PbCrO_4.2PbSO_4$ being mentioned. (Br. Pat. 182,693. H. Hetherington and W. A. Allsebrook, Matlock Bath, Derbyshire. Aug. 30, 1922.)

Bleaching—Loose cotton and cotton yarns or fabrics, etc., are bleached by first treating the goods with a soda lye containing soluble hydrosulphites, preferably in a vacuum at temperatures below 100 deg. C., and then bleaching by means of other bleaching agents, such as hypochlorites, hydrogen peroxide, perborates, percarbonates, persulphates, etc. Sodium or ammonium hydrosulphites may be used, and the goods may be scoured and washed during the bleaching process. (Br. Pat. 182,776; not yet accepted. C. Bochter, Günzburg. Aug. 30, 1922.)

Ethers and Esters—Ethers and esters of ethylideneglycol and vinyl alcohol are produced by passing acetylene together with the vapor of compounds containing hydroxyl or carboxyl groups over heated catalysts, especially metals, their oxides and salts. Examples of suitable catalysts are cadmium, zinc, mercury, magnesium, barium, copper, silver, cerium, nickel and iron, or their compounds, preferably mounted on a support such as charcoal, pumice or infusorial earth. The reaction may be carried out under increased or reduced pressure; and is preferably conducted as a cyclic process, the unchanged hydroxyl or carboxyl compound being continuously separated from the product and returned with fresh acetylene into the reaction chamber. According to the example, equal volumes of acetylene and acetic acid are passed at a temperature of 200 deg. C. over charcoal inpregnated with cadmium acetate; ethylidene diacetate is isolated from the condensed product. (Br. Pat. 182,112; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Aug. 23, 1922.)

Cyanamide Residues — The residues resulting from the decomposition of calcium cyanide by acids to obtain assimilable nitrogen compounds are converted into industrial products such as nitrogenous manures, lime and carbon dioxide. If carbon dioxide or sulphur dioxide is employed as the acid, the residues contain calcium carbonate or sulphite carbon and impurities. According to one process they are air-dried and mixed with solutions of urea, urea salts or any assimilable nitrogenous compounds obtained from calcium cyanamide. In an example the residue from the carbon dioxide process is air-dried and mixed with a solution of urea sulphate and the whole evaporated to obtain a manure. The residue from the carbon dioxide process may also be employed instead of a mixture of limestone and coke to obtain quicklime and carbon dioxide. In this case the air-dried residue is either calcined directly or briquetted and calcined. Additional oxygen may be introduced into the furnace. (Br. Pat. 182,134; not yet accepted. Soc. d'Etudes Chimiques pour l'Industrie, Geneva. Aug. 23, 1922.)

Titanium Catalyst for Hydrocarbons—Aromatic hydrocarbons are oxidized by passing their vapor admixed with air or oxygen over a catalyst consisting of or containing titanium compounds—for example, titanium oxide or brick rich in titanium. The presence of nitrogen oxides assists the oxidation; steam or other inert gas may also be added. The catalyst may be supported on a carrier, such as brick, asbestos or pumice. Examples are given of the oxidation of anthracene to anthraquinone and of naphthalene to phthalic acid and phthalic anhydride. (Br. Pat. 182,843, F. W. Atack, of British Alizarine Co. Ltd., Manchester. Sept. 6, 1922.)

Book Reviews

RAYS OF POSITIVE ELECTRICITY AND THEIR APPLICATION TO CHEMICAL ANALYSES. Second Edition. By *Sir J. J. Thomson, O.M., F.R.S.*, 237 pp. New York: Longmans, Green & Co. Price $5.25 net.

The appearance of the second edition of this well-known monograph in the series of monographs on physics, of which the author is the editor together with Prof. Frank Horton, will be welcomed by a wide circle of readers. The second edition contains much new material, the size of the first edition having been doubled. Besides the value it possesses for physicists and those especially engaged in the problem of the conduction of electricity through gases, it presents a particular interest for chemists through its direct bearing on the constitution of atoms, molecules and gaseous ions.

The author states in the preface to the new edition: "I have paid special attention to those properties of the positive rays which seem to throw light on the problem of the structure of molecules and atoms and the question of chemical combination. The hope expressed in the first edition that the method of positive rays would be of service in connection with important chemical problems has been fulfilled to a remarkable extent by the researches of Mr. Aston and others on the determination of atomic weights and the detection of isotopes. I am convinced that as yet we are only at the beginning of a harvest of results which will elucidate the process of chemical combination, and thus bridge over the most serious gap which at present exists between physics and chemistry."

Besides a full discussion of theory and descriptions of experimental details, including Aston's focus method and Dempster's method, the text is replete with a judicious weighing of evidence for and against the assumption of the existence of isotopes. The author makes it very clear that he has maintained an open mind on this subject and that he does not accept as final the proofs hitherto adduced which have appeared conclusive under a less searching analysis. The possibility that the isotopes of neighboring atomic weights may prove to be hydrides of the ordinary atoms is given the most careful consideration. While there is strong evidence against this assumption, the author does not dismiss it without a thorough examination.

The concluding pages are devoted to the opportunities of future application of positive rays in studying molecules and the mechanism of their structure, and strong recommendation is made for the method as a means of spectroscopic analysis much simpler and more definite than ordinary spectroscopy. The field is one which should not be neglected in experimental chemistry, and, as the author points out, involves, in its simpler applications, neither a complicated apparatus nor a difficult technique.

S. C. LIND.

ORGANIC CHEMISTRY, OR CHEMISTRY OF THE CARBON COMPOUNDS. By *Victor von Richter.* Vol. II, Chemistry of the Carbocyclic Compounds, edited by Prof. R. Anschütz and Dr. H. Meerwein. Translated from the eleventh German edition by E. E. Fournier D'Albe, D.Sc., A.R.C.Sc. xvi + 760 pp. Philadelphia: P. Blakiston's Son & Co. Price $8.

Richter's Organic Chemistry needs no introduction to organic chemists. To others mention of the fact that it has passed through eleven German and three American editions is sufficient introduction. Richter's text has been enlarged so much in order to make it complete that it is now a compendium—a sort of abridged Beilstein—rather than a class text. This fact does not, however, detract from its usefulness in advanced classes, especially for certain topics—for example, the terpenes—and as a handy reference book.

The eleventh German edition was published 10 years ago and therefore some of the very recent developments are not included in the volume under review. Yet the book contains an abundance of material which is well classified, well described and well illustrated with examples. This second volume is a good translation of the major portion of the German second volume. It treats of the following subjects: cyclo-paraffins, cyclo-olefines, general aromatic chemistry—benzene, its homologs and their numerous derivatives, hydro-aromatic compounds, terpenes, naphthalenes, anthracenes, etc., glucosides, bitter principles, and natural dyes, the last three only very briefly. The part covering the heterocycles is omitted and probably will appear as a third volume. Some idea of the number of compounds discussed in the present volume may be obtained when it is mentioned that the index covers thirty-one full pages, two columns to the page and seventy-five lines to the column.

The translation is clear and generally accurate, and the arrangement of the work is admirable. The typography is excellent, better than in the first volume. The name of each compound when first described is emphasized by being printed in bold-faced type.

A somewhat careful reading of a goodly portion of the text brings out a few errors and raises some questions which require comment. In the spelling of names and radicals the translator is not always consistent or correct according to the best usage. "Benzene" and "benzol" sometimes alternate in the same sentence or paragraph, and the homologs of benzene, except mesitylene, are given the suffix "ol" instead of "ene." The obsolete term "amido" is found here and there in place of "amino" (pp. 382, 406), and "amine" as a name and the names of amines such as toluidine in a few instances have no final "e." This spelling shows a direct transcription of the name rather than a tendency to shorten the ending. Similarly with naphthalene and some of its derivatives, which are frequently given the less used ending "in." The translation of "Benzolkohlenwasserstoffe" in the heading (p. 49) as "Benzene Carbohydrates" instead of "Benzene Hydrocarbons" is unfortunate. It oftens seems that the translator is endeavoring to vary the names or their spelling in order to avoid monotony but, commendable as this practice is, clearness and accuracy may be sacrificed by so doing. He naturally uses the English spelling in such words as "oxidised," "colour," etc., although the book is printed in Philadelphia. "Nitrogenation" (62), "nitrogenated" (67), "nitrifying" (107, 170, 416) and "nitrified" (445) are neither correct nor advantageous terms for nitration, nitrated, etc., which are properly used in many other places. The reviewer believes that if another word is to be substituted for nitration where the introduction of a nitro group is meant, "nitronation" would be more satisfactory, since it is definite and corresponds to the term sulphonation in the type of reaction as well as the name. The terms "rejection" (95, 106, 108, 116, 208) and "discarding" (448) used in connection with water, carbon dioxide, etc., do not carry the meaning conveyed by "elimination" or "separation," and certainly are not in good usage, nor is "acetyling" (166) for acetylation, and "water vapor" for steam. Translation of the German plurals as "phenolene" (61) for "phenols," and "alkylene" (116) for "alkyls" is very puzzling at first. A number of structural formulas have a dot or line missing. The formula for heptachloro-resorcin (460) is incorrect in both original and translation, several formulas mentioned in the text on p. 514 have been left out, and there is a mix-up in the translation referring to 1,4-anthraquinone (705). The typographical errors are really few in such a difficult piece of work.

The comments given above are not meant in the least to detract from the real service which the translator and publishers have rendered in giving English-speaking chemists this standard and important work in their own language.

HARRY L. FISHER.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Fine Chemical Manufacturers Will Appeal for Tariff Rate Changes

Will File Applications Under Flexible Tariff Provisions—No Difficulties in Administering New Rates

PRESSURE already is being brought by those interested in the synthetic organic chemicals not of coal-tar origin to have early hearings before the Tariff Commission with a view toward securing an increased rate on many of the chemicals embraced in paragraph 5 of the tariff act. The manufacturers of these chemicals believe the rate provided in the new law is entirely inadequate, particularly for the fine chemicals of high value. This also applies to the medicinals.

Regulations under which applications for changes in tariff rates may be filed under the flexible tariff section of the new act are expected to be issued by the Tariff Commission about Oct. 11. A committee of the commission is conferring with its legal department regarding the rules and the methods of procedure. Precedents established by the Federal Trade Commission and the Interstate Commerce Commission for complaints and hearings are being studied in this connection.

Provisions for Rate Changes

Under the Fordney-McCumber tariff act, applications for a change in rates may be filed either with the President or with the Tariff Commission. If filed with the former, they will be referred to the commission for investigation and report. The commission shall report its findings to the President, who thereupon may increase or decrease a rate within a range of 50 per cent. If an increase of 50 per cent be insufficient to equalize the cost of product here and its cost abroad, an ad valorem duty may be transferred to the basis of American valuation, but in this event the figure cannot be changed. A specific rate may not be changed to an ad valorem, nor an ad valorem to a specific. The duty on coal-tar products, placed on American valuation in the act, cannot be increased under this clause.

The Tariff Commission probably will open an office in New York City to conduct some of the hearings and gather the samples and data required of it under the new law, according to announcement of Chairman T. O. Marvin.

Although hard pressed by work, owing to an inadequate force, the customs division of the Treasury Department has encountered no serious difficulty in administering the new tariff, and, according to Ernest W. Camp, chief of the division, none is expected of an extraordinary nature.

In administering the rates on imports of coal-tar products, which were placed on American valuation in the new tariff, the customs service has taken over the files and records of the Dye and Chemical Control Board, which automatically went out of existance with the effective date of the new tariff which ended the licensing system or so-called embargo. The board had many samples and data which were necessary under the licensing system and which have proved useful in handling the tariff.

No Difficulty Expected

"We do not expect any great difficulty in administering these coal-tar products rates," said Mr. Camp. "If there is a doubt, we will assess the highest rate that might apply in the case, as provided by the tariff act and as was the law under the old tariff, and an appeal may be had.

"The appeals board may be kept busy, and final liquidations may get congested, but it may be expected that very rapidly there will be established sufficient precedents to remove further difficulties."

Customs Personnel Insufficient

The customs division officials expect to work out new regulations as rapidly as cases are called to their attention. Meanwhile, collectors who appeal to headquarters for rulings are being given instructions to admit imports under bonds which will fully protect the revenues pending final liquidation. Thus there will be no delay in getting goods to consignees who are willing to supply bond and await adjudication of their cases.

The most serious handicap in administering the customs is said to be insufficient personnel. This is not a new complaint, but it has been aggravated by change in tariff duties. When the war came and imports decreased heavily, the customs force was reduced from 8,200 to about 6,700. No increase was made when the emergency tariff was imposed in 1921, affecting many imports, and none has been provided for the new tariff. Heavy foreign travel has been delaying ordinary work at some ports because of the necessity of switching inspectors from cargo work and appraisers' warehouses to the inspection of personal baggage.

Representatives of the manufacturing chemical industry have assured Secretary of Commerce Hoover that their flag has been nailed to the mast and that they will continue to do an export business.

Salesmen's Association Discusses Exposition Plans

To Investigate Claims of Rival Enterprises and Support Management Offering Best Service

A meeting of the executive committee of the Salesmen's Association of the American Chemical Industry was held at the Chemists' Club, New York City, Monday evening, Sept. 25. Those present were: President, John W. Boyer, Williams Haynes, Fred J. Signer, Ray P. Dunning, R. E. Dorland, Walter Goff, J. D. Lowery, F. P. Summers, David Stewart and George T. Short, secretary.

Reply to invitation from Adriaan Nagelvoort, manager of the new co-operative chemical show, was the appointment of a committee to investigate claims of the rival show managements and to report back to the association with recommendations. The sentiment of the meeting was that one show was essential to success and that the exhibits, being in charge of the sales departments of the chemical manufacturers, the Salesmen's Association could render constructive service to the whole industry by sifting the rival claims and throwing weight of their support with the management offering best service to American chemical makers.

F. P. Summers, of the Noil Chemical Co., was named chairman of the membership committee.

Salesmen's Study Course

F. E. Breithut, of the College of the City of New York, outlined a plan for a short night course for chemical salesmen and offered college co-operation in giving such a series of lectures under the auspices of Salesmen's Association. His invitation to hold the next meeting up in the tower of the college was accepted and the date set for Friday Oct. 13. This will be the annual meeting of the New York chapter, at which new local officers will be elected.

Doubt Report That German Dyes Will Pay Bill of Army on Rhine

State Department Did Not Authorize Statement That 5 Per Cent of German Output Will Be Accepted Without Cash Payment

PUBLICATION in the daily press of an article to the effect that the Secretary of State has worked out a plan whereby the cost of maintaining the American army of occupation on the Rhine would be met in part by turning over to the United States its proportion of the reparation dyes without money payment has caused great uneasiness within the dye industry, as is attested by the large number of telegrams which have been received by officials concerned. At the State Department it was asserted positively that no such information had been given out, but Secretary Hughes declined to confirm or deny the statements made in the article.

Dye specialists in Washington are inclined to doubt that any such plan is in contemplation.

The story, which was given some prominence in the daily press last week, stated that Secretary Hughes, after consultation with allied governments, had agreed to permit the United States to receive its share of German dyes without money payment, as has been the practice heretofore, the cost of these dyes to be credited on the American bill against Germany for the army of occupation.

History of Reparation Dyes

During the peace conference in Paris there were subsidiary negotiations between the United States and the Allies on the one hand and Germany on the other relative to the exceedingly complicated question of German dyes. These negotiations, extending over a considerable period, were held at Spa and it was agreed that 25 per cent of the total German dye output should be delivered to the Allies on account of reparations. The United States was to receive one-fifth of this, or 5 per cent of the total German output, but since the United States sought no reparations from Germany it was stipulated that this government should pay cash for any dyes received at market prices.

Later, when the question of payment of the United States for the maintenance of its army of occupation on the Rhine arose, Secretary Hughes made it plain that the United States did not propose to be left out in the cold by any arrangement by the Reparation Commission that would interfere with payment by Germany of the cost of the maintenance of the American forces on the Rhine. The justice of the American contention could not be denied and the Reparation Commission finally announced that the matter had been referred to the allied governments for consideration, note being taken by the commission of the American objection to payment of general reparations in advance of a settlement of the costs of maintaining the American army of occupation.

Method of Distribution

Before the ratification of the treaty of peace between the United States and Germany the understanding regarding German dyes had not received a clear legal status. The Textile Alliance had been organized for the distribution of German dyes in the United States. The American treaty with Germany, however, specifically guarantees the rights of the United States with respect to the reception of German dyes, and the same treaty further makes it possible for Congress to create a mechanism for handling such dyes whenever received in the United States.

Customs officials state that, unless Congress specifically directs otherwise, dyes imported under such a plan would pay duties charged under the new tariff bill.

Pottery Firms Indicted for Price Fixing

Twenty-Three Companies Charged With Conspiracy to Fix Prices and Stifle Competition

Conspiring in price fixing and unlawful restriction of sales are the two counts charged in an indictment against twenty-three companies, representing 85 per cent of the pottery industry of the United States, and twenty-four men, officers of the same companies.

This indictment is the last of the series resulting from the housing investigation of the Lockwood committee, authorized by the New York State Legislature. It was returned by the July Federal Grand Jury, but on motion of Colonel Hayward, United States Attorney for the Southern District of New York, was held under seal pending further investigation.

Charges Price Fixing

The indictment charges specifically that the defendants engaged in a price-fixing combination whereby they refrained from competing with one another on a price basis, thus exacting "uniform, arbitrary and non-competitive prices."

The second charge, as explained by Colonel Hayward, involves a practice whereby the defendants were barred, by common consent, from selling their products directly to builders, architects or contractors. All sales, it is alleged, had to be made through so-called "legitimate jobbers." In this manner, according to the District Attorney, prices to the consumer were increased "beyond all reasonable proportions."

Stifled Competition

After adding a profit, the charge continues, the jobber would confine his sales to a so-called legitimate plumber, who would add his profit. After that it would go to the contractor. Each group by this plan, according to charges, was placed in a position to dictate prices and profits without fear of competition.

It is understood that the defendants will be called for pleading within 2 weeks and will be brought to trial soon. The individuals indicted and the companies they represent are as follows:

James E. Slater, president and manager of the Abingdon Sanitary Manufacturing Co., Abingdon, Ill.

James A. Dorety, Jr., secretary of the Acme Sanitary Pottery Co., Trenton, N. J.

Bart O. Tilden, president of the B. O. T. Manufacturing Co., Trenton, N. J.

John W. Bowers, president of the Bowers Pottery Co., Nannington, W. Va.

T. Munro Dobbins, president and treasurer of the Camden Pottery Co., Camden, N. J.

Theodore H. Sharker, secretary and treasurer of the Chicago Pottery Co., Chicago, Ill.

Walter F. Drugan, vice-president of Cochran-Drugan & Co., Trenton, N. J.

Raymond E. Crane, vice-president of the Eljer Co., Cameron, W. Va., and Ford City, Pa.

Edward V. Brigham, vice-president and general manager of the Kalamazoo Sanitary Manufacturing Co., Kalamazoo, Mich.

G. E. Rhodes, general manager of the Kokomo Sanitary Pottery Co., Kokomo, Ind.

Harry J. Lyons, president and treasurer of the Keystone Pottery Co., Trenton, N. J.

Philip J. Faherty, treasurer of the Lambertville Pottery Co., Lambertville, N. J.

William B. Maddock, secretary of John Maddock & Sons, Trenton, N. J.

Archibald M. Maddock, president of Thomas Maddock Sons Co., Trenton, N. J.

Harry F. Weaver, secretary and general manager of the National-Helfrich Potteries Co., Evansville, Ind.

Newton W. Stern, president of the Pacific Sanitary Manufacturing Co., Richmond, Calif.

John F. Smith, treasurer of the Resolute Pottery Co., Trenton, N. J.

(*Continued on page* 713)

Stansfield to Address Cleveland Iron and Steel Engineers

Prof. Alfred Stansfield, well-known authority on the electric furnace, will be the speaker at the Oct. 9 meeting of the Cleveland District Section of the Association of Iron and Steel Electrical Engineers. Dr. Stansfield has taken as his subject "Electric Smelting of Iron Ores" and will illustrate his remarks with lantern slides. The meeting will be preceded by a dinner at the Cleveland Engineering Society's club rooms at the Hotel Winton.

Muscle Shoals Disposal Will Be Revived

Scheduled for Consideration After Recess—Big Power Demand in District

Advocates of acceptance of the Henry Ford offer for the Muscle Shoals project caucused before Congress adjourned and laid tentative plans to renew their effort when the two houses reconvene. Conferences were held with Majority Leader Mondell and others prominent on the Republican side of the House with a view to learning the prospects of having the McKenzie and Wright bills set on the calendar for early consideration. The McKenzie bill provides for acceptance of the Ford bid with the Gorgas steam plant excluded from the property, and the Wright bill would accept the Ford offer with Gorgas included.

Leader Mondell is quoted as having assured the Ford advocates that he saw no objection to having the Ford offer brought on the floor of the House early in the next session, although he pointed out that there is much other important legislation which has been pending for a longer period.

In the last week of the recent session of Congress, the Ford advocates abandoned their tactics of obstructing other legislation in an effort to have the Muscle Shoals bills called up, because it was realized that nothing could be accomplished in the short time remaining. Leaders of the movement declared for an aggressive fight when Congress meets unless the measures are given early consideration.

Hearings also will be asked immediately by Representative Hull on his resolution to refer the whole question of disposition of the Muscle Shoals properties to the Secretary of War with power to act.

Sheffield Steam Plant Loaded

Electrical energy being generated at the government steam plant at Sheffield, Ala.—one of the Muscle Shoals plants—is now being sent to the rescue of industry in various communities of southeastern United States, being relayed by intervening systems to aid industry as far as 600 miles away, according to a statement made public in Washington by Thomas W. Martin, president of the Alabama Power Co.

Several thousand miles of high voltage transmission lines are being used, Mr. Martin states, and with the various interconnections in Alabama, Tennessee, Georgia, North Carolina and South Carolina, the system now in use is shown to be the largest in operation in the whole country.

Demand for Power

"There is an unusual industrial demand for power in this section," Mr. Martin says. "This, coupled with the coal shortage, the inability to obtain prompt deliveries of coal and the drought, has brought about a serious situation. The water-power plants and reserve steam plants in some parts of North and South Carolina and Georgia have been unable to take care of the power requirements of cotton mills and other industries in various communities in those states. Therefore, the Sheffield steam plant is now being operated by the power companies for the benefit of the public in the entire Southeast through interconnection of the lines of the companies in the states of Alabama, Tennessee, Georgia and North and South Carolina. The Sheffield plant is nearer the coal mines than other plants and the wheels of industry are being turned again, by that plant, in many far away communities."

The proximity of the steam plants in Alabama to the coal fields of that state makes it feasible to operate them when other plants remote from those fields have difficulty in obtaining fuel. Owing to the fact that this superpower zone is in actual operation at this critical period, several of the largest cotton mills in that section are able to continue at work.

German Sale of Alsace Petroleum Fields Set Aside

The petroleum fields of Pechelbronn (Alsace) were owned, previous to 1914, by two German societies, the Allgemeine Birgemeinegesellschaft and the Deutsch Erdol Aktiengesellschaft. After the armistice the fields were sold by the German societies to a Swiss society, Laterra, which was subsequently consolidated with another Swiss concern, L'Union Internationale des Petroles. The French Government placed the fields under sequestration, their administration being given to the Société Alsacienne d'Etudes Minieres. The Swiss societies recently requested the civil court to validate certain attachments of the property of the Société Alsacienne d'Etudes Minieres and, on the other hand, the Office des Biens et Interets Privés requested the lifting of the attachments. The court, according to information recently received by the Department of Commerce, has rejected the demand of the Swiss societies, stating that under the terms of the treaty of peace all enemy property was to be under the administration of France, and that the Pechelbronn fields had been unduly sold by the German owners.

Germany Rapidly Restoring Nitrogen Fixation Plants

At the meeting of the British Association held at Hull on Sept. 12, J. A. Harker, in the course of a paper on "Post-War Progress in the Fixation of Nitrogen," said Germany was finding vast sums for the restoration and development of her plant for the fixation of nitrogen. The figures Dr. Harker gave show that in 1913 Germany used 200,000 tons of fixed nitrogen, and by May of this year she was already producing and using at the rate of 290,000 tons per annum. She had by no means reached the limit of her capacity, and by the end of the year he estimates that the output will be at least 500,000 tons.

Time Extension for Chemical Foundation

Month More Allowed for Filing Answer —Situation Complicated by Trademark Clause

The Department of Justice has instructed the District Attorney in Delaware to consent to a 30-day extension of time in which the Chemical Foundation may file its answer to the bill in equity demanding the return of the 4,700 former German patents. The consent was granted on the condition that both parties, the Department of Justice and the Chemical Foundation, cooperate to obtain a speedy settlement of the controversy, which is reaching serious proportions due to the trademark clause in the new tariff bill.

Sept. 28 was the date originally set for the filing of the Foundation's answer. The extension plea was made on the ground that the bill was of such length that more time was necessary properly to prepare its answer. Attorney-General Daugherty, in a statement last week, said that the department realized that more time was essential and that it had no disposition to force the Foundation into trial until it had been given time in which to prepare its defense. If the Delaware court grants the extension, and confidence is expressed that it will, the Chemical Foundation must file its answering plea on Oct. 27.

Trademark Clause Tangles Situation

The government is anxious that the question of title to the patents be settled as speedily as possible. A clause inserted in the Fordney-McCumber tariff bill makes it illegal to import into the United States "any merchandise if any such merchandise or the label, sign, print, package, wrapper or receptacle bears a trademark owned by a citizen of, or by a corporation or association created or organized in the United States."

Many of the trademarks included in the purchase by the Chemical Foundation are internationally known, and the trademark or trade name could not be changed without losing practically all the old trade. It is generally predicted that the German manufacturers, rather than injure their own markets by changing the trademarks on these products, mostly pharmaceuticals and dyes —will abandon the American market if the Chemical Foundation is victor in the suit.

Officials freely admit that it is a complicated situation and are unwilling to predict the final solution, even if the government is able to set aside the sale.

No More American Caustic for Germany

The demand for American caustic soda in Germany has ceased suddenly according to recent advices to government officials. No report has been received as yet explaining definitely why it became necessary for German interests to purchase such large amounts of caustic soda in this country.

English Develop New Fertilizer From Straw

Valuable Farmyard Manure Produced by Action of Bacteria on Cellulose

A process of leading importance in agriculture has been developed by H. B. Hutchinson and E. H. Richards at the Rothamsted Experiment Station at Harpenden in Hertfordshire, England. It consists in producing farmyard manure from straw in the form of humus with its full complement of nitrogen, or about 2 per cent, within 3 months and under easily controlled conditions. The process is patented and experiments are under way in several stations in England to work out the simplest and most available technique. The manure is a well-disintegrated, plastic material in which the tubular character of the straw has been to a great extent destroyed.

Home Made Fertilizer

The maximum results are obtained by subjecting the straw to the action of a culture of aërobic cellulose-destroying organisms with the requisite moisture and the addition of nitrogen as ammonia, diluted urine, urea, ammonium carbonate, ammonium sulphate or cyanamide, to start the reaction. Unless the water is very hard, lime in some form is needed also—that is, soluble nitrogen is supplied at the rate of 0.72 part nitrogen to 100 parts of dry straw. Then little or no loss of nitrogen ensues and the final product contains, as stated above, about 2 per cent. This is also about the same proportion that is contained in the feces of cattle.

An alternative method in which inclosed containers are used and the air supply regulated provides gas (methane) for lighting and driving machinery on the estate of Lord Liveden, but it seems questionable whether the cost of installation to produce this convenience would not be too great for ordinary farm practice.

Superior Properties

The extraordinary value of farmyard manure as compared with nitrogen in any other form and the invigorating effect of the added humus to the soil make the discovery of leading importance. Straw of itself is not a useful fertilizer; indeed in many cases it depresses the crop. But once it is decomposed in this manner its value is immediately developed and many pot and field cultures show it to be a true farmyard manure. The straw and the organisms working on it must have abundance of air and just enough but not too much nitrogen. Ordinary urine is too concentrated and destroys the bacteria. Straw immersed in water or in urine will not undergo change. Therefore control of these factors is necessary, although it is believed that processes will shortly be worked out to make any intelligent farmer able to transfer all of his straw into about half its weight of this precious nitrogen-bearing humus. What the invention may mean to the farmers of the West, for instance, in improving their wheat crop with the aid of a proper manure spreader needs no comment. The same may be said of the wheat farmers of Canada and of the ranchers who burn their flax straw in the Dakotas.

Heat Standard for Gas Is Established in New York

For 15 years there has been a distinct tendency toward adoption of heating value standards for gas quality to replace candle-power requirements. New York City has been the outstanding example where candle-power standards remained until very recently. By order entered on Aug. 30, the New York State Public Service Commission adopted for all gas companies in greater New York a heating value requirement of 537 B.t.u. per cubic foot monthly average, specifying that no daily average should be less than 525 B.t.u. Thus practically the last candle-power requirement of consequence in the country is superseded.

There are two other rather interesting requirements as to gas quality in the commission order. The first specifies that the gas must not contain more than 15 per cent inert constituents. It is doubtless the expectation that this rule will prevent the practice, which has seemed to be particularly prevalent abroad, of making unnecessarily low-heating value gases through excessive vacuum on retorts or slovenly operation with water-gas equipment. The requirement is one of the first where such limit on the total of oxygen, nitrogen and carbon dioxide in a gas has been fixed.

The second novel requirement in this order provides that the heating value shall not have a variation greater than 5 per cent during any 3 consecutive days. This specification is intended to prevent the practice, which has occasionally been found in smaller plants, of running very close to the average requirement until near the end of the month and then bringing up the average by excessively high heating values during the last few days. The result of such practice is, of course, very bad service, because uniformity of quality is of first importance.

The new requirements took effect on Oct. 1.

American Interests Get Oil Concessions in Czechoslovakia

Czechoslovakian official sources announce the formation of a petroleum company having a capital of 100,000,000 crowns. Half of the capital will belong to the government, in exchange for which the Franco-American Standard Oil Co. is granted a monopoly for the exploitation of the oil lands which have not yet been bored. A small part of the capital, about 4,000,000 crowns, will be underwritten by the Credit Bank of Prague, while the remainder will be held by the Franco-American Standard Oil Co.

Power Exposition of Interest to Industries

Show in New York Will Cover All Phases of Development and Utilization of Power

Engineers well known in industrial circles make up the advisory committee which is guiding the National Exposition of Power and Mechanical Engineering. This exposition will open at the Grand Central Palace, New York City, on Dec. 7 at noon and will extend through to Dec. 13, except the intervening Sunday. It will immediately follow the annual meetings of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers. Irving E. Moultrop, of the Edison Electric Illuminating Co., of Boston, heads the advisory committee, and his colleagues are: Dexter S. Kimball, president of the American Society of Mechanical Engineers; Alexander G. Christie, chairman of the power division A.S.M.E.; Fred Felderman, president of the National Association of Stationary Engineers; Milan R. Bump, president National Electric Light Association; N. A. Carle, vice-president, Public Service Production Company of New Jersey; E. B. Katte, chief engineer, electric traction, N.Y.C.R.R. Co.; Fred R. Low, editor *Power;* David Moffat Myers, consulting engineer; Calvin W. Rice, secretary American Society of Mechanical Engineers.

Stress Engineering Features

This advisory committee is keenly alive to the importance of an exposition that will stress the engineering phases of the problems involved in the economical uses of fuel and the more effectual generation and utilization of power. The effect of such an exposition must be far reaching and the plan outlined by the committee insures a show that will benefit the manufacturer who uses only a small boiler for process steam as well as the engineers of the cement, ceramics, metallurgical and power generation industries, whose fuel and power problems are extensive and severe.

The list of firms which have already reserved space shows that all apparatus and materials used in harnessing the energy released from fuels will be represented. The general appreciation of the importance of the exposition further insures the showing of the newest devices and best methods.

Program of Meetings

The program for the week has been arranged so that those interested especially in fuels and power can attend the technical sessions on these subjects at the annual meeting of the American Society of Mechanical Engineers. Sessions on ash-handling machinery, stokers and steam utilization have already been announced; others are to come later and it is probable that the papers on these subjects will be amplified by the exhibits at the exposition.

Tax Returns Show Volume of Chemical Business

Over 3,000 Companies in Chemical and Allied Fields Paid Nearly $100,000,000 in 1920

The net income of the 3,047 corporations engaged in the manufacture of chemicals and allied substances for the calendar year 1920 was $441,369,660. This total is taken from a compilation just made by the Bureau of Internal Revenue. The total number of manufacturing chemical concerns which made returns to the Bureau of Internal Revenue was 5,826. Of that number 2,779 reported no net income. The total deficit reported by those concerns was $96,439,756.

The 3,047 concerns reporting net income paid taxes to the extent of $98,163,376.

The concerns engaged in manufacturing chemicals proper which made returns in 1920 numbered 908. Of these, 516 reported net incomes aggregating $42,034,248. They paid taxes to the extent of $9,823,369. The remaining 392 concerns reported no net income, with deficits of $7,919,341.

Paints and Oils

The Revenue Bureau figures show that 648 concerns engaged in the manufacture of paints and varnishes made returns. Of that number 438 reported net incomes aggregating $17,371,134. The tax paid by these concerns totaled $3,688,282. The remaining 210 concerns reported no net income, with deficits totaling $3,154,247.

There were 457 concerns engaged in the preparation of vegetable and animal oils. Of that number 156 reported net incomes aggregating $1,272,359. They paid taxes to the amount of $3,820,496. The remaining 301 concerns reported no net income, with deficits totaling $12,455,527.

Petroleum and Refining

Petroleum and mineral oil refining is included under the chemical activities. Those concerns numbered 390. Of that number 203 reported net incomes aggregating $245,599,730. The tax collected from those companies totaled $54,554,347. The remaining 187 concerns reported no net income, with deficits totaling $4,570,838.

Soap

Soap-manufacturing concerns making returns numbered 157. Of that number 63 reported net incomes totaling $3,657,175. They paid taxes amounting to $632,501. The remaining 94 concerns reported no net income, with deficits totaling $14,798,185.

Fertilizers

Two hundred and thirty concerns engaged in the manufacturer of fertilizers made returns in 1920. Of that number 107 reported net incomes totaling $5,480,826. Their total tax bill was $885,771. The remaining 123 concerns reported no net income, with deficits totaling $25,788,478.

The bureau classifies returns from 3,036 as manufacturers of "all other chemicals and allied substances." Of that number 1,564 reported net incomes totaling $111.768,470. They paid taxes to the extent of $24,758,610. The remaining 1,472 concerns reported no net income, with $27,753,740 deficits.

Bureau of Mines Completes Fluorspar Investigation

Accurate information on methods of mining, milling and utilization and on costs of production of fluorspar is so lacking that it has been considered advisable by the Bureau of Mines to investigate all phases of the fluorspar industry in the United States. At the request of and in company with several Eastern fluorspar producers, examination has been made of the principal fluorspar deposits of the Western states. This examination was followed by an intensive study of the producing mines in Illinois and Kentucky. It was found that most of the deposits in the Far Western states were small and could not be relied on to produce much surplus over the needs of the Western states. Costs of production in the Illinois-Kentucky field have increased greatly, owing to the increasing depth of the principal mines, the large amount of water that must be pumped and the increased costs of labor and supplies. A report on all phases of the fluorspar industry is in preparation.

Pacific Coast Steel Plants Consolidate, Planning Expansion

The Pacific Steel Corporation, San Francisco, Calif., recently organized to take over and consolidate the Pacific Coast Steel Co., the Southern California Iron & Steel Co. and the Milner Corp., is perfecting plans for immediate enlargement in the different plants of the affiliated interests, estimated to cost in excess of $7,000,000. The Pacific Coast company has plants at San Francisco, Portland and Seattle. All of these will be extended with new buildings and equipment, including practically a doubling of the present capacity at the San Francisco works. The Southern California company has going plants at Los Angeles and San Diego, both of which will be enlarged in the near future.

Prospective plans provide for the early erection of a new blast furnace on site to be selected in Utah, estimated to cost approximately $5,000,000. It will be devoted to the production of pig iron, which will be utilized at the different steel mills of the company. The new corporation proposes to arrange facilities for the complete manufacture of fabricated steel shapes and other steel products from raw materials on the Pacific coast. It is capitalized at $20,000,000, with 200,000 shares of common stock, no par value. Organization plans and the election of officers and directors are now being consummated. The company is represented by T. T. C. Gregory, attorney, Insurance Exchange Building, San Francisco.

Agricultural Chemists to Meet in Washington

Variety of Food and Drug Products to Be Discussed at Annual Convention

The thirty-eighth annual convention of the Association of Official Agricultural Chemists will be held in Washington, D. C., at the Raleigh Hotel, beginning Nov. 15.

The morning session, the first day of the meeting, will include discussions on the general subjects of water, tanning, insecticides, soils and food products. That afternoon symposiums will be held on fertilizers, dairy products, baking powder, fats and oils and inorganic plant constituents. The drug section will meet at the same time and twenty-one papers on the preparation, analysis and properties of various drugs are scheduled.

The Thursday sessions will be devoted to papers on foods, food preservatives and the testing of food products. Vinegars, flavoring extracts, gelatine, tea, coffee, spices, cereal foods and beverages will come in for a share of the discussion.

Harvey W. Wiley, honorary president of the association, will address the meeting Thursday morning at 11 o'clock. F. P. Veitch, president of the association, will also speak at this time and will introduce Senator E. F. Ladd, who is tentatively scheduled for a talk. Secretary of Agriculture Wallace is on the Thursday afternoon program.

Friday will be devoted to committee reports, fourteen reports being expected.

Electric Welding by Alternating Current

A system of electric arc welding using an alternating current, the invention of A. Tornblom, a Swedish engineer, has been placed on the market by Carlson-Hedborg-deVerdier, Stockholm, under the trade name "Wex system." Use of the alternating current in electric welding is an important feature in view of the fact that most shops use this current. The rheostat is designed to keep the current continuously at even strength. An economic advantage is that welding may be made with a comparatively weak current. Thus it requires only 3.6 kw.-hr. to melt 1 kg. of iron.

Fertilizers Given Transportation Priority by I.C.C.

By including fertilizers among the commodities given priority in transportation in its service order 25, the Interstate Commerce Commission has given official recognition for the first time to the essential character of the fertilizer industry. The effect of service order 25 has been to relieve very greatly the situation which for a time made it impossible to move fertilizers in anything like the volume necessary to meet the country's requirements. The situation was aggravated by the seasonal character of this movement.

Safety Institute of America Plans Accident Prevention Week

More than 6,000 industrial plants in New York City employing nearly one million men and women will participate in the campaign for the prevention of accidents which will be launched during the week of Oct. 8 to 14 by the Safety Institute of America through the Public Safety Committee, of which Elbert H. Gary is chairman. This announcement was made by Laurence Vail Coleman, director of the Safety Institute of America, following the appointment of Henry D. Sayer, Commissioner of the New York State Department of Labor, as chairman of the industrial committee for the safety week campaign.

In urging the industries to conduct a safety campaign within their own plants, the Institute believes that it is reaching effectively not only workmen but fathers and citizens, thus making a direct contribution to the campaign.

Commissioner Sayer is asking each of the 3,000 plants under the jurisdiction of his department to conduct a safety drive within its own gates throughout safety week, to hold mass meetings of employees which will be addressed by safety speakers and at which in many cases safety motion pictures will be shown. Each plant has been requested to post at each entrance and on bulletin boards throughout the plant the "Don't Get Hurt" posters issued by the Safety Institute.

Big Australian Power Project Progressing Rapidly

Electrification of the State of Victoria, Australia, by the utilization of the Morwell brown coal is being rapidly carried forward by the State Electricity Commission, according to reports to the Department of Commerce.

The main power house, which is to be situated at the new township of Yallourn, about 5 miles from Morwell, and which is expected to be in operation in about 2 years' time, will have an initial capacity of 50,000 kw. and will contain five 12,500 turbo-generators. All the principal contracts for the plant and machinery for the main power station at Yallourn are being placed, and the reports indicate that the progress with the manufacture of the machinery is good. A considerable portion of the equipment has already been delivered, while the manufacture of the five turbo-alternators and of the condensing plant is well advanced.

The greater part of the preparatory work of the site has been completed; contractors for the steel work for the power station are at work on the ground and steel is arriving. Gangs have been organized for the erection of the transmission line (over a distance of 112 miles) for which much of the material is now at hand.

The erection of the auxiliary station at Newport is proceeding satisfactorily and justifies the expectation that the station will be in operation by May, 1923, as originally intended.

Pottery Firms Indicted

(Continued from page 709)

Arthur Plantier, Sr., president and general manager of the Sanitary Earthenware Specialty Co., Trenton, N. J.

George C. Kalbfleisch, factory manager of the Standard Sanitary Manufacturing Co., Kokomo, Ind.

Sigmund B. Kling, factory manager of the Standard Sanitary Manufacturing Co., Tiffin, Ohio.

Willard C. Chamberlain, sales manager of the Standard Sanitary Manufacturing Co.

Elzey S. Aitkin, general manager of the Trenton Potteries Co., Trenton, N. J.

J. E. Wright, president and general manager of the Wheeling Sanitary Manufacturing Co.

Chris Horton, president and treasurer of the Horton Pottery Co., Chillicothe, Ohio.

Surplus Picric Acid in Demand for State Roads

Over 4,000,000 lb. of the War Department's surplus picric acid has been distributed to date through the Bureau of Public Roads. All orders received from states have been filled as follows: California, 72,400 lb.; Connecticut, 20,400; Georgia, 37,800; Idaho, 135,100; Indiana, 24,000; Iowa, 57,300; Kansas, 16,100; Louisiana, 37,300; Michigan, 804,800; Minnesota, 1,133,300; Mississippi, 23,000; Missouri, 65,000; Montana, 35,200; New York, 100; North Carolina, 117,200; Ohio, 42,000; South Carolina, 17,100; Tennessee, 81,100; Washington, 72,600; Wisconsin, 1,456,800, and Vermont, 3,200.

Personal

Dr. JAMES C. ANDREWS has severed his connection with E. I. du Pont de Nemours & Co. in order to teach physiological chemistry in the medical school of the University of Pennsylvania, Philadelphia, Pa.

GEORGE A. BOLE has been appointed superintendent of the ceramic experiment station of the Bureau of Mines at Columbus, Ohio. For the past 5 months Mr. Bole has been acting superintendent of the station. Mr. Bole joined the Bureau of Mines staff on Aug. 6, 1921, as an associate chemist. For 9 years prior to that time he had been professor of ceramic chemistry at Alfred University. He was graduated from Geneva College in 1906 and from Columbia University in 1911.

RICHARD H. EURICH, formerly with the Westinghouse Electric & Manufacturing Co., Trafford, Pa., is now vice-president and works manager of the Morristown Electric Steel Foundry, Morristown, N. J.

LEON W. PARSONS has tendered his official resignation as assistant director of the Research Laboratory of Applied Chemistry and assistant professor of applied chemical research of the Massachusetts Institute of Technology, to take effect Nov. 1, in order to accept the position of chief chemist with the Tide Water Oil Co. His headquarters will be at Bayonne, N. J.

Dr. ROBERT E. SWAIN, head of the department of chemistry at Stanford University, spoke before the Southern California Section of the American Chemical Society, Sept. 28, on "Some Aspects of the Smoke Problem."

ROBERT C. WEED, formerly metallurgist for Fairbanks, Morse & Co., is now with the Minnesota Steel Co., Duluth, Minn.

W. B. WIEGLAND has recently been appointed general manager of the reorganized Ames-Holden McCready, Ltd., a wholesale rubber goods concern of Montreal. Mr. Wiegland has been an executive of the company during the past 3 years.

The following have joined the staff of the research laboratory of the Eastman Kodak Co., Rochester, N. Y.: Dr. Helge Schibsted, formerly with the Atmospheric Nitrogen Co.; Clyde Brockett, Massachusetts Institute of Technology, 1922; Alasco Burgess, Bates College, 1922; D. Henry Harris, Massachusetts Institute of Technology, 1922; Roger P. Loveland, Grinnell College, 1919.

The Massachusetts Institute of Technology, Cambridge, Mass., in preparation for the opening of its new academic year on Oct. 2, announces a number of additions to its faculty and instructing staff. Chief among these are the appointments of W. Spencer Hutchinson to the professorship of mining, Dr. G. B. Waterhouse to the professorship of metallurgy and Dr. Frederick G. Keyes to be acting head of the department of chemistry. Professor Hutchinson was graduated from the Institute in 1892 after having studied in the civil engineering and mining departments. Professor Waterhouse was born in England 40 years ago and was educated at Sheffield, where he received the degree of Bachelor of Metallurgy. He came to the United States in 1900 and later studied at Columbia University, where he obtained the degree of Doctor of Philosophy in 1906. Professor Keyes, the present acting head of the department of chemistry, is a graduate of Rhode Island State College and of Brown University. At the latter institution he received the degree of Doctor of Philosophy in 1909. In 1920 he first joined the staff of the Institute. From 1913 to 1916 he was chief engineer of the Cooper-Hewitt Co., and in 1916 he returned to the Institute as associate professor of physicochemical research.

Obituary

FRANK M. HAWKINS, who had been actively connected with the Crouse-Hinds Co. for more than 25 years, died recently.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Clearing the Way for Business Progress

Settlement of Labor, Tariff and Bonus Issues Removes Obstacles That Have Retarded Improvement—Unemployment Now Non-Existent—Rising Wages and Prices

NOT AT ANY TIME in recent months have fundamental business conditions appeared in a more favorable light. The wreckage of industrial strife has been almost entirely cleared away, the uncertainties of the tariff are definitely ended, the threat of the bonus has been effectively defeated and, finally, the summer lull in production and demand is gradually giving way to the seasonal activity that usually accompanies the fall and winter months. Thus one by one the serious obstacles in the path of the present business revival have been removed, leaving the way clear for the operation of those factors making for progress and improvement.

Tariff and Bonus Legislation

From a national viewpoint the President's veto of the bonus bill and the enactment of the new tariff are of most significance to business. The former action though not entirely unexpected, has had a cheering influence on those who have been appalled by the prospects of a four-billion-dollar drain on the public treasury. The effects of the new tariff are problematical. It will probably yield an annual revenue in the neighborhood of $400,000,000, but its opponents contend that it will cost more than that in more expensive living conditions and unfavorable reaction on our export trade.

That the industrial situation has improved with the settlement of the strikes goes without saying. Over 600,000 coal miners and 400,000 railway shopmen are back at their jobs and the textile workers' strike in New England has finally ended after 8 months of struggle. There are, however, certain cumulative effects that must still be accounted for by industry. The tremendous economic losses arising from interruption and disturbance in these basic industries must be paid for in the long run, even though their full effect may not be felt immediately.

Coal and Transportation

Two closely related factors which may yet have a retarding effect on further business expansion are fuel and transportation. Both at present, however, are most encouraging. Normal production at the anthracite mines during the week ended Sept. 23 brought the total output of coal, anthracite and bituminous, up to 11,650,000 net tons. Soft coal production of 9,661,000 tons compares with 8,187,000 tons in the corresponding week of 1921 and 10,685,000 tons in 1920. Car loadings, both of coal and other revenue freight, are setting new high records. More cars were loaded during the week which ended Sept. 16 than during any week since Oct. 29, 1921. Coal loadings alone amounted to 172,241 cars, the largest number during any single week since the beginning of the miners' strike. This was an increase of 32,671 cars over the preceding week and 6,730 over the same week of last year.

Unemployment is no longer a factor in the industrial situation. In comparison with 5,500,000 workers out of employment at this time last year, the *Guaranty Survey* estimates that at present only 1,500,000 are seeking work. The Bureau of Labor Statistics has recently reported the volume of employment in 2,595 representative establishments covering 1,249,144 employees in forty-two manufacturing industries. Of this number thirty industries reported increases in the number of persons employed in August as compared with July. The largest increase, 30.6 per cent, was in stamping metal products. Fertilizers showed an increase of 16 per cent and chemicals an increase of 3.2 per cent. The results reported for a few of the more important industries are shown in Table I.

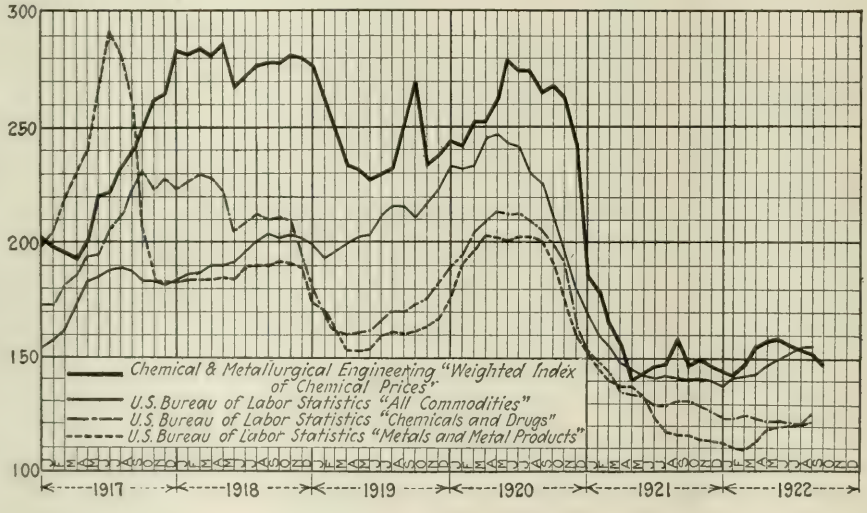

FIG. 1—THE TREND OF CHEMICAL AND METAL PRICES, 1917-1922

Wage Increases and Inflation

The advance of 20 per cent in wages made effective by the U. S. Steel Corporation appears to have been the cue for all other industries to follow suit. It is a very serious question, however, as to whether or not the rising tendency of both prices and wages is to be regarded as a favorable development. There is abundant evidence to indicate that widespread inflation always has its beginnings in just such general move-

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	**150.14**
Last week	146.86
October, 1921	151
October, 1920	263
April, 1918 (high)	286
April, 1921 (low)	140

Seven of the twenty-five commodities included in this index advanced in price during the past week. There were no declines. Higher prices were reported for acetic and citric acids, barium chloride, formaldehyde, glycerine, methanol and crude potassium carbonate.

BLE I—COMPARISON OF EMPLOYMENT IN JULY AND AUGUST, 1922

Industry	Establishments	Period of Payroll	Number on Payroll in July, 1922	Number on Payroll in Aug., 1922	Per Cent Increase or Decrease
tomobiles..	97	1 wk.	152,147	152,827	+ .4
tomobile ires.....	34	1 wk.	30,343	30,786	+ 1.5
ck.....	136	1 wk.	13,077	13,095	+ .1
emicals....	36	1 wk.	8,390	8,659	+ 3.2
tilizers....	20	1 wk.	2,575	2,987	+16.0
undry and nach. shops	154	1 wk.	67,614	68,094	+ .7
ass.....	59	1 wk.	15,492	15,319	— 1.1
n and steel	125	½ mo.	155,030	153,260	— 1.1
ther.....	72	1 wk.	22,992	23,758	+ 3.3
per and pulp.....	90	1 wk.	32,871	32,875	+ *
troleum....	20	2 wks.	25,985	25,860	— 0.5
ttery.....	17	1 wk.	5,194	5,404	+ 4.0
mped ware	10	1 wk.	3,225	4,213	+30.6

* Increase less than one tenth of one per cent.

ents as this. Already we hear talk of econdary inflation," so called, per-aps, for the purpose of mitigating its ost undesirable effects. A recur-nce of conditions existing in 1919 d 1920 can be viewed only with ap-rehension by those interested in fun-amental business conditions.

Thirty-three of the forty-two indus-ies included in the survey of the De-artment of Labor show increases in he total amount of payroll for August, 922, as compared with July. The per apita increase in earnings reported by me of these industries are as fol-ws: Iron and steel, 15.1 per cent; utomobiles, 8.6 per cent; fertilizers, 3 per cent; tires, 5.2 per cent; pot-ry, 5.1 per cent; glass, 4.8 per cent; emicals, 3.6 per cent; pulp and aper, 3.6 per cent, and leather, 2.2 er cent. Among the industries show-g a decrease in individual earnings as petroleum, with 3.6 per cent.

The Trend of the Chemical Market

A Review of the Principal Price Changes and Tendencies During the Third Quarter of 1922

The factors which have had most effect on the chemical market during the past 3 months are no longer of real significance. The uncertainties connected with the framing of the new tariff came to an end with its enactment on Sept. 21, 1922. The difficulties caused by the railroad shopmen's and the coal miners' strikes were largely relieved by their resumption of work. Except for the spasmodic activities resulting from threats of fuel shortage or transportation tie-up, the chemical market has been without any significant development.

Those who are in closest touch with the chemical market, however, are of the opinion that the fourth quarter of 1922 will witness a marked revival and a healthier condition of trading.

Market Features

The outstanding feature of the market has been the sharp advances on all commodities of an imported nature. *Barium carbonate*, quoted at $60 per ton during July, was advanced to $80 per ton since the passage of the tariff. *Barium chloride* showed a complete recovery from its temporary slump during August, and prices are again at the high level of $105 per ton, with all indications toward higher figures. The prussiates were another feature of marked interest. *Yellow prussiate of potash* was quoted during July at 31½c. per lb. and has steadily advanced to 37c. per lb. for the beginning of the last quarter. *Yellow prussiate of soda* has also shown signs of much livelier trading, and quotations were advanced from 21c. per lb. during July to 24c. per lb. for October. The price for this commodity in January, 1922, was 17¼c. per lb. *Caustic soda* for export has been a complete disappointment to producers. Their only consolation was the very active domestic demand from leading consumers. Contract prices remained at the same levels, with export figures somewhat lower at $3.55 per 100 lb. *Oxalic acid* increased in price from 14½c. per lb. in July to 17c. per lb. at the close of the quarter. *Calcium acetate* manufacturers increased quotations from $2.35 per 100 lb. to $2.75. Increased cost of production has been directly responsible for the several advances in this item. *Caustic potash*, 88-92 per cent, has shown considerable activity since the passage of the tariff and prices were advanced from 5½c. per lb. to 6½c. Late trading was of much larger volume than at any other time this year. *Bleaching powder* has also been one of the features of the market. Stressed lots have entirely disappeared during the interval and factors have experienced difficulty in filling old contracts. Quotations were advanced from $1.60 per 100 lb. in July to $2 per 100 lb. for October. *Formaldehyde* prices jumped from 8c. per lb. during July to 10½c. per lb. for October. Increased prices for *methanol* were directly responsible for the advance. Trading in this item has also shown additional activity. *Ammonium sulphate* prices were materially advanced from $3.50 per 100 lb. to $3.75.

A monthly comparison of the average prices of forty-five important chemicals in the New York market is to be found in the accompanying table.

COMPARISON OF THE AVERAGE MONTHLY PRICES IN THE NEW YORK MARKET FOR 45 IMPORTANT CHEMICALS

Article	Unit	Average Price for Month of Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Price on Oct. 1
cetic acid, glacial	Lb.	$0.10	$0.09	$0.09	$0.09	$0.09	$0.08½	$0.09½	$0.12	$0.11½	$0.11
luriatic acid, 20 deg.	100 lb.	1.25	1.15	1.15	1.10	1.10	1.10	1.10	1.10	1.10	1.10
itric acid, 40 deg.	Lb.	.06¼	.06¼	.06¼	.06	.06	.06	.06	.06	.06	.06
xalic acid	Lb.	.14	.14	.14	.11½	.13½	.14	.14½	.16	.17	.16¾
ulphuric acid, 66 deg.	Ton	16.50	16.00	16.00	17.00	15.50	15.00	15.00	14.50	15.00	15.00
cetate of lead	Lb.	.10⅝	.10⅝	.09⅝	.09⅝	.09⅝	.09¼	.09¼	.10¼	.10½	.10¼
mmonia alum, lump	Lb.	.03½	.03½	.03½	.03½	.03¼	.03¼	.03¼	.03¼	.03¼	.03¼
luminum sulphate, iron free	Lb.	.02½	.02½	.02½	.02½	.02½	.02½	.02½	.02½	.02½	.02½
al ammoniac, white gran.	Lb.	.06½	.06¾	.07	.07	.07	.06¾	.06¾	.06½	.06¾	.06¾
mmonium sulphate	100 lb.	2.35	2.50	3.25	3.75	3.60	3.30	3.50	3.55	3.75	3.75
myl acetate	Gal.	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.35	2.35
rsenic, white powder	Lb.	.07	.07¼	.07¼	.07	.07	.07¼	.08	.08¼	.08½	.08½
arium chloride	Ton	50.00	56.00	75.00	95.00	105.00	93.00	90.00	87.00	95.00	105.00
leaching powder	100 lb.	2.25	2.10	1.75	1.60	1.60	1.60	1.60	1.60	1.90	2.00
alcium acetate	100 lb.	1.75	1.75	1.75	1.75	1.75	1.75	2.35	2.35	2.35	2.75
amphor	Lb.	.90	.92	.90	.82	.79	.79	.80	.82	.83	.86
opperas	Ton	15.00	15.00	15.00	15.00	20.00	20.00	20.00	20.00	20.00	20.00
opper sulphate, crystals	100 lb.	5.65	5.60	5.55	5.50	5.75	6.00	6.50	6.50	6.00	5.75
psom salts, U.S.P.	100 lb.	2.65	2.65	2.60	2.50	2.50	2.50	2.00	2.00	2.00	2.00
ormaldehyde, 40%	Lb.	.10½	.10	.08¾	.08½	.08½	.08¼	.07¼	.08	.09½	.10½
usel oil, refined	Gal.	2.50	2.50	2.50	2.15	2.15	2.25	2.25	2.25	2.75	2.75
lauber's salt	100 lb.	1.25	1.15	1.00	.85	.90	.95	.90	.90	.85	.80
lycerine, c.p.	Lb.	.16½	.16½	.16	.15¾	.15	.14½	.15½	.16½	.17½	.18½
lethanol, 95%	Gal.	.61	.59	.58	.57	.57	.57	.57	.57	.60	.70
ickel salt, single	Lb.	.12	.11	.11	.11	.11	.10½	.10	.11	.12	.12
hosphorus, red	Lb.	.45	.45	.45	.45	.45	.45	.45	.45	.45	.45
otassium bichromate	Lb.	.10½	.10⅛	.10⅛	.10⅛	.09¾	.09¾	.09½	.10⅛	.10½	.10
otassium bromide, gran.	Lb.	.14	.13⅝	.18	.17	.17	.17	.17	.17	.17	.17
arbonate of potash, 80-85%	Lb.	.04½	.04½	.04½	.05	.4⅜	.05	.05	.05	.05	.06
hlorate of potash, crystals	Lb.	.05½	.05½	.05⅞	.06¼	.06¾	.06½	.06½	.06½	.07½	.07½
austic potash, 88-92%	100 lb.	6.00	5.75	6.00	5.80	5.85	5.75	5.50	5.50	6.50	6.50
ermanganate of potash, U.S.P.	Lb.	.14	.13½	.15	.15	.14½	.14	.14	.13	.15½	.18
russiate of potash, yellow	Lb.	.25	.25	.26	.27	.31	.32	.31½	.32½	.36	.37
alt cake, bulk	Ton	17.00	17.00	17.00	18.00	20.00	20.00	20.00	18.00	25.00	25.00
oda ash, light, 58%	100 lb.	1.75	1.70	1.80	1.80	1.90	1.80	1.75	1.75	1.75	1.75
ichromate of soda	Lb.	.07½	.07¾	.07¾	.07½	.07¼	.07¼	.07	.07½	.07½	.07½
luoride of soda	Lb.	.10½	.09¼	.09½	.09½	.09	.10	.09½	.09½	.09	.09¾
yanide of soda	Lb.	.26	.23½	.23½	.22	.22	.22	.21	.19½	.19½	.19½
austic soda, solid 76%	100 lb.	3.25	3.35	3.65	3.65	3.85	3.80	3.60	3.70	3.60	3.55
itrate of soda	100 lb.	2.37½	2.37½	2.85	2.90	2.70	2.55	2.60	2.50	2.40	2.40
russiate of soda	Lb.	.17½	.18	.17½	.16½	.21	.22	.21	.20½	.23	.24
ulphide of soda, 60%	Lb.	.04¾	.04½	.04¾	.04¼	.04¼	.04¼	.04¼	.04	.04½	.04½
ulphur, crude	Ton	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
nc chloride, gran.	Lb.	.09	.09	.06	.05½	.05¾	.06	.06	.06	.06	.06
nc oxide	Lb.	.07½	.07½	.07½	.07½	.07½	.07½	.07½	.07½	.07½	.07½

The New York Market

NEW YORK, Oct. 1, 1922.

The new tariff has already shown its effect among imported chemicals and in many instances important advances were recorded. Consumers have changed their conservative methods of trading and it looks as though buyers are gaining confidence in the offerings of leading sellers. Throughout business circles a pronounced spirit of optimism is noted for the last quarter of the year. The tariff has caused a marked increase in citric acid, barium carbonate and chloride, tartaric acid, cream of tartar, prussiate of soda, fluoride of soda, barium nitrate, carbonate of potash, permanganate of potash and various other items. Formaldehyde was advanced 1c. per lb. due to the recent increase in methanol. The recent advance in acetate of lime has been reflected on all grades of acetic acid and acetone. The domestic demand for caustic soda and soda ash has continued very strong at recent levels. Export inquiry is somewhat dormant. Producers of alcohol have increased their prices of the denatured alcohol and methanol. The demand has shown noticeable improvement of late. Glycerine has also shown new advances to 18c. per gal. for the chemically pure in drums. No declines of any importance were recorded during the interval.

GENERAL AND SPECIAL CHEMICALS

Acetic Acid—Prices on all grades have been advanced by producers, due to the higher market on calcium acetate. Commercial 28 per cent is quoted at $2.80@$3.50 per 100 lb. The 56 per cent is held at $5.60@$6.30 per 100 lb. The demand is moderately active.

Acetone—Leading factors have advanced the market on quantity lots to 16½c. per lb. and smaller proportions at 17½c. per pound.

Barium Carbonate—Importers have advanced spot quotations to $80 per ton. Goods afloat were quoted in several quarters at $72 per ton in bond. The inquiry is fairly active, although actual transactions were very scarce.

Barium Chloride—Spot prices have been advanced to $105 per ton. The general tone of this market is very firm with holders not inclined to force any business. Buyers appear eager to purchase at the new levels.

Barium Nitrate—Importers are quoting much higher prices and name 9c. per lb. as the lowest figure on spot. Trading is rather quiet.

Bichromate of Soda—The condition of this market is quite steady, with prominent sellers asking 7½@7⅝c. per lb. The consuming inquiry is mostly for small lots.

Carbonate of Potash—Importers are asking much higher prices for this commodity. Spot quotations ranged around 6c. per lb. for the calcined 80-85 per cent. Demand is generally active.

Caustic Soda—Export prices remain quotably unchanged at $3.55 per 100 lb. for standard brand goods. The domestic demand, however, continues exceedingly active and quite a volume of business is being transacted. Spot goods is quoted at $3.75@$4 per 100 lb. Contract prices remain unchanged.

Chlorate of Potash—Imported material is quoted around 7½@7⅝c. per lb. Domestic factors quote 8½c. per lb. f.o.b. works. Demand is moderate.

Cream of Tartar—Leading importers are asking around 26½c. per lb. for spot goods. Buyers were not inclined to purchase at this high level and actual sales were very few.

Formaldehyde—Producers of this material were forced to advance prices due to the sharp advance of methanol. Factors quote 10½c. per lb. for available material in barrels.

Oxalic Acid—Manufacturers quote the market at 16¾c. per lb. f.o.b. works. Odd lots of spot goods have been offered as low as 16¾c. per lb. The general tone has been fairly active, but most sales were for small-lot requirements.

Permanganate of Potash—Spot quotations were advanced considerably and the lowest figure heard was 18c. per lb. U.S.P. crystals.

Prussiate of Soda—Spot goods are being held at higher prices, with sellers naming 24@25c. per lb. Few holders were willing to sell any round lots at the inside figure, as the general feeling among sellers is very bullish. Goods afloat were quoted around 24@24½c. per lb., duty paid. Demand is quite active.

VEGETABLE OILS

Linseed Oil—The market during the past week was rather easy and without any outstanding features. Crushers seemed quite anxious for new business at 88c. per gal., carload lots, on spot. October oil sold down to 85c. per gal. London reported a much higher market for oil, due to the covering of several short sellers. There was no special interest noted among buyers for imported material and the market was merely nominal at 52c. per gal., in bond. Foreign oil on spot held around 85@87c. per gallon.

Coconut Oil—A much better tone was to be noted throughout the past few weeks for all grades. Ceylon grade oil for October shipment from the coast reached 6⅞c. per lb., sellers' tanks. Ceylon type for immediate shipment from New York was quoted at 7⅞c. per lb., sellers' tanks. Spot goods in barrels ranged around 8¼c. per lb. Cochin type oil in barrels held around 8¾@9c. per pound.

Peanut Oil—Crude domestic material was somewhat limited to small lots. Recent sales were recorded around 8c. per lb., tank cars, f.o.b. mills. There were no offerings of Oriental peanut oil, due to the new tariff rates. Refined oil on spot was in fair demand at 12@12½c. per lb., in barrels.

Rapeseed Oil—The spot market for refined oil was quite irregular at 78@80c. per gal. Refined oil for shipment was quoted at 74@76c. per gal. The inquiry during the interval was dull.

The Chicago Market

CHICAGO, ILL., Sept. 28, 1922.

The industrial chemical market was very irregular during the past week. Price advances were numerous and holders were very reluctant to dispose of their supplies on quite a few items. Most of the price advances were due to higher duties imposed by the new tariff. Business in general was good, although no large orders from consumers were reported. Speculators were active in securing supplies of several items that were well protected by the new tariff, but their activities had little or no effect on the general condition of the market.

GENERAL CHEMICALS

Caustic soda was apparently in a firm position and supplies were reported to be moving in a good volume to the consuming trade. Prices were firm with the 76 per cent solid quoted in ton lots at $3.75@$3.85 per 100 lb. and the ground or flake at $4.25. *Caustic potash* was sharply advanced to 7½c. per lb. for the 88-92 per cent material and moved in a good volume. *Soda ash* was unchanged in price at $2.25 per 100 lb. for the 58 per cent in cooperage and the demand was good. *Sal soda* moved very well at $1.90 per 100 lb. for moderate lots in barrels.

Potash alum was quoted slightly higher, with a fair demand reported. The iron-free lump was available at 5½@6c. per lb. and the powder at 6¼@7c. *Sal ammonic* was in a firm position and the prime white 98-100 per cent material was quoted at 7¾c. per lb. *Barium chloride* was sharply advanced and only small lots were offered at $125 per ton. *Bleach* was in good demand and was quoted higher at $2.60 per 100 lb. for spot material. *Copper sulphate* was easy, with supplies plentiful at 6@6½c. per lb. *Carbon bisulphide* continued firm with only moderate supplies offered at 7½c. per lb. *Carbon tetrachloride* was slightly firmer, but the general quotation remained 9c. per lb. for the large drums. *Formaldehyde* was advanced to 10½c. following the advance in methanol and supplies were reported to be light in some quarters. *Furfural* was quoted at 35c. per lb. in 1000-lb. lots. Another advance occurred on *glycerine*, the c.p. material being quoted at 18@18½c. per lb. *Lead acetate* was advanced due to the higher price of acetic acid to 12@13c. per lb. for the white crystals. *Magnesium metal* was quoted higher due to the greater replacement cost. The powdered material was held at $1.35 per lb. by the principal dealer.

Bichromates were quoted slightly higher, with the potash at 12@13c. per lb. and the soda at 9@9½c. *Potassium permanganate* was in good demand, with only very small supplies available on spot. The U.S.P. crystals was quoted at 19@20c. per lb. *Soda bicarbonate* moved in a fair way to the consuming trade and was unchanged at $2.25 per 100 lb. *Sodium cyanide* was in fair demand and imported material was quoted at 25c. per lb.

The Iron and Steel Market

PITTSBURGH, Sept. 29, 1922.

Apart from the heavy buying of rails, which is a seasonal movement, the finished steel market is distinctly quiet. In a particular sense the rail buying is the exception that tests the rule, the rail buying having been brought about by the rail mills, apparently, for the purpose of supplying needed reinforcement to order books. The mills announced that, effective at the beginning of October, the rail price would advance from $40 to $43 a gross ton, giving the railroads meanwhile an opportunity to buy at the old price, with the stipulation that delivery should be completed by July 1. The railroads have taken hold freely, to profit by the saving, and the total of rails ordered will lie between 1,000,000 and 1,300,000 tons.

CORPORATION AND INDEPENDENT PRICES

Various isolated incidents, viewed together, represent a merging of prices of the Steel Corporation and the independents. Until very lately the two parties were apart on nearly all commodities, the corporation being unable to enter orders for early delivery, while most of the independents could make rather early delivery and obtained what amounted to a delivery premium. In wire products the independents were $3 a ton above the corporation, while the corporation has now advanced $2 and the independents are reducing their prices by the extra dollar. In bars, as indicated above, purchases from some independents can now be made at 2c., while on the other hand the corporation has withdrawn its 1.90c. price on bars, leaving its price at 2c. In shapes there is also a common price of 2c. As to plates, it is doubtful whether at the present time any independent is willing to go as low as 2c., which seems to be the corporation price. Small lots of bars and shapes for very early shipment are bringing above 2c. In the case of pipe there has been no difference between the corporation and the independents except that one independent, able to make relatively early delivery, is asking prices $2 to $3 a ton above the regular figures.

In sheets no direct comparison can be made, because the corporation, with a price schedule based on 3.35c. for common black, is sold out until it opens its order books for the first quarter. Independents are getting 3.50c. on most of the tonnage, but mills able to make particularly early deliveries are obtaining up to a 3.75c. basis on small lots. In automobile sheets the disparity is great, much independent tonnage going at 5.25c., against 4.70c. represented in the last sales of the corporation.

Steel production is now at about two-thirds of capacity, having been at close to three-fourths of capacity in June and having dropped to one-half capacity at the end of August.

While the steel interests have sharply increased their blast-furnace operations in the past 30 days, the merchant furnaces have been unable to do likewise, there being the great difference in position that the steel interests have by-product coke ovens and coal mines, while the merchant furnaces depend chiefly upon purchased Connellsville coke, supplies of which continue very light. Only two or three merchant furnaces in this general territory have resumed.

The pig iron market has been stagnant for several weeks, consumers being apparently unable to pay prices asked, while at best very little tonnage could be obtained by paying one price or another. The Cambria Steel Co., Johnstown, now operating six blast furnaces, has been offering merchant pig iron at prices below the valley basis at points where there is no great freight disparity. It has sold 2,000 tons of basic to a West Virginia sheet interest at $30 Johnstown, and 1,000 tons of bessemer (silicon 2 to 2.50 per cent) to a Pittsburgh consumer at $33.50 Johnstown. It is now quoting $30.50 Johnstown on basic iron, $32 on malleable and $32.50 on foundry. Freight Johnstown to Pittsburgh is $1.77, the same as the valley rate to Pittsburgh.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0 38 – $0.40
Acetone	lb.	$0 16½– $0 16½	17 – .17½
Acid, acetic, 28 per cent	100 lbs.	2 80 – 2 90	2 95 – 3.50
Acetic, 56 per cent	100 lbs.	5 60 – 5 75	5 80 – 6.25
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		11 00 – 11 25	11 50 – 12 00
Boric, crystals	lb.	11 – 11½	11¾– .12
Boric, powder	lb.	11 – 11½	11¾– .12½
Citric	lb.	..... –	50 – .51
Hydrochloric	100 lb.	1 10 – 1 20	1 25 – 1 70
Hydrofluoric, 52 per cent	lb.	.11 – 11½	11 – .12
Lactic, 44 per cent tech	lb.	09½– .10	10½– .12
Lactic, 22 per cent tech	lb.	04½– 04½	05 – 05½
Molybdic, c.p.	lb.	3 00 – 3 25	3 30 – 3 75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg	lb.	.06 – 06½	06¾– .07
Nitric, 42 deg	lb.	06½– 06¾	07 – .07¼
Oxalic, crystals	lb.	.17 – .17½	17½– .18
Phosphoric, 50 per cent solution	lb.	.07½– .08	08¼– .09
Picric	lb.	.20 – .22	23 – .27
Pyrogallic, resublimed	lb.	..... –	1 65 – 1 75
Sulphuric, 60 deg., tank cars	ton	10 00 – 10 50	..... – .....
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15 00 – 16 00	..... – .....
Sulphuric, 66 deg., drums	ton	19 00 – 20 00	20 50 – 21 00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19 00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22 00 – 22 50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31 00 – 32 00	33 00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.31 – .31½
Tartaric acid, imported, powdered	lb.	..... –	.31¼– .31½
Tartaric acid, domestic	lb.	..... –	..... – .32
Tungstic, per lb. of WO	lb.	... –	1 00 – 1 10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4 95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.36 – .38
Alum, ammonia, lump	lb.	.03½– .03⅝	03¾– .04
Alum, potash, lump	lb.	.03¼– 03¾	.04 – .04½
Alum, chrome lump	lb.	.05 – 05¼	05½– 06
Aluminum sulphate, commercial	100 lb.	1 50 – 1 65	1 70 – 2 25
Aluminum sulphate, iron free	lb.	.02½– 02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½– .07¼	.07½– .08
Ammonia, anhydrous, cyl (100-150 lb.)	lb.	.30 – .30½	.30½– .31
Ammonium carbonate, powder	lb.	.08½– 08¾	09 – .09½
Ammonium nitrate	lb.	.06 – 06½	06¾– .07¼
Amylacetate tech	gal.	..... –	2 35 – 2.50
Arsenic, white, powdered	lb.	.08¼– 09	09¼– .09½
Arsenic, red, powdered	lb.	12 – 12¼	12½– .13
Barium carbonate	ton	80 00 – 82 00	83 00 – 85 00
Barium chloride	ton	105 00 – 107 00	108 00 – 110.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½– .22
Barium nitrate	lb.	.09 – .09½	.09½– .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½– .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05¼– .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½– .35
Calcium acetate	100 lbs.	2 75 – 2 85	2 90 – 3.25
Calcium carbide	lb.	04½– 04¾	.05 – 05½
Calcium chloride, fused, lump	ton	22 00 – 23 00	23.50 – 27 00
Calcium chloride, granulated	lb.	.01½– .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	15 – .16
Camphor	lb.	..... –	.86 – 88
Carbon bisulphide	lb.	.06¾– .07	.07¼– .07½
Carbon tetrachloride, drums	lb.	.10 – .10¼	.10½– .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½– .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	03½– .03½	..... – .....
Chalk, precip.—imported, light	lb.	.04½– .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½– .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2 00 – 2.10
Copperas	ton	20 00 – 22 00	23 00 – 30 00
Copper carbonate, green precipitate	lb.	20 – .20½	.20¾– .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6 10 – 6.50
Cream of tartar	lb.	..... –	.26 – .27
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	10½– 10¾	.11 – .11½
Fullers earth, f.o.b. mines	net ton	16 00 – 17 00	..... – .....
Fullers earth—imported powdered—net	ton	30 00 – 32 00	..... – .....
Fusel oil, ref	gal.	..... –	2 75 – 2.90
Fusel oil, crude	gal.	..... –	1.65 – 1.85
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p drums extra	lb.	..... –	.18 – .18¼
Iodine, resublimed	lb.	..... –	4.40 – 4.50
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	10½– .11½
Lead arsenate, powd	lb.	.13 – .13½	.13¾– .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07¾– .08	.08½– .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾– .07¾
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.25	2 30 – 2.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.70 – .71
Methanol, 97%	gal.	..... –	.71 – .72
Nickel salt, double	lb.	..... –	.11 – .11½

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Nickel salt, single	lb.	..... –	.12 – .12½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35½
Potassium bichromate	lb.	.10 – .10¼	.10½ – .11
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06½	.06½ – .06¾
Potassium chlorate (powdered and crystals	lb.	.07½ – .07½	.08 – .08½
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7.00
Potassium iodide	lb.	..... –	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.18 – .18½	.18¾ – .19
Potassium prussiate, red	lb.	..... –	.95 – 1.00
Potassium prussiate, yellow	lb.	.37 – .37½	.37¾ – .38
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06¾ – .07	.07¼ – .07½
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.08 – .08½	.08½ – .09
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07½	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04¾ – .05½
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.19¾ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09½	.09¾ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09¼ – .09¾	.10 – .10½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.24 – .24¼	.24½ – .24¾
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60–62 per cent (conc.)	lb.	.04 – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	..... – .....
Talc—domestic powdered	ton	18.00 –25.00	..... – .....
Tin bichloride	lb.	.10 – .10¼	.10½ – .10¾
Tin oxide	lb.	..... –	.39 – .40
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.06 – .06¼	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.53 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.72 — .75
Dipnenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	$0.15 — $0.10
N-W acid	lb.	1.15 — 1.30
Ortho-amidophenol	lb.	2.10 — 2.15
Ortho-dichlor-benzene	lb.	.17 — .20
Ortho-nitro-phenol	lb.	.80 — .85
Ortho-nitro-toluene	lb.	.10 — .13
Ortho-toluidine	lb.	.12 — .14
Para-amidophenol, base	lb.	1.20 — 1.25
Para-amidophenol, HCl	lb.	1.25 — 1.30
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .80
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.85 — .90
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.21 — .22
Pyridine	gal.	1.75 — 2.75
Resorcinol, technical	lb.	1.50 — 1.55
Resorcinol, pure	lb.	2.00 — 2.10
R-salt	lb.	.55 — .60
Salicylic acid, tech., in bbls.	lb.	.25 — .27
Salicylic acid, U. S. P.	lb.	.29 — .30
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.27 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.12 — .14
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — .....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — .....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.19½ — $0.20
Beeswax, refined, dark	lb.	.30 — .32
Beeswax, refined, light	lb.	.34 — .35
Beeswax, pure white	lb.	.36 — .40
Candellila, wax	lb.	.43 — .45
Carnauba, No. 1	lb.	.40 — .42
Carnauba No. 2, North Country	lb.	.25 — .26
Carnauba, No. 3, North Country	lb.	.19 — .19½
Japan	lb.	.15 — .15½
Montan, crude	lb.	.03¾ — .04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04½ — .....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02¾ — .....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½ — .03¾
Paraffine waxes, refined, 125 m.p.	lb.	.03½ — .03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ — .04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05¼
Stearic acid, single pressed	lb.	.09 — .09½
Stearic acid, double pressed	lb.	.09½ — .09¾
Stearic acid, triple pressed	lb.	.10½ — .10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$6.60 —	$6.75
Rosin E-I	280 lb.	6.80 —	6.85
Rosin K-N	280 lb.	6.90 —	7.00
Rosin W. G.-W. W.	280 lb.	7.85 —	8.40
Wood rosin, bbl.	280 lb.	6.25 —	.....
Spirits of turpentine	gal.	1.37 —	1.38
Wood turpentine, steam dist.	gal.	1.15 —	.....
Wood turpentine, dest. dist.	gal.	1.12 —	.70
Pine tar pitch, bbl.	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl.	500 lb.	—	9.00
Rosin oil, first run	gal.	.38 —	.....
Rosin oil, second run	gal.	.41 —	.....
Rosin oil, third run	gal.	.48 —	.....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist.	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr.1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref.	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.75 —	3.80
Blood, dried, f.o.b., N. Y.	unit	4.60 —	.....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.40 —	2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	.....

Crude Rubber

Para—Upriver fine	lb.	$0.18¾ —	.19
Upriver coarse	lb.	.13¾ —	.14
Upriver caucho ball	lb.	.13¼ —	.13½
Plantation—First latex crepe	lb.	.15¼ —	.15½
Ribbed smoked sheets	lb.	.15¾ —	.15¾
Brown crepe, thin, clean	lb.	.14¼ —	.14¼
Amber crepe No. 1	lb.	.14½ —	.14½

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls.	lb.	.13 —	.13½
China wood oil, in bbls.	lb.	.12½ —	.12½
Coconut oil, Ceylon grade, in bbls.	lb.	.08¼ —	.08½
Coconut oil, Cochin grade, in bbls.	lb.	.08¾ —	.09
Corn oil, crude, in bbls.	lb.	.10 —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.07 —	.07¼
Cottonseed oil, summer yellow	lb.	.11½ —	.11½
Cottonseed oil, winter yellow	lb.	.12 —	.12½
Linseed oil, raw, car lots (domestic)	gal.	.88 —	.88½
Linseed oil, raw, tank cars (domestic)	gal.	.83 —	.84
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.91
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.06¼ —	.07
Palm, Niger	lb.	.06 —	.06¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08½ —	.08¾
Peanut oil, refined, in bbls.	lb.	.12 —	.12½
Rapeseed oil, refined in bbls.	gal.	.78 —	.80
Rapeseed oil, blown, in bbls.	gal.	.86 —	.87
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11¼ —	.....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09½ —	.09¾

FISH

Light pressed menhaden	gal.	$0.51 —	.....
White bleached menhaden	gal.	.54 —	.55
Brown menhaden	gal.	.61 —	.....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700 00	$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65 00 —	100 00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17 00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24 00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	16.00 —	20.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, No. 1 pottery grade	long ton	7.00 —	7.50
Feldspar, No. 2 pottery grade	long ton	5.75 —	5.90
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21 00 —	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal.	per ton	40.00 —	.....
Kieselguhr, f.o.b. N. Y.	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00 —	15 00
Pumice stone, imported	lb.	.03 —	.05½
Pumice stone, domestic, lump	lb.	.05 —	.05
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	63 —	.64
Shellac, orange superfine	lb.	65 —	.66
Shellac, A. C. garnet	lb.	.65 —	.66
Shellac, T. N.	lb.	.58 —	.60
Silica, glass sand, f.o.b. Indiana	per ton	1 50 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2 50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00 —	16.00
Silica, building sand, f.o b. Pa.	per ton	2.00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7 50 —	12 00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00 —	17.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00	
Chrome brick, f.o.b. Eastern shipping points	net ton	50	
Chrome cement, 40-50% Cr_2O_3	net ton	23–27	
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23 00	
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	35–40	
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–28	
Magnesite brick, 9-in. straight (f.o b. works)	net ton	60	
Magnesite brick, 9-in. arches, wedges and keys	net ton	70	
Magnesite brick, soaps and splits	net ton	90	
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50	
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	50–53	
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	45–47	
Silicon carbide refractory brick, 9-in.	1,000	1100.00	

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	69.00 —	72.00
Spiegeleisen, 19-21% Mn	gross ton	38 00 —	39.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	1.85 —	2 00
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	63 00 —	65.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.75 —	.80
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19 00 —	20.00
Coke, foundry, f.o.b. ovens	net ton	13.50 —	14 00
Coke, furnace, f.o.b. ovens	net ton	12.00 —	12 50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	
Manganese ore, chemical (MnO_2)	net ton	70.00 —	75.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport.	unit	27.00 —	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	7.00 —	7.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	6.75 —	7.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1 75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2 50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent.	19.50–20.00
Antimony, wholesale lots, Chinese and Japanese	7.00–7.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32 00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal shot and blocks	32 00
Monel metal ingots	35 00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	32 375
Lead, New York, spot	6.35–6.50
Lead, E. St. Louis, spot	6.25
Zinc, spot, New York	7.15–7 20
Zinc, spot, E. St. Louis	6.875

OTHER METALS

Silver (commercial)	oz.	$0.69⅜
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.20
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent.	lb.	1.00@1.05
Platinum	oz.	$118.00
Iridium	oz.	2.75@3.00
Palladium	oz.	55.00
Mercury	75 lb.	72.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	16.75
Low brass wire	19.60
Low brass rods	20 25
Brazed brass tubing	23 00
Brazed bronze tubing	28.00
Seamless copper tubing	24 75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@ 8.75
Lead, heavy	4.50@ 4.75
Lead, tea	3.25@ 3.50
Brass, heavy	5.50@ 5.75
Brass, light	5.00@ 5.25
No. 1 yellow brass turnings	5.50@ 5.75
Zinc	2.25@ 2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	$2.90
Soft steel bars	2.80	2.80
Soft steel bar shapes	2.80	2.80
Soft steel bands	3.40	3.40
Plates, ¼ to 1 in. thick	2.90	2.90

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arizona

AJO—The New Cornelia Mining Co. has awarded a contract to the Wisconsin Bridge Co. for the erection of the building for its proposed concentrating and flotation plant, and will arrange a list of equipment for installation at an early date, to include ore crushers, conveyors, electric equipment and other operating machinery in addition to primary concentrating machinery. The plant is estimated to cost in excess of $2,500,000.

California

LONG BEACH—The Pacific Petroleum Products Co., Los Angeles, is selecting a local site for the construction of a new refinery, to be used primarily for the production of gasoline. L. C. Monks heads the company.

LOS ANGELES—The Mathews Paint Co. has plans under way for the construction of a new 1-story plant, 50x170 ft., on the San Fernando Road, near Ave. 26, to cost about $17,000. The Moran Co., 206 Kerckhoff Bldg., is architect.

VISALIA—The Kaweah Lime Products Co. has plans under way for the construction of an addition to its plant at Terminus, near Visalia, to cost about $25,000. A. C. Root is general manager.

LOS ANGELES—The Downing Process Laboratories, Inc., 6363 Santa Monica Blvd., is having plans prepared for the construction of two 2-story additions, 40x60 ft. and 32x50 ft. respectively. Edward T. Flaherty, 435 I. W. Hellman Bldg., is engineer.

Connecticut

ROCKY HILL—The Connecticut Foundry, Inc., has awarded a contract to C. P. Waterman, Inc., 43 Framingham Ave., Hartford, for the construction of a 1-story foundry addition, about 20x42 ft.

Delaware

WILMINGTON—A 2-story foundry, 98x240 ft., will be constructed at once at the plant of the Hilles & Jones Division of the Consolidated Machine Tool Corp., 9th and Church Sts., estimated to cost about $40,000.

District of Columbia

LANGDON—The Fleischmann Co., 701 Washington St., New York, N. Y., has awarded a contract to the Schneider-Spleidt Co., Washington, D. C., for extensions and improvements in its local 3-story yeast-manufacturing plant, to cost about $50,000.

Illinois

EAST ALTON—The Western Cartridge Co. is completing plans for the construction of a 1-story addition to its brass mill, 86x240 ft., estimated to cost approximately $50,000.

Louisiana

MONROE—The Monroe Glass Co., recently organized with a capital of $25,000, has plans under way for the establishment of a new local plant for the manufacture of lamp chimneys and other blown glass products. John Hartman, Alexandria, La., is vice-president.

Maine

MONTAGUE—The International Paper Co., 30 Broad St., New York, N. Y., is reported to be planning for the rebuilding of the portion of its local pulp mill, destroyed by fire Sept. 5, with loss estimated in excess of $50,000.

Maryland

BALTIMORE—The Solarine Co., Emerson Bldg., manufacturer of metal polishes, will take bids at once for the construction of its proposed new 1-story plant, 100x150 ft., on Eagle St., estimated to cost about $75,000, including equipment. E. H. Glidden, American Bldg., is architect.

BALTIMORE — The Baltimore Steel Co., Eastern Ave., has plans under way for the construction of an addition to its plant, on property adjoining the present works, recently acquired, estimated to cost approximately $250,000, including equipment.

BALTIMORE — The Toledo Bottle Cap Co., Toledo, O., manufacturer of paper bottle caps and kindred specialties, has leased space in the Chandler Bldg., comprising about 6,000 sq.ft., and will soon commence the installation of machinery for a new branch plant.

Massachusetts

FITCHBURG—The Crocker Burbank Co., Westminster St., manufacturer of paper products, will commence the immediate construction of a 2-story mill addition, 45x90 ft. The general building contract has been let to Wiley & Foss, Central St.

MALDEN—Wadsworth, Howland & Co., Inc., 139 Federal St., Boston, has awarded a contract to William Daniels, 161 Exchange St., Worcester, Mass., for the construction of a new 5-story building, 52x190 ft., at Malden, to be used in connection with its general line of paint and varnish manufacture.

SALEM—Baker & Kimball, 28 South St., Boston, have acquired property at 5 Fort Ave., Salem, 70x175 ft., and have plans in preparation for the construction of a 2-story plant on the site, to be used for the manufacture of leather products.

Michigan

KALAMAZOO—The Bryant Paper Co. has plans under way for the construction of two new plant buildings, and enlargement of a number of plant departments for considerable increase in production. The work will include a 1-story machine shop, and new power plant. A bond issue of $5,000,000 is being arranged, a portion of the fund to be used for the expansion.

New Jersey

OLD BRIDGE—The Ceramics Products Corp., recently organized with a capital of $200,000, has acquired the local plant of the Brookfield Glass Co., comprising a number of buildings on a tract of 150 acres of land, with considerable equipment previously used by the former owner, for glass and pottery manufacture. Plans are under way for a number of improvements in the plant, and operations will be commenced at an early date, giving employment to about 200 persons. The new company is headed by Gerald M. McLaughlin and T. Bryant Smith.

LAMBERTVILLE—The Lambertville Rubber Co. is planning for enlargements in its plant, to include the establishment of a new department for the manufacture of different rubber specialties. It is purposed to increase the working force by about 50 operatives.

TRENTON—The Economy Pottery Co., Bunting Ave., manufacturer of sanitary earthenware, has filed plans for the construction of a 1-story addition.

BAYONNE — The Standard Oil Co., 26 Broadway, New York, N. Y., has commenced excavations for the construction of a new 3-story building, 80x100 ft., at its local oil works, estimated to cost about $75,000.

TRENTON—The Murray Rubber Co. is being organized to take over and operate the plant of the Empire Tire & Rubber Corp., North Clinton and Mulberry Sts., recently acquired at a receiver's sale by William M. Pepper and associates for a consideration of $1,675,000. The new company plans for the immediate resumption of operations at the plant, and will soon commence the installation of machinery for enlargements in a number of departments. C. Edward Murray, Jr., is president and general manager. Mr. Pepper is vice-president and treasurer.

TRENTON—Fire, Sept. 19, damaged a portion of the plant of the Mercer Pottery Co., Muirhead Ave., manufacturer of chinaware products. The loss, including power plant and damage to the main 4-story pottery, has not been officially estimated.

New York

NORTH HOOSICK—The Stevens & Thompson Paper Co., operating a local mill, with branch plants at Walloomsac and Greenwich, N. Y., will make enlargements at the two last noted mills to increase the capacity from 85 to 100 tons per day. The company is also arranging for extensive operations at the plant of a subsidiary organization at Bloomfield, N. J. To provide for the expansion, a bond issue of $1,000,000 has been arranged. Frank L. Stevens is president.

ROCHESTER—The Don-o-Lac Co., manufacturer of paints, varnishes, etc., is considering the rebuilding of the portion of its local plant, destroyed by fire, Sept. 18 with loss estimated at about $60,000.

NEW YORK—The Braden Copper Co., 120 Broadway, is arranging an appropriation of $1,500,000 for the construction of an addition to its copper mill, to increase the capacity from 10,000 to 15,000 tons of ore per day. The company is a subsidiary of the Kennecott Copper Corp., same address.

North Carolina

GREENSBORO—City Manager P. C. Painter is taking bids until Oct. 10 for the construction of a new filtration plant with capacity of 6,000,000 gal. The Ludlow Engineers, Inc., Winston-Salem, N. C., is engineer.

HILTON—Fire, Sept 18, destroyed a portion of the acid works of the American Cotton Oil Co., with loss estimated at about $25,000. It is planned to rebuild.

Ohio

LANCASTER—The Fairfield Glass Co., manufacturer of window glass, has plans nearing completion for the construction of a new plant, to consist of a number of buildings, estimated to cost close to $2,500,000, including machinery. The De Vore Co., 908 Nicholas Bldg., Toledo, O., is architect and engineer. Leopold Mambourg is vice-president and general manager.

MINERVA—The Owen China Co. has awarded a general contract to W. A. Rabold, 804 Columbus Ave., N. W., Canton, O., for the construction of a new 1-story pottery, on local site, 165x190 ft., estimated to cost approximately $175,000, including equipment. C. W. Foreman is president.

Oklahoma

OKLAHOMA CITY—The North American Oil Co., recently organized under Delaware laws with capital of $35,000,000, has tentative plans under consideration for extensions and improvements in the oil refineries of a number of companies lately consolidated. The properties of the new company include the Noco Petroleum Co., the Noco Mexican Oil Co. and the Noco Pipe Line Co., all of Oklahoma City; the Black Petroleum Corp., Okmulgee, Okla.; the Puritan Petroleum Co., Lesh Refining Corp., Lesh Oil Products Co. and the Petroleum Transit Co. all of New York. C. F. Colhord heads the new organization.

OKLAHOMA CITY—The Golthorpe Oil Refining Co., including refinery and equipment, has been acquired by George Smith and associates. The new owners plan for enlargements and improvements in the plant, to include the installation of additional equipment.

Pennsylvania

BOYERTOWN—The Eastern Foundry Co. will soon take bids for the construction of a new 1- and 2-story foundry addition, 100x150 ft. A. S. Keptner, 121 Hanover St., Pottstown, Pa., is architect. E. M. Rhoads is president of the company.

KUTZTOWN—The Reading Rubber Co., Reading, Pa., has acquired the local plant of Jacob K. Boyer, heretofore devoted to box manufacturing, and will remodel and improve the works for the establishment of a new plant for the manufacture of rubber tubes for automobile service. Machinery to cost close to $25,000, will be installed.

PHILADELPHIA—The West Philadelphia Cut Glass Co., 5920 Baltimore St., has taken bids and will soon commence the construction of a new plant at Redfield and Baltimore Sts. Emile G. Perrot, Boyertown Bldg., is architect.

PITTSBURGH—The Hanlon-Gregory Galvanizing Co., 24th St. and the Alleghany Valley Railroad, is completing plans for the construction of a new 1-story plant at 56th and Butler Sts., 100x400 ft., to be used for the manufacture of galvanized metal products. It will cost about $100,000. J. R. Dwyer, Forbes-Murray Bldg., is architect.

HARRISBURG—The Rocbond Co., VanWert, O., manufacturer of cement-stucco products, has work under way on a new plant at

ucknow, near Harrisburg. It will be 1-ory, 50x300 ft. H. S. Webster and O. E. hompson, formerly located at the VanWert lant, will be in charge at the new local orks.

PITTSBURGH—The Ball Chemical Co., Ful-on Bldg., has awarded a contract to the Villiams & Haas Co., Empire Bldg., for the onstruction of a new building at Whitmar tation, to cost about $25,000.

Texas

PORT ARTHUR—The Gulf Refining Co. has reliminary negotiations under way for the urchase of a tract of about 100 acres of and, to be used as a site for the construc-ion of an addition to its local refinery. The ew plant will operate under an aluminum hloride process of gasoline separation from rude oil, and is estimated to cost close to 500,000. George H. Tabor is vice-presi-lent.

DAMON—The Union Sulphur Co., Sulphur, a., has acquired a tract of local land, com-rising about 215 acres, to be used as a site or the construction of a new plant. The works will consist of a number of buildings, ncluding machine shop, power house, etc., nd will be supplemented with a housing levelopment for employees. It is expected o require close to 24 months for the com-letion, with estimated cost close to $5,000,-000.

DALLAS—The Southwestern Paper Co. is ompleting plans and will soon commence he construction of a new building on Lacy St. near Young St. George L. Thompkins s general manager.

GALVESTON—The Galveston Gas Co. will uild an addition to its artificial gas plant at 32nd St. and Ave. D, estimated to cost close to $100,000. It will have a capacity of 100,000 cu.ft. per hour. Paul E. Nichol is general manager.

DALLAS—The Garvey Vinegar Co. has plans in preparation for the establishment of a new local plant for the manufacture of vinegar products, with initial capacity of about 25,000 gal. per month. Thomas Gar-vey is head.

West Virginia

WHEELING—The Wheeling Mantle & Tile Co., 829 Market St., has awarded a gen-eral contract to George A. Reed, Wheeling, for the construction of a new 1-story plant, estimated to cost about $15,000.

WHEELING—A 1-story foundry, 100x320 ft., estimated to cost about $40,000, will be constructed on Warwood Ave., by the Centre Foundry & Machine Co., 2011 Main St., estimated to cost about $40,000. It will be used for the production of steel castings. The general contract has been let to the Riverside Bridge Co., Martins Ferry, O. J. H. Young is general manager.

Industrial Developments

GLASS—The Ruth-Hastings Glass Co., Conshohocken, Pa., manufacturer of bottles, vials and other hollow ware, is arranging for the immediate resumption of operations at its plant, after an idleness of more than 2 years.

The Twin City Glass Co., Texarkana, Tex., manufacturer of blown glass ware, has resumed operations at is local plant, following a curtailment for some time past. Employment will be given to about 300 men. A wage increase of 5 per cent has recently been granted.

The Elk Run Window Glass Co., Punxsutawney, Pa., has resumed operatons at its local plant, after a shut-down for several months past.

The F. L. Freas Glass Works, Conshohocken, Pa., specializing in the production of chemists' glassware and kindred glass products, is running full at its local plant, giving employment to the regular working force. The company is said to have orders on hand for considerable advanced production.

T. C. Weaton & Co., Millville, N. J., have resumed operations at one of their bottle plants, following a shut-down of about 6 weeks.

The Whitall-Tatum Co. has commenced production at two glass plants at its South Millville, N. J. works, following a suspension of several weeks past.

The Noble Glass Co., Conshohocken, Pa., manufacturer of small bottles, vials, etc., is operating at regular capacity with normal working force, and is said to have orders on hand to insure this basis of production for some time to come.

The Millville Bottle Works, Inc., Millville, N. J., has resumed operations at one of its furnaces, following a suspension for more than a month past.

LEATHER—The Pearse Leather Corp., Peabody, Mass., has adopted a full-capacity working schedule at its local tannery, with an overtime shift in a number of departments.

The General Leather Co., Newark, N. J., is operating at full capacity for the production of leather for automobile service, and is said to have orders on hand to insure this basis of production for an indefinite period.

V. & F. W. Filoon & Co., Brockton, Mass., has inaugurated an overtime working schedule at its local tanneries, averaging about 4 hours a day.

The DeFord Co., Baltimore, Md., is operating at full capacity at its leather tanneary at Luray, Va. The Covington, Va., plant of the company is said to be running on a curtailed basis, with plans to advance production at an early date.

The Empire Tanning Co., Big Run, near DuBois, Pa., is arranging to close its local plant early in October for an indefinite period. It has been operating on a half-time working basis for a number of months past, and orders on hand will be transferred to other plants of the company. The tannery has been giving employment to about 80 men.

The Fred Rueping Leather Co., Fond du Lac, Wis., is operating at full capacity, giving employment to a regular working force.

J. S. Barnett & Sons, Inc., Lynn, Mass., has adopted a capacity schedule at its local tannery, with employment of normal working force.

PAPER—The D. M. Bare Paper Co., Altoona, Pa., is running at full capacity at its mills at Roaring Springs, near Altoona, giving employment to about 400 operatives. A wage advance of 25 cents a day has been placed into effect.

The Belgo-Canadian Paper Co., Shawinigan, Que., is operating at full capacity at its local paper mills, with employment of maximum working force. The company has plans in progress to double the capacity of the present plant.

The Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., is running full at its local paper mills. A wage advance of 10 per cent, averaging from 3 to 5 cents an hour has recently been granted.

IRON AND STEEL—The American Swedo Iron Co., Danville, Pa., has resumed operations at its local plant, following an idleness for a number of months past. The plant will give employment to about 75 men under full production. The company is said to have orders on hand for about six months to come.

The Punxsutawney Furnace Co., Punxsutawney, Pa., has commenced production at its local plant, following a suspension of operations for more than a year and a half past. It is planned to employ a full working force for an indefinite period.

The Bethlehem Steel Corp. is arranging for the immediate resumption at its Reading, Pa., rolling mill, which has been idle since early in 1921. The works will give employment to about 100 men for initial production, and this number will be increased gradually until a full working force is reached.

The Jones & Laughlin Steel Co., Pittsburgh, Pa., is advancing production at its blast furnaces, and is now running at 75 per cent of normal.

The Struthers Furnace Co., Struthers, O., will blow in its local blast furnace at once, after a suspension of operations for about 20 months past.

The American Sheet & Tin Plate Co., Farrell, Pa., is developing capacity production at its local sheet mill for the first time in a number of weeks past. Arrangements are being perfected for the resumption of operations at the Aetna Standard plant at Pittsburgh, Pa. The company is advancing production at its Sharon, Pa., works, and has recently advanced wages 10 per cent at this plant.

The Illinois Steel Co., Chicago, Ill., has increased production to about 65 per cent of capacity at its mills, and plans for a further advance at an early date.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., is arranging to blow in its No. 1 blast furnace within the next few weeks, making ten furnaces in service at the Alabama mills of the company. The No. 1 unit has a capacity of 550 tons per day.

The Hanna Furnace Co. has arranged for the blowing in of its blast furnace at Dover, O., following a suspension since last August. Employment will be given to about 100 men.

The Lockhart Iron & Steel Co. of Pittsburgh has started operations at the recently acquired plant of the Sligo Iron & Steel Co. at Connellsville, Pa. The plant has been reconstructed and furnished with up-to-date equipment for the production of muck bars, which will be shipped to the McKees Rocks plant for finishing. Twenty puddling furnaces are now operating, with a capacity of 22,000 tons a year. The plant employs 100 puddlers.

MISCELLANEOUS—The Keystone Tire & Rubber Co. has placed its new plant unit at Kingsbridge, N. Y., in operation on a full-capacity basis.

The Lee Tire & Rubber Co., Conshohocken, Pa., has advanced production at its plant, and is now running on a full day and night schedule.

The Austin Mfg. Co., Wilkes-Barre, Pa., recently organized to manufacture chemical products, has opened a local plant and will operate on a full capacity basis for an indefinite period.

The St. Louis Coke & Chemical Co., a subsidiary of the National Enameling & Stamping Co., is operating its battery of 80 process coke ovens at Granite City, Ill., at full capacity. The parent organization has resumed operations at 14 additional sheet mills at its local plant, and all departments are now running full.

New Companies

THE B. C. TILLINGHAST RUBBER MFG. CO., Jersey City, N. J., care of the Corporation Trust Co., 15 Exchange Place, representative, has been incorporated with a capital of $50,000, to manufacture rubber products. The principal incorporator is B. C. Tillinghast.

THE ANGELES SNOWOLENE REFINING CO., Los Angeles, Calif., care of G. A. McElroy, 510 West 6th St., representative, has been incorporated with a capital of $200,000, to manufacture refined petroleum products. The incorporators are F. E. Snowden, W. P. Rhodes and K. M. Dean, all of Los Angeles.

THE C. L. SANFORD BRICK CO., Southold (Suffolk County), N. Y., care of G. C. Terry, Southold, representative, has been incorporated with a capital of $60,000, to manufacture brick and other burned clay products. The incorporators are C. L., L. N. and F. S. Sanford.

THE CLASON CHEMICAL CORP., Brooklyn, N. Y., care of the Delaware Registration & Incorporators' Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture chemicals and chemical byproducts. The incorporators are Marcus Bassell and Samuel Zimmerman, both of New York.

THE ALUMINUM PRODUCTS CO., Boston, Mass., has been incorporated with a capital of $25,000, to manufacture aluminum and kindred metal products. Ralph L. Dodge is president, and John A. Carpenter, 6 Brigham Ave., Waverly, Mass., treasurer. The last noted represents the company.

THE ENAMELING MFG. CO., 549 West Fulton St., Chicago, Ill., has been incorporated with a capital of $15,000, to manufacture enamelware products. The incorporators are James D. White, Edward R. Mills and Herbert C. Moore.

THE REDWOOD OIL & REFINING CO., Cross Plains, Tex., has been incorporated with a capital of $250,000, to manufacture refined petroleum products. The incorporators are C. T. Pledger, J. H. Montgomery and R. B. Forbes.

THE UTILITY COLOR & CHEMICAL CO., Newark, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and affiliated products. The incorporators are M. M. Williams, Jacob S. Lasky and Louis Schneider, Kinney Bldg., Newark. The last noted represents the company.

THE ATHENIA CHEMICAL CO., Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are George Drossinos and Henry Brenner, 150 Governor St., Hartford.

THE INTER-CONTINENT OIL CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $5,000,000, to manufacture petroleum products.

THE RUMO CHEMICAL CO., New York, N. Y., care of M. G. Cutler, 42 West 39th St., representative, has been incorporated with a capital of $5,000, to manufacture chemicals and kindred products. The incorporators are P. Trachtenberg, G. Rosenberg and D. W. Gregory.

THE MIDDLESEX REFINING CO., Middletown, Conn., has been incorporated with a

capital of $50,000, to manufacture soaps, fat byproducts and kindred specialties. The incorporators are S. S. and Jacob Mattes, 151 Church St., Middletown.

THE BRIGHTON ELECTRIC STEEL CASTING Co., Beaver Falls, Pa., has been incorporated with a capital of $25,000, to manufacture steel and other metal castings. The incorporators are W. D. Fox, New Brighton, Pa.; Fred Dewhirst and Earl D. Townsend, Beaver Falls. The last noted is treasurer and represents the company.

THE AMERICAN CHEMICAL GAS Co., Philadelphia, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., representative, has been incorporated with a capital of $1,500,000, to manufacture special chemicals and chemical byproducts.

THE SUPERIOR PORCELAIN PRODUCTS Co., 138 North La Salle St., Chicago, Ill., has been incorporated with a capital of $5,000, to manufacture porcelain specialties and kindred ceramic products. The incorporators are G. J. David and James H. Davis.

THE CRYSTAL PRODUCTS CORP., Newark, N. J., care of David N. Popik, 790 Broad St., representative, has been incorporated with a capital of $50,000, to manufacture chemicals, alkalies, etc. The incorporators are Karl J. and Bernard W. Von Smuda, and Abraham Shapiro.

THE METHOLAM PRODUCTS CORP., Brooklyn, N. Y., care of Maxwell Lustig, 154 Nassau St., New York, N. Y., representative, has been incorporated with a capital of $50,000, to manufacture chemicals and affiliated products. The incorporators are V. P. Mehta, J. O. Olsen and C. G. Dutemple.

THE CONSOLIDATED BRICK Co., Melrose, Mass., has been incorporated with a capital of $98,000, to manufacture brick and other burned clay products. George L. Baldwin is president, and James E. Fraser, 24 Natalie Ave., treasurer. The last noted represents the company.

THE GENERAL TESTING LABORATORIES, INC., 525 Woodward Ave., Detroit, Mich., has been incorporated with a capital of $6,000, to manufacture chemicals, chemical compounds, etc. The incorporators are Paul H. Kramer, Charles L. Mann and Joseph A. Wolf.

THE CHINA FIBRE CONTAINER Co., care of the Corporation Trust Co. of America, due Pont Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $250,000, to manufacture fiber products.

THE DAYTON BRICK Co., Dayton, O., has been incorporated with a capital of $200,000, to manufacture brick and other burned clay products. The incorporators are Lincoln L. Davis and John M. Mulford, both of Dayton.

THE POMPTON IRON Co., 745 East 23rd St., Paterson, N. J., has been incorporated with a capital of $250,000, to manufacture pig iron. It is proposed to operate a blast furnace in the state. The incorporators are Halsey M. Search, J. Fred Weller and Arthur Searck.

THE HAMILTON INTERNATIONAL PULP & LUMBER Co., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, has been incorporated under Delaware laws with capital of $2,500,000, to manufacture pulp and paper products.

THE PEAVEY RUBBER Co. OF NEW ENGLAND, Boston, Mass., has been incorporated with a capital of $40,000, to manufacture and deal in rubber products. Ralph A. Peavey is president and treasurer, 101 Homer St., Newton, Mass.

THE NATIONAL OIL Co., Long Beach, Cal., care of Guy F. Rice, Ocean Park, Cal., representative, has been incorporated with a capital of $250,000, to manufacture petroleum products. The incorporators are F. N. and J. L. F. Cosby, and Paul J. Wessel, Long Beach.

THE NEW JERSEY METAL SALTS Co., Bayway and South Front Sts., Elizabeth, N. J., has been incorporated with a capital of 200 shares of stock, no par value, to manufacture metal salts, chemical specialties, etc. The incorporators are J. Alvin Van Bergh, Donald C. Strachan and Albert L. Fiorillo.

THE TENNESSEE CHEMICAL Co., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $1,000,000, to manufacture chemicals and chemical byproducts.

THE ATHENS OIL Co., Athens, Tex., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are J. F. Gilmore, W. G. Crumpler and J. M. Hardaway, all of Athens. The same incorporators have also organized the Kaufman Oil Co., Kaufman, Tex., with like capitalization, to manufacture a similar line of products.

Industrial Notes

A. DAIGGER & Co. announce that an erroneous report has been circulated regarding a fire which started on their premises at 54 E. Kinzie St., Chicago, Ill. The fire referred to occurred in the block in which the premises of A. Daigger & Co. are located, but no damage occurred to the property of A. Daigger & Co., who were fortunately spared any suffering on this account. They are doing business without any interruption whatsoever and are in excellent position to give immediate, efficient and satisfactory service.

JOHNS-MANVILLE, INC., in order to afford better service to clients, has been appointed joint selling agent by the H. H. Robertson Co. In the future all asbestos-protected metal roofing, siding, accessories and ventilators will be manufactured and shipped from the plant of the H. H. Robertson Co. at Ambridge, near Pittsburgh, Pa. Hereafter, in the manufacture of asbestos-protected metal produced by the H. H. Robertson Co., Johns-Manville asbestos saturated felts will be used, thus affording to the customer both the advantages of the experience of Johns-Manville, Inc., in the manufacture of saturated asbestos felts and the experience of the H. H. Robertson Co. in the fabricating to the finished product.

THE AMERICAN AGRICULTURAL CHEMICAL Co., New York City, at a recent directors' meeting, elected the following officers: Chairman of the board, Robert S. Bradley; president, George B. Burton; vice-presidents, Royall Vistor, Horace Bowker and J. D. C. Bradley; treasurer, Arthur P. Stemm; secretary, J. A. Starrett.

THE BROWN INSTRUMENT Co., Philadelphia, Pa., announces the opening of a Southern branch at 619 Brown-Marx Bldg., Birmingham, Ala., in charge of Charles L. Saunders, and a New England branch at 185 Devonshire St., Boston, Mass., in charge of George Goodman.

M. F. KING, formerly of the Kings Refractories Co., has joined the sales and service department of the Quigley Furnace Specialties Co. Mr. King brings to the Quigley organization the benefit of his wide experience in the application of refractories and high-temperature cements and will devote his attention to service and sales work in New York City.

THE POWER SPECIALTY Co., New York, announces the appointment of Pell W. Foster, Jr., as New England district manager, with offices at 50 Congress St., Boston. Mr. Foster was formerly in the New York sales office.

THE MUELLER ELECTRIC Co. announces the completion of its new building at 1583 East 31st St., Cleveland, where it will continue in a larger way to manufacture electric specialties.

THE CHICAGO FLEXIBLE SHAFT Co. has opened a new district sales office with headquarters in Indianapolis for the handling of furnace sales and Stewart engineering service in southern Indiana, southern Ohio and western West Virginia. F. W. Odemar is in charge of this office and the address is 305 Merchants Bank Bldg.

THE H. K. FERGUSON Co., engineer and builder, Cleveland, O., has elected Jos. S. Ruble vice-president in charge of all construction. Mr. Ruble resigned recently as vice-president of the Austin Co., which position he has held for the past 9 years.

Manufacturers' Catalogs

THE ALLIS-CHALMERS MFG. Co., Milwaukee, Wis., in Bulletin 1821, illustrates and describes Rod Mills.

THE YARNELL-WARING Co., Philadelphia, Pa., has published Bulletin T-1701, describing Yarway steam traps recently developed and placed on the market.

THE LEWIS SEARING Co. OF MICHIGAN, Detroit, Mich., has issued a booklet on "Eight Common Grease Cup Troubles Eliminated."

THE REDMANOL CHEMICAL PRODUCTS Co., Chicago, Ill., has issued an attractive booklet, descriptive of Redmanol products. The booklet tells what Redmanol is, its strength, list of products made from Redmanol, how to mold, etc.

THE ARMSTRONG MACHINE WORKS, Three Rivers, Mich., has published a booklet—Catalog C—on "Armstrong Steam Trap," which gives a description of the operation, application and construction of the traps.

THE ZELLER LACQUER MFG., Co., New York City, has published a booklet, "250 Lacquer Questions Answered," which it is distributing to all who write for it on business stationery, or otherwise identify themselves. This is the first time that anything of this comprehensive nature has been published. It is presented in question and answer form, practically every problem confronting the lacquer user being answered.

THE PHILADELPHIA GEAR WORKS, Philadelphia, Pa., has issued a catalog and price list which shows an increase in the company's standard stock gears and a still greater increase in its facilities for making gears.

THE ESTERLINE-ANGUS Co., Indianapolis Ind., has issued Bulletin 722, on the graphic wattmeter.

THE U. S. GALVANIZING & PLATING EQUIPMENT CORP., Brooklyn, N. Y., has issued newly revised bulletins on U. S. Moving Cathode Plating Apparatus (for plating or electrogalvanizing) and U. S. Automatic Cleaning, Pickling, Acid Dip Neutralizing, Rinsing, Drying and Allied Equipment, Bulletins 100 and 105, respectively.

THE VINELAND SCIENTIFIC GLASS Co., Vineland, N. J., has issued a booklet on Glassware Facts, including machine made homeopathic vials, ampoules, radio tubes (for crystal detector sets), oil cup glasses and test tubes.

THE ARMSTRONG CORK & INSULATION Co., Pittsburgh, Pa., has issued a small folder on "A Neglected Source of Economy," which deals with the savings that can be effected in manufacturing plants by the use of refrigerated drinking water systems.

THE DURIRON Co., INC., Dayton, O., calls attention to Bulletin 128-A, just issued describing the latest Duriron centrifugal pump Series 102.

Coming Meetings and Events

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN SOCIETY FOR STEEL TREATING is holding its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

AMERICAN WELDING SOCIETY is holding its fall meeting Oct. 2 to 5 at Chicago.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month. The first meeting of the fall season will be held on Oct. 9.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its fall meeting Oct. 9 and 10, at the Hotel Wolverine, Detroit, Mich.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, 52 East 41st St., New York City: Oct. 6—American Chemical Society, regular meeting Oct. 13—Société de Chimie Industrielle, regular meeting. Oct. 20—Society of Chemical Industry, Grasselli Medal. Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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A Forward Movement in Chemical Engineering Education

THE announcement printed in our news pages of this week that the American Institute of Chemical Engineers has appointed its committee on chemical engineering education records a step that is worthy of more than passing attention.

The tremendous success and widespread interest in the conference which was held last spring under the auspices of the Institute showed that the field was ripe for active endeavor. The able and comprehensive report which was the basis of discussion at this conference, presented by the chairman of the retiring committee, Dr. A. D. LITTLE, of Boston, contained a complete survey of the field and indicated the points on which there must be marked activity in the future. The next step was the indorsement of the report by the Institute at its Niagara Falls meeting in June and the authorization for a committee of the Institute to carry on this work and, within three years, announce a classification of the chemical engineering courses of the country, approving those deserving commendation.

The committee has now been appointed, five members being from industry and five from educational instiitions. The personnel is distinguished not only by service to industry and to education but by a soundness of ideas on this important subject and a rationally progressive attitude which augurs well for the success of the work.

"It Pays To Advertise"

ADVERTISING MEN can argue quite convincingly that anything can be sold if it is properly advertised. And there is one phase of this doctrine that should appeal particularly to technical men. It is the presentation of technical facts through the advertising pages of the daily and popular press.

It is getting to be quite the proper thing to appeal to the reader through advertising on the ground that the quality of the product advertised is maintained by very careful laboratory and plant supervision. Not infrequently the name is given of the laboratory investigator making marked achievement, and the advertiser almost invariably makes haste to stress his superiority of product when he establishes a new control method or when his research department has developed new information of interest to the user of the product.

This tendency to utilize technical achievement as a basis for publicity work should be taken into account by directors of research and chief chemists. When new work of importance is developed, the possibility of gaining advantage for their companies through judicious publicity should be recognized. Very often the laboratory investigator or the chemical engineer will be the first to recognize these possibilities and it then becomes his responsibility to bring them to the attention of the proper officials. A technical story clearly and simply but convincingly told in an advertisement in the daily press should be helpful to all concerned.

Preaching And Practice

TWO eminent army officers, Generals PERSHING and HARBORD, speaking at the first convention of the Reserve Officers' Association, have stressed the same point—that it is false economy excessively to curtail military preparation in peace time. General PERSHING in stressing this point uses the following language: "It would be false economy to save a few dollars by neglecting common-sense preparation in peace time and then to spend billions to make up the deficiency when war comes." General HARBORD lays greater emphasis upon the intimate association between those responsible for the management of military affairs and those whom he characterizes as "stockholders" in the business. The doctrine advanced by these officers is sound and would meet with almost universal agreement, but it is unfortunate that the practice of the army, particularly the theory upon which General PERSHING has administered army affairs, does not accord with the doctrine which he advocates.

If there is any branch of military activity in which preparation in time of peace and training of an organization nucleus is required, it is in the field of chemical warfare. In this particular field it has seemed to be a hobby of the Chief of Staff to discourage any progressive thinking or constructive effort. He, more than any other individual in the world, is responsible for the rather abortive effort made in the treaty preventing the promiscuous use of poison gas. In that field the conclusion which he has advocated has been illogical.

It is idle now to argue whether the treaty should have been adopted in the form and phrasing which was approved. But it is still entirely reasonable to insist that the preparation and training of men in the modern methods of warfare through use of chemical weapons must go forward if any degree of security is to be had. Troops put in the field must know how to defend themselves against gas attack, for if there be any conflict of consequence it is certain that some forms of chemical warfare will very promptly be used. Moreover, there should be the nucleus of an offensive chemical warfare service thoroughly trained to handle all the problems involved in preparation, transportation and projection of war chemicals. Especially is it essential that work on tear gases, sneeze gases and the other non-toxic weapons be thoroughly developed.

While the Chief of Staff and the Deputy Chief of

Staff are pleading with reserve officers on behalf of preparedness, it would be well if they think through the problems of chemical warfare again. If they will carefully consider all aspects of the case, they cannot fail to realize that this branch of the service has been sadly handicapped during the last year or two. In fact, were it not for the much broader, better vision of the Naval Staff our Chemical Warfare Service would be practically out of business at present.

During the coming sessions of Congress it will be appropriate that General PERSHING and his principal deputies lend a much-belated support to adequate appropriations for this work. An extra million dollars a year in this field will maintain effective research and development; and if ever again we suffer from serious war, this small expenditure will represent insurance having face value in the billions. May we not hope that the practice of high army officers will agree in the future more closely with the preaching than it seems to have done in the past?

Anecdotes of Old Galchester

WHEN chemists get into high finance, the bell should ring. There were Derby and Darby and Durby and Dorby of Galchester who made, let us say, dubium oxide, dubium chloride and a series of widely used dubium compounds. Each one was in business for himself, each was rich, possibly a little vain, as becomes the habit of rich men, but they were a pretty good sort, every one of them; and every one proud of his reputation as a citizen and a manufacturer. Their friendship was an asset, especially to their customers; for when bad times came around they did their best to see their old customers through, while if markets got crazy and prices went up in the air, they stuck to their contracts, fulfilling them exactly as agreed. They would even renew them in seasons of great prosperity at the lowest figures they could profitably make. Each one was jealous of his good will, and resolved to maintain it at any cost. They were also good friends.

Off in one corner of the county was Digby who had dubium interests, and Derby thought it would be a good thing to buy him out. He therefore proposed joint action to his friends Darby, Durby and Dorby, who agreed, and negotiations were begun. They bid 5, and Digby asked 10, but finally they compromised on 9. Digby proved to have more dubium interests than they had reckoned on, so in order to swing the deal they called on Mr. Quickturn Capital, who asked them questions about their own business. He was interested, having already picked up "a few blocks of stock" in the dubium industry.

Mr. Capital was amazed. He was also shocked. But he said he would come into the deal and help them out. He offered to put up $5 in cash and to give his note for $2.50 more for each of Digby's dubium units and to let the other gentlemen put up $1.50 more, to make up the price; but this was with the proviso that they give him one-quarter of the profits on the transaction. To this they agreed. Digby said if they were to give notes he wanted $9.50, and Mr. Capital surprised his associates by his quick decision. He was above bargaining.

"Let it be $9.50," said he, "and we will make one note for the whole amount. You gentlemen can indorse it, and I'll put my name on last and guarantee you."

To this all agreed, and a note for the large sum was made to Digby and indorsed by Derby, Darby, Durby and Dorby. Then Mr. Capital wrote underneath: "In case any or all of the above indorsers should default on this note, I agree to make good such default. Quickturn Capital." Digby turned over his papers; Capital handed him the note.

"I've always remarked," said Mr. Capital, "that you chemists are children in business. You're soft. You neglect your opportunities. Business is business; it isn't a tea-party. You have foolish ideas about good will, and you sell dubium at a price way below the market to your so-called customers—and let them reap the profits. Business is business, I repeat, and its purpose is to make profits. You people don't know how to keep books, and you don't know anything about markets or how to control them. In fact, you're little children. This incident of the note is an example of how slow you are at trading. You're way behind the times. This whole trade is a mere bagatelle. We'll sell this Digby dubium at 25, but that is nothing to what we can make. I think I shall have to take a hand in your affairs and look into the dubium market."

He proceeded to do so while the others lost their breath once more and caught it again. Then followed weeping and wailing and gnashing of teeth, but there rolled in such a flood of golden money that, according to the legend, Derby and Darby and Durby were comforted. But Dorby retired because the cries smote his ears and caused him great distress. Dorby comforted himself with apples.

Long Range Price Trends

WE HAVE all been very much interested, since the armistice, in commodity prices. The interest has not been merely the selfish one involving the question of what we could get for such dollars as we ourselves had. Prices have furnished an index to economic conditions, in which we all have a general interest.

When, just after the armistice, prices displayed a greater reluctance to decline than had commonly been expected, we wondered whether this meant that the value of the dollar had been permanently depreciated. Some observers insisted that such was the case, citing the large increases in the currencies of various countries together with the large issues of government bonds. If so, the real value of all bonds and mortgages had been greatly depreciated, while at the same time it would be justifiable to mark up the value of all real estate, plants, etc.

In the great price rise of the latter part of 1919 and the early part of 1920 the common view was that the particularly high prices represented a deficiency in production, the assigned reason being that men were not working hard enough. With the declines of 1921 we concluded that men were working harder and manufacturers and dealers were contenting themselves, perforce, with smaller profits. More recently prices have been advancing again, and most people are talking about "secondary inflation."

We have got into the way of making practically all price comparisons by using the 1913 average as standard. Undoubtedly it was necessary to adopt a standard, and the calendar year before the war seemed the natural year to take. The point that it is desired here to emphasize is that we are certain to make serious mistakes if we consider 1913 a perfect standard, with which all current prices may properly be compared. The easy concept must be avoided that 1913 was really

typical, while furthermore we must not overlook the fact that in nine years many conditions would have changed had there been no war and no inflation. All commodities would not now be at the same level as in 1913, or 25 per cent above or 25 per cent below. Some would be higher, some would be lower, and even the general average would not be the same.

The Department of Labor has just issued "Wholesale Prices, 1890 to 1920." this being the eighteenth of a series, begun in 1902. The last bulletin of similar character was published in 1916. Meanwhile there has been a change in the system whereby the relative to 1913 is given for each of many commodities or groups, for each year beginning with 1890. Thus a fresh and valuable means of comparison is now afforded.

In order to judge rightly the significance of a given comparison, that the commodity is 125 or 150 or 175, relative to 1913, we need to consider how the commodity in 1913 compared with prices in previous years. The commodity may have been falling up to 1913 and in that case it is particularly remarkable if now it is much above 1913. It may have been advancing up to 1913, in which case a further advance is not remarkable. At this late date we cannot hold that because one commodity is 150 relative to 1913 another commodity should likewise show a relative of 150.

To illustrate, one finds that, with 1913 prices as 100, carpets were at their highest in that year, having been 80 in 1890, 70 in 1895 and 1896 and 92 to 93 in 1909, 1910 and 1911. Wheat, on the other hand, was 101 in 1891, 63 in 1893 and 126 in 1909. Thus it would be much more remarkable for wheat than carpet to have a high relative to 1913 at the present time. Again, compare brick and plate glass. Brick was 100 in 1890, 75 in 1897 and 130 in 1906. Its 1913 price was therefore quite typical of the average for a period of years. Plate glass, on the other hand, was 180 in 1890, 139 in 1900 and of course 100 in 1913. Thus it had been experiencing a great decline. In no year from 1890 on were matches as cheap as in 1913, while in none of those years were kitchen tables as dear.

Views on University Research

IT IS a matter of common remark that "experts disagree." Men of approximately the same education and environment often develop wide differences in view on questions of common interest. But it is worthy of notice when leading educators start from the same premise, defining the proper aim of education, and finish with entirely different proposals as to how that destiny can be met. Particularly is this true when both of them were formerly associated as deans in the same university.

They both recognize that the university must be something more than a storehouse, where the sum of human knowledge is iced away and preserved. Furthermore, the university must be of use to a far wider public than the favored students who are fortunate enough to attend its classes. And they are further in agreement that the university faculty should be investigators as well as instructors. In short, they recognize that a modern university has grown beyond the ambitions of its predecessors. Indeed, the end of the dark ages and the revival of learning were both foreshadowed by the determination of educated men to push out into the unknown and discover more facts to add to the accumulated store.

But that's about as far as these two scholars agree. A modern university, says one, should have as its "chief objective the development of knowledge, while instruction becomes incidental." By no means, says the other, "Scientific research and the advancement of knowledge should be in a position of equal importance with the work of instruction." An even wider difference of opinion exists on the methods of research. The former says, "The faculty becomes a body of real scholars who will exert all their powers toward discovering new facts and setting them into their proper places with related facts in order that principles may be brought to light—a great process of critical analysis and synthesis, with logical deduction which we call research." But the second educator holds that "the solution of the problems of most industries can best and most economically be undertaken through association with the universities and technical schools," and further in his address argues the thesis that the faculty should devote their time not pre-empted by the class room to the solution of troubles cropping up here and there in the industries.

We venture to disagree with both these conclusions.

From an engineer's point of view it is essential that the universities keep *instruction* as their great work—instruction of matriculated students and instruction of the far greater public outside the cloistered walls. An institution which does not pay first attention to instruction of others besides its own faculty is not a university. Consequently we shall not argue the point at length. On the other hand, an institution officered by immature instructors is not a university, as we understand the term.

There are two very good reasons why the faculty of a technical school should engage in research. In the first place, a true teacher is also a student—he is curious about the unknown. There is that within his spirit which urges him to investigate. In the second place, the schools and their faculties must advance in order to hold their jobs. Abstruse science of yesterday is commonplace technology of today. So if there were not more new things constantly discovered, the engineering and scientific colleges would quickly become trade schools.

It seems agreed that investigation is necessary to the well-being of our schools. But what kind?

We believe that the true scientific researcher does not go to the XYZ bolt works and select his problem from its scrap pile, nor to the farmers of Jones' Corner and bring back a sample of bad vinegar. But with a background made up of thorough familiarity with the literature of his specialty, an acquaintance with the principal workers in the field and the useful applications which have so far been made, he selects one of the broader problems that remain to be solved and attacks the matter with a quite disinterested perspective. He throws all the resources he can bring to bear into the search, and in time, perhaps years, reaches a solution—or at any rate it becomes known that he is very well informed in that particular branch. Then with the advantage of this position, he is able to give the public the maximum amount of seasoned, correct advice with the least amount of distraction from his ordered routine. And that's the only kind of advice he will attempt to give. It is more than doubtful that this eminent and influential position could ever be reached by a university faculty that devoted itself to commercial research—which is time consuming, but rarely broad and never disinterested.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, Sept. 18, 1922.

CHEMICAL markets are, on the whole, featureless, prices remaining steady, although the outlook and industrial conditions continue to show improvement. Pitch and carbolic acid crystals are firmer, American demands being a favorable factor in the latter case. The trade in aniline dyestuffs and intermediates is improving. There is increased demand for sulphuric acid, about two-thirds of the available plants being in continuous operation. The recent reduction in railway freight rates is having a beneficial effect in enabling manufacturers to enlarge their areas of distribution, particularly of products for which transportation charges are a material factor.

REPARATION DYES TO BE DISTRIBUTED BY BRITISH DYESTUFFS CORPORATION

Perhaps the principal factor underlying this change in the Board of Trade's policy was the fear that the Central Importing Agency might ultimately compete with old-established traders. No attention is being paid to the critics who have made criticism their business at all costs without being in a position to propound any reasonable alternative. The corporation is to act substantially as agent of the government on a commission basis and the business is to be handled by a separate department not concerned with the disposal of the corporation's products. Prices are to be fixed by the government with an advisory committee on which the Color Users' Association is to have two representatives. The general impression is that the new arrangement will work very satisfactorily from the user's standpoint and the prospect of its benefiting producers is already reflected by an appreciation in the quotation for the corporation's shares. Sir William Alexander, the chairman, has emphatically contradicted the rumor that the color users are dissatisfied and his forthcoming visit to the United States should lead to a useful interchange and clarification of ideas on this very controversial industry.

INDUSTRIAL AND GENERAL DEVELOPMENTS

The British Cellulose Co.'s scheme for providing new capital is approaching fruition and prominent directors of the Société de Soie Artificielle de Tubize (Belgium) have joined the board of the company and of the "holding company" which is providing the new capital. Acetyl cellulose silk is now finding its way into the market and although, as is usual with a new product, its value is likely to be exaggerated, the fiber is being favorably considered as being a closer approach to natural silk in spite of difficulties in dyeing which are still in process of being surmounted. The prospectus of the "holding company" will be issued shortly and the £300,000 which is to be provided as first mortgage debenture stock is repayable in 1924 or by purchase in the market. There has been a very interesting exchange of letters between Sir Harry MacGowan, the managing director, and the Belgian silk works, from which it may be gathered that sales are increasing sufficiently rapidly to warrant an increase in the capacity of the plant from 1 to 3 tons per day and also for the installation at Tubize of a half-ton plant for manufacture of the new silk. This decision has been taken earlier than was originally provided for and indicates confidence on the part of the Belgian directors.

Owners of motor lorries and omnibuses are displaying interest in the use of "Discol" motor spirit, which is being marketed by the Distillers' Co., Ltd., and is mainly a mixture of alcohol (made from molasses) with benzol and other hydrocarbons. Considerable economies in fuel consumption have been recorded in this connection by the use of an economizer tank holding three quarters of an imperial gallon, which when filled with "Discol" fuel is stated to be of sufficient capacity for 150 miles run. The hot water from the radiator is circulated through a coil in this tank and by means of an adjustable air inlet a steady supply of gas of up to 30 per cent of the normal fuel requirements can be fed to the carburetor, variations in running being then taken up with petrol from the carburetor itself. The cost of the fuel is stated to be 1s. per gallon and increases of mileage of 75 per cent per gallon have been recorded, while the makers guarantee no pinking in the engine even at full load with ignition fully advanced.

SCIENTIFIC AND INDUSTRIAL RESEARCH COUNCIL ISSUES SEVENTH REPORT

Although much really useful work has been done in an unobtrusive way, a great deal of the work reported in this publication has not yet produced tangible results. As a contemporary aptly puts it, Faraday's simile "What is the use of a baby?" is still the best answer to scoffers at scientific research. Perhaps the most immediate benefit achieved lies in reduced consumption of fuel, increased output in gas works and the indirect fuel saving to shipowners from the steady work accomplished in the National Froude Tank. A saving of about 5 per cent was shown in many cement works with an increase of 10 per cent in output. Among the various state-aided research associations, those for the cotton and linen industry have done particularly useful work, while the food investigation board is able to record a success in the diagnosis of "brown-heart," a disease which affected apple shipments. Previously attributed to insects, it was found that the apples had been affected by self-evolved carbonic acid gas. Perhaps the most useful innovation is the establishment of co-ordinating research boards and committees to prevent overlapping and to facilitate investigations that are of common interest to several industries.

SUCCESS OF BRITISH ASSOCIATION MEETING

The meetings of the Chemical Section have this year had an exceptionally good lay press and as a result there has again been some criticism of the policy so frequently insisted upon by other learned societies of restricting publication prior to the appearance of contributions in the societies' own journals. None of the bodies criticised seems to possess sufficient courage to give the idea a trial and the critics are too apt to forget that the British Association is really an exception, inasmuch as it meets only once a year and possesses insufficient funds to publish the whole of the papers contributed to it. The symposiums on hydrogenation of oils and particularly that of the nitrogen industry were well attended. Dr. Harker's review of the nitrogen situation was really a masterly exposition, although the speaker's lips were unfortunately sealed in respect of some recent important developments. The published reports of the various papers presented are instructive reading from the national standpoint and tend to show that the German menace is still an important factor.

Detroit Meeting American Society for Steel Treating

Forty Per Cent of the Membership Present at the Best Convention the Society Has Ever Held —Papers on Carbonizing, Heating Practices, Tool Steel, Hardness and Metallurgical Education

EDITORIAL STAFF REPORT

STEEL TREATERS have done something which is perhaps unparalleled in the history of American technical societies—they have held a national convention at which 40 per cent of their entire membership nrolled as present. Being held in Detroit, several of he larger local chapters in the Middle West came in body, but in order to set that record a great many thers traveled from New England and the coast states. They were rewarded by the best meeting and exposion the American Society for Steel Treating has ever ad. Being but a young organization, the earlier conentions showed many marks of inexperience on the art of their managers. Much praise is therefore due the Detroit committees, under the general chairanship of W. P. Woodside, for their part of the work. They provided quite adequate meeting and exhibition acilities in the magnificent General Motors Office Buildng, gathered together a notable list of meritorious echnical papers, and provided a number of excursions nto manufacturing plants and social entertainments hich filled every minute. No doubt some of the sucessful results—particularly in the exposition of steel nd steel-treating equipment—were due to the coperation of the American Drop Forging Institute, hich held its annual convention in conjunction with he Steel Treaters as a sort of co-operative affair.

BIRTHPLACE OF BESSEMER STEEL IN U. S.

One feature of the non-technical activities is worthy f comment and emulation. It seems that the first essemer steel made in America on a commercial scale as blown in 1864 by William Kelly at the village of Vyandotte, on the river a few miles south of Detroit. he site of these works—now long since dismantled— the business center of the present community, but is ow marked by a bronze tablet erected by the Detroit nembers of the Society for Steel Treating.

Kelly, it may be recalled, was an ironmaster who ad discovered the pneumatic process many years before hen observing the action of the air blast on the metal n one of his forges, left unprotected by the usual charoal blanket. In fact, he had made knobbed iron with ttle or no charcoal for many years before he was able o interest anyone sufficiently to finance large experinents on what is now known as the bessemer process. plant was finally erected alongside the blast furnaces f the Wyandotte Iron Works, and operated with the sual vicissitudes of radically new processes for sevral months. A considerable tonnage of steel, however, as made, rolled and sold. During part of that time aptain Robert W. Hunt was in charge of the operaions, and fortunately this venerable engineer was able o be present at the dedication ceremonies and give ome reminiscences of those early times.

An echo of the vicious litigation which was fought ver the Kelly American patents, the bessemer British atent and the improvements made by Mushet was eard in the remarks made by William C. Kelly, the on of the discoverer of the pneumatic process. It seems that Kelly's achievements in the manufacture of iron without charcoal had become fairly well known, both here and abroad, through information spread by Kelly's Cincinnati house—jobbers and importers of iron and steel. During these times the forges were visited by two Englishmen of intelligence, who remained a few months, even assisting the owner in his experiments looking toward an improvement of the process or an adaptation to larger-scale operation, eventually leaving as suddenly as they appeared. According to the son, William C. Kelly, one of these visitors was identified by his father as Bessemer, when a photograph of the latter was brought over from England shortly after the introduction abroad of Bessemer's process in a commercial way. This incident, mentioned by William C. Kelly as never before having been made public, was told him by his mother before her death, several years ago.

Session on Carbonizing

CYANIDE HARDENING

Some experiments on case-hardening were reported by A. H. d'Arcambal, metallurgist for the Pratt & Whitney Co. He treated 1-in. rounds of S.A.E. 1015 steel in a bath composed of 76 per cent sodium cyanide, then removed the shell by 0.005-in. steps, analyzing each sample for carbon and nitrogen. A typical set of results are given below, after a heating for 45 minutes at 1,550 deg. F. and cooling in lime:

Sample	Carbon	Nitride Nitrogen
First 0.010 in.	0.44	0.353
Second 0.010 in.	0.22	0.036
Third 0.010 in.	0.18	0.017
Fourth 0.010 in.	0.14	0.009
¼ center drillings	0.14	0.006
Original stock	0.14	0.003

Carbon and nitrogen are both increased by temperature and time—e.g., 120 minutes at 1,550 deg. F. gives C 0.56 and N 0.451 in the outer 0.010-in. shell. Forty-five minutes at 1,450 deg. F. gives an outer case of only 0.30 C and 0.215 N. When hardened and fractured, the hard "case" measures about 0.010 in. deep for all heatings. Under the microscope, nitride needles are observed near the "breaking-off" point of the case.

IMPACT TESTS ON CARBONIZED SAMPLES

d'Arcambal also presented many data on the impact strength of several commercial steels after carbonizing 4 hours at 1,650 deg. F. in a mixture of ¼ sole leather, ¼ $BaCO_3$ and ½ hardwood charcoal. Subsequent heat-treatments were on the "high side" of S.A.E. recommendations, all samples being drawn to 350 deg. F. Some of the results are given in Table I (averages of 3 to 6 samples). Depth of case was measured under the microscope, and found to be 0.025 in. for the carbon steels and 0.03 in. for the alloy steels.

All pieces packed in sand and given the regular heat-treatment showed very much higher impact values than corresponding samples packed in the carbonizing mixture, a result to be expected. Heating for this long period in a neutral atmosphere will permit all soluble impurities to diffuse thoroughly; subsequent double

TABLE I—PHYSICAL TESTS ON CARBONIZED SPECIMENS

Steel	Carbonizing	1st Quench	2nd Quench	Izod	Sclero-scope Case	Brinell Core	Izod Fractures: Case	Izod Fractures: Core	Tensile Tests: Ultimate	Tensile Tests: Elongation in 2 in.	Tensile Tests: Reduction
S.A.E. 1015*	Carbonized; pot-cooled	1650-oil	1440-water	2	90	157	Slightly coarse	Coarse	.....	....	....
do	do	1450-water	None	2	88	180	do	Very coarse	.....	....	....
do	Carbonized, oil-quenched	1650-oil	1440-water	2	90	157	.....	.....	.....	....	....
do	do	1450-water	None	3	..	166	.....	.....	.....	....	....
do	Sand packed, pot-cooled	1650-oil	1440-water	70	..	163	.....	Fine	103,100	11.5	26.5
do	do	1450-water	None	10	..	180	.....	Very coarse	127,500	4.8	5.3
S.A.E. 6120†	Carbonized; pot-cooled	1650-oil	1475-water	10	92	265	Fine velvety	Fine	.....	....	....
do	do	1500-water	None	2	92	255	Fine	Coarse	.....	....	....
do	Sand packed; pot-cooled	1650-oil	1475-water	37	..	265	.....	Fine	125,500	17.0	35.4
do	do	1500-water	.....	23	..	252	.....	Coarse	137,800	13.1	30.0

* Analysis: C 0.19, Mn 0.42, P 0.01, S 0.04, Si 0.1.
† Analysis: C 0.14, Mn 0.65, P 0.008, S 0.03, Si 0.13, Cr 1.03, V 0.18.

quenching will produce very fine grain. Izod bars so treated should show maximum toughness. Carbonizing, however, places a mass of very brittle martensite at the root of the notch, where the force of the impact is concentrated. Splitting of the specimen starts with a minimum of resistance, and results in correspondingly low values for the work of rupture. The double heat-treatments recommended by the S.A.E. give fine-grained fracture in case and core for all carbonizing steels, and the single quench refines the case, but leaves the core very coarse. The grain of an impure steel, such as bessemer screw stock, is not refined, however. All cases which had scleroscope over 90 were hard to a Nicholson flat temper-testing file; 3½ per cent Ni steels (S.A.E. 2315) gave scleroscope 87, and file-soft cases. After double quenching, all cases show a fairly fine martensitic structure, containing some globular cementite. The single quenching given preserves a trace of cementite network. Steel 6120 develops no network at any time. In general, this network is suppressed by quenching from the pot.

Izod values, in the single quenched condition, ranged the steels tested thus: 6120, 2315, 1015, 3115 and 1112. Oil-hardening gear steels range similarly—e.g., 6150, 2350, 3250 and 3150.

In view of the brittle material existing at the root of a notch, after the test-piece has been carbonized and hardened, it is doubtful if the impact specimens give results of much importance. Major Bellis noted that carbonized rifle receivers would withstand 150,000 lb. pressure under actual ballistic test, whereas the same part before carbonizing would fail at 85,000 lb. Notched test specimens, however, would invert the order.

Precautions in Carbonizing

H. B. Knowlton, of the Milwaukee Vocational School, recounted precautions which it is necessary to observe in commercial operations in order to insure uniform results.

First, it is necessary to have uniform carbonizing material. If this is homemade, or if a certain amount is being re-used, it is necessary that it be quite thoroughly mixed. Next, the temperatures must be under control. Time at heat is the most important thing to regulate, and in view of the variations in furnace firing, temperature of walls, loading of boxes, and so on, it is essential that the actual temperature at the center of the boxes be observed, either by a properly placed pyrometer or by frequent withdrawal of test pins Given these factors under control, the most fruitful source of trouble is leaky pots. Air or furnace gases entering them will burn the carbonizer, and the pieces near the leak or the top of the charge will actually be oxidized. Erratic results are also found on parts placed too near the surface of the pot, if the carbonizer shrinks and settles unduly.

Session on Tool Steel

Breakdown Tests

About twenty-five brands of commercial tool steel have been investigated by the breakdown test by H. J. French of the Bureau of Standards and Jerome Strauss of the Naval Gun Factory. Lathe tools (1x½ in.) of approved shape were given recommended or appropriate heat-treatments, and then tested dry to break down on a heavy duty motor-driven engine lathe, cutting a 15-in. forging of heat-treated 31 per cent Ni steel (Brinell 200). A feed of 0.045 in. and cut $\frac{3}{16}$ deep, was used. Under fast cutting, failure ordinarily occurred in less than 15 minutes. The amount of energy required to drive the lathe was not affected by the kind of steel in the tool.

Selection of the steels was made at random from about sixty-six lots of tool steel on hand. These had been analyzed and grouped into the following classes (analyses noted here being the average):

	C	Cr	W	V	Co
Low-tungsten, high-vanadium	0.65	3.7	13.0	1.5	
Medium-tungsten	0.66	4.0	15.0	1.5	
High-tungsten, low-vanadium	0.66	3.5	18.0	0.9	
Cobalt	0.69	3.7	16.4	1.2	3.3
Special (with molybdenum or uranium)					

Three tests were run, at various speeds, and the performance, noted as per cent of time of cutting of the best type, follows:

	Speed 67	Speed 61	Speed 60	Total
Low-tungsten steel	100	94	100	294
Cobalt steels	68	100	97	265
High-tungsten steels	56	55	64	175
Medium-tungsten steels	54	56	62	172

There seems to the authors to be such a great variation in the results, both for individual tools in the same test and for the class averages in tests which have their only difference in a minor change in cutting speed, that breakdown tests should not be relied upon to govern large purchases of tool steel in a competitive market, except when the tools are for very heavy roughing work, as in the test itself. There seems to be no doubt, however, the low-tungsten steels or cobalt steels are definitely better for this duty than the high-tungsten varieties.

Uniformity of the tests became better as the severity was reduced, and was very good when failure occurred at about 20 minutes, the time recommended years ago by Frederick W. Taylor. Mr. Spaulding recommended Taylor's method rather than the severe breakdown tests, because he had found that the former gave results which could be duplicated consistently to within 5 per cent, regardless of the kind of cutter or tool tested J. H. Parker, on the other hand, told of an extended breakdown test which selected steel X as being best and Y as second choice. Twelve sizes of each steel were then purchased, six tools were made by each size and put into regular production, working on appropriate

machines and various alloys. Ten grinds were given each tool. In every shop test, X (a low-tungsten, low-vanadium steel) was first, and Y (a high-tungsten, low-vanadium steel) was second.

Proper Microstructure for Best Machining

J. V. Emmons, of the Cleveland Twist Drill Co., presented an account of that company's extended studies on the influence of the microstructure of high-carbon tool steel upon the ease and excellence of the machining operations necessary to form it into a cutting tool. Such steels as received by them, having been given an anneal at the mill, would always show more or less massive cementite (the remains of the original network) more or less sorbite or pearlite, or pearlite in various stages of decomposition to ferrite plus spheroidized cementite. The variations cause troubles of such moment to them that they anneal all such steel received to a definite microstructure found most suitable to their shop conditions. If a variety of machining operations —such as turning, milling, fluting and tapping—have to be done on the same piece, a compromise structure is chosen. In general it will usually be one containing but few traces of the original massive cementite network, and perhaps only 25 per cent of the area covered by lamellar pearlite, the rest being spheroidized. In general, these slight changes in structure have far less influence on the final hardness and toughness of the steel, if they are given a heat-treatment in keeping with their constitution. For instance, if coalescence of the cementite is into unduly large particles, the tool must soak for a longer time at the hardening heat to get these carbides uniformly diffused in the austenite.

Several speakers emphasized that Mr. Emmons' paper was one which should be used as an indication of the correct principles of operation rather than a detailed guide. There seems to be a very powerful "shop factor" operating in such problems. For instance, several manufacturers of taps have shop methods and machines which are practically identical, and purchase steel of the same chemical composition. Yet one will specify a maximum Brinell hardness of 160, and another a minimum of 200. Each believes he is getting the best material for quantity production. Similarly manufacturers of ball bearings use the same shop methods and the same kinds of steels. Yet Plant A prefers 160 Brinell, B specifies 160 to 180, and Plant C demands 180 to 200.

Hollow Drill Steel

A brief account of the terrific duty which is imposed on hollow steel for rock drills was described by N. B. Hofman, of the Colonial Tool Steel Co. Until about 2 years ago nearly all of this steel used was a plain carbon steel. Since that time several attempts have been made to market alloy steels, but they have not been entirely satisfactory, owing to the fact that the forging and hardening of the steels is invariably done in the crudest blacksmithing manner by men who do not understand the idiosyncrasies of modern alloys. However, a steel containing 0.75 to 0.85 C, 0.25 to 0.35 Mn, 0.12 to 0.16 Si and 0.2 V has given very excellent results. It is hardened and tempered like the more usual carbon steel, and has given from two to three times the life in endurance tests and actual service. One difficulty still to be overcome is in the condition of the metal surrounding the longitudinal hole. By common methods of manufacture it is decarbonized and too often full of minute cracks or folds from which detailed fractures—the so-called "fatigue failures"—commence and spread rapidly.

Session on Heating Practices

Scale Formation Upon Heating Steel

G. C. McCormick, of the Crompton & Knowles Loom Works, Worcester, pointed out that the terms "neutral atmosphere" and "reducing atmosphere" as used in shop parlance are misnomers. His experiments show that it is impossible to operate a semi-muffle furnace without badly oxidizing steel left in it for an hour at temperatures greater than 1,200 deg. F.

Using a tube furnace, with an atmosphere of still air, he plotted the losses by scaling[1] after an hour's exposure at various temperatures. The curve resembled a parabola—the loss was very low at 1,200 deg. F., but increased at an accelerating rate, and at 1,600 deg. was excessive—0.50 gram per sq.in. of surface. In all the experiments, low-carbon steel scaled more readily than high-carbon, probably because the latter had to be decarbonized as well as oxidized.

Shopmen call a "neutral" atmosphere one where the fuel is fed into the combustion chamber with just sufficient air to burn it. The furnace then contains an atmosphere made up of the products of combustion: little or no oxygen but much CO_2 and H_2O, both of which, as a matter of fact, oxidize steel badly at high temperatures. It was shown that the scaling loss in a furnace operating with such a "neutral" atmosphere was about as great as in still air.

Again, the term "reducing" atmosphere refers to one where an insufficient amount of air is supplied the burner; therefore the furnace atmosphere contains more or less CO, H_2 or unburned hydrocarbons. It is characterized by a "hazy" heat and flames burning around the door and exhausts. Mr. McCormick experimented in a furnace which was operating on the maximum surplus of gas possible to give it. The atmosphere analyzed 11 per cent CO_2, 0.8 per cent CO and no oxygen. Nevertheless scaling continued at about half the rate in still air.

It is recognized, of course, that for brief stays at temperatures even much above 1,600 deg. F. oxidation may be materially reduced by operating with a large excess of fuel. Yet it appears impracticable to produce an atmosphere in a commercial semi-muffle furnace which will not scale badly after several minutes at temperatures above 1,200 deg. F. In other words, "a high-temperature furnace always scales." Consequently the ordinary terms "neutral" and "reducing"—when referring to atmospheres in such furnaces heating steel —should be abandoned.

Electric Furnaces

C. L. Ipsen presented a brief paper describing some electric furnaces which have done very good service in heat-treating. The heating elements consist of loops of bare nichrome ribbon, hung on refractory lugs built into the furnace lining. These loops may cover the side walls, roof and even be placed under the floor, which latter is usually constructed of a good conductor of heat, like special alloys or carborundum brick. Turret furnaces with rotary hearths are becoming very popular for continuous production. One such has now been in operation 8 hours daily for 3 years without any expense for renewals. Current is switched on auto-

[1]Scale was removed by dipping the steel into cyanide for 10 minutes at 1,450 deg. F., quenching in water, and cleaning in soda.

matically at 4 a.m., the furnace is up to heat when work starts in the morning, and is automatically controlled during the day. Furthermore, such furnaces avoid the smoke, heat and noise of a fuel-fired furnace and may be installed in their proper place in the production stream without becoming a nuisance. Furthermore, annealing may be done in automatic electric ovens at night, requiring practically no attention and taking advantage of low rates for off-peak loads.

Discussion on Hardness

An extended discussion on hardness testing was held under the chairmanship of Major A. E. Bellis, in which a large number of members participated. Dr. H. P. Hollnagel, of the Lynn plant, General Electric Co., laid the matter open in a paper describing the various popular methods of measuring "hardness" and the inherent difficulties in standardizing and correlating them.

"Scratch hardness" is the oldest method, and perhaps the most used. A physicist performs the test by drawing a minute jeweled point across a smooth surface, and examines the width and depth of the microscopic furrow cut across the individual crystals of the piece. Ordinarily, an engineer is more interested in the properties of an aggregate of crystals, rather than of the individual crystal—he takes a set of standard files, and judges which will just scratch the piece. In this way he gets a relative value. File testing, however, would probably be most difficult to standardize—the files themselves would have to be quite uniform and never used after slightly dulled; furthermore, the speed and cutting pressure introduce a very large personal factor. As an illustration: If conditions are right, diamond will cut diamond, and chalk will polish quartz.

"Wear hardness" has been proposed as a term devoting the time required to wear 0.001 in. from a pin under a fixed load. In such a test the original surface becomes quickly polished (covered with an amorphous film) and therefore the specimen hardens as the test proceeds.

"Penetration hardness" denotes the usual method employed by metallurgists, wherein they press a ball or point into a surface and measure the indentation. To perform the test the material must be overstrained, thus automatically hardening the deformed material. In manganese steel this characteristic is so aggravated that figures for penetration hardness do not mean anything. In other metals, the method is extremely useful, despite the limitation that its results are greatly influenced by the properties of the material in its deformed state—even when the test is so superficial as barely to penetrate the surface.

Deformation under impact has been utilized in many commercial hardness testers. Some of them are of the semi-resilient type, where the indications are estimated by the rebound of the testing implement. This method is thought by Dr. Hollnagel to be especially defective, since the rebound is a function of the duration of impact, which in turn varies with the manner and speed by which stress waves travel through the body which is struck. Of all kinds of hardness, that kind which presents resistance to a rapid penetration—like projectile and armor plate—is the most difficult to control or reproduce.

Even when the ideal test is established many of the present hardness tests, and more to be devised, will always be useful for "inspection" purposes. Of course, they will give only relative figures, and in some cases will only be able to pick out defectives from parts supposedly all the same. Their use will always involve a large personal factor and considerable common sense—nevertheless, they are performing a very useful rôle in technical control of shop practices.

It would be desirable, as Sam Tour pointed out, if the term hardness could be defined, or some new one invented to which could be ascribed some definite physical property, thus having a connotation free of the many shades of meaning associated with our present word. Unfortunately, all of our present tests are called "hardness" tests, even though they obviously measure different combinations of qualities, so different that correlation is quite impossible.

Metallurgical Education

A symposium on metallurgical education under the chairmanship of Prof. S. L. Goodale, of the University of Pittsburgh, brought out many suggestions from practicing engineers on "What to Teach" and in return educators told how the colleges were meeting these new demands. Both parties were agreed that the basis of a sound metallurgical education was a solid foundation in the great art of language and the fundamental sciences—mathematics, chemistry and physics. University professors were apparently unanimous in the belief that the technical student should also give much more attention to the so-called "humanities"—ancient languages, literature, history and fine arts—and the newer studies, economics and psychology. In fact, the demands upon the modern engineer, first as a citizen, and then as a specialist, appear to require such thorough preparation that there is a distinct trend toward the 5-year course. In this additional year of college life the student could really specialize in his chosen field, already having been fitted by a much more general education to enter any one of several engineering specialties. Undoubtedly such a 5-year course, properly taught, would make better engineers and better citizens, but it was recognized that such an innovation would have to be approached with care, in view of the present unpopularity of a lengthy college course. On the other hand, it was pointed out that nearly if not quite all university curricula in metallurgy were offshoots of schools of mines or of chemical engineering and contain many studies which have only a remote bearing on metals and their alloys. If these excrescences could be removed—or in other words, if a real metallurgical curriculum could be established—there would then be available no small amount of time for "humanities" without extending beyond the conventional 4 years' time.

There is of course one very important kind of metallurgical education which lies beyond the university. It consists of teaching artisans—machinists, toolmakers, blacksmiths, forgemen and heat-treaters—as well as foremen and executives—something of the great advances which are being made in the art and science of alloys. Many of these men can never be reached, because of their own mental stagnation. On the other hand, the American Society for Steel Treating, through its frequent local meetings, the technical press and the trade and continuation schools, is doing a great deal for the younger and more ambitious men engaged in manufacturing metallic goods. Much leavening of this whole mass is being done by the graduate metallurgist himself. When he enters a plant he finds his activities touch many of the operating, executive and selling departments, and, if he is the right sort, he preaches the gospel of "quality" in metal in season and out.

Handling the Finished Products of Industry—V

Handling Bricks From Kilns for Storage and Shipment Is a Problem Easy to Solve—Why Modern Methods Have Not Been Generally Adopted in This Industry—Suggested Solution Based on Experience of American Enameled Brick & Tile Co.

By Graham L. Montgomery

THE OPERATIONS in the average brickyard are particularly adapted to the successful application of mechanical handling equipment. The basic raw materials are few in number and are received in relatively great bulk. The additional materials used are of such small bulk that the means used for handling them is unimportant. In the treatment of the material for manufacturing the brick, from the first operation which the raw material undergoes to the point where the burned brick is removed from the kiln, we have a manufacturing process which is ideal for the application of straight-line flow and automatic handling methods. After the bricks leave the kiln, whatever the design of the kilns may be, they are products of a form which permits the simplest and most economical type of handling.

The conveyor engineer or the experienced conveyor salesman can hope for no easier job than that of laying out a handling system for handling finished brick. The product is uniform in shape and weight. The sources of origin—the kilns—will be approximately all in the same location. Any intermediate operations which may happen to the brick, such as sorting and storage, will happen to all of the products, and may easily be arranged to occur in a straight line between the kilns and the point of shipment. Since the product is entirely uniform, the method used in shipping will be exactly the same, and therefore presents a splendid field for the application of mechanical carloading equipment.

Status of Handling for Finished Bricks

In spite of these considerations, there is scarcely a brick plant in the country which is taking full advantage of the saving to be made through the use of this mechanical equipment. Some plants have made a beginning and have applied conveyors here or there; and the plants that have done this have found they derive a distinct advantage from the use of these machines. A large majority of plants, however, have failed to take any advantage whatever of equipment of this type for handling the product at any point beyond the kilns.

Attitude of Some Ceramic Engineers

Perhaps the reason for their attitude is explained by the attitude taken by some of the leading ceramic engineers of the country. As an example of the attitude which these engineers take I quote from the work of Ellis Lovejoy on "Economy in Brickyard Construction and Operation." Mr. Lovejoy in his chapter entitled "Drawing and Loading" writes as follows: "We wish to express our respect for the wheelbarrow. We have little use for a wheelbarrow in handling clay, but in handling the burned product, the wheelbarrow makes a brave showing in competition with any other method."

When engineers who are presumably leaders in their field write in this manner, it seems hopeless to look for an appreciation of modern equipment on the part of those whom we may assume to be under their guidance. The situation is not, however, as bad as this might lead one to believe. There is at the present time a distinct shortage of cheap, unskilled labor. For this reason many of the brickyards, in order to produce and ship any product whatever, are under the necessity of adapting some mechanical means of handling. The wheelbarrow, which Mr. Lovejoy admires so much, was undoubtedly an economical appliance in the days of free immigration from Europe. Under present conditions the unskilled laborer, when it is possible to hire one, wants almost as much for his day's work as the most skilled man in the plant. For this reason operators of brickyards are thoroughly aware of the fact that they must revamp their methods in such a way as to abolish the horde of wheelbarrow pushers which at present characterize this industry.

Handling at American Enameled Brick & Tile Co.

As an example of what has already been done in handling finished brick, the plant of the American Enameled Brick & Tile Co., at South River, N. J., is suggestive. The methods already established and working at this plant indicate a simple extension to complete mechanical handling. This extension could be made without any change whatever in the plant layout, and would necessitate only a slight change in the operating methods now in vogue.

The products of the American Enameled Brick & Tile Co. consist of brick and tile having one or more white porcelain enameled faces—such material as is commonly used for engine rooms, basements and swimming pools. Bricks of this type are among the most difficult to handle. Any unduly rough treatment is sure to damage the enameled face. It is also necessary to subject these bricks, after they leave the kiln, to a most searching inspection. Only those bricks which are absolutely without flaw can be sold as first-grade enameled bricks. Bricks having cracked enamel or other defects must be separated out, classified and sold as seconds or thirds.

How Handling Equipment Was First Used

The management of this company had considered the installation of conveyors for many years, but with the consideration of their particular difficulties in view, they did not feel that this equipment could be installed and used without resulting in more damaged product. During the war this plant went extensively into the manufacture of firebrick for the government. This required no change-over in the arrangement of the plant, as the base material from which the enameled brick is made is the same as that from which firebrick is manufactured.

Due, however, to the fact that they had no problem of enameled faces to deal with, it was thought that greater efficiency could be realized in the face of the labor shortage by installing conveying equipment for unloading the kilns and for taking the brick from storage and other points to the cars in which they were shipped.

*Previous articles in this series have appeared in *Chem. & Met. Eng.* as follows: Article I, vol. 26, No. 18, p. 823, May 3, 1922; Article II, vol. 26, No. 19, p. 885, May 10, 1922; Article III, vol. 26, No. 24, p. 1,114, June 14, 1922; Article IV, vol. 27, No. 5, p. 199, Aug. 2, 1922.

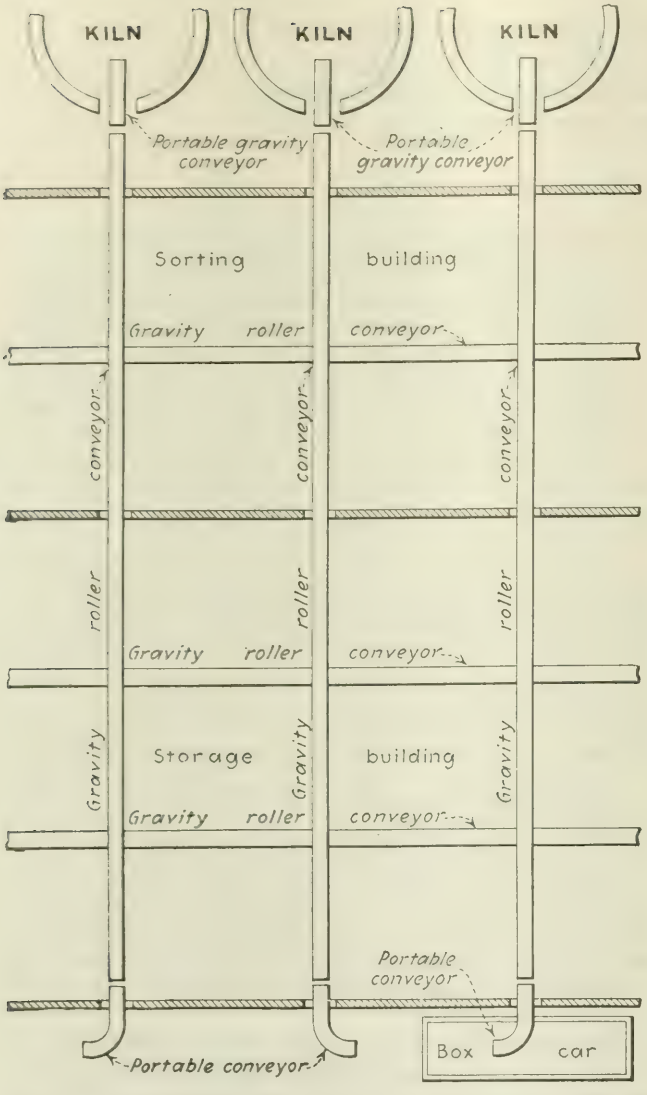

FIG. 1—DIAGRAMMATIC LAYOUT OF HANDLING SYSTEM FOR BRICK FROM KILNS TO STORAGE AND SHIPPING

Consequently, gravity conveyors were installed for this purpose.

Layout of This Handling Equipment

Reference to Fig. 1 gives a diagrammatic idea of the layout of the kilns, the storage space and the location of the shipping track. This sketch is not an exact reproduction of the plant, but does give the relative position of these various elements. The space on the sketch which is marked "sorting building" is used in the production of enameled brick for sorting the brick into the various grades in which it is sold. After the sorting is accomplished, the bricks are taken into the storage building and piled to await shipment. When shipment occurs, they can easily be taken through the doors of the storage building directly into the cars in which they are to be shipped.

This handling was formerly accomplished in two ways: Between the rows of kilns and extending into the sorting building are industrial railway tracks; at right angles to these tracks extending between the kilns in the other direction and extending up and down the floor of the sorting building are other industrial railway tracks. By means of a transfer car, then, the bricks could be unloaded from any kiln and taken to any position in the sorting building where they were to be sorted. After the sorting they were loaded on handbarrows and wheeled to the required position in the storage building or directly into the car if shipment was to occur immediately.

The industrial railway, such as described above, is a common type of handling equipment used in the few plants which have installed any handling equipment at all at this point. This apparatus is quite flexible enough for the service and is fairly cheap to operate. But its operation either requires power in the form of a storage battery locomotive or requires that the cars be pushed by one, two or three men, depending on their weight. Of course, these men may not all be necessary to push the car along a straight run of track, but at the transfer point their services cannot be dispensed with. It is plainly good business to dispense with this extra labor if possible.

Handling Firebrick

In handling the firebrick, it is evident that the brick can be taken directly from the kilns to storage or to the cars by gravity conveyors. The kiln floor is some distance above the floor of the manufacturing building. This is because of the fireboxes and flues of the kiln, which are on the floor level, the kiln floor being above these. This permitted sufficient slope to be given to a gravity conveyor to run the brick directly across the sorting and storage buildings into the cars.

This routine worked very well with the firebrick where there was no necessity of sorting prior to shipment and where the product was of such a nature that it was not necessary to take particular care in handling it. In practically every plant manufacturing common building brick or firebrick, this system can be applied, if the plant layout is of the straight-line type. Where the necessary drop in the gravity conveyor is not available, it is a simple matter to depress the loading track. The expense entailed in such depression would easily be covered by the wages of the wheelbarrow pushers who would be dispensed with by this course of action.

Special Care Needed to Handle Enameled Brick

When it comes, however, to the handling of products such as face brick and enameled brick, where the purchaser desires a definite standard of perfection, the brickyard is faced with a more difficult problem. There seems to be a general doubt among superintendents and managers of plants of this type as to the possibility of handling their product on conveyors of any type without damaging it in some way.

At the present time, at the American Enameled Brick & Tile Co., the enameled brick is handled in two ways. The usual way is approximately as follows: A short run of portable gravity conveyor is placed to extend from within the kiln to a point adjacent to the nearest industrial railway track. The men in the kiln place the bricks on this conveyor, and the men at the other end remove them and place them on a rack-car on the industrial railway. This operation is completed without any damage whatever to the brick. In fact, there is much less damage than there would be if the brick were loaded directly from the kiln to the industrial railway car by hand, as several passings of the brick from hand to hand are eliminated.

Sorting Face Brick

After the industrial railway car is loaded, it is pushed by hand along the track and taken by means of the

transfer car to the desired position at a sorting table in the sorting building. The bricks are here sorted and piled according to the various gradings in vogue. They are taken from this sorting building to the storage building, or in some cases directly into the cars, on hand-loaded, man-pushed wheelbarrows. From the storage building, they are more often loaded into the cars by a second portable gravity conveyor. In this case, the men pick up the brick from the pile in the storage building, several at a time, place them on one of the papers which are used to separate them in the box-car and permit this package to run down the gravity conveyor into the car. This work also is accomplished without any damage to the bricks—that is, provided the men who are handling them take sufficient care in placing them on the conveyor and removing them from it. By sufficient care it is not meant to imply that such extreme care is necessary as to slow up the operation. It is only meant that the handlers shall not carelessly knock the faces of the brick against one another, or against the framework of the conveyor.

Full Conveyor Handling for Finished Brick

At other times when conditions are right in the plant, a full run of conveyor is placed directly from the kiln into the car. In this way, by having the bricks pass slowly through the sorting building, it is possible to select from the conveyor all those grades which are not to be shipped in that particular car and to permit only the desired grade to continue on through the storage into the car should it be desired to sort in this way. The flexibility of application of this system is evident, as it is possible at any time to stop the bricks at the sorting place, at the car, or any other desired point in the plant merely by the extension of the portable gravity and by the introduction of a few small power boosters.

Referring again to Fig. 1, we see there the possible ideal extension of this gravity handling system by the application of fixed conveyors. The three runs of gravity conveyor extending across the page and the three runs extending perpendicular to them could well be permanently installed. By the application of switches at the intersection of these conveyors and by using portable conveyors to connect the permanent conveyor to any kiln, to load or unload bricks to or from the permanent conveyors at any portion of the sorting or storage buildings, and to take the brick from the end of the permanent conveyors into the cars, a system would be established which would eliminate all possible rehandling of the brick from the time it left the kiln until the time it left the plant.

Operation of Full Conveying System

To operate such a system, it would be necessary to develop a certain routine and technique so that the brick would move regularly and without damage. But no matter what the handling system used may be, there is a routine and a technique of some kind which must be developed in the handling. It is evident in any case that the fewer the number of rehandlings which the brick undergoes the less chance it has of being damaged. Experience proves that brick cannot be damaged while it is passing along the conveyor, if it is placed on the conveyor in a correct manner. The majority of the damage seems to have occurred in the past when the brick was passed from hand to hand in unloading the kiln, when the brick was placed on the barrows in the sorting or storage building and when the brick was again passed from hand to hand in the car.

With this means of mechanical handling as used at present in the plant described, there has been effected an increase in the number of bricks which a given number of men could handle in a given time of about 20 per cent. If such an increase can be effected by a partial application of the system, the savings effected from a full and judicious use of this type of conveyor should be even greater and more worth while.

The writer wishes to acknowledge the courtesy of the American Enameled Brick & Tile Co. in making available the data on which this paper is based.

Production of Clay for Sale Decreases in 1921

The output of clay mined and sold as clay in the United States in 1921 was 1,716,746 tons, valued at $6,025,300, or $3.51 per ton, according to the United States Geological Survey. This was a decrease of 45 per cent in quantity and 48 per cent in value as compared with 1920. These figures represent only clay sold as clay by the original producers; they do not include the much greater quantities of clay burned into clay products by the producers themselves.

The production of kaolin, the clay that is used in making high-grade pottery and porcelain as well as paper and other products, was 162,726 tons, valued at $1,579,-163, a decrease of 39 per cent and 45 per cent, respectively, as compared with 1920. The clay of largest production and value is fireclay. The sales of fireclay in 1921 amounted to 1,195,861 tons, valued at $3,560,373, a decrease of 49 and 52 per cent, respectively, as compared with 1920. The output of every kind of clay as classified by the Geological Survey in its statistical report decreased in quantity and value in 1921 as compared with 1920.

The imports and exports of clay also decreased in 1921 as compared with 1920.

Factors Affecting Yield of Carbon Black

Factors of utmost importance in the efficient recovery of carbon black from natural gas are the design of a plant, the kind of lava tip used, the distance from the depositing surface to the top of the lava tip, the arrangement for admitting air and the rate of movement of the collecting surface. Provision should be made in construction for changing the height of burners, as different gases require different distances below the depositing surface. In West Virginia the lava tips are about 3 in. below the channels, but in Louisiana this distance is too great. By changing the position of the lava tips, one company in Louisiana increased its production of carbon black 20 per cent. If the tips are placed too near the collector, the flame tends to pass around the surface and loss of carbon black in flue gases increases. The rate of actuation of the depositing surface affects the quality of the carbon black manufactured more than it affects the quantity recovered. This factor, therefore, is determined by experiment; it is one of the flexible features, whereby various grades of black may be made by using the same method. The devices for admitting air are controlled by using as an index the color of the smoke issuing from the buildings, the superintendent having in mind the quality of black to be made and compensating losses in flue gas according to the quantity of black recovered.—*From Bulletin 192 of the Bureau of Mines.*

Sulphuric Acid Recovery In Oil Refineries

By Lewis B. Skinner
Consulting Chemical and Metallurgical Engineer

IN THE early American practice recovered sulphuric acid was evaporated in lead pans to a strength approximating 60 deg. Bé. and then brought to 66 deg. Bé. in a number of glass retorts or stills, each having an average capacity of about 40 gal. The lead pans, in series, were fired by a number of oil burners. The glass retorts were fired separately and individually, and the waste heat from them was passed generally to the pan flues.

Each retort was bedded in sand, so as to furnish a uniformly distributed support for such fragile material, since, if improperly carried, the swirling and bumping of the acid would be likely to break the glass. The upper part of the still projected above the arch of the firebox to such an extent that the top level of the acid was above the brickwork after the original charge had been reduced in bulk by the concentration. Each retort was charged with 60 deg. Bé. acid from the pans. After the acid had been evaporated down to 66 deg. Bé., it was siphoned off and the retort recharged. All these operations required careful and experienced manipulation.

Dilute sulphuric acid may be evaporated by heat up to a certain point without loss, unless substances are present which cause decomposition. The dilute evaporating mixture does not reach a boiling point approaching the melting point of lead or possess chemical activity of such a pronounced nature as to rapidly destroy the metal until a strength above 60 deg. Bé. is attained. Lead pans may therefore be used in concentrating part of the way, and condensation of the distillate produced is not required. The evaporation above 60 deg. Bé. is attended by a loss of acid as well as water, so that it is necessary to collect and recover the fume or distillate. Each still was provided with a glass connector set in a hole at the top, for the purpose of delivering the vapors to one of a number of openings in a lead condenser pipe, ordinarily submerged in water in a lead-lined, wooden box. Cooling water was fed at the end of the condenser system farthest from the stills and removed at the hot end.

Platinum Stills Given a Trial

In the early days, the oil refineries usually shipped their separated acid to the chemical manufacturers for concentration but, in spite of the careful attention given, it was found that the intermittent style of operation, the breakage of glassware, the high cost and uncertainty of the material and the man-handling required made the concentration too costly. Platinum stills having lead covers and arranged in series to run continuously were tried, but it was felt that the high cost for interest on investment and for amortization, along with lesser evils, made such equipment undesirable, so cast-iron stills were introduced.

Cast-Iron Still With Lead Cover

Eventually, all the chemical plants abandoned the glass retorts in favor of cast-iron stills. These were provided with lead covers, somewhat pyramidal in shape, over which cooling water was cascaded. Later, the oil refineries adopted this style of equipment themselves, feeling that they should eliminate the expense of handling and freighting the water in the weak acid, and also avoid the cost due to the corrosion of ordinary metals when shipping such material in bulk.

The design handed over by the chemical manufacturers has been largely adhered to in later built refineries until quite recently. Now, however, there seems to be a desire to get rid of a method which is particularly obnoxious when large tonnages are to be handled. Such layouts are undesirable because the stills are small, because the water-cooled lead covers abstract heat from the acid being concentrated below, because the leadwork requires almost constant attention from high-priced mechanics, because neither the latent nor the sensible heat transmitted to the distillate vapors is conserved, because of the slopping about and the cost of the water used for cooling and because of the high consumption of fuel oil.

Having designed and built a number of pan-and-still sets, the author does not recommend the complete abandonment of this style of apparatus. There are situations where the desirability of its use is indicated. With a relatively low first cost in its favor, the arrangement, properly modified, may be employed to advantage, either when small quantities of acid per day are to be concentrated or when tenure of life for the plant is not reasonably assured, or when sludge acid is not produced regularly or at a reasonably uniform rate. A low-cost standby for peak tonnages should be available in addition to the regularly run equipment.

Improvements in Cast-Iron Still and Accessories

The modifications or improvements consist in the use of large stills, cast-iron covers, a small, packed, heat-exchange tower, to which the fumes from the stills are taken by a slight suction and condensed by contact with the cold acid being fed to the system, and a rigid form of construction which does not permit the bulging ordinarily produced by acid stills. The small tower cuts down the quantity of fuel oil required when water-cooled condensers are used, because it provides for the efficient utilization of approximately one-half of the heat delivered to the stills, which heretofore has been wasted in the vapors. It does away with that part of the pan area formerly needed to bring the feed acid from its cold state to the temperature of actual evaporation. It renders unnecessary a cumbersome condensing system with its attendant repairs and the demand for a supply of condenser water, and it avoids the nuisance arising from the leakage of fume from the numerous joints of a condenser train.

Since the strength of the pan acid delivered to the stills is usually 60 deg. Bé., and this, when concentrated to 66 deg. Bé., produces a given amount of fume and requires a definite amount of heating surface, the size of the tower and stills can be fixed, but the area of the pans must be varied to suit the strength of the weak acid to be fed and the amount of organic matter to be contended with.

To obtain 20 to 25 tons of 66 deg. Bé. product from 35 deg. Bé. feed acid, an oil-fired plant should have eight lead pans in series, of a combined area of about 1,200 sq.ft.; two cast-iron stills of about 50 sq.ft. and a condenser tower about 5 ft. square, lead to lead, and 18 ft. high.

Since pan-and-still layouts should evaporate the water from the surface of a weak acid instead of distilling it through a scum, the mixture of oil and carbon that

orms on the surface of the liquid should be skimmed egularly throughout a shift, the routine to be adopted epending upon the kind of material being run. To vaporate below the boiling point, advantage should e taken of the physical law that liquids in contact ith foreign gases are affected in a general way as hough in a vacuum. A stream of gas passed through liquid produces the effect, at the surface of each ubble, of a tiny vacuum pump. A rapidly changing tmosphere, acting upon the film at the surface of a iquid body, has the same effect. Therefore, in order o get the benefit of the contact of the water in the veak acid and the atmosphere, the viscous, semi-solid, loating organic matter should not be allowed to inter- ose itself any longer than necessary. Provision should e made for ready access to every one of the lead pans.

The organic matter present reacts with the sulphuric cid and decomposes it. The effervescence of the fixed ases formed produces a mist, so that working over he pans in the atmosphere created is certain to be ndesirable even under the best of conditions, and articularly so when the plant is a large one. To vercome this and the other objectionable features of igh repair cost of burnt out pans, time lost in such epairs and in replacing stills, high fuel consumption nd other annoyances, the author designed tower con- entrators, arranged in a special manner.

The Skinner Tower Concentrator

For sludge acid, a plant consists of four towers; one or evaporating weak acid without condensation of the apors, since they do not contain sulphuric acid; one or bringing the partially concentrated acid to 66 deg. Bé., wherein fume is produced; and two in series con- ected to the strong concentrator, for condensing this ume.

The strength to which the feed acid is brought in the vaporating tower depends upon the kind of oil-treat- ng that has been done. The temperature applied in he tower and the elimination of a part of the water auses, in many cases, a separation of oily matter without a noticeable decomposition of the acid. To furnish some idea as to the part of the work done in his preliminary treatment, it appears that a concen- ration to 50 deg. Bé., approximately, works well. How- ever, the great variety of products treated and the hanges in oil-refinery practice do not permit of a defi- nite statement. This is not a serious matter in con- sidering the plant engineering and may be settled by bservation of plant-running, in co-operation with laboratory research.

Heat is applied by direct contact of products of combustion with acid, the gases being furnished at a high temperature from a firebox attached to the tower at its base. Draft is induced by an exhauster requiring very little power, since the tower itself has a pronounced chimney effect. Carbon should not be introduced into the acid by the fire gases. In using fuel oil, this is guarded against by having two arches in the firebox, which zigzag the gases before entry into the tower. When coal is used, the result is attained by a specially designed underfeed stoker.

The evaporating-tower product is led to coolers and separating tanks where the oily matter is continuously skimmed from the acid to be further concentrated.

The strong-acid concentrating tower is built more substantially than the weak-acid tower, inasmuch as it is subjected to much greater punishment. The condenser towers are arranged in a rather simple manner, since they are not subjected to high temperatures and pronounced corrosion.

For work of this character, it has not been the author's experience that capital expenditure is lessened as a result of constructing towers of special acid-resisting brick or other shapes. The laying of such is very expensive, owing to the extreme care required from especially trained bricklayers in fitting tight and close joints, in selecting only bricks which are true to dimensions, and in chipping interminably to make tight fits. In the case of the concentrators, square steel frames are used for supporting lead sheets, the latter being lined with ordinary vitrified brick which are cheap and may be put in place rapidly in acid-resisting cement, by ordinary workmen. The condensers are not lined; it is not necessary and cuts down capacity. The wall lining is of sufficient thickness at the various heights to prevent the high inside temperature from reaching the lead sheets outside. Vitrified bricks, spaced sufficiently far apart to minimize the tendency of the solids introduced with the acid to "bridge across," are used for packing.

Tower Packing

The use of broken material of various sizes and shapes is likely to take up solids from the acid and obstruct the draft. Brick packing, spaced regularly, reduces this possibility and therefore provides for higher average daily tonnages. When broken material is used in towers, it is assumed generally that the voids produced represent 50 per cent of the volume of the solids. This may be so at the outset, but dirt settles out readily on the horizontal or nearly horizontal surfaces, eventually closing open passages, with the result that only a few irregular vertical channels are left to do the work. The void area is required to take care of the extremely large volume of gas which must be passed compared to the small amount of liquid so that, even though constricted, the liquid may flow freely enough, while the gas cannot. Washing a tower packed with broken material does not prove very efficacious, because the solids, being supported as indicated, are not readily dislodged, even though a flood is passed for some time.

Relatively massive arches, at a considerable height from the tower base, are used in the concentrators for supporting a short column of packing. Such an arrangement permits the anhydrous ferric sulphate mud to precipitate from the acid when it is raining down, instead of in the packing where it would tend to bridge across the voids and to obstruct the draft. Such a condition develops when the arches are placed down near the tower base, as is generally done. Then too, were single bricks exposed to the destructive influence of strong, hot acid and fire gases at an efficient firebox temperature, as would be the case were the packing supported on arches near the bottom of the tower, they would be cracked and spalled, with the result that the packing would become disarranged and the tower obstructed in a manner not to be overcome by washing. By having the brick checkerwork at the uppermost part only, where it provides for a uniform distribution of the acid fed in, and for a finished heat exchange between it and the ascending gases, cracking or spalling is at least minimized, because, immediately upon entering the tower, the combustion gases are greatly reduced in temperature as a result of coming into con-

tact with a shower of acid. The arches are made massive because, even though the surface brick near the base of the tower crack and spall to some extent, those in the core remain sufficiently intact to support the weight above.

Acid Distribution

An acid distributor, consisting of a disk to which the acid is supplied at the center and having any number of equal-sized compartments at the rim, which are connected at their bottoms to sealed distributor pipes with heads of several feet above the tower top, has been found to furnish an equally divided and continuous-running feed, as the main supply is varied. The compartments are formed by the disk rim, by an outer circular rim and by equally spaced division walls which are radii of the circle. The acid delivered to the center spreads evenly in all directions and overflows the disk rim according to the spacing of the division walls. If the pipes are provided with sufficient head to force any sediment which might collect in an "S" bend seal to pass along with the acid, a regular, uniformly divided supply is assured.

"V" slots, weirs, or small holes, generally used for dividing in a variety of distributor systems and depending upon the care and judgment exercised by a towerman in poking or cleansing from the mud or débris furnished by dirty acid, are to be condemned when ease of operation is desired, particularly in view of the uncertainty as to whether, under the best of conditions, the streams can be equal in quantity.

It is important that the strong concentrator, in particular, should have a uniformly divided and continuous-running supply, since, should some part of the packing fail to receive its share of the acid, that part would become dry and overheated and, upon again receiving its quota, might be cracked and spalled. A poor distributing system might permit the acid to shift from part to part of the tower to such an extent as to require that the tower be repacked frequently.

Condensing Towers

When working normally, the gases leave the strong tower at about 240 deg. F. in a volume corresponding to the products of combustion from regular firebox practice, with the exception of the addition of the condensible vapors. Therefore they are not large in amount and do not require extensive condensing equipment to remove the acid evaporated. The two condensing towers are loosely packed because the acid fed to the concentrator may continuously furnish traces of organic matter to them, and an accumulation might fill the voids of tight packing.

The gases enter the top of the first condenser tower and travel from the base to an acid exhauster, from which they pass upwardly in the second tower. Since these towers do not have brick walls, they radiate heat freely, but they are cooled further by circulating a part of the distillate which has been brought down to ordinary temperature in coolers. For a production of 25 tons per day, the power required to run the acid fan is not over 3 hp. The distillate produced may average 40 deg. Bé., the strength being regulated to some degree by the amount of cool distillate which is circulated. Thus a material amount of water vapor is passed out of the tailstack.

The evaporating, or weak-acid, tower is constructed in a manner similar to the strong-acid concentrator, but is not connected to condensing apparatus because the effluent is not brought to a strength which permits the escape of acid with the water vapor.

The strong tower will require washing from time to time, the frequency depending upon the amount of dirt in the acid. This may have to be done as often as twice a month, but the operation is relatively simple and of short duration, in that it consists in turning on a larger acid stream for a period of 4 to 5 hours, so as to make a product of 58 to 60 deg. Bé. instead of 66 deg. Bé. The weak product so made may be delivered to the "partially concentrated" stock tanks, when, after the mud has settled out, the acid may be used along with that fed to the strong tower.

The packing in the strong tower will last in proportion as the bricks used are vitrified, and as care is exercised in maintaining uniform operating conditions but even should such efficient, economical and low-first-cost equipment as this require repacking in the course of a few years, it does not become a hardship, because there are only a few thousand bricks in the checker work and six men can do the job in about a week.

A tower layout, such as has been described, for producing about 25 tons of 66 deg. Bé. acid per day, may be put into commission under average conditions applying in January, 1922, for approximately $40,000. As industrial conditions improve, this cost may be reduced.

Denver, Colo.

Variety of Chemical Byproducts Tried as Wood Preservatives

A list of the various substances that have been used or suggested for preserving timber from decay would include a surprisingly large proportion of those known to industrial chemistry. Byproducts for which no use could be found have often taken their last stand as possible preservatives of wood. There have been sent to the U. S. Forest Products Laboratory for testing of their preservative qualities the condensed fumes of smelters, the waste liquors of pulp plants, the refuse of tanneries, the skimmed milk of creameries and a wide assortment of compounds under trade names. Very few materials have been found to have value as wood preservatives.

To preserve wood against decay a substance must first of all be poisonous to wood-destroying fungi. Decay in wood is not due to direct chemical action or action of the elements but is always the result of the activity of these plants which feed on the wood and thus destroy it. To prevent fungous infection, the preservative must be able to penetrate the wood thoroughly enough to form a continuous exterior shell of poisonous treated wood deeper than any surface checks which are likely to develop, and to retain its toxicity, or poisoning power, under service conditions.

Safety in handling and use is another important consideration. A wood preservative must not be a dangerous poison to men and animals, a highly flammable substance, or a material injurious to wood. If it seriously corrodes iron, steel or brass, its use is limited because of its action on the treating equipment and on bolts and metal fastenings in contact with the wood in service. Color, odor and effect on paint are sometimes of considerable importance.

Provided a preservative meets these requirements its cost, availability and uniformity will largely determine its usefulness.

Decomposition Processes Applicable to Certain Products Of Coal Carbonization

An Experimental Study in Which Mixed Xylenes Were Decomposed Under Varied Conditions of Temperature, Pressure and Atmosphere—Effects of Different Contact Surfaces—Identification of Many of the Important Decomposition Products

By M. J. Bradley* With S. W. Parr

THE extensive experimental work carried on in these laboratories on the coking of Illinois, Eastern bituminous, Utah, Canadian and many other coals has demonstrated the possibility of increasing the yield of tar oils approximately one hundred-fold, depending upon the variety of coal used in the low-temperature carbonizing process. The distillate obtained in this manner contains a large quantity of neutral, low-boiling, aromatic oils, some of which under normal commercial conditions have a limited application in the industries. For instance, xylene could be obtained in large quantities even under present conditions, if its industrial demand were such as to warrant the expense of recovery and purifying. This hydrocarbon, having a boiling range from 137 to 141 deg. C., has too low a vapor pressure to be an efficient motor fuel, but if by pyrogenic decomposition it can be converted into benzene, which boils at 80 deg. C., its value as a motor fuel is greatly increased. Xylene can also be decomposed in such a manner as to form higher boiling compounds, many being solids at ordinary temperatures. Anthracene and methyl-anthracenes can be obtained in this manner, but, by known methods, in small yields.

In this research an endeavor was made to find out the mode of decomposition and formation of the various products obtained from xylene in order to be able to increase the yields of the desired compounds, and if possible to use this knowledge in working over crude tar oils in order to obtain similar products. In the following experimental work some striking results were obtained which seemed to be directly opposed to those recorded by other investigators.[1] Pure xylene was passed through an electrically heated furnace, at various temperatures, under different pressures and in the presence of such contact surfaces as iron oxides, reduced iron, copper, tin, molybdenum, chromium, the alloy Illium, aluminum, nickel, cobalt, manganese, charcoal, pumice and refractory. The condensible compounds were collected, weighed and analyzed and the non-condensible measured and analyzed. The vapor condition inside of the furnace was varied by introducing, at the same time with the xylene, air, superheated steam, carbon dioxide, carbon monoxide, hydrogen, nitrogen or ethylene.

Apparatus Used in Experimental Work

The essential parts of the apparatus are shown in the photographs accompanying this paper. The complete outfit, being of a conventional type, requires little explanation, with the possible exception of the furnace. It was made by taking 6 ft. of 4-in. wrought-iron pipe, threading on flanges and thermocouple pockets and then having these joints acetylene-welded to insure having no leaks under conditions of high temperature and pressure. The caps were cast particularly for this furnace and extended 1½ in. into the end of the pipe and were fitted with three ¾-in. threaded openings leading into the furnace.

The pipe was thinly coated with alundum cement, wound in five sections, each having 36.5 ft. of nickel-chromium resistance wire, and again coated with cement. It was surrounded by a wooden box, 20 in. square and as long as the furnace, which contained the pulverized-asbestos and Sil-O-Cel insulation. Each heating element, when connected directly across the 110-volt line, permitted a maximum current of 20 amperes to pass through, but this could be reduced to 5 amperes by means of an external resistance connected in series at the switchboard. At no time was more than 10 amperes permitted to go through the heating elements. By this means the heat of the furnace could be kept constant at any desired temperature between 250 and 900 deg. C.

The top end was fitted with feed pipes for xylene, superheated steam and other gases, also with a pressure and reduced pressure gage. On the exit at the bottom end was a safety relief valve, or constant pressure valve, which could be adjusted to let the gases escape into the line leading to the gas meter at any desired pressure. This outfit has been operated at pressures as high as 180 lb. per square inch. The temperature was measured by means of a thermocouple. The cold junction was kept at zero by means of a Thermos bottle well and ice water, and the e.m.f. was read on a millivoltmeter which had been standardized at known temperatures.

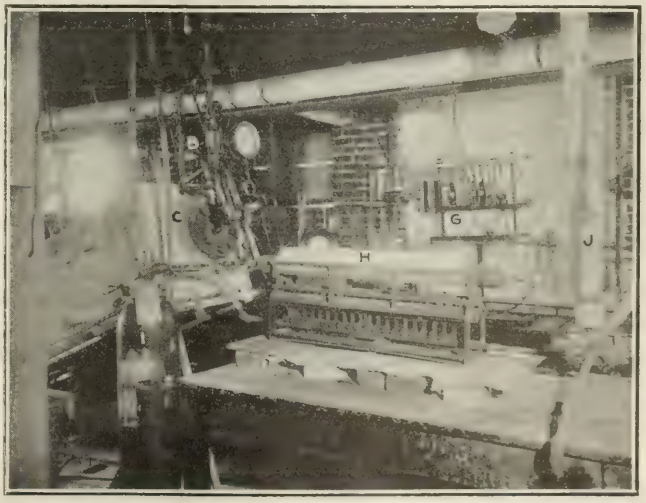

FIG. 1—UPPER END OF FURNACE

*An abstract of work carried out by M. J. Bradley in partial fulfillment for the degree of Doctor of Philosophy at the University of Illinois.

[1]In order to conserve space, no discussion of other investigations is included in this paper, but a list of articles on the pyrogenic reactions of aromatic hydrocarbons which appeared to be most important in connection with the present problem is given at the end.

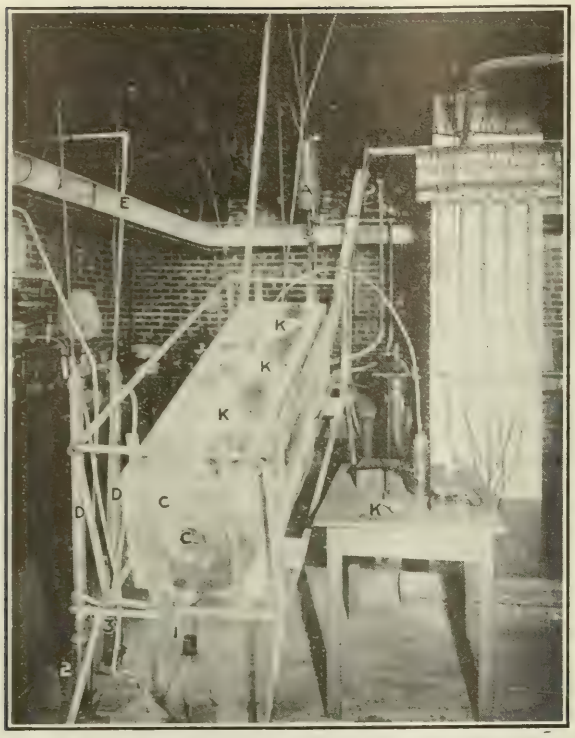

FIG. 2—LOWER END OF THE FURNACE

By this method the temperature could be read accurately within 4 or 5 deg. The thermocouple pockets *K* (see Figs. 1 and 2) extended into the middle of the furnace and thus gave the temperature of the area where the largest volume of vapors passed.

Method of Operation

The mechanical arrangement of the apparatus is apparent from the explanation of the progressive steps of a typical run. The xylene was placed in the reservoir *A* (Figs. 1 and 2), fed by means of a regulating valve through the sight-glass or bypass *B* into the upper end of the furnace *C*. Here also could be introduced gas, such as hydrogen, nitrogen, carbon dioxide or ethylene, from the cylinder *I* or steam from the high-pressure steam line *J* could be introduced through the gas-fired superheater *H*. Another attachment, not shown in the illustration, permitted the use of compressed air.

In passing down through *C* the vapors came in contact with the various contact surfaces used. The highest boiling condensate was collected in receiver *I*, the medium oils in No. 2, while the gases, after passing through the water-cooled condensers *D*, were scrubbed with heavy oil in receiver 3. The gas leaving receiver 3 passed through pipe *E* to be measured by the meter *F* and was then burned, or analyzed by means of the modified Orsat apparatus *G*.

When running under increased pressure, extra lengths of piping, fitted with a gate valve, were attached to the ends of the condensers. By keeping the lower valve closed and the upper one open, the condensate collected between them and could be easily removed, by closing the upper valve and opening the lower one, without causing any change in the pressure within the furnace.

Method of Analyzing Products

The condensible products were weighed, fractionated through a 6-in. wash column of glass beads until all the liquids boiling below 145 deg. C. were removed. The liquid boiling above 145 deg. C., designated in the following results as high-boiling product, was then transferred to an ordinary distilling flask and the fractionation continued until all but coke was driven over. These operations were carried out in electrically heated pot furnaces built to accommodate the particular flask used and maintained at a constant temperature by means of external resistances. Thus each furnace could be regulated so that no distillate would be driven over above a certain temperature. One furnace was used for each cut, up to 105 deg. C.; from 105 deg. C. to 130 deg. C.; from 130 deg. C. to 145 deg. C.; and finally one for the higher boiling compounds. This method saved much time, as it was possible to have several fractionating flasks going at the same time as the furnace and gas analyses.

The solids obtained from the high-boiling oils were purified and analyzed by a combination of various methods as described by Charlton (17), Clark (21), Cook (22) and others (see bibliography at end of article). Partial separation was obtained by making the distillation cuts at various temperatures and then lowering the temperature sufficiently to freeze out the solids. In some cases steam distillation, fractional solution, class reactions and other methods were used to advantage, but these operations are too long to be described in this paper.

The products not removed in the scrubbing process were measured by a standard wet meter and then burned. The sample taken for analysis was collected before passing through the meter. The gases were analyzed by means of a modified Orsat apparatus constructed by the author. It is shown in Fig. 3 with the oxygen and nitrogen reservoir permanently attached to the manifold ready for use and the furnace removed, showing the copper oxide tube. Another modification of this apparatus is shown in a text[2] describing a number of processes and apparatus developed in this laboratory. The carbon dioxide was removed with 35 per cent KOH solution; oxygen by potassium pyrogallate; acetylene by ammoniacal silver chloride; ethylene by bromine water; aromatics by 20 per cent fuming sul-

[2] S. W. Parr, "The Analysis of Fuel, Gas, Water and Lubricants," 3rd edition, 1922, McGraw-Hill Book Co., Inc., New York City.

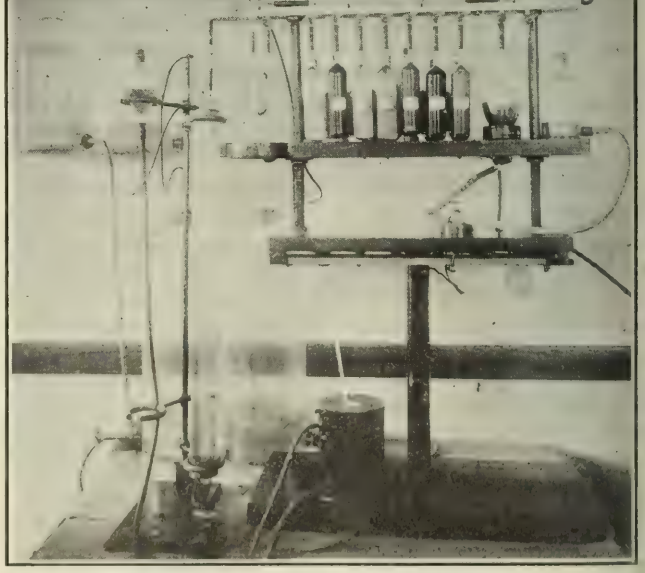

FIG. 3—MODIFIED ORSAT GAS ANALYZING APPARATUS, SHOWING THE WATER-COOLED FURNACE REMOVED

phuric acid; hydrogen and carbon monoxide by combustion with copper and ceric oxides; ethane and methane by slow combustion by means of a platinum coil in pure oxygen; and the nitrogen was estimated by difference.

The gas sample was taken in at the top of the burette and measured at atmospheric pressure by means of twin burettes joined at bottom. The copper oxide tube was made of Pyrex glass and contained about 30 grams of granular copper oxide which passed through a 10-mesh and remained on a 20-mesh screen. To this was added about 0.9 gram of finely powdered ceric oxide, which seemed to activate the copper oxide and greatly to hasten the combustion of hydrogen. In fact, where the carbon monoxide content was low or previously removed by acid cuprous chloride, 70 to 80 c.c. of hydrogen could easily be completely burned in 5 minutes. In the presence of considerable quantities of carbon monoxide the combustion was slower. The combustion tube was frequently oxidized with pure oxygen.

The absorption pipettes contained thin-walled glass tubing to give surface and speed up the absorption. The slow combustion pipette for ethane and methane was made from a 300-c.c. thick-walled Kjeldahl Pyrex flask, which proved very satisfactory. The temperature of the platinum coil was regulated by means of a chromel resistance in series shown on the front of the stand. It is realized that an exact separation of acetylene and ethylene cannot be obtained in the above manner, but by leaving the gases in contact with the ammoniacal silver chloride solution during a constant time interval in each analysis, a relative idea of the two constituents can be obtained. The complete analysis could be made in this apparatus in less than 30 minutes.

Specification of the Hydrocarbons

The mixed xylene, which was the commercial product such as is usually marketed in 10-gal. cans, was used in the major portion of this work. After redistilling, it was water-white, contained no suspended material, was free from moisture, had no foreign odor, practically all distilled over between 137 and 142 deg. C. and had a specific gravity of 0.8664 at 15.5 deg. C.

The benzene, toluene and naphthalene used were the commercial product in stock in the chemistry storeroom. They were not analyzed or purified in any manner, as only a few runs were made with them to compare with the results obtained on xylene under similar conditions.

The results on the decomposition of xylene are summarized in Table I and the outstanding features are discussed briefly in the comments on each series.

Results of Tests

Each run selected for use in the table is a typical result obtained in a series of eight to twelve similar runs made while the furnace was heated up and with similar conditions inside the furnace—that is, as to contact surfaces and lining. The results are given as obtained for various temperature ranges, different pressures and under the influence of other gases which were introduced into the furnace at the same time as the xylene. The amount of xylene used was 1,000, 500 or 200 grams and was fed through the furnace in 2-hour or 1-hour periods. The sample of gas for analysis was taken when the run was about three-quarters completed. The loss in per cent is given on the basis of the weight of the original xylene; the different fractions of the condensate and coke obtained are given on the same basis. The results tabulated for fractions boiling above 145 deg. C. are not given on a particular run, but on heavy boiling product obtained in several runs in the same series.

A number of preliminary runs between 200 and 600 deg. C. at 50 deg. C. intervals were made on 1,000-gram samples of xylene to see if the iron surface of the furnace would promote any reactions. The loss was less than 1 per cent and the volume of gas was so small that it was not analyzed; the condensate was practically unchanged xylene.

Charcoal as a Catalyst

For series 1, No. 26 being a sample, 2 kg. of wood charcoal, cut in small cubes about $\frac{3}{4}$ in. square, were placed inside of the furnace. The first run was made at 250 deg. C., but no appreciable reactions were noted. As the temperature rose, more gas was given off and contained increasing amounts of CO. Xylene seemed very stable under these conditions up to temperatures above 650 deg. C., when about one-fourth of it was lost. At lower temperatures considerable ethane was found in the escaping gas, while the proportion of methane was small. At 600 deg. C. the ethane content was at its maximum, about 7.5 per cent, and with 20.0 per cent of methane present, but as the temperature rose, the ethane decreased rapidly, while the percentage of methane increased. On the conclusion of the series, considerable carbon, from the decomposition of xylene, was found adhering to the furnace walls.

TABLE I—SUMMARY OF EXPERIMENTAL RESULTS IN THE DECOMPOSITION OF XYLENE

Series	1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	20	21	25
No. of run	26	33	50	61	78	88	94	104	113	125	133	142	151	163	167	286	287	288
Time taken (hr.)	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Xylene used (gr.)	1,000	1,000	1,000	500	500	200	200	200	200	200	200	200	200	200	200	200	200	200
Gas put in	....	....	Air	Steam	....	H_2	....	....	....	H_2	....	....	....	....	....	C_2H_4	H_2	H_2
Pressure; lb.	Atm.	Atm.	Atm.	Atm.	Atm.	Atm.	Atm.	Atm.	Atm.	15	Atm.	Atm.	Atm.	Atm.	Atm.	5	125	150
Temp., deg. C.	750	665	500	650	610	765	700	700	625	665	680	575	600	680	550	610	650	615
CO_2	0.0	0.0	3.5	25.1	3.8	0.6	1.7	0.7	1.0	0.0	0.6	0.6	0.3	0.4	0.6	0.4	0.5	0.0
O_2	0.4	0.3	0.3	0.7	2.4	0.4	0.8	0.7	0.9	0.0	0.0	0.6	0.5	0.7	0.3	0.3	0.2	0.1
C_2H_2	0.3	0.7	0.0	0.0	0.4	1.0	1.3	0.6	1.0	0.0	0.3	0.2	0.5	0.3	0.7	0.7	0.3	0.2
C_2H_4	1.7	0.1	0.1	1.2	1.4	2.4	3.0	2.2	9.2	0.4	1.1	1.5	3.4	1.5	4.2	31.1	0.5	0.4
Aromatics	2.7	1.4	0.6	2.5	5.4	1.6	2.0	1.2	2.7	0.6	1.6	1.4	1.3	1.0	4.1	0.6	0.6	0.4
H_2	45.0	71.9	69.9	56.3	40.4	44.5	33.7	53.8	29.4	81.5	33.4	76.7	52.2	72.5	30.8	4.0	58.7	60.0
CO	0.7	3.0	5.1	3.0	2.6	13.8	14.8	5.0	3.6	3.4	2.2	4.6	0.4	1.0	0.3	3.1	5.3	4.0
CH_3CH_3	0.8	1.2	4.1	1.0	0.0	0.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.8	0.0	0.0
CH_4	39.4	21.5	7.0	6.6	31.9	35.0	37.4	33.6	58.0	14.1	60.8	12.6	40.4	22.6	41.1	37.0	35.6	34.9
N_2	9.0	0.0	9.4	3.6	11.7	0.0	3.8	2.2	1.2	0.0	0.0	1.8	1.0	0.0	16.9	0.0	0.0	0.0
Gas, cu.ft.	8.4	25.6	1.0	5.1	0.7	4.0	2.4	3.7	1.5	9.0	3.3	3.2	2.1	5.0	0.4	10.0	7.4	6.5
Loss, per cent	34.0	100.0	66.0	12.0	7.5	63.5	29.0	64.0	27.0	100.0	76.5	45.0	44.0	90.0	14.0	22.3	37.5	26.0
Up to 105 deg. C.	13.0	....	....	....	0.0	18.0	6.0	2.5	5.0	....	16.5	2.0	4.0	0.0	1.0	....	55.5	69.0
105 to 130 deg. C.	16.0	....	....	....	25.0	12.5	40.0	19.0	25.0	....	0.0	29.0	30.0	8.0	9.0	....	0.0	0.0
130 to 145 deg. C.	19.4	....	44.0	86.0	63.0	0.0	17.0	9.5	36.0	....	0.0	20.5	6.0	0.0	71.0	....	0.0	0.0
Above 145 deg. C.	16.2	....	....	2.0	4.0	6.0	8.0	5.0	7.0	....	7.0	3.5	16.0	2.0	5.0	77.7	7.0	5.0
145 to 175 deg. C.	11.2	....	....	12.8	....	45.5	17.7	....	....	....	....	....	....	....	....	11.5	....	....
175 to 225 deg. C.	8.8	....	....	13.3	....	4.9	11.0	....	....	....	....	....	....	....	....	19.1	....	....
225 to 300 deg. C.	24.6	....	....	44.4	....	16.5	16.7	....	....	....	....	....	....	....	....	26.5	....	....
300 deg. to coke	41.4	....	....	20.4	....	28.3	44.4	....	....	....	....	....	....	....	....	38.8	....	....
Coke, per cent	13.9	....	....	8.8	....	5.0	10.2	....	....	....	....	....	....	....	....	4.0	....	....

Before commencing series 2, the furnace was cleaned by means of a wire brush and 2 kg. of new charcoal cubes inserted. To insure against leaks, the furnace was subjected to 125 lb. pressure of live steam before heating up. This steaming of the charcoal seemed to activate it so the reactions commenced at lower temperatures, for instance at 550 deg. C. over 20 per cent ethane was found in the outgoing gas and about 25 per cent of the condensate was toluene. At 600 deg. C. the ethane had disappeared and the toluene fraction decreased, while the hydrogen and methane were greatly increased. During the run at 700 deg. C. the temperature of the furnace fell rapidly and a great increase in the volume of gases took place. The furnace became activated in such a manner that the xylene was completely decomposed into gaseous products and amorphous carbon. Run 33 summarizes the results. Several other runs at lower temperatures gave similar products; even introducing hydrogen from a cylinder at various pressures up to 150 lb. did not stabilize the reactions in such a way as to obtain any condensate. The xylene was completely decomposed into hydrogen, methane and carbon.

Effects of Oxygen and Hydrogen

Before beginning series 3 about 8 cu.ft. of air was passed through the heated furnace; approximately 14 per cent of CO_2 was found in the issuing gases. The air poisoned or deadened the activity of the furnace, with the result that 44 per cent of the xylene was unchanged at 500 deg. C. The air was discontinued during run 50. In this series it was found that charcoal, when heated to 700 deg. C. under reducing conditions and then cooled out of contact with air, would, at ordinary temperatures, take up air readily. On again heating, the oxygen came off as carbon oxides, the dioxide at lower and the monoxide at higher temperatures. It was extremely difficult to remove the oxygen even at 700 deg. C. in the presence of hydrogen, diminishing amounts being given off after several days' treatment.

Before series 4 the furnace had been thoroughly cleaned of carbon and new charcoal added. While heating up it was kept under reducing conditions with hydrogen from a cylinder. During this series considerable toluene was formed, especially at 650, 700 and 750 deg. C. At the latter temperature, under excess hydrogen from the cylinder, a yield of 56 per cent was obtained, while without the hydrogen only 43 to 45 per cent was obtainable. In this case hydrogen seemed to stabilize rather than promote the decomposition of toluene. Superheated steam deadened the activity of the furnace in such a way as to stabilize the xylene passing through, although after steaming and then reducing for a short time the furnace became activated in such a manner as to decompose the xylene completely. This was also found to be true without any charcoal in the furnace. That is, the iron surfaces could be freshly oxidized or activated by means of steam when heated between 600 and 790 deg. C. and after reducing slightly became activated so that the xylene was completely decomposed into carbon, hydrogen and methane. Run 61 shows the results of the first run after passing superheated steam through the furnace; after reducing with hydrogen for a short time, the xylene was completely decomposed, but could be partly stabilized by passing CO or CO_2 into the furnace at the same time as the hydrocarbon. Hydrogen even at 140 lb. pressure did not stabilize any of the liquid products, once the furnace was in this activated condition. The carbon deposited was intensely black and fluffy, contained some small percentage of liquid hydrocarbon and about 11 per cent of iron, which was found to be a mixture of the magnetic oxide and other oxides, along with very small particles of finely divided metallic iron. It was impossible to tell from these results whether it was the iron or the charcoal surfaces which was causing the complete decomposition of the liquid hydrocarbons.

Effect of Metal Furnace Wall

In series 5 a lining tube of No. 18 sheet copper was placed snugly in the furnace so that no iron surfaces were left exposed. Copper seemed to have a tendency to decompose xylene into lower rather than higher boiling compounds, as shown in run 78. Oxidizing the copper made it somewhat more active, but on reducing it again complete decomposition of the xylene did not take place. What decomposition did take place seemed to form liquid and gaseous products rather than amorphous carbon, which was formed only in extremely small amounts.

In series 6 the furnace was copper lined and contained 2½ kg. of charcoal cubes. Typical results obtained in this series is shown in run 88. The reactions below 600 deg. C. were unimportant, but as the temperature rose the loss became greater. The loss was cut down somewhat by introducing hydrogen into the furnace, which appeared to stabilize and increase the toluene fraction. However, it was found impossible to activate the furnace and charcoal as described for series 2 and 3.

In series 7 the furnace was copper lined and the contact surface consisted of 3½ kg. of oxidized Illium turnings, mechanically mixed among small pieces of pumice. These runs demonstrated that around 700 deg. C. the decomposition of xylene was greatest and giving the maximum quantity of the lower boiling fractions.

Series 8 was made over small pieces of pumice which had been dipped in nickel nitrate and then reduced at 500 deg. C. with hydrogen. This was to get the metal in a finely divided condition and over as much surface as possible. Several runs were made between 500 and 800 deg. C., run 104 being a sample. Nickel under these conditions did not promote the formation of liquid products, but rather favored complete decomposition of the hydrocarbons into hydrogen, methane and carbon. In fact, the deposited carbon soon filled the furnace so that the series had to be discontinued. At this time the copper lining was found to have become broken in several places, leaving iron surfaces exposed, which no doubt had influenced the reactions.

Before commencing series 9 the furnace was relined with tinned copper, the tin surface being on the inside. Run 113 gives a typical example of results obtained. The series seemed to indicate that in the neighborhood of 700 deg. C. tin promoted the formation of low-boiling liquids. No other contact materials were in the furnace during these runs.

Effect of Nickel, Molybdenum and Cobalt

Series 10 was run through the tinned-copper lining and using 2½ kg. of charcoal cubes which had been dipped in a thin paste of nickel oxide and dried at 110 deg. C. In this case the nickel oxide and furnace were not reduced before commencing the runs. The results obtained were similar to those of the iron-charcoal

eries—that is, the xylene tended to be completely broken down into carbon, hydrogen and methane. Even at as low a temperature as 450 deg. C., 83.5 per cent total loss was obtained. During run 125 hydrogen was introduced at 15 lb. pressure, but did not stabilize any of the liquid hydrocarbons. Small amounts of water were collected in the condensate in every run. The furnace was soon choked up by the deposited carbon. During this series practically all the tin surface scaled off the copper lining.

The next series, No. 11, was run in the copper-lined furnace after over ½ lb. of metallic molybdenum powder had been scattered among the small pieces of pumice stone. As in the preceding series, considerable moisture was collected in the condensate. No appreciable decomposition of the xylene took place below 600 deg. C., but above this temperature the reactions greatly favored the formation of benzene and of methane rather than hydrogen and carbon. Run 133 gives a fair idea of results obtained.

Series 13 was run with the copper-lined furnace containing 5 kg. of 1-cm. cobalt cubes. To reduce all the oxide surfaces the furnace was heated to 500 deg. C. and maintained under 60 lb. pressure of hydrogen for several hours. Even after this treatment moisture was collected in the condensate. Cobalt promotes the decomposition of xylene at low temperatures; even at 450 deg. C. about 35 per cent was lost, and at 550 to 575 deg. C. considerable toluene was formed, as shown in run 142.

Manganese and Aluminum

In series 14 manganese in a fine powder was scattered among the small pieces of pumice stone. This metal promoted the decomposition of xylene at lower temperatures than any tried previously and the products formed were liquid rather than gaseous. Run 151 indicates the decomposition products obtained.

In series 15, 440 grams of aluminum powder was scattered among the small pieces of pumice stone and several runs were made at various temperatures. Below 600 deg. C. very little decomposition of xylene took place, but what was changed went to hydrogen and deposited carbon. Run 163, at 680 deg. C., indicates that aluminum does not favor the formation of higher boiling compounds from xylene. It should be mentioned that the copper lining during this series had given way in several places so that some iron was exposed.

Before series 16 the copper lining was removed from the furnace, the latter cleaned by means of a wire brush, reduced while hot with hydrogen and when cold was coated with a lining made by mixing 80 per cent Hytempite with 20 per cent alundum cement. After drying and baking, several runs were made without other contact surfaces. Under these conditions the xylene did not decompose much below 600 deg. C., while above this temperature liquids rather than gaseous compounds were formed. Run 167 gives results at 550 deg. C. and shows the amount of ethylene formed.

Cracking in Atmosphere of Ethylene

For series 20 a cylinder of commercial ethylene was connected to the upper end of the furnace. The refractory lining was in good repair and no other materials were introduced for contact surfaces. The preliminary runs introducing ethylene at 45 lb. pressure into the furnace gave some interesting data regarding the stability of ethane, methane and ethylene under these conditions. At 415 deg. C. the waste gases contained 89.4 per cent of ethylene, no ethane and 8.5 per cent of methane; at 475 deg. C. it contained 73.9 per cent of ethylene, 4.6 per cent of ethane and 10.0 per cent of methane. The maximum amount of ethane was obtained at 500 deg. C.; the methane increased with temperature, and at 675 deg. C. the outgoing gases contained 84.1 per cent of methane. Below 475 deg. C. very little decomposition of xylene took place, the loss being less than 5 per cent. In the runs below 475 deg. C. there was always a gain in weight in the liquid condensate, although little xylene was decomposed. This was found to be due to the xylene dissolving considerable volumes of the ethylene, which was readily given off when redistilling. Around 600 deg. C. the furnace decomposed xylene and ethylene very rapidly, the latter going principally to methane. In order to keep the furnace atmosphere mostly ethylene, the pressure outlet gage was set at 2 lb. and the ethylene introduced into the furnace very rapidly. Under these conditions the maximum yield of high-boiling compounds was obtained. The results are given in run 286. Many other runs under various conditions of pressure, rates of feed and gaseous atmospheres were made, but the percentage of higher boiling compounds were lower than in the run tabulated.

In series 21 the refractory-lined furnace was found to decompose xylene as described for series 16. It was now desirable to see if the lower boiling liquids could be stabilized by deliberate control of the gaseous atmosphere inside the furnace. In run 287 the furnace was maintained under 125 lb. pressure with hydrogen from a cylinder while the xylene was being introduced. The results indicate that the major portion of the xylene was decomposed into lower boiling liquids.

In series 25 the low-boiling liquids were slightly increased by increasing the hydrogen concentration in the furnace. The maximum yield is shown in run 288. This result is calculated from the weight of xylene used, while by referring to the equation $C_8H_{10} + 2H_2 \rightleftarrows 2CH_4 + C_6H_6$, it is evident that this would equal about 93.7 per cent of the possible theoretical yield. The carbon deposited in these runs was very different in appearance from that described previously. It was a metallic gray color and was granular or sandy, while the other deposits had been intensely black and slightly oily.

Runs Using Benzene, Toluene and Naphthalene

The runs with benzene were made through the iron furnace containing 2½ kg. of charcoal, the purpose being to try to check the results of Cobb and Hollings (23). They found that benzene passing through coke heated to 800 deg. C. could be entirely stabilized by means of excess hydrogen. In these experiments it was found that when the charcoal and furnace were activated it was impossible to stabilize the benzene even at 500 deg. C. Pressures as high as 125 lb. of hydrogen per square inch were used. On the other hand, if the charcoal and furnace had been treated with superheated steam, air or carbon dioxide, benzene could be entirely stabilized at temperatures as high as 800 deg. C. with very small pressures of hydrogen.

Cobb and Hollings (23) had found that when toluene was passed through red hot coke it was more stable alone than in the presence of excess hydrogen—that is, hydrogen promoted the decomposition of toluene into benzene and methane. In series 4 hydrogen was found to increase the toluene fraction slightly. Pure toluene was

used under similar conditions and found to be somewhat more stable in the presence of hydrogen, except when the furnace was in the activated condition, when it was entirely decomposed with or without hydrogen.

In making the runs with naphthalene, it was preheated in an electrically heated retort connected to the upper end of the furnace. The naphthalene vapors were carried into the furnace by means of the gases which were bubbled through. It was noticed that practically as soon as the run commenced the temperature of the furnace dropped. Even when the current passing through the heating elements was materially increased, the temperature fell slowly. This would indicate that the reactions taking place inside the furnace were absorbing considerable heat. Another feature, particularly noticeable in the nitrogen run, was that the gas recovered did not equal the amount passed into the furnace from the cylinder, even with the addition of the gas from decomposition of the naphthalene. The charcoal may be partly responsible for this result.

In the runs using carbon dioxide as the carrying gas the product contained a heavy, black, high-boiling oil, some free carbon and a very light, fluffy, red material with very little odor of naphthalene. With hydrogen the product was dark gray, containing also traces of the light reddish material. The product from the nitrogen runs was a compact greenish color and from carbon monoxide the reddish fluffy material formed the bulk of the recovery.

The bulk of the recovered product was naphthalene, with small amounts of benzerythrene and α-methyl-naphthalene. A considerable amount of β-β-dinaphthyl, m.p. 187-8 deg. C., was obtained and identified by the picrate, m.p. 183 deg. C. The α-α and α-β forms were present in very small amounts.

Gaseous Products Synthesized

The process of decomposition of hydrocarbons can never be regarded as a simple effect of heat, independent of contact surfaces and the gaseous atmosphere in which it is conducted. The way in which we were able to modify the results of decomposition in various directions was by the deliberate control of these two factors. The gaseous products obtained in these experiments were extremely important and played as important a part in the final products as the gas introduced. Their effects can be considered from two standpoints—mechanical and chemical. An inert gas, like nitrogen, would not enter directly into chemical reaction under these conditions, but would play a very important part by washing the products of decomposition from the surface of the contact material, assist their volatilization by lowering their concentration in the vapor phase, and hurry them away from the region of decomposition. In the case of hydrogen, being much lighter, it has a greater diffusing power, the molecules travel at a higher speed and thus penetrate small areas where the larger gas molecules never reach. The all-important action of hydrogen, however, is chemical. It tends to reduce the single ring benzene hydrocarbons to benzene itself. A similar action may be inferred, as is very probable, on the attached groups of more complicated ring structures resulting in the formation of naphthalene and anthracene. It seems that this was the part played by hydrogen in the majority of the experiments carried out. However, other factors must be able to modify this tendency of hydrogen, because in the experiments giving the largest yields of the toluene fraction it was found possible to increase this fraction by introducing hydrogen from a cylinder. It was possible to change the production of hydrogen in these experiments by changing the temperature or the activity of the furnace.

Methane could also be produced in varying quantities, depending upon the furnace conditions. Bone and Coward (24) concluded that methane decomposes chiefly directly into hydrogen and carbon, the process being reversible and a surface phenomenon at least up to 1,200 deg. C. At the temperature these experiments were run methane is practically stable and its chemical reaction would be negligible, but its mechanical action would be very important, as in the case of nitrogen.

The carbon dioxide formed was in small quantities and was always in equilibrium with carbon monoxide. They seemed to deaden or poison the activity of the furnace, although it is possible CO_2 caused partial combustion.

Acetylene was formed in small quantities and although many investigators claim that the building up process is through the ability of acetylene to polymerize, it was concluded from these experiments that acetylene played a very small part. At higher temperatures it was more likely to be decomposed to carbon and hydrogen than to be built up.

Ethylene Formation

The production of ethylene in these reactions was very desirable, because it was noticed that wherever the percentage of ethylene in the outgoing gas approximated 3 or 4 per cent, the yields of the higher boiling compounds were appreciably increased. In general, it was found that ethylene decomposed into a mixture of ethane and methane in the neighborhood of 500 deg. C. Above 500 deg. C. the ethane content gradually decreased and around 650 deg. C. disappeared entirely with a resultant increase in methane. Ethylene seems to be able to decompose in several ways, which no doubt explains its usefulness in the building up process.

Bone and Coward (24) concluded that the primary action of heat on ethylene is to eliminate hydrogen. The residue $\equiv CH$ thus formed may decompose or be hydrogenated to methane, or it may unite with another such residue to form acetylene. Hollings and Cobb (23) found that at lower temperatures, around 800 deg. C., it decomposed into methane and acetylene, while at higher temperatures it went into methane and hydrogen.

In some of these experiments as high as 15 per cent of the waste gas was found to be ethane. It was also found that very little ethane was formed below 475 deg. C. and that it was all practically decomposed at 700 to 725 deg. C., except in the presence of steam, which seemed to stabilize it at slightly higher temperatures. These temperatures are far lower than found by Hollings and Cobb (23), who found that the decomposition of ethane was rapid but not complete in 46 seconds at 800 deg. C. At 1,100 deg. C. only 88 per cent was decomposed, the chief products being ethylene and methane. No doubt the molecular decomposition of ethane played an important part in these experiments. According to J. J. Thomson (25), such residues as $\equiv CH$, $=CH_2$ and $—CH_3$ may exist momentarily in the free state. The four possibilities open to the residue $= CH_2$ are: (1) To form ethylene by uniting with another similar residue; (2) to break down into carbon and hydrogen; (3) to be hydrogenated

to methane; (4) to attach to some heavier molecular formation—a partial decomposition of the benzene nucleus or homologs.

The above is only a partial list of the gaseous constituents in the furnace atmosphere during decomposition; undoubtedly many more complex groups or radicles from the higher boiling compounds exerted an important influence on the decomposition processes.

Liquid Hydrocarbons Identified

Some of the liquid hydrocarbons which were purified and definitely identified by physical contents or known derivatives are listed below. Other compounds were obtained but have not been identified.

n-Hexane, b.p. 68 deg. C., was obtained in the ethylene series of runs in considerable quantities along with an unsaturated hydrocarbon, which had very similar physical properties, probably hexylene. They were partly separated by the usual methods and the last traces of the unsaturated compound were removed by selenium oxychloride. This reagent reacts too violently to use, however, where any considerable quantity of the unsaturated compound is present.

Cyclo Hexane, b.p. 80 deg. C., was obtained in small quantities, and after a partial separation from benzene, was purified by the above reagent. However, a solution of benzene in selenium oxychloride will readily dissolve cyclohexane. In cases where only traces of benzene were present the separation was rapid and complete.

Benzene, b.p. 80.5 deg. C., was obtained in several runs. The maximum yield obtained was 93.0 per cent of the possible theoretical.

Toluene, b.p. 110 deg. C., was obtained in many of the runs over charcoal. The maximum yield of the crude product was about 66.0 per cent of the possible theoretical.

α- and β-*Methyl-Naphthalenes*, b.p. 240-3 deg. C., were identified by the picrate, m.p 112 deg. C.

Di-Tolyls (mixed), b.p, 275-8 deg. C., were identified by the acid derivatives. They were oxidized by prolonged boiling in chromic and glacial acetic acids.

1.2.*Dimethyl-Naphthalene*, b.p. 262-4 deg. C., was identified by the picrate.

Diphenyl-Ethane, b.p. 286 deg. C., was obtained in small quantities.

Some of the Solids Obtained

The solids synthesized were numerous and complex. In a single series of runs the high-boiling constituents were very similar, but in different series the variation was marked. In the series using cobalt and manganese the high-boiling oils contained a larger percentage of solids containing anthracene. The partial list follows:

Diphenyl, m.p. 70 deg. C., was obtained in considerable quantities in the fraction boiling from 340 to 255 deg. C. On standing, it settled out as a white solid. This compound could come from two benzene molecules with the liberation of hydrogen. Dufton and Cobb (18) have proved this to be a reversible reaction by passing diphenyl and hydrogen through a hot silica tube and producing benzene.

Naphthalene, m.p. 80 deg. C., was obtained in considerable quantities, as closely as could be determined, in approximately 4 per cent yields on the original xylene used. In view of the conflicting reports in the literature concerning the formation of naphthalene at low temperatures and from similar liquids, toluene especially, particular care was taken in the purification and identification of this compound. The presence of stilbene may give a clue to its formation.

Phenanthrene, m.p 98-100 deg. C., was obtained in small yields. It was difficult to oxidize, but the picrate was easily obtained.

Stilbene, m.p. 124 deg. C., was found in small quantities; apparently it had been mostly condensed to naphthalene.

Pyrene, m.p. 145-7 deg. C., was identified by the picrate, m.p. 220 deg. C.

Methyl-Anthracene, m.p. 200-5 deg. C., was obtained in good yields. Both alpha and beta forms were present and were separated by means of the methyl-anthracene-carbonic acids, which have considerable difference in the melting point temperature.

p-Diphenyl-Benzene, m.p. 207 deg. C., was also formed.

Anthracene, m.p. 212-14 deg. C., was formed in considerable yields. It was rather difficult to purify it.

2.3.*Dimethyl-Anthracene*, m.p. 244-6 deg. C., was purified and identified by the quinone, m.p. 180-2 deg. C.

Chrysene, m.p. 248-50 deg. C., was obtained in small amounts in the runs with ethylene and xylene under high pressures.

Another compound which has been separated is similar to asphaltenes in its appearance, behavior toward solvents, especially ether and hexane, and contains sulphur. The sulphur must have come from the contact surfaces inside the furnace.

Summary and Conclusions

Some of the more important results as indicated by the foregoing investigation are given in the following summary:

1. Mixed xylenes were decomposed by heat and contact surfaces, under the stabilizing influence of hydrogen and methane, almost theoretically into benzene and methane. Sixty-nine per cent of the original xylene was converted into crude benzene, which boiled below 100 deg. C. This is approximately 94.0 per cent of the possible theoretical.

2. At slightly lower temperatures, under the same condition of contact surfaces but in a gaseous atmosphere in which ethylene greatly predominated, 77 per cent of the mixed xylenes were built up into higher boiling compounds, the majority of which were solids at ordinary temperatures.

3. Mixed xylenes, under other conditions of temperature and contact surfaces, were converted into crude toluene in quantities approximating 64.0 per cent of the theoretical.

4. Mixed xylenes, under the influence of heat and iron surfaces, were decomposed quantitatively into amorphous carbon and gaseous products. Metallic oxide surfaces, especially after being slightly reduced at temperatures where they decompose xylene freely, accelerate this reaction. Small particles of iron oxides and reduced iron were found in the deposited carbon.

5. The reduced metallic surfaces, or freshly oxidized surfaces at the same temperature are much less reactive and tend to promote partial decomposition.

6. Non-metallic substances such as charcoal, pumice or refractory material at like temperatures tend to decompose xylenes into unsaturated and higher boiling compounds. The decomposition to carbon is materially lessened.

7. Activation of heated iron and carbon surfaces could be induced by treating with superheated steam during a short period and afterward slightly reducing with hydrogen.

8. A deadening effect, opposite in characteristics to the above, was caused when carbon dioxide, carbon monoxide, air or superheated steam was passed through the activated furnace. This condition seemed to be the same, as is ordinarily described, as poisoning of the catalyzer. Under these conditions the liquid hydrocarbons were most stable.

9. Contact surfaces are very important to hydrogenation and dehydrogenation of aromatic hydrocarbons.

10. The gaseous atmosphere in which pyrogenic decomposition takes place exerts an extremely important influence on the yields and products of decomposition. Gases like methane and nitrogen between temperatures of 600 to 700 deg. C. have mostly a mechanical action. Ethylene, acetylene, hydrogen and ethane between the same temperatures have also a mechanical bearing on the end products, but their all-important action is chem-

ical. Ethylene, acetylene and ethane were found to be entirely decomposed at temperatures above 725 deg. C.

11. The decomposition of ethylene was controlled so that practically pure methane or mixtures of methane and ethane were obtained as end products.

12. Pressure under some conditions favors molecular condensation, particularly if the pressure is made up of unsaturated gases. In other cases, where the pressure was made up by hydrogen, it caused the decomposition of the heavier molecules into the single ring compounds. Pressure in all cases lessened the percentage of unsaturated hydrocarbons in the final products.

13. Decomposition of hydrocarbons increases with rise in temperature, the larger molecules being less stable than the smaller ones at temperatures above 700 deg. C. The lower the temperature at which decomposition takes place the more economical the reaction. Lower temperatures can be used in the presence of activated surfaces.

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Use of Bentonite in De-inking of Newspapers Gives Promise of Forest Conservation

Although the de-inking and re-use of old magazines has been practiced for a long time, it has never been possible to apply the process to the recovery of old newspapers, because the strong alkaline solutions used in the process and the subsequent bleaching operation discolor any pulp containing ground wood. These solutions might be reduced in strength and temperature so as not to discolor the pulp and still serve to dissolve the varnish from the ink and free the carbon black. But the carbon particles would then collect in masses which would not pass through the washing screen or would remain enmeshed with the paper fibers. It is therefore necessary to provide some finely divided, colloidal carrying agent in the wash water which will help gather up the carbon and carry it off. Clays and talcs are used for this purpose, but ordinarily they are so coarse that they need to be peptized, or broken up, by strong alkalis at high temperatures before they are effective. It is this requirement that has made it necessary to use solutions in the de-inking process of such strength that they would discolor the ground-wood pulp of which newspaper is made.

Experiments have recently been conducted by the Forest Products Laboratory at Madison, Wis., using bentonite, a very fine cream-colored clay found in Wyoming, as a de-inking agent. Bentonite occurs in finer particles than any other natural mineral substance, and will go into colloidal suspension in water without the aid of strong alkalis. In preliminary de-inking runs made on old newspapers at the Forest Products Laboratory, bentonite was used with an alkali solution just strong enough to loosen the ink without discoloring the paper. It was found that the bentonite particles were so small that they could gather up the freed carbon and still pass through the ordinary washing screen. In the experimental runs, paper fiber matted on the screen and tended to prevent thorough washing; but even with this difficulty a sheet almost equal in quality to the original was obtained.

De-inking trials made later at a Minnesota paper mill, using ordinary paper-making equipment except for a special washing screen, show that the process can be carried out on a commercial scale to produce a sheet which can compete in the open market with standard news.

From 2,500 lb. of old newspapers 2,000 lb. can be recovered by the new de-inking process. In Chicago alone, it is estimated, 325 tons of waste newspapers daily might be economically collected and converted into approximately 260 tons of clean paper ready for reprinting. This would mean a daily saving of the cut on 97 acres of 100-year old spruce wood. The total saving in pulpwood which appears possible through the erection of newspaper de-inking mills in metropolitan centers is equivalent to the cut on 275,000 acres of densely stocked spruce forests yearly.

Wood-Pulp Production and Sales in Sweden

Consul General D. I. Murphy reports that the Swedish output of sulphite cellulose for the first 4 months of the present year, according to estimates from the Wood Pulp Association, amounted to 70 per cent of the normal capacity of the factories.

During this period 75,000 tons was sold, although prices were low and unsatisfactory. Prices recently have been stable, bleached sulphite being quoted at $80.43 to $85.79 per ton; easy-bleaching sulphite, $50.94 to $56.30 per ton; and strong sulphite, $38.87 to $53.61 per ton.

The production of sulphate pulp from January to April of this year was 73½ per cent of normal, or at the rate of about 28,000 tons per year. The strikes at the sawmills throughout northern Sweden, upon which the sulphate mills depend for their supplies, have contributed to the reduction of the output. Sales have recently been reported, quotations being from $52.28 to $54.93 per ton both for easy-bleaching and strong sulphate.

Mechanical pulp production during the January-April period of the present year amounted to about 75 per cent of the normal output. Quotations at present are firm at $30.29 to $33.51 per ton, dry pulp, but there appear to have been no sales of wet mechanical pulp.

Legal Notes

By Wellington Gustin

Failure to Give Notice of Defects Under Provision of Contract Constitutes Acceptance

From Georgia comes an action at law brought by the York Manufacturing Co. against the South Atlantic Packing & Provision Co. to recover the price of certain ice-producing machinery installed for it under written contract. The machinery was to be affixed to and used with certain other machinery of the defendant, for the purpose of connecting a distilled-water ice plant into a raw-water ice plant. The contract contained necessary specifications and two guaranties were included as follows:

(1) That the plant when changed as specified will be capable of producing 100 tons of merchantable raw-water ice per day of 24 hours when in full and continuous operation according to instructions.

(2) That the coal consumption of this plant when producing 100 tons of ice per 24 hours would be not less than a ratio of 16 tons of ice per ton of 14,000 B.t.u. coal burned, based on the guaranteed boiler evaporation of 9 lb. of water per pound of coal with steam at 185 lb. and 160 deg. superheat at boiler.

The guaranty of quality of ice was based on water being taken from well known as No. 3, which had been tested.

Plaintiff Agreed to Remedy Defects if Notified Within 30 Days

The contract also provided that when plant was ready for charging written notice should be furnished to defendant of that fact and that if for a period of 30 days thereafter the defendant should fail to notify plaintiff in writing of any claim that the said machinery, apparatus or plant as furnished did not fulfill the terms and requirements of the contract, this fact would be taken as an acknowledgment by the purchaser that they did fulfill all requirements and should consistute a complete acceptance of the same as fulfilling all the terms and requirements of the contract. If such notice of failure was given within 30 days, the plaintiff was to remedy any such defects.

Defendant Failed to Give Notice Within Specified Time

It appears that no objections to the plant as completed were given within 30 days thereafter. Yet defendant pleaded in answer to the suit that the plant failed to produce 16 tons of ice to 1 ton of coal, 14,000 B.t.u., and that the plant failed to produce 100 tons of merchantable ice in 24 hours' continuous operation.

The District Court excluded all testimony offered to show that the plant did not comply in all respects with the contract and did not fulfill its terms and requirements, on the ground that defendant, having failed to give notice of such defects and failures within 30 days after receiving notice that the plant was erected ready to charge, had under the terms of the contract accepted said plant as fully complying with said contract and its guaranties and could not thereafter make such denial.

The United States Circuit Court of Appeals (276 Federal, 509) has upheld the District Court on this point, holding the 30-day provision valid and enforceable; and a failure to give such notice within 30 days after completion of plant was held a complete acceptance of said plant, precluding defendant from claiming breach of a warranty that plant would produce a stated quantity of ice per ton of coal consumed.

Contracts Requiring Return of Acetylene Containers Held Not in Restraint of Trade

Contracts under which tanks are furnished to purchasers of acteylene gas to be returned and refilled exclusively by the original manufacturer are not unconscionable nor in restraint of trade, in violation of the Clayton act of Oct. 15, 1914, section 3 (Comp. St., par. 8835c), says the United States Circuit Court of Appeals, affirming a decree of the District Court in favor of the Prest-O-Lite Co. in a suit in equity against the Auto Acetylene Co. (276 Fed., 537.)

The Prest-O-Lite Co. has for many years been engaged in generating, storing and distributing acetylene gas for use in automobile lighting and in welding. Its gas is stored in portable steel cylinders lined with asbestos or other porous material, which absorbs a quantity of acetone, which, in turn, is saturated with acetylene gas introduced under pressure, the outflow for consumption being valve controlled. The entire package so filled is furnished the consumer in the first instance. When the tank is consumed, the tank is accepted in exchange for a package fully charged by the company. It appears that this company has had much litigation in protecting itself and its product against unfair competition.

Contracts With Welding Trade

In 1913 the company extended its service to the welding trade, under a system generally similar to that relating to automobile lighting, but differing therefrom in the fact that its welding tanks are supplied to its customers under contracts which treat the tanks as held by the customer as containers merely of its gas, and on rental only, each tank bearing on the outer surface permanent legends, including the serial number of the cylinder, the date of manufacture, its weight and the fact that it is plaintiff's property, together with the statement that the acetylene is prepared and pressed into porous substance in compliance with certain governmental specifications, and that, when empty, it is to be redelivered to plaintiff.

Defendant Refilled Plaintiff's Tanks

The defendant, Auto Acetylene Co., is engaged in manufacturing and selling acetylene gas in tanks similar to those of plaintiff. Now the complainant alleged defendant's knowledge of plaintiff's rights, including its contracts and exchange service, and charged that defendant induced, procured and assisted plaintiff's customers in violating their contracts with plaintiff, by refilling tanks with defendant's gas, etc. An injunction was asked against such acts of defendant.

Defendant answered alleging that plaintiff's contracts with its customers amounted really to sales, that the consumers believed that they were purchasing the tanks and that such contracts violate the Clayton anti-trust act. Further, the defendant sought affirmative relief asking that plaintiff be enjoined from representing to

its customers that it is the owner of the tanks, and from seeking to prevent such consumers from having their tanks refilled by defendant.

Defendant Enjoined From Interfering

The final decree in the case enjoined the defendant from interfering with plaintiff's system of exchange and from causing such welding service contracts to be violated, and procuring the delivery of plaintiff's exhausted tanks to any one other than plaintiff for refilling or otherwise, from receiving or refilling such tanks or damaging the same, and from dealing in or exchanging such welding tanks.

Plaintiff Retained Title to Tanks

The court found that plaintiff by its contracts with customers retained title to the tanks, the contracts providing that complainant shall keep filled tanks in reserve and exchange them for empty tanks when returned without charge, except for the contents, and did not pass title in tanks. And the refilling by defendant of the tanks furnished by plaintiff to its customers for their use, but which remained its property, and in so doing knowingly assisted and encouraged customers to violate their contracts under which the tanks were furnished, was such a violation of plaintiff's rights as to entitle it to an injunction.

The important question presented was whether the contract between plaintiff and its customers violated the Clayton act, which makes it unlawful to lease "goods, wares, merchandise, machinery, supplies or other commodities" on the condition, agreement or understanding that the lessee shall not use the supplies of a competitor of the lessor, where the effect of such lease or condition, agreement or understanding may be "to substantially lessen competition or tend to create a monopoly."

If the transaction were an absolute sale of the tank (and the court found it was not), any restriction whatever upon its use would be void, independently of the Clayton act. The contract in substance forbids the customer to use in the tank any gas except that manufactured and packed by plaintiff.

Tanks Not Leased

Regarding the charged violation of the Clayton act two questions were presented to the court. One was whether the contract effects a lease of a tank, and the other was whether the refilling of the tanks with gas amounts to using or dealing in "supplies" within the meaning of the act. These were answered in the negative by the court. No given tank was leased, for under the contract any tank, of one class or the other, is in the first instance delivered to the customer. This tank is to be returned when empty. The same tank is not then returned to the customer, and may never be, but another tank of the same class is returned, refilled, and so on to the end of the service. The customer has no interest in any particular tank, except while filled and in his possession, and then only because it is the container of the gas.

It was found that the Mimeograph case, 32 Sup. Ct., 364, relating to supplies, did not apply here. The court says it is more proper to say that the delivery of the storage tank as a package or container is merely incidental to the furnishing of the gas than that the former is the subject of a lease and the latter a supply for a leased package. Acetylene gas cannot be bought, sold or delivered in the market in the way that ordina merchandise and "supplies" are sold and delivered; b it can be delivered only by filling the package with g compressed therein—a circumstance which differen ates it from supplies as the term is ordinarily used.

No Precedent to Guide Court

This case presents a new point and no precedent co be found to guide the court.

As to the charge that the contracts in question su stantially or unreasonably lessen competition or te to create a monopoly, it was shown there was no agr ment between competing companies, through division trade or regarding price, and the records showed highly active competition between plaintiff and defer ant, unless in the bare fact that the customer und contract with plaintiff is more apt, other things bei equal, to obtain its gas from plaintiff than from a co petitor. In this relation this case bears some analo said the court, to the so-called pump and tank cas where it was held that a requirement that deale distribute only the loaner's product from leased devic is not an unfair method of competition, nor does substantially lessen competition.

Belgian Artificial Silk Industry Approaching Pre-War Condition

The Belgian artificial silk industry, which before t war produced about one-quarter of the world's supp has recently shown unmistakable signs of improveme and the largest of the four mills in Belgium reports th present demand exceeds production. Production b fore the war averaged 2,700,000 kilos. Of the fo largest plants which survived the war, only one w able to resume manufacturing in July, 1919, but t other mills followed at short intervals, so that by t end of 1920 the industry had resumed about 70 p cent of its pre-war status.

Only 5 per cent of the total production was co sumed at home in 1914. Half of the total producti went to Germany, whence many of the raw materia and chemicals were obtained. In recent years, howeve exports of artificial-silk yarn have gone largely to t United Kingdom and Switzerland. The latter countr as may be seen from the following table, took 111,0 kilos out of a total export of 153,000 kilos exported Belgium in 1921:

BELGIAN IMPORTS AND EXPORTS OF WASTE-SILK YARN AN ARTIFICIAL-SILK YARN

	Imports			Exports		
			January-March,			Janu Mar
Countries	1920 Kilos	1921 Kilos	1922 Kilos	1920 Kilos	1921 Kilos	192 Kil
Germany	293	1,127	161	9,028	1,307	...
Spain	...	...	...	1,504	600	...
France	2,882	1,419	354	...	1,874	3,51
United Kingdom	1,441	1,133	252	7,856	29,451	6,03
Switzerland	1,357	1,047	153	5,278	111,463	9
Other	47	1	...	4,696	8,002	33
Total	6,020	4,727	920	28,362	152,697	9,98

Statistics concerning manufactures containing ar ficial silk can not be identified in trade figures. Sh ments to the United States, which for a time had fall off considerably, have of late been resumed, as so large American orders were placed with Belgian mi A brisk demand is also reported from Spain, Portug Switzerland and Japan, but despite the present activ one large manufacturer is pessimistic as to the futu of artificial silk manufacture in Belgium because tariff restrictions.

Effect of Temperature, Pressure and Structure on Mechanical Properties of Metal

Recrystallization, Annealing, Cold-Work and Inclusions Have Profound Effect on Size and Shape of Crystalline Grains and Therefore on Properties of Metal —A Study of the Mechanical Properties of Single Crystals

By Zay Jeffries and R. S. Archer

In a previous paper entitled "Mechanical Properties of Commercial Iron" (*Chem. & Met. Eng.*, vol. 27, p. 694, Oct. 4, 1922) the art of testing metals was discussed in a general way, and some indication given as to how the various circumstances surrounding the test —such as size of specimen or rate of loading—affect the results obtained. Given the fact that such extraneous conditions have been standardized and are under close control, three principal variables affect the properties of metal: temperature, pressure and structure. We shall have most to say on the third of these factors.

Temperature Scale

The recrystallization temperature constitutes a point of division in the temperature scale of a metal: at higher temperatures the metal is "hot" and at lower temperatures "cold." Deformation at 250 deg. C. is hot working for lead or zinc but cold working for iron or nickel. When the various ductile metals are compared at a fixed temperature, such as the ordinary atmospheric temperature, they are found to be widely different in mechanical properties, but if the comparison is made at temperatures similarly related to the respective recrystallization temperatures, the metals are found to be not so unlike.

Below the temperature of recrystallization the structure of a metal is relatively permanent. Any change produced by deformation prior to a mechanical test or by the deformation incident to the test itself is cumulative. Above the recrystallization temperature, on the contrary, the internal structure is constantly subject to grain growth which largely wipes out the effects of deformation. Material at grain boundaries also possesses a capacity for viscous flow under stress much greater than at lower temperatures. The phenomena encountered in the two temperature ranges therefore fall naturally into different classes.

There is another fairly marked but not very definite point in the temperature scale of a metal. It is the temperature at which the metal becomes brittle on cooling. Iron in the annealed condition is ductile at room temperature but brittle in liquid air (—185 deg. C.) unless very fine grained. Equiaxed tungsten wire is ductile at 200 deg. C. but brittle at room temperature. Annealed copper, however, is ductile at the lowest temperatures at which it has been tested. In general the temperature at which brittleness appears on cooling is highly dependent on the structure of the metal. This brittleness is often accompanied by low or erratic strength, due to the easy development of high local stresses by eccentric loading. It follows that values for strength are likely to be most dependable when the temperature of test is such that there is appreciable ductility.

The temperature scale of a solid metal can thus be roughly divided into three regions: (1) A region of low-temperature brittleness. For most metals this is below ordinary atmospheric temperatures. (2) An intermediate region above the temperature at which the metal becomes brittle due to cold, but below the temperature of recrystallization. It is in this temperature region that most metals are used. Mechanical working in this zone is called "cold-working" and causes an increase in hardness and decrease in plasticity. (3) A zone of hot-working, lying above the temperature of recrystallization. Metals possess little elasticity at these temperatures, but flow slowly under small loads. In this zone mechanical working can be carried on to a practically unlimited extent.

The strength and hardness of metals normally decrease on raising the temperature, while the plasticity increases. Fig. 1 shows the effect of temperature on the tensile strength, elongation and reduction of area of copper. The elongation was measured on a gage length equal to eighty times the diameter of the specimen, so the values represent general elongation practically unaffected by the local stretch at the fracture. The results obtained at the higher temperatures depend largely on the rate of loading. The tests from which these curves are plotted were made in from 2 to 10 minutes.

Tensile strength decreases continuously from —185 deg. C. to 950 deg. C., and is known to continue decreasing to the melting point (1,084 deg. C.).

Elongation also decreases continuously from —185 deg. C. to the melting point. Throughout the same temperature range the plasticity *increases*, but elongation depends on both plasticity and strength; the decrease in elongation with rising temperature is due to the large decrease in tensile strength. Since the elongation has its highest value at the lowest temperature shown, it is obvious that the entire curve lies within the last two of the temperature regions mentioned above—i.e., the intermediate and the high. Copper probably enters the low-temperature zone of brittleness some-

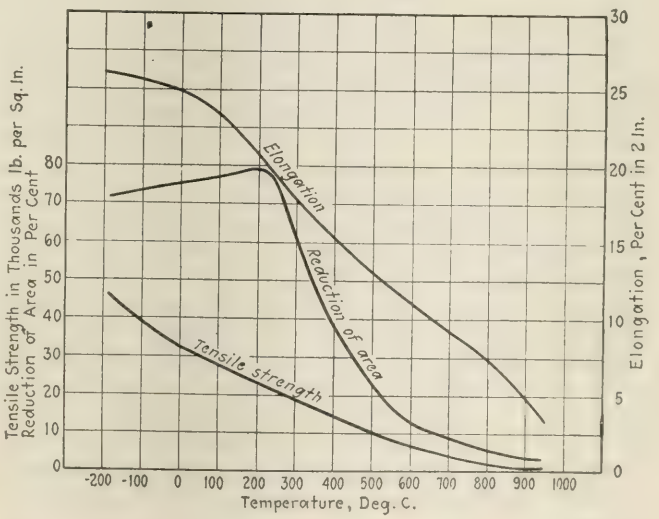

Tensile Strength in Thousands lb. per Sq. In.
Reduction of Area in Per Cent
Elongation, Per Cent in 2 In.
Elongation
Reduction of area
Tensile strength
Temperature, Deg. C.
-200 -100 0 100 200 300 400 500 600 700 800 900 1000
0 10 20 30 40 50 60 70 80
0 5 10 15 20 25 30

FIG. 1—EFFECT OF TEMPERATURE ON TENSILE PROPERTIES OF ANNEALED COPPER WIRE

where between —185 deg. C. and absolute zero, but no actual tests are known to the authors.

Reduction of area increases slightly with rising temperature up to the temperature of recrystallization, above which it falls off sharply.

Tensile strength, elongation and reduction of area are all increased to a marked extent by increasing the rate of loading when testing above the recrystallization temperature.

Fig. 2 shows the effect of temperature on the elongation of annealed molydenum. In these curves the low and intermediate temperature zones are represented. Recrystallization occurs at about 900 deg. C., the highest temperature at which these tests were carried out. It is to be noted that the fine-grained wire retained its ductility at lower temperatures than the others.

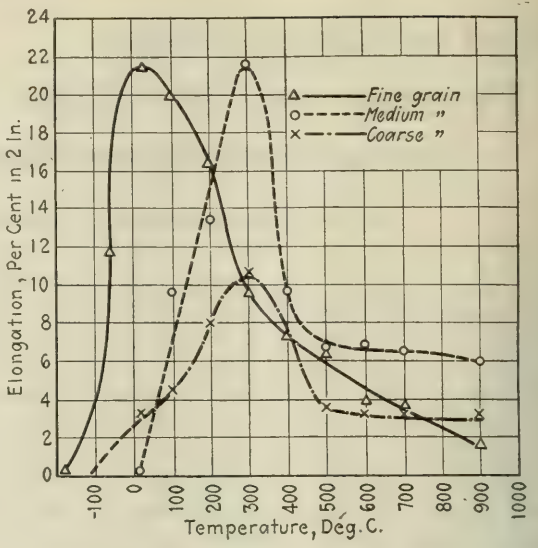


FIG. 2—EFFECT OF TEMPERATURE ON ELONGATION OF ANNEALED MOLYBDENUM WIRE (SYKES)

Pressure

Metals are perfectly elastic under pressure applied uniformly on all sides (under hydrostatic pressure). They are compressed as the pressure is applied, but on removal of the pressure regain their original volume except for the closing up of cavities. There is no permanent change in structure or properties. Hydrostatic pressure does not cause plastic deformation or cold-working effects.

Hardness increases with pressure, especially for soft materials. When a metal is under great hydrostatic pressure its resistance to deformation is greater than at low pressures.

Metals are seldom used under hydrostatic pressures of any important magnitude, but such pressures are encountered in some fabricating processes. Extrusion is probably the best example. The metal is confined in a receiver, usually of cylindrical form, and pressed out through a die by a ram. Pressure is exerted on the metal on all sides except at the opening through which it is extruded. When a metal is worked in confined dies, as in swaging, and to a less extent in pressing and forging, it is under hydrostatic pressure, although there are of course other forces which cause the desired deformations. Hydrostatic pressure acting on the metal in these fabricating processes contributes to its plasticity by holding the crystalline fragments in more intimate contact during deformation.

Elements of Structure

The crystalline grains of a metal may vary as to size, shape and orientation. Of these qualities size[1] is by far the most definite. Shapes are so irregular that they are not subject to more than qualitative description. The most apparent distinction is perhaps that between equiaxed grains and elongated grains. In this connection it must be remembered that the elongated "grains" of a cold-worked metal are in reality aggregates of very small grain fragments. In a strictly pure metal recrystallization ordinarily results in the formation of equiaxed grains. When sufficient insoluble (or soluble but segregated) impurities are present, there is a tendency for the grains to become longer in the direction of working. Elongated grains are also found in cast metal, especially after rapid solidification.

Grains also differ in shape with respect to their boundaries—whether made up of straight or of curved lines. Grain boundaries in ferrite (alpha iron), for example, are normally quite curved and irregular, although they tend to become more rectilinear after certain annealing treatments. In gamma iron and the austenitic solid solutions formed from it the grain boundaries are as a rule straight and regular.

To describe the structure of a metal with reference to the orientation of its grains is still more indefinite. To begin with, it is quite difficult or at least tedious to determine the orientation of any particular grain. It seems that ordinarily the grains possess fairly well-mixed orientations. X-ray diffraction patterns show, however, that in some cold-worked metals there is a tendency for the crystal fragments to assume a certain uniformity of orientation, which is found to persist to some extent after annealing. There is a peculiar type of "rectangular" brittleness sometimes encountered in annealed mild steel sheet which is attributed by Stead[2] to a more or less uniform orientation of the grains.

Fine grain is generally held to be a desirable structure, promoting toughness, strength and ductility. Strength and hardness increase as grain size decreases, at least in the intermediate temperature zone. At high temperatures fine grain is a source of softness, especially under prolonged application of load which leads to flow at the grain boundaries. In general, small grain size contributes to hardness under conditions of temperature and rate of loading which lead to deformation by slip.

Plasticity decreases with grain size, in the sense that more effort is required to bring about a given deformation and that the strain hardening effect of a given deformation increases. Malleability often increases as the grain size becomes smaller, however, because of the increased strength. Fine-grained zinc, for example, is malleable at ordinary temperatures, whereas coarse-grained zinc is brittle. Maximum ductility usually occurs at an intermediate grain size. Alpha brass, nickel, silver and copper show maximum elongation at room temperature after an anneal well above the lowest recrystallization temperature, but well below the melting point, and hence with medium grain size. The reduction of area seems to be greater

[1] Methods of measuring and expressing grain size are described in an article on Grain Growth, *Chem. & Met. Eng.*, Feb. 22, 1922, p. 343.

[2] "Brittleness Produced in Soft Steel by Annealing," J. E. Stead, *J. Iron & Steel Inst.*, 1898, No. 11. pp. 137-184.

the finer the grain, within the limits of our ability to produce fine-grained recrystallized structures. There must be a limit to the reduction in grain size beyond which further refinement of grain will produce less reduction of area.

Deformation

It is now known that cold deformation produces refinement of grain in the sense that one original grain, after severe cold-work, exhibits a mixture of orientations.[3] This type of grain refinement is not the same as the refinement of grain produced by annealing at low temperatures. For example, a metal may be obtained with the same hardness by moderately cold-working a coarse-grained piece or by annealing a severely worked piece at a temperature which will produce small unstrained grains. Although the hardnesses are the same, the other properties may not be and usually are not the same. These and other considerations make it necessary to consider that cold-working produces a structure unlike that obtained in any other manner. Even though there is refinement of grain by cold-working, the directional properties of the crystals are never obliterated, and in fact it seems that the extreme conditions of cold-work actually favor additional directional characteristics, such as a tendency for the crystal units to be oriented in a certain manner with reference to the direction of deformation. This condition has been described by Berger[4] in very fine tungsten wire.

Inasmuch as the structures produced by cold deformation are unique and are too minute for direct observation, the structural condition of cold-worked metals must be described in terms of the deformations to which they have been subjected.

The general effect of cold deformation is to increase hardness and decrease plasticity. The yield point and tensile strength are increased, and the elongation and reduction of area are decreased. The capacity for further cold-work is of course decreased. Annealing above the recrystallization temperature removes the hardening effects. Fig. 3 shows the effect of progressive cold-rolling on the properties of a very pure grade of copper. After being reduced cold 50 per cent in section, the metal was annealed at various temperatures, with the results shown on the right-hand side of the diagram.

[3] "Mixed Orientation Developed in Crystals of Ductile Metals by Plastic Deformations," by E. C. Bain and Zay Jeffries. *Chem. & Met. Eng.*, vol. 25, p. 775, Oct. 26, 1921.

[4] Communication from laboratories of N. V. Phillips Lamp Factory, Eindhoven, Holland, September, 1921.

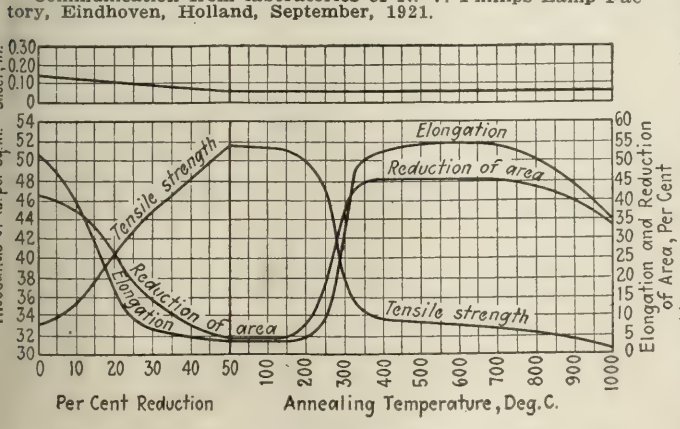


FIG. 3—EFFECT OF COLD-ROLLING AND ANNEALING ON PROPERTIES OF COPPER (MATHEWSON AND THALHEIMER)

In general the effects of hot-working are very much the same as those of cold-working followed by annealing above the recrystallization temperature. Although at high temperatures metals are capable of some permanent deformation by the process of viscous flow at the grain boundaries and perhaps migration of the boundaries themselves, most of the deformation incident to hot-working takes place by the breaking up of the crystals and the movement of the fragments along the slip planes. This type of deformation produces conditions favorable to grain growth. Immediately after a deforming operation, such as a hammer blow or a pass through rolls, grain growth takes place in accordance with the temperature until interrupted by the next deformation, which again breaks up the grains. The final grain size of hot-worked metal therefore depends largely upon the finishing temperature. A very high finishing temperature is apt to result in excessively coarse-grained metal. If, on the other hand, working is continued until the metal has cooled down around the recrystallization temperature, a somewhat strain-hardened condition may obtain.

Hot-working creates "fiber." Physical defects in a cast metal such as blow holes, pipes, slag or oxide films are drawn out in the direction of working. The non-metallic impurities, being often brittle at the working temperature, are also to a large extent broken up and scattered. The result is a general improvement because of the greater continuity of the metal, and a special improvement in the direction of the working. The distribution of the impurities is such that their total cross-section on planes perpendicular to the direction of working is much less than on planes parallel to the direction of working. This may lead to quite appreciably lower physical properties—particularly elongation and reduction of area—in test-bars taken at right angles to the direction of working, or "across the grain" of the metal. This effect is of course more marked the greater the amount of impurities present.

Impurities also affect the shapes of the grains. A perfectly pure and physically sound metal would, after hot-working, not only have the same properties in all directions, but would have equiaxed grains. Non-metallic impurities generally obstruct grain growth, and because of their distribution in worked metals, the obstruction to growth at right angles to the direction of working is greater than the obstruction to growth in the direction of working. The grains of hot-worked metals, or of metals that have been cold-worked and annealed, therefore tend to be elongated in the direction of working.

Properties of Metal Crystals

A single crystal is an aggregation of atoms occupying (or vibrating about) definite equilibrium positions to which they tend to return if displaced by the application of an external force. This gives rise to the property of elasticity. The mathematical exactness of the space lattice results in a perfection of elasticity not attained in non-crystalline bodies. It may follow that single crystals are perfectly elastic. Any deformation short of rupture produced by an external force disappears on removal of the force. Furthermore the extent of the deformation remains constant under a constant force—that is, there is no flow in a single crystal. The rate of application and the dura-

tion of load, therefore, are of little significance, and return to the initial form on removal of load takes place very quickly with none of that "creep" shown by amorphous solids.

Failure of crystals under load seems always to take place on crystallographic planes, which are to be recognized as planes of weakness. If the fragments adhere to each other, the crystal is said to be plastic, and the planes of failure are slip planes or gliding planes. If the fragments do not adhere, the crystal is brittle and the planes are called cleavage planes. In either case failure takes place by a shearing action, and the first failure marks the end of the single crystal. Up to this point the crystal is elastic. Therefore the only "strength-property" of a single crystal is its elastic limit in shear, which is of course different in different crystallographic directions. Hardness depends on the same property, since any method of hardness testing involves failure by shear. Conversely, we may regard the "strength" of single crystals, whether of pure metals or of metallic compounds, as approximately proportional to their hardness.

Crystallization of a metal from the molten state is accompanied by the sudden development of a definite shearing strength. This strength increases as the temperature falls in a manner which, so far as we know, is continuous, unless there is an allotropic change. The strength of a crystal is evidently due to the attractive forces between its atoms. Thermal vibrations of the atoms oppose these attractive forces so that at high temperatures the crystals are relatively soft and weak. As the temperature falls the amplitude of atomic vibration decreases and the interatomic forces become more and more assertive, increasing the hardness and strength. Since the damping of atomic vibration is a continuous function of the temperature, the increase in strength of a single crystal on cooling must also be continuous, as long as there is no change in the arrangement of the atoms—that is, no allotropic change. The modulus of elasticity also increases continuously on cooling.

The properties of crystals of the various metals depend on the characteristics of the atoms of which they are built and on the type of space lattice in which the atoms are arranged. Only three types of lattice, all simple, have been found in most metals. These are the face-centered cubic, body-centered cubic (or centered cubic), and hexagonal close-packed. All metals known to crystallize with the face-centered cubic arrangement are ductile throughout a wide range of temperature. Examples of this class are gold, silver, copper and aluminum. The hexagonal arrangement appears less conducive to ductility, as illustrated by the metals zinc, cadmium and magnesium. Hull has pointed out that in the hexagonal arrangement there is only one set of planes parallel to which easy gliding or slip can take place, whereas in the face-centered cubic there are four. Both ductile and brittle metals are found with the body-centered cubic arrangement, which seems somewhat less favorable to ductility than the face-centered.

Amorphous Metal

There must of necessity be some disorganization of the crystalline structure at the grain boundaries of metals and on most of the surfaces of slip. The degree of disorganization probably varies all the way from perfect crystallinity to the completely disorganized structure denoted by the term "vitreous amorphous." All such metal of disorganized structure simulates the vitreous amorphous materials in its mechanical properties.

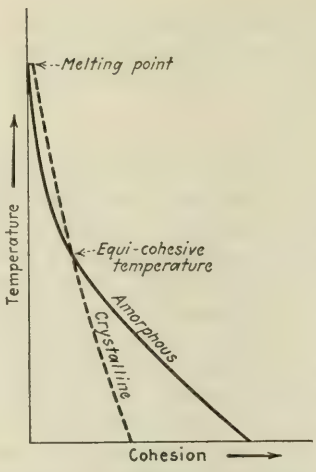


FIG. 4—COHESION-TEMPERATURE RELATIONS OF AMORPHOUS AND CRYSTALLINE METAL

Fluidity is the important characteristic of amorphous materials. Plastic deformation takes place by the same kind of flow as in ordinary liquids, except that at low temperatures the viscosity is very great. Whereas the strength of a crystal depends on temperature and is practically unaffected by the duration of loading, the resistance to deformation of an amorphous material not only varies rapidly with the temperature for a given rate or duration of loading, but if the temperature is constant depends entirely on the rate and duration of loading.

In Fig. 4 are two curves representing qualitatively the effect of temperature on the "cohesion" of crystalline and amorphous metal. For this purpose cohesion of crystalline metal denotes the stress required to cause failure by slip. That is, cohesion is measured by the elastic limit of the crystal. Cohesion of amorphous metal is also measured by the elastic limit—i.e., the maximum stress that can be sustained without permanent deformation. This quantity obviously depends on the time during which the stress acts. The curve therefore represents only one rate and duration of loading.

It will be noted that the crystalline metal is represented as acquiring a definite cohesion at the time of its formation—that is, at the freezing point of the metal—but there is no discontinuity in the cohesion of the amorphous metal at this point. Below the freezing point the cohesion of each modification increases continuously as the temperature falls, the rate of change being most rapid in the case of the amorphous metal. At some temperature the curves intersect, indicating that the cohesion of the amorphous modification has become equal to that of the crystalline. This temperature has been called the "equicohesive temperature." As indicated above, the actual temperature depends on the rate and duration of loading. In general it corresponds closely with the temperature of recrystallization. Above the equicohesive temperature the crystalline metal has the greater cohesion; below the equicohesive temperature the cohesion of the amorphous modification is the greater.

This conception is believed to be useful and suggestive in interpreting the properties of metals, but it must be remembered that it is qualitative rather than exact. It may be considered that in general the relative amount of amorphous metal increases with grain refinement and with cold-working. It may also be considered that in a qualitative way the greater the amount of the amorphous modification present the more do the properties of a metal tend toward those of a vitreous amorphous material. For example, the

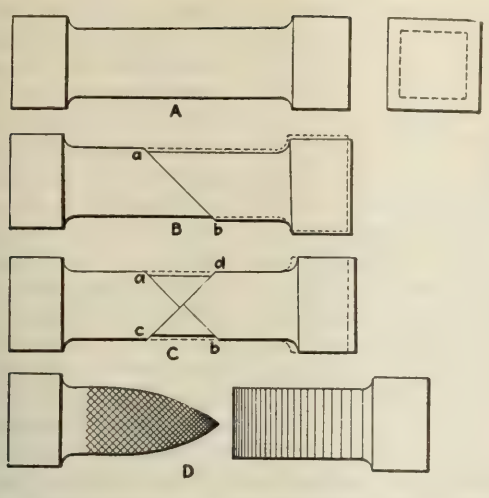


FIG. 5—PLASTIC DEFORMATION OF TEST-BAR COMPOSED OF SINGLE DUCTILE CRYSTAL

property which metals have at high temperatures of yielding slowly under constant load is presumably due (at least in part) to the viscous flow of the disorganized metal at the grain boundaries. Since the amount of this disorganized or amorphous metal is greater in a fine-grained metal than in a coarse-grained metal, we should expect the fine-grained metal to be softer at high temperatures and harder at low.

Tensile Tests of Single Crystals

Sykes[5] has described some very interesting tests of molybdenum wire in which many of the grains extended completely across the diameter of the wire (0.025 in.). At 200 deg. C. and lower temperatures the path of rupture followed the grain boundaries. At 300 deg. C. and up to 900, which is approximately the recrystallization temperature of molybdenum, the fracture was decidedly transcrystalline. In this temperature range, the wire drew down to a wedge at the fracture. The reduction of area was practically 100 per cent, but in one direction the *diameter* of the wire was scarcely reduced at all. This means that the deformation has been confined chiefly to two sets of slip planes.

The mechanism of deformation of a single crystal is illustrated schematically in Fig. 5, wherein *A* represents a test-bar of square cross-section consisting entirely of a single grain of a ductile metal. It is further supposed that this grain has such an orientation that planes of easy slip are perpendicular to the plane of the paper and make angles of about 45 deg. with the axis of the test-piece. Now if the piece is subjected to tension, shearing stresses are developed which reach a maximum value at 45 deg. to the tensile load and hence parallel to the planes of easy slip. As these stresses increase, failure of the crystal will take place in the form of slip, or block movement, along one of these planes, *ab*, the location of which will generally be determined by some local weakness. (Fig. 5-B.)

Ductile metals possess the property of automatically limiting the extent of the movement on any particular slip plane. Instead of slip continuing on the first plane until complete rupture of the piece occurs, the movement comes to a stop after a displacement which is very small as compared with the dimensions of the test-piece. Resistance to movement along the first slip plane increases; further slip is forced to take place on new planes.

Let us suppose that the second slip is on a conjugate plane *cd*, making an angle of about 90 deg. with the planes of the first set. (Fig. 5-C.) It is readily seen how repeated slips of this character result in a general increase in the length of the test-bar and a decrease in its diameter.

Fig. 5-D represents the test-bar after rupture. The view on the left shows the same surface of the bar as in the three views above, and illustrates the multiplication of intersecting slip planes, especially near the fracture. The view on the right shows a face of the test-bar at 90 deg. to that on the left. It will be noted that there has been no reduction in diameter on this face at the fracture. The test-piece has drawn out into the shape of a wedge.

A remarkable study of single crystals of aluminum has been reported by Carpenter and Elam.[6] These investigators worked with flat test specimens 1x0.125 in. and with round specimens having diameters of 0.564 and 0.798 in. With each type of specimen they succeeded in converting the entire parallel portion into a single crystal.

The bars of circular cross-section in which a single crystal occupied the entire cross-section drew out into the form of wedges, as did Sykes' wires. Because of the much larger size of the aluminum bars, the edge of the wedge was not actually sharp, but retained a well-defined lens shape at the fracture. Reduction in diameter in the other direction was very slight.

Flat single-grain test specimens of aluminum assumed forms during deformation and fracture which varied widely with the orientations of the grains, as would be expected. In one type the specimen became narrower, but retained practically its full thickness, while in a second type the specimen became thin, but retained substantially its original width. All bars were characterized by the small number of the systems of slip planes on which movement took place, and by a uniformity of direction of slip in any one grain.

Acetone as a Solvent for Mineral and Rosin Oils

In the course of an investigation being conducted at the Mellon Institute of Industrial Research of the University of Pittsburgh regarding the solvent properties of acetone on various commercial products, a number of mineral lubricating oils were tested. From the data thus obtained it has been concluded that acetone does not possess high solvent power for such oils. It was noted that the solvent power of acetone decreased as the viscosity of the mineral oils increased. Acetone is miscible in all proportions with gasoline and kerosene and possesses the least solvent action on the paraffin, from which it has been concluded that it is a better solvent for the lower molecular weight hydrocarbons.

Acetone has been used to remove paraffin wax from shale oil and lignite tar. Claim has also been made for its use in removing tarry matter from light lubricating oils, thus increasing their suitability for cylinder lubrication.

The grade of acetone used in these tests was obtained by the destructive distillation of calcium acetate and was of excellent purity and uniformity.

[5] "Effect of Temperature, Deformation, Grain Size and Rate of Loading on the Mechanical Properties of Metals," W. P. Sykes, *Trans.*, A.I.M.E., vol. 60, p. 780.

[6] "The Production of Single Crystals of Aluminum and their Tensile Properties," H. C. H. Carpenter and C. F. Elam. *Proceedings* of the Royal Society, A, vol. 100, 1921. Abstracted in *Chem. & Met. Eng.*, vol. 26, p. 514, March 15, 1922.

Deformation of Material by Impact Test

IT HAS BEEN frequently stated that anomalies in impact testing have been due to variations in the dimensions of the test-piece and to the habit of expressing the result in energy of rupture per square inch of fractured area. M. Moser of Krupp's laboratory recently tested[1] the theoretical conclusion that if the total energy of rupture were divided by the volume of deformed steel, the result would be independent of the size of the bar. His colleague, Dr. Fry, determined the volume of overstrained metal by the latter's new etching method.

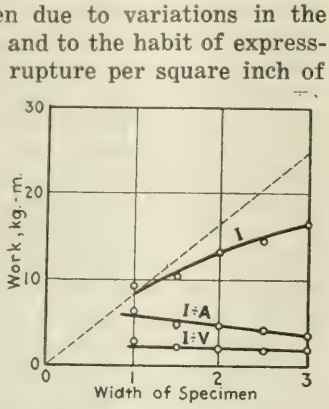


FIG. 1—IMPACT VALUES FOR 0.70 C STEEL

Standard German impact pieces are 3 cm. square notched by saw cut terminating in a drilled hole 4 mm. in diameter; the surface to be broken is 1.5 cm. deep and 3 cm. wide. Moser tested four steels (Table I) by varying the width of the specimen from 0.5 to 3 cm.

TABLE I—STEELS USED IN THE RESEARCH

	Analysis				Principal Properties			
	C	Si	Mn	Ni	Elastic Limit	Ultimate	Elongation	Contraction
Carbon steel A	0.70	0.24	0.52	....	57,000	112,000	12.2	18.0
Carbon steel B	0.43	0.16	0.36	....	43,000	71,500	30.5	51.0
Carbon steel C	0.35	0.29	0.61	....	49,800	78,300	30.3	56.4
Nickel steel D	0.12	0.05	0.35	4.85	60,200	73,900	32.5	70.8

His machine was of the Charpy type, its pendulum weighing 66.1 kg., falling 2.868 m. from an angle of 80 deg., and striking the piece with an energy of 189.6 kg.m. Results are shown graphically in Figs. 1 to 4 inclusive. Except for the nickel steel, the energy of rupture departs widely from proportionality. Likewise, that steel only has a constant value for energy of rupture per unit area. However, when the energy of rupture is divided by the volume of overstrained metal, the value is constant and independent of the width of specimen, yet quite different for the materials. Numerical results follow:

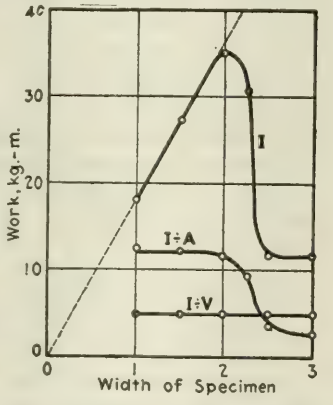


FIG. 2—IMPACT VALUES FOR 0.43 C STEEL

Steel	Rupture Work Per Unit Volume
0.70 Carbon steel A	1.9
0.43 Carbon steel B	4.8
0.35 Carbon steel C	5.3
4.85 Nickel steel D	11.6

As before noted, Dr. Fry examined the broken specimens by preparing polished cross-sections at various points and etching them by his newly developed methods. In this way the boundaries of the deformed material were determined and the volume of this material could be calculated.

A further striking relationship exists for the carbon steels between the contraction in area under tensile test and the rupture work per unit volume, as determined above, the latter being 0.094 times the former. This ratio does not apply to the nickel steel. Since the rupture work per unit of deformed volume is constant but the total work expended varies with the width of specimen, it follows that the volume of the steel overstrained must vary as the width of the specimen changes. Plotting such volume against width, we get four curves of the same shape as the respective curves for total work in Figs. 1 to 4. Each of the curves is tangent at its lower end to a line passing through the origin. The carbon steels deflect from this line when the width of specimen exceeds 2.0 cm., but the nickel steel holds to the line for widths as high as 3.0 cm. Strangely enough, the slope of the line is identical for all four steels. This seems to indicate that the amount of material deformed when breaking a test specimen notched according to the German standard depends only upon the width of the specimen. That is to say, the metal is deformed on the average 1.4 cm. deep on either side of the fracture, for specimens shaped as described and up to 2.0 cm. wide, despite the strength of the material. Figures for total work of rupture for such specimens should therefore give comparative figures; i.e., stand in the same relationship as the work per unit volume of overstrained metal[2].

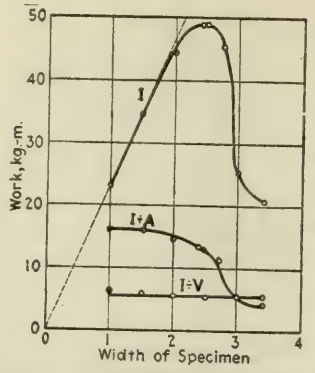


FIG. 3—IMPACT VALUES FOR 0.35 C STEEL

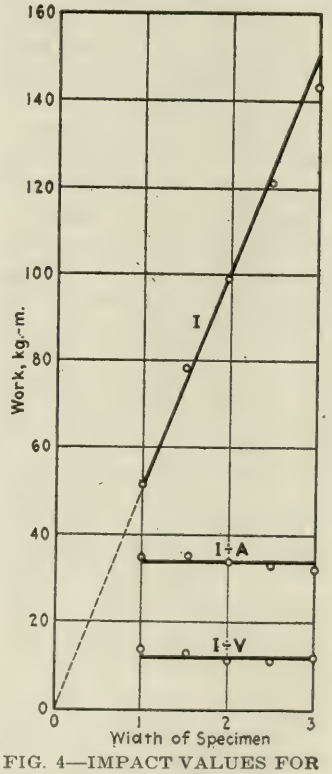


FIG. 4—IMPACT VALUES FOR 4.85 Ni STEEL

Since the energy of the falling hammer is far greater than that necessary to break the weaker steels, the height of fall was reduced to 1 m., just sufficient to break the 3.0-cm. test-piece of steel B. Testing pieces of different width with this milder impact, a series of curves similar in form to Fig. 4 were obtained, showing that under these circumstances the energy of rupture is now proportional throughout to the width of the specimen. The energy of rupture ex-

[1] *Stahl und Eisen*, 1922, vol. 42, p. 90.

[2] The following tabulation gives numerical results as determined from experiment, and from these an idea may be had on the correctness of the generalization.

VOLUME OF DEFORMED METAL

	Specimen 1.0 Cm. Wide	Specimen 1.5 Cm. Wide	Specimen 2.0 Cm. Wide
Steel A	4.0	5.5	6.8
Steel B	3.8	5.7	7.3
Steel C	4.2	6.5	8.3
Steel D	4.0	6.3	8.7
Approximation from rule	4.2	6.3	8.4

pressed in energy per unit of area or per unit of volume has become a straight line and a linear relationship exists between the deformed volume of metal and the width. The specimen is therefore behaving exactly as did the nickel steel with the higher velocity.

It is the purpose of notched-bar testing to localize the deformation at the root of the notch, the surrounding material being so strengthened and stiffened by its greater bulk not to enter into the test. Furthermore, it is apparent that the amount of material deformed by the shock depends upon the shape of the notch. The author, therefore, investigated the effect of the diameter of the hole ending the notch, using specimens of steel C, 2 cm. wide. Examination of the fractured pieces by Fry's reagent showed deformed metal to the following depth from the broken surfaces:

Diameter of Notch	Depth of Deformation
1 mm.	0.4 cm.
2 mm.	0.8 cm.
4 mm.	1.4 cm.
6 mm.	1.6 cm.
10 mm.	1.8 cm.
13 mm.	1.95 cm.

Practically there exists no method for the accurate and quick determination of the volume of material which is deformed by a blow. It would furthermore be very desirable to determine an impact velocity suited to the material to be tested so that it would fall by deforming the predicted volume of material. Neither of these ends being commercially obtainable, the best recourse is to devise a form of specimen in which the errors in question are minimized. For this purpose a specimen 1 cm. square in cross-section at the root of the notch and having the notch end in a hole 4 mm. in diameter is preferable.

Electrical Precipitation of Solids From Smelter Gases*

Suspended solids in smelter gases are largely sulphides, sulphates and oxides, but the physical condition is of far more importance than the chemical composition. Dust of any sort is easy to precipitate in a Cottrell treater; condensed fume is extremely difficult. The author thinks this is due to the fact that the fume first gathering on clean electrodes is compact, smooth, and a high insulator; on the other hand, the angularity of dust particles causes them to build up a granular deposit, the pores of which are lined with jagged points and rough edges from which an electric charge can readily leak. Both the gas and the precipitated coatings must be kept conductive.

It is of utmost importance, therefore, to condition fume-laden gas before treatment. In fact, it is an operating maxim to "get the gas right and electrical troubles may be forgotten." While fume precipitation may sometimes be increased slightly by introducing true dust, the best way now known is to add a certain amount of water vapor or sulphuric acid mist.

Water vapor may be put into the flue by spraying a considerable quantity of water finely atomized by very high air pressure. Since the relative humidity for good clearance and a dry deposit must be kept between 40 and 70 per cent, it follows that the temperature of the gases must be largely reduced in order to attain this with a reasonable amount of water. In fact, the evaporation of the water is of prime importance in reducing the gas temperature. Similarly, in winter it is often possible to cool the furnace gases by radiation so that their humidity will rise to the required limits. Mr. Rathbun believes that fume particles adsorb a surface film of water, which is held in the deposit without giving the appearance of moistness, yet having a great influence on its conductivity. Furthermore, humid gas is itself more conductive.

Conditioning with sulphuric acid is a more important method, since it permits good clearance on gas whose temperature (and therefore whose draft) has not been materially lowered. Sulphuric acid has a high enough boiling point so that it remains liquid at ordinary gas temperatures—it therefore aids conductivity because it actually wets the surfaces of the fume particles, spreading out at a very high rate. It also absorbs water vapor (and this water vapor must be supplied if the gas is naturally very dry) at temperatures well above 100 deg. C., so that the liquid films become dilute enough to be very good conductors of electricity. It is very necessary to add the acid at a high dispersion. This is effected best by boiling the acid and thoroughly mixing the mist with the gas to be treated—e.g., by spraying acid into the hot interior of a converter hood. If the solid particles react very rapidly, forming sulphates and thus wasting acid, conditioning must be done shortly before entering the treater, by an atomized spray of dilute acid. It has been found that good clearances are had in dust which contains from 1 to 5 per cent of free acid. Higher contents gives a sticky precipitate difficult to remove and handle. As high as two-thirds of the acid sprayed into the gas will pass through the treater.

Electrodes may be conditioned by slightly dampening them daily (or oftener if the fume contains much oxide) with fine H_2SO_4 mist. Acid appears to adhere to the collecting surfaces and absorb enough water from the passing gases to build up a continuous conducting coat.

*Abstracts of a paper read by Ross B. Rathbun, of the American Smelting & Refining Co., before the Vancouver convention of the American Institute of Electrical Engineers, Aug. 8, 1922.

Factice—A Rubber Substitute

A recent note published by the Stamford Rubber Supply Co. discusses the use of factice in rubber compounding. Factice is made from vegetable oils, ranging from the best imported French rapeseed oil to domestic corn oil. It is combined with sulphur chloride and the product thus formed, free from sulphur, from sulphur chloride and from the original oil, is called factice. It is a substitute for rubber and has often been called "rubber substitute." It has been found possible to use it in proofing cloth for clothing, hospital sheetings, carriage and automobile tops, etc. It is an economy to use it in this sort of work, as it cuts down the use of expensive solvents, such as gasoline, benzol, coal tar, etc., and permits a lighter, smoother spreading of the coating on the cloth. It is used in druggists' sundries, such as hot water bottles, and tubing, and numerous hard rubber articles. It is also used in tires to a limited extent, especially in the side wall, where from 5 to 10 per cent of the compound can be used. Bicycle tires can contain as high as 20 per cent of factice and even motorcycle tires use considerable amounts. And finally, it is used in mechanical work, such as belt frictions and covered stock or for conveyor belts, fire hose, etc. It has been in use in Europe for a long time among conservative and thoroughly reliable firms and it promises to have more extensive use in America in the near future.

Thermo-electricity

Since Seebeck conducted his original research, which covered a variety of phenomena, in 1821, a good many thermo-electric and electrothermic effects have been discovered and rediscovered over again. They are all interconnected; but three main effects may be distinguished, apart from the primary Joule effect—viz., that every conductor is heated by the electric current flowing through it. When the two metals of a heterogeneous circuit, consisting of two different metals in contact, are kept at different temperatures, an electric current is generated (Seebeck). When conversely an electric current is sent through that circuit, the junction is heated or cooled (Peltier, 1834). When the circuit is homogeneous and consists of one metal only, the temperature of which varies from point to point, however, an electric current is set up by the temperature difference (W. Thomson, 1856). The converse of the Seebeck effect, a generalized Thomson effect, had not been demonstrated, until Benedicks described his new X-effect. He claims to have established a direct "phoretic" transport of heat by the electric current, with or against the current direction, when flowing in a perfectly homogeneous conductor, of the same temperature throughout. The Thomson effect would only be a special case of this new effect. That heat transport would influence the Peltier and Thomson effects as usually measured; it would also play a part in the unipolar conduction of a crystal detector.

Investigation of Steel for Precision Gages

As an outcome of the organization of a committee of interested manufacturers and users (noted in *Chem. & Met. Eng.*, Feb. 8, 1922, p. 248), a 2-year program of research into the properties of gage steels has been agreed upon. Steels have been donated by the mills, the gages will be made by toolmakers, and the Ordnance Department, U. S. Army, and the Bureau of Standards have financed the experimental work. Howard Scott has been chosen investigator and will devote his entire time to the problem.

Six types of steel are to be investigated: carbon steels with 0.85 C, 1.10 C, and 1.10 C, 0.5 Cr; ball bearing steel with 1.10 C, 1.40 Cr; non-deforming steel with 0.90 C, 1.25 Mn, 0.5 Cr, 0.5 W; and a nickel-chromium case-hardening steel. It is planned to make fifteen thread gages and fifteen plug gages of each type, to study the influence of rate of heating before hardening.

A number of disks, 2⅛ in. diameter and 0.4 in. thick, are to be used to study the resistance to wear. While actual endurance in service is the ultimate test, a quick approximation is needed for an investigation, if for no other reason than to pick out steels worthy of service tests. Therefore the Amsler abrasion test machine is being studied. It produces dry wear on the periphery of two disks by a combination of rolling and sliding friction. Carbon steels are now being tested against oil-hardened steels in order to determine whether check runs give consistent results.

Changes in dimension on hardening are caused by at least two independent factors—viz., (*a*) temperature stresses due to non-uniform heating and cooling rates, and (*b*) volume changes due to the transformation of austenite to martensite. The former may be reduced by most careful control of the heat-treatment, a knowledge of the quenching power of the baths, or the use of an air-hardening steel. Given uniform cooling rates, the amount of distortion from austenite transformation should be uniform and predictable.

Slow changes in dimension on aging are probably due to a slow change in constitution of the steel; sudden changes to rearrangements of internal stresses. If these assumptions are true, the volume changes will be greatest and most rapid in untempered steel, and for investigative purposes it seems safe to assume that if a steel is stable as quenched, it will have better aging properties after tempering.

Machinability of a gage steel might best be studied by noting the temperature of the cutting tool when working under standard conditions.

These four tests—wear, changes upon hardening and subsequent thereto, and machinability—should permit one to determine readily the relative merits of a collection of commercial steels when used for gages.

A Steel Maker's Library

A number of leading men in the steel industry have been asked to select ten books on their specialty, which in their opinion would be most useful for inclusion in a business library to be installed in the Hotel McAlpin, New York. Replies were received from Charles M. Schwab, J. S. Unger, George G. Crawford, A. A. Corey, Jr., and John A. Mathews, citing the following books:

Title	Author	Publisher	Chosen By
Principles, Operations and Products of the Blast Furnace	J. E. Johnson, Jr.	McGraw-Hill	Co, Cr, S, U
Metallography and Heat-Treatment of Iron and Steel	Albert Sauveur	Sauveur & Boylston, Cambridge, Mass.	Co, Cr, S
Metallurgy of Iron and Steel	Bradley Stoughton	McGraw-Hill	Cr, M, S
Manufacture and Properties of Iron and Steel	H. H. Campbell	McGraw-Hill	Co, S, U
The Metallography of Steel and Cast Iron	H. M. Howe	McGraw-Hill	Co, Cr, M
Basic Open-Hearth Steel Process	Carl Dichmann	D. Van Nostrand Co.	Cr, S
Blast-Furnace Construction	J. E. Johnson, Jr.	McGraw-Hill	Cr, U
Electric Furnaces in the Iron and Steel Industry	Roenhauser, Schoenawa and Vom Baur	John Wiley & Sons	Co, M
Metallurgical Calculations	J. W. Richards	McGraw-Hill	Co, Cr
Principles of Iron Founding	Richard Moldenke	McGraw-Hill	Cr, U
The Making, Shaping and Treating of Steel	Camp and Francis	Carnegie Steel Co., Pittsburgh, Pa.	Co, U
Cambria Steel Co. Handbook			Co
Coal and Coke	F. H. Wagner	McGraw-Hill	U
Heat-Treatment of Tool Steels	Harry Brearly	Longmans, Green & Co.	M
Helmets and Body Armor in Modern Warfare	Dashford Dean	Yale University Press	M
Iron and Steel	H. P. Tieman	McGraw-Hill	Co
Iron and Steel Works Directory of the United States and Canada, 1920		American Iron & Steel Institute	U
Iron in All Ages	J. H. Swank	American Iron & Steel Institute	M
Mechanical Engineer's Pocket Book	Kent	John Wiley & Sons	U
Materials of Construction	G. B. Upton	John Wiley & Sons	M
Metallurgy of Cast Iron	T. D. West	Cleveland Printing & Publishing Co.	S
Metallurgy of Steel, 2 vols.	Harbord and Hall	Charles Griffin & Co.	S
Steel—A Manual for Steel Users	W. Metcalf	John Wiley & Sons	Co
Steel and Its Heat-Treatment	D. K. Bullens	John Wiley & Sons	Cr
The A B C of Iron and Steel		Penton Publishing Co., Cleveland, Ohio	U
The Chemical Analysis of Iron	A. A. Blair	Lippincott	Cr
The Electric Furnace	Alfred Stansfield	McGraw-Hill	S
The Engineering Index		American Society of Mech. Eng.	S
The Inside History of the Carnegie Steel Co.	J. H. Bridge	Aldine Press	M
The Ore Deposits of the United States and Canada	J. F. Kemp	McGraw-Hill	U
The Steel Foundry	J. H. Hall	McGraw-Hill	S
Year Book		American Iron & Steel Institute	S
Journal		British Iron & Steel Institute	S

Recent Chemical & Metallurgical Patents

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Magnesium Chloride — Anhydrous magnesium chloride is prepared by the action of chlorine on a mixture of magnesium oxide and carbon at a temperature below the melting point of magnesium chloride, the reaction materials being preferably dry and the carbon free from gas. The reaction is started at 300 deg. C. or above, whereafter a sufficiently high temperature is maintained by the heat of the reaction. Fusion or sintering of the chloride may be prevented by keeping the charge in motion—for example, by carrying out the reaction in a revolving converter. The temperature of the charge may also be controlled by feeding in fresh quantities of material and by adjusting the velocity of the chlorine current. (Br. Pat. 181,375; not yet accepted. Aktieselskabet de Norske Saltverker, Bergen, Norway. Aug. 10, 1922.)

Basic Magnesium Chloride — Basic magnesium carbonate is obtained by emulsifying the normal carbonate with water at 40 to 50 deg. C. in a homogenizing apparatus having at least one turbine bucket wheel. A product of the composition $4MgO{\cdot}3CO_2{\cdot}4H_2O$ is obtained. The normal carbonate may be obtained by mixing solutions of magnesium chloride and ammonium carbonate in an apparatus of the kind mentioned above, a product of the composition $MgCO_3{\cdot}3H_2O$ being thus obtained. (Br. Pat. 181,388; not yet accepted. Chemische Fabrik Griesheim-Elektron, Frankfort-on-Main. Aug. 10, 1922.)

Oxidation of Ammonia—The oxidation of ammonia by means of oxygen is effected by passing the gas mixture through a catalytic zone in which the concentration of the catalyst gradually increases in the direction of the gas flow; in this way mixtures containing up to 40 per cent of ammonia can be treated without explosion. The apparatus consists of a nickel or aluminum tube containing nickel rings, each of which carries a nickel net. Plates of platinized pumice are placed between the nets, the concentration of platinum increasing from the inlet to the outlet. The nickel nets and rings serve to conduct and radiate heat away from the reaction zone. (Br. Pat. 181,486. I. W. Cederberg, Lidingö-Brevik, and H. M. Bäckström, Djursholm, Sweden. Aug. 10, 1922.)

Purifying Acetylene—To basic materials such as a mixture containing ferric oxide and chloride, used for removing phosphoretted and sulphuretted hydrogen from acetylene, is added a copper compound such as copper hydrate or chloride to act as a catalyst. The mixture is incorporated with kieselguhr, and to it, in addition to the copper compound, may be added a small proportion of mercuric chloride. Improved results are obtained if the mixture is kept for some months before use; when exhausted it is revivified by exposure to the air. (Br. Pat. 181,571. J. R. Booer and District Chemical Co., London. Aug. 10, 1922.)

Synthetic Resins—Cyclohexanone or a homolog thereof is condensed with acetaldehyde, using an acid or alkaline condensing agent. The acetaldehyde in aqueous solution or otherwise is added gradually to a mixture of the cyclohexanone and condensing agent in a closed vessel and the whole stirred and heated. The product is cooled and stirred with water to remove soluble matter. Diluents or solvents may be employed. In an example, caustic soda acts as condensing agent and alcohol as diluent. The products may be employed as resin substitutes or in making varnishes, electric insulating compositions, etc. (Br. Pat. 181,575. H. Dreyfus, London. Aug. 10, 1922.)

Alumina — A solution of alum is treated with ammonia under such conditions that the alumina is precipitated in a readily filterable form. The alum solution is precipitated at a temperature near its point of ebullition, the ammonia is added gradually and the liquor is subjected to continuous agitation. An aqueous solution of ammonia may be introduced in the form of a spray into the alum solution, or preferably gaseous ammonia is injected, in order to utilize the heat of solution. After the removal of the alumina by filtration the potassium and ammonium sulphates are separated by crystallization, and the mother liquor is employed in the treatment of more alum. When the alum is obtained by hot lixiviation of crude material such as that obtained by treating leucite with sulphuric acid the precipitation may be effected advantageously directly while the solution is still hot. (Br. Pat. 181,678; not yet accepted. G. A. Blanc, Rome. Aug. 10, 1922.)

Imitation Metal Leaf—Thin films, particularly such as contain metal powder and serve as substitutes for metal leaf, are manufactured by applying a concentrated or pasty solution containing cellulose acetate, etc., and metal powder or pigment, by a single spreading operation on to a smooth support and then drying the film without further treatment. The support may be an endless band or a rotating drum or roller; and the solution may be supplied to a box in contact with the support and having an opening in its bottom, and spreading effected by a knife or a roller which may be stiff or flexible, for instance of india rubber. (Br. Pat. 181,706; not yet accepted. Akt.-Ges. für Anilin-Fabrikation, Berlin. Aug. 10, 1922.)

Ferrocyanides—Coal gas, preferably freed from ammonia, is passed through a mixture of a ferrous salt and an alkali such as sodium carbonate, preferably containing no free alkali, oxygen being excluded and the reaction being effected in the cold. The liquor is then treated with an oxidizing agent, such as air, to oxidize sulphides while leaving the ferrocyanide and any sulphocyanide that may have formed unaffected. The liquor is then filtered, the filtrate being alkali ferrocyanide solution. Prussian blue is obtained by acidulating this solution and adding a ferric salt or, preferably, a ferrous salt followed by oxidation of the precipitate with air. The precipitate first separated, consisting of ferric hydrate and sulphur, is treated with dilute sulphuric acid, preferably at 60 deg. C., when the sulphur collects in lumps and ferric sulphate is obtained which may be used to oxidize the ferrous ferrocyanide. (Br. Pat. 181,719; not yet accepted. A. Dessemond and A. H. Delcleve, St. Etienne, France. Aug. 10, 1922.)

Starch — Starch is obtained from wheat flour by the action of a single protolytic enzyme such as pepsin or trypsin which is without action on starch or its cellulose envelope, but which converts the insoluble nitrogenous constituents of the flour into soluble substances which can be removed by water. In an example a mixture of pepsin, water and hydrochloric acid is heated to 40 to 50 deg. C., the flour then being added and the heating continued till the density of the liquor remains constant. The amount of pepsin employed is 0.04 per cent of the weight of flour. When the reaction is complete the liquor is separated from the starch in a centrifuge, the starch being intermittingly washed with water till free from acid. If trypsin is employed, it is dissolved in a solution of sodium carbonate or bicarbonate. The starch is removed from the centrifuge and dried. Any gluten remaining in the starch may be removed by a solution of sodium hydroxide. The nitrogenous liquor obtained as a byproduct can be used as a fertilizer or as a base for foodstuffs. (Br. Pat. 182,829. F. H. Campbell, Melbourne. Sept. 6, 1922.)

Recovery of Sulphur—Sulphur in a pure state is recovered from an aqueous emulsion in which it occurs with gangue or other earthy matter by heating under pressure in an autoclave to a temperature above the melting point of sulphur but not exceeding 165 deg. C., the emulsion being agitated. Under these conditions the sulphur melts and may be separated by gravity from the aqueous liquid, the gangue, etc., remaining in suspension. The process may be applied to the mixture

of sulphur and flue dust obtained in the treatment of certain metallurgical gases. If, in addition to sulphur and gangue, metallic sulphides are present in the emulsion, they coalesce with the sulphur (which may be added if the amount originally present is insufficient) when the latter is melted as described above, the gangue remaining in suspension as before. (Br. Pat. 181,984. B. Hunt, London. Aug. 16, 1922.)

Dyeing Cellulose—Threads, filaments, strips or films of cellulose are dyed with vat or sulphuretted dyes by incorporating with viscose the leuco compound of the dye. The mixture or viscose and leuco coloring matter is preferably obtained by first bringing the dyestuff into solution and then mixing with the viscose, either as such or during its production. With a sulphur coloring matter sodium sulphide may be used in small quantities for this purpose, but it is preferred to replace it by sodium hydrosulphite. The use of large quantities of sodium sulphide is to be avoided. According to examples, Thional Black O.G., Duranthrene Blue C.C. and indigo are dissolved in caustic soda and sodium hydrosulphite and then mixed with cellulose xanthate. The mixture is spun in the usual way, and during the further treatment of the thread, particularly the washing and drying, the oxidation of the leuco compound proceeds. (Br. Pat. 181,902. Courtaulds, Ltd., London. Aug. 16, 1922.)

Dyeing Cellulose Acetate—Cellulose acetate goods are dyed direct in aqueous solution or suspension with non-sulphonated or monosulphonated soluble or insoluble dyes containing one or more of the following "active" groups: hydroxyl, amino, imino, imide, nitro, nitroso, isonitroso, acidylamino or azo groups; when a sulphonic group is present, the dye must contain at least two "active" groups. Carboxyl groups may be present or not. The dyes may be acid, basic or substantive dyes, vat dyes of the indigo or anthracene series, natural organic dyes, etc.

Salts which form double salts with basic dyes—for example, magnesium chloride, stannous chloride or zinc chloride—may be present in the dye bath when basic or other dyes are employed, or the basic dyes may be used in the form of such double salts. Examples are given of dyeing in an aqueous bath of gallocyamine DH, or in an aqueous foam bath of the kind described in specification 102,310 and containing insoluble Induline in suspension. (Br. Pat. 182,830. R. Clavel, Basel. Sept 6, 1922.)

Ammonium Sulphate — Commercial ammonium sulphate is neutralized by the addition of a solid neutralizing agent, preferably in powdered form, to the acid salt while it is being centrifuged. The neutralizing agent, which should be one capable of evolving a gas when in contact with the warm salt, is preferably added after the bulk of the mother liquor has been expelled, and is introduced into the centrifuge so that it becomes spread on the inner surface of the crystals in the lower portion of the basket. The flow of the remaining liquor then disseminates the neutralizing agent, or the gas envolved therefrom, throughout the mass. The salt is preferably discharged from the centrifuge before neutralization is complete, the continued decomposition of the reagent in contact with the hot salt serving to complete the process and, in addition, to dry the salt. The amount of neutralizing agent required may be less than the theoretical. (Br. Pat. 183,089. G. Weyman, Gateshead-on-Tyne. Sept. 6, 1922.)

Book Reviews

ELEMENTS OF INDUSTRIAL HEATING. By the engineers of the W. S. Rockwell Co., New York City.

"The influence of heat upon the quality and cost of practically all manufactured products, and the comparatively inefficient methods in general use, indicate the necessity of developing a broader view of the industrial heating problem. The demand for better and cheaper products can only be met with better methods of heating and handling, better equipment and, above all, men better qualified to understand and properly apply in practice the simple principles of one of the oldest and most important, though indifferently practiced, industrial arts."

There is no doubt of the importance of the problems thus outlined in the preface of this book, and furthermore there is no doubt that the engineers who have prepared it have done much for industry in furnishing this well-illustrated, effective summary of important considerations in fuel application. Much of the material in this book has appeared in pamphlets previously issued, but when this material is brought together under one cover, it again emphasizes the complexity as well as the importance of the fundamental problems as these problems are seldom stressed.

One of the purposes of this new book is to bring together in convenient form for the use of chemical and mechanical engineering teachers material that may be employed as a "supplementary textbook for shop training classes, vocational schools, colleges, etc., as well as for the man in the shop and others interested in the subject." Several institutions have already announced that they expect their engineering students to use this pamphlet. If this practice is extended widely, as it well may be, we may look forward to the time when engineers will think not alone of cost of fuel per ton or the relative cost of various fuels per million heat units, but rather of that important over-all efficiency, the fuel cost per unit of quality product. In bringing out the importance of that feature, this book gives attention not alone to the selection of the fuel but also to the selection of the furnace, the placing of the material in the furnace, the quality of product and the time factor in heating.

The book does not in any way argue for any single type of equipment or any particular fuel; it affords an unusually well-balanced and impartial review of the various types of heating furnaces, annealing equipment, automatic and continuous methods and the many variations of heat-applying devices that modern technology furnishes. It will be well worth while for experienced engineers as well as those beginning their studies in engineering to look through this booklet.

R. S. McBride.

THE LEAD STORAGE BATTERY. By *H. G. Brown.* 62 pp., illustrated. London, England: The Locomotive Publishing Co. Price, 5s. net.

As a handbook for those interested in the practical functioning of a storage battery, particularly stationary types, this book has considerable merit. It is exceptionally well written, being readable, clear and concise. The fundamental characteristics are given, but there is little attempt to discuss them and no attempt to include anything but very elementary theory.

The three opening chapters, which are largely introductory, deal with the chemistry of the lead cell, giving the familiar double sulphate theory. Characteristic voltage curves for charge and discharge are given and the influence of temperature is stated. A short chapter is devoted to a comparison of the Faure and Planté processes and characteristic structures and uses of each type of plate.

The main portion of the book, six chapters, is a discussion of stationary batteries, their construction, sphere of usefulness and maintenance. One chapter is devoted entirely to auxiliary apparatus such as boosters and automatic cut-outs. There are numerous wiring diagrams and the economies to be effected by the use of D. P. Battery Co., Ltd's., batteries are well advertised. All this material should prove of valuable assistance to the power plant engineer.

Unfortunately, however, the proportion of the industry interested in stationary batteries is much smaller in this country than in England. Only one chapter is devoted to our major product, portable batteries. This includes train lighting, vehicle, automobile starting and lighting and submarine, and, as far as it goes, is a good summary of the general demands in regard to voltage and capacity for each service and the types of batteries used. There are a few hints as to the care, but it is much too abbreviated to be of use to the American battery service station.

Since the book is so very well written both in regard to clearness of expression and the selection of essential facts, it is to be regretted that more emphasis has not been placed on the maintenance and repair of the portable type. Had this been included, the work would rank among the first of the storage battery handbooks. Helen Gillette Weir.

SYNTHETIC TANNINS: THEIR SYNTHESIS, INDUSTRIAL PRODUCTION AND APPLICATION. By *Georg Grasser*, Lecturer in Tanning Chemistry at the German Technical College, Brunn. Translated by F. G. A. Enna. viii + 143 pages. New York: D. Van Nostrand Co., 1922. Price, $4.

In the leather industry it has become customary to consider as tannins all materials which are capable of converting hide substance into imputrescible product. Without an understanding of this usage the term "synthetic tannins" is likely to appear misleading, since the chemical constitution of most of the industrial syntans bears not the slightest relation to that of true tannin. Indeed, much of the pioneer work on syntans was carried out before the chemical constitution of tannin was known. In order that this distinction may be clearly evident, the author devotes the first section to a review of the recent work on the synthesis of the true vegetable tannins. This is followed by a consideration of the different groups of syntans resulting from the condensation of phenols, hydroxybenzenes, naphthalene derivatives and products containing the anthracene, di- and tri-phenylmethane groups. The tanning effects of mixtures and of natural products other than true tannins (including sulphite waste liquor) are next treated, followed by a short section on analytical methods.

Part II covers the industrial production and application of syntans. Naturally, since much of the author's work was done in the laboratories of the Badische Anilin und Sodafabrik, the products of this company receive practically exclusive attention. Much of the material in this part will be of interest to the practical tanner, and the book should find a place in every tanner's library. ALAN G. WIKOFF.

A TEXTBOOK OF CHEMICAL ENGINEERING. Second edition. By *Edward Hart*, Ph.D. 241 pages, 229 illustrations. Easton, Pa.: Chemical Publishing Co., 1922. Price, $4.

Considerable additional information has been incorporated in the second edition of this book. New chapter headings include: Corrosion, Industrial Management, Pumps, Mechanical Handling of Materials, Autoclaves. Several of these could quite profitably receive more extended treatment in subsequent editions. It would seem that Professor Hart has formed the nucleus for a work which will become increasingly important as succeeding editions embody the suggestions which are sure to result from the author's earnest solicitations.

The author's perfect frankness on several points is quite refreshing. Thus, in speaking of obstacles to publication of information he says: "Boards of directors very often pursue the very silly policy of refusing to allow publication of information obtained in the working out of a process. The cry is that it has cost them much money and they are therefore unable to reveal it to competitors. This is true in some cases, but it is nevertheless true that the publication of many results whose publication could do no possible harm is forbidden in pursuance of a narrow policy which the directors deny in public and practice in private. As a result of this, research departments are often little better than information departments whose chief aim is to steal methods from competitors."

While many valuable data are scattered throughout the volume, the impression made upon the reader by the work as a whole is that of a collection of miscellaneous notes grouped somewhat hastily rather than a careful, orderly presentation of the subject. More attention to this point might add greatly to the value of subsequent editions without in any way interfering with the textbook style. Logical arrangement is not inconsistent even in a textbook. ALAN G. WIKOFF.

Synopsis of Recent Chemical & Metallurgical Literature

Comprehensive Study of Analyses of Coals

The results of analyses of hundreds of coals from 25 states and the Territory of Alaska are given in Bulletin 193, "Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1916 to 1919," by Arno C. Fieldner, Walter A. Selvig and J. W. Paul, recently issued by the United States Bureau of Mines. Information as to the heating values of all coals tested is also given in the bulletin, which should be of interest to all extensive users of coal fuel.

Many mine samples of coal are analyzed each year in the laboratories of the Bureau of Mines. The analyses are made in connection with investigations relating to fuels belonging to or for the use of the United States Government, the causes of accidents in coal mines, the geologic relations of coal beds and the quality and the value of the coal and lignite in the public lands. The systematic collection and analysis of such samples in connection with fuel investigations were begun in 1904 at the government fuel-testing plant at the Louisiana Purchase Exposition, and were under the direction of the United States Geological Survey for 6 years. Descriptions of the coal samples collected between the beginning of this work, July 1, 1904, and the transfer of the fuel-testing and mine-accident investigations to the Bureau of Mines, July 1, 1910, were compiled and published in Bureau of Mines Bulletin 22. Descriptions and analyses of samples collected during the fiscal years 1911 to 1913 were published in Bureau of Mines Bulletin 85. Descriptions and analyses of samples collected during the fiscal years 1913 to 1916 were published in Bureau of Mines Bulletin 123.

In order that the material in this bulletin may be used to supplement that presented in Bulletins 22, 85 and 123, the same plan of geological classification has been followed, the analyses and descriptions of the samples being grouped in alphabetical order according to the states, county and town near which the mines or prospects sampled are situated.

Information regarding coal sampling and analytical methods employed by the Bureau of Mines and a bibliography on the coal resources of the world are contained in the bulletin.

The entire distribution of Bulletin 193 will be through the Superintendent of Documents, Government Printing Office, Washington, D. C., from whom the report may be obtained at a price of 35 cents. Bulletins 22, 85 and 123, the previously issued compilations of coal analyses made by the Bureau of Mines, are sold by the Superintendent of Documents at prices of 85, 45 and 50 cents, respectively.

Is Borax a Deleterious Constituent of Fertilizer?

Considerable interest during the past 5 years has been centered around the effect of borax in fertilizer on crops. This originated when the potash from Searles Lake was used in some mixed fertilizers and disastrous results followed. The reason for this was traced to the presence of borax in the fertilizer, and this in turn was traced to the Searles Lake potash. The recent paper of the United States Department of Agriculture, Bulletin 998 (July 3, 1922), by B. E. Brown of the Bureau of Plant Industry, is therefore extremely interesting. Experimental work was carried on during the year 1920 at various experimental fields of the Bureau of Plant Industry. Rows of potatoes were fertilized with a 4-8-4 mixture from nitrate of soda, sulphate of ammonia, cottonseed meal, muriate of potash and acid phosphate, the ammonia being derived equally from the three nitrogen sources. To this mixture was added 1, 2, 3, 4, 5, 10, 20, 30, 50, 100, 200 and 400 lb. respectively of borax per acre of ground. The yield from the various plots was compared. It is interesting that with 1, 2 or 3 lb. of borax per acre the plant growth is apparently stimulated, but when the borax is increased to 5 and 10 lb., marked injury and stunting of the plant is very evident. This effect is increased with 20, 30, 40 and 50 lb. of borax until with 100 and 200 lb. almost no plant growth is evident. From differences noted in the way in which the fertilizer is applied, it was found that if a week were permitted to elapse after the application of borax fertilizer, the effect of the borax was somewhat less, although not markedly so. This experimental work is a splendid contribution to the knowledge of the effect of borax on potatoes and is extremely interesting to the chemical industry in view of its connection with the Searles Lake potash. This potash, of course, has now been prepared free from borax so that no hesitation need be felt in its use. It served originally, however, to call attention to the borax problem.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Synthetic Chemical Interests Plan Tariff Change Appeal to Congress

Will Not Take Advantage of Appeal Under Flexibility Provisions of New Law Until After Attempt to Modify Rates in Congress

TARIFF duties on coal-tar products and synthetic organic chemicals from other than a coal-tar base will be the subject of attention when Congress reconvenes, although just what will be asked by the industries affected has not been made clear to the House Ways and Means Committee or the Senate Finance Committee.

From direct correspondence and other information received by the Finance Committee, it appears that at present there are three distinct movements in this connection to change the recently enacted tariff law and involving two, or more likely three, separate bills.

One of these movements looks toward a higher duty on synthetic organic chemicals and medicinals from other than a coal-tar base. The new tariff act gives these products a rate of 25 per cent ad valorem, foreign valuation. This was the rate recommended by the Finance Committee. The House used the same figure, but as the bill when it passed that body originally based ad valorem rates on American valuation, the result would have been much higher in cost of imports. The Bursum amendment, adopted by the Senate, placed these products on the same footing and with the same rates as coal-tar products, but after the various changes in conference the provision was stricken from the coal-tar paragraph and restored to an individual paragraph at the 25 per cent, foreign valuation duty. The duty on these products in the Underwood tariff varied, some being free and others bearing duty up to 20 per cent. However, for many months synthetic organic products were protected by the dye and chemical control act. This embargo was lifted with the effective date of the new tariff and the industry's protection dropped from an embargo to 25 per cent.

Will Appeal to Congress

Under the flexible tariff section, it would be possible for this industry to apply for relief through investigation by the Tariff Commission and Presidential proclamation increasing rates if the results of the investigation justified such action, but it is understood here that an effort first will be made to secure a higher rate direct from Congress. What rate will be asked has not been made known to the committees.

In connection with coal-tar products, two ideas have been suggested to the Finance Committee, which may be handled in a single bill or in separate measures, with the probabilities favoring the latter method if the ideas are to be pushed.

The first is to reclassify the paragraph on finished products entirely, and probably that on intermediates also, and to insert different duties for different products. The claim is advanced that some products do not require as high protection as given in the existing law, while others need much greater protection against foreign competition. The second suggestion is to remove the proviso in the Fordney-McCumber act which prohibits an increase in rates on coal-tar products under the flexible tariff section, these being the only rates to which this prohibition applies.

Overemphasized Dyes

Definite moves along these lines may be expected in a few weeks. Reception by Congress is of an uncertain nature. There is a strong bloc, especially in the Senate, which believes that the synthetic chemical industry has not been given adequate protection.

Friends of the industry believe that a mistake was made in the past in stressing dyes so strongly and that if at least equal emphasis had been put upon other features of the industry the results might have been different.

Would Expand Tariff Commission

The Director of the Budget has been asked to approve an appropriation of $1,000,000 for the United States Tariff Commission for the year 1923-24.

A study of the new responsibilities devolving upon the commission under the administrative sections of the Fordney-McCumber tariff bill are so great that the members of the commission think the present appropriation should be trebled.

If the directors of the budget and Congress approve the request for the $1,000,000 appropriation that the Tariff Commission has requested for the fiscal year 1924, a large expansion in the various commodity divisions will take place. The commission expects to enlarge its commodity division staffs all around, with the more pronounced increases in the sugar, chemicals and textiles staffs.

Franco-German Potash Combine Rumor Persists

Alsatian Company Admits Negotiations Relative to Division of U. S. Business

Reports persist that negotiations are under way looking to a division of the American potash market between Germany and France. French potash interests have repeatedly made the threat that they would enter into an agreement with the Germans if they did not secure a just share of the business in the American market. They advocate an allotment of 75 per cent of the American business to German producers and 25 per cent to France.

Inquiries made by the American Embassy at Paris at the request of the Departments of Commerce and State resulted in the following report to the latter department:

"The Embassy is informed by the Alsatian Commercial Co. that while conversations are being held relative to a potash agreement no decisions have yet been reached."

French Production Grows

Potash production in France increased during the second quarter of the current year, according to official French figures just furnished the Department of Commerce. The production during that quarter was 46,282 tons K_2O. The production during the first quarter was 38,733 tons.

A material increase is noted in the exports from France of the double sulphates of potash and magnesia. The exports of carbonated potash also have increased. On the other hand, there have been material decreases in exports of nitrate and chloride of potash.

The Sulphur Export Association

Taking advantage of the Webb law provision authorizing the organization of export associations, the three sulphur producers—namely, the Union Sulphur Co., the Freeport Sulphur Co. and the Texas Gulf Sulphur Co.—have entered into a combination for handling the sale of their product in foreign markets.

The new organization is to be known as the Sulphur Export Association and its officers are as follows: C. A. Snider, president; executive committee, H. D. Whitton of the Union Sulphur Co., E. P. Swenson of the Freeport Sulphur Co. and W. L. Aldridge of the Texas Gulf Sulphur Co. A board of directors, to consist of two representatives of each company, is still to be appointed.

Reparation Dye Plan Is Harmless to Industry

State Department Gives Assurance That American Dye Industry Will Not Be Jeopardized

No action toward the acceptance of reparation dyes to be credited against the United States' account for maintenance of American troops on the Rhine will be taken until Congress meets, the State Department has indicated, as legislation will be necessary to establish machinery for distribution.

Official word has come from the State Department that whatever is done in this matter will fully protect domestic interests and that the quantity of dyes to be accepted will be valued at only a small fraction of the American bill for troop maintenance. It was indicated that the value of the reparation dyes to be accepted under the contemplated scheme would be between $3,000,000 and $5,000,000 a year. In this connection it is pointed out that the life of the Reparations Commission, under the treaty of Versailles, has less than 3 years yet to run. It is said that the plan is acceptable to all of the Allies.

Outline of Proposal

Under the treaties, the Reparations Commission is entitled to 25 per cent of the output of the German chemical works. Of this quantity, approximately one-fifth has been allotted the United States. Until recently, when the act expired, the character of the dyes accepted here has been regulated by the dye and chemical control act. The Textile Alliance has been acting as unofficial distributor, and the money paid by the consumers has been sent to the Reparations Commission.

The general idea of the pending proposition is to accept approximately the same quantity and the same character of dyes and have the money paid for them go into the United States Treasury to be credited against the bill for keeping American troops in the occupied areas of Germany.

Machinery for Distribution

The machinery for the distribution of the dyes will be set up under executive authority, with Congressional sanction, it is stated. In advance of Congressional action, however, the State Department does not expect to reveal just how it will provide for the distribution. The Secretary of State declines to discuss how the prices of the dyes would be fixed or other details.

It has been intimated that probably authority will be asked to empower the President to dispose of this matter, which would enable him to designate any government department or any trade association for that purpose. A resolution to this effect was introduced in the Senate last July, but did not receive action before adjournment. However, assurance was given that the importation of the German dyes would not threaten with extinction the American dye or chemical industries.

There is no question about the deliveries of the dyes. This has already been arranged for, it was stated. The only question remaining now is how they are to be sold.

Congress heretofore has been wary of taking any action which might be interpreted as involving the United States with the League of Nations, but under the circumstances here presented, when a method for partly collecting a foreign account is held forth, a more favorable view might be taken.

Chemical Engineers to Survey College Courses

In accordance with the vote of the Institute of Chemical Engineers at the June meeting in Niagara Falls, the council of the Institute has appointed a committee on chemical engineering education. The purpose of this committee is to obtain, as far as possible, the adoption of recommendations, embodied in the final report of the former committee on this subject, by the educational institutions. It is intended that, after 3 years' efforts to obtain this adoption, the committee shall select and publish the names of institutions offering chemical engineering courses which are approved by the Institute.

H. C. Parmelee, editor of *Chemical & Metallurgical Engineering*, is chairman of the committee, which is composed of ten other members, five of whom represent educational institutions and five the industry. The members who are interested primarily in educational work are Joseph H. James, W. K. Lewis, A. H. White, R. H. McKee and S. W. Parr. The members engaged primarily in industrial work are C. E. K. Mees, A. D. Little, C. L. Reese, W. C. Geer and W. R. Whitney.

Hoskins to Address New York Section of French Chemical Society

"Experiences of a Consulting Chemist" is the promising title of an intimate talk which will be delivered by Dr. William Hoskins, of Chicago, before the regular meeting of the American Section of Société de Chimie Industrielle, at the Chemists' Club, New York City, Oct. 13, 1922. All chemists and chemical engineers of New York and vicinity are cordially invited to be present at this meeting, which should be extremely interesting, as Dr. Hoskins' experiences have been wide and varied, and his reminiscences will no doubt be entertaining as well as instructive.

Tables of Data Issued for Zinc Chloride Solutions

A copyrighted zinc chloride solution table has been issued by the Manufacturing Chemists' Association. The table shows the relationship between Baumé degrees, specific gravity, concentration, weight per cubic foot and pounds of zinc chloride per cubic foot. Approximate allowances for temperature also are shown.

Leading Paint Men Select Technical Books

Leaders in Industry Express Choices for Ten Basic Books in Field

The basic books in the paint industry, as selected by leading members of the industry for inclusion in the business library of the McAlpin Hotel of New York, have been announced by L. M. Boomer, manager of the hotel. These selections came to Mr. Boomer as a result of an inquiry instituted among the leaders in the paint industry to assist him in building up a business library of the ten books in each of twenty industries selected by the leaders of those industries.

Among those giving selections from which final choice will be made are:

Paul S. Kennedy, industrial department, Murphy Varnish Co., Newark, N. J.; G. B. Heckel, secretary Paint Manufacturers' Association of the United States, Philadelphia, Pa.; R. L. Hallett, National Lead Co. research laboratories, Brooklyn, N. Y.; Nathaniel D. Chapin, the Billings-Chapin Co., Cleveland, Ohio; Henry A. Gardner, Institute of Paint and Varnish Research, Washington, D. C.; J. Sibley Felton, president Felton, Sibley & Co., Philadelphia; Maximilian Toch, vice-president Toch Bros., New York City; C. M. Lemperly, the Sherwin Williams Co., Cleveland, Ohio; A. S. Butler, president McDougall Co., Inc., Buffalo, N. Y., and G. C. Morton, president Carpenter-Morton Co., Boston, Mass.

Among the books selected were:

The Manufacture of Varnish and Kindred Industries, Livache and McIntosh; Varnishes, Oil Crushing, etc., Livache and McIntosh;; Drying Oils, Boiled Oils, etc., Louis E. Andes; D. Van Nostrand & Co., New York City.

Technology of Paint and Varnish, Sabion, John Wiley & Sons.

Quality Varnish, P. S. Kennedy, Murphy Varnish Co.

White Lead—Its Use in Paint, A. H. Sabin, John Wiley & Sons.

Red Lead and How to Use It, A. H. Sabin, National Lead Co., 111 Broadway.

Lead and Zinc in the United States, W. R. Ingalls, Hill Publishing Co.

Linseed Oil and Other Seed Oils, W. D. Ennis, D. Van Nostrand & Co.

Lead and Zinc Pigments, C. D. Holley, John Wiley & Sons.

An Introduction to the Study of Physical Metallurgy, Walter Rosenhain, D. Van Nostrand & Co.

Metallurgy of Lead, H. O. Hofman, Scientific Publishing Co.

Metallurgy of Lead, H. F. Collins, Charles Griffin & Co., Ltd., London.

Painters' Colors, Oils and Varnishes, Hurst, Chas. Griffin & Co.

Chemistry of Paints, Toch, D. Van Nostrand & Co.

German and American Varnish Making, Bottler and Sabin, John Wiley & Sons.

White Paints and Painting Materials, Scott, *Modern Painter*, Chicago.

Mixed Paints, Color Pigments and Varnishes, Holley and Ladd, John Wiley & Sons.

Paint Technology and Tests, Gardner, McGraw-Hill Co.

Paint Researches and Their Practical Application, Papers on Paint and Varnish; Gardner, P. H. Butler, Washington, D. C.

Proceedings of Scientific Section, Paint Manufacturers' Association of United States, P. H. Butler, Washington.

Paint Researches and Their Practical Application; Paint Technology and Test; Papers on Paint and Varnish, H. A. Gardner.

Corrosion and Preservation of Iron and Steel, Garner and Cushman.

Mixed Paints, Color Pigments and Varnishes, Drs. Holley and Ladd.

Paint Vehicles, Japans and Varnishes; Lead and Zinc Pigments; Dr. Holley.

Pigments, Paint and Painting, E. Berry.

A.I.C.E. to Establish Student Chapters

Amendment to Constitution Provides for Undergraduate Societies in Engineering Schools

The Council of the American Institute of Chemical Engineers has reported that the amendment to the constitution, printed in full below, has been passed by letter ballot of active members. This amendment provides for the establishment of student chapters of the A.I.C.E. at engineering schools of high standing where there is an active member of the Institute on the faculty.

REGULATIONS FOR STUDENT CHAPTERS

1. A student chapter in affiliation with the American Institute of Chemical Engineers, composed of students in a school of engineering of recognized standing, whose teaching staff includes an active member of the Institute, may be organized upon favorable vote by the Council. The name of such an affiliated society shall be "The ————————Students Chapter of the American Institute of Chemical Engineers."

2. The qualifications required of a proposed student chapter shall include:

(*a*) An organization of students in an engineering school of high standing which affords opportunity for specialization in chemical engineering;

(*b*) The endorsement of the application by the head of the chemical engineering department;

(*c*) A minimum membership of 12 students.

3. Each student chapter shall establish its own rules of government and procedure, which shall conform with any regulations which may be formulated by the American Institute of Chemical Engineers. It is also intended that each student chapter shall control the occurrence and character of its own meetings; but the American Institute of Chemical Engineers desires especially to aid in promoting the success and value of student chapters by frequent consultations and advice, as well as by arranging for speakers, on request, whose address will broadly supplement the class-work of the members. To this end the Council of the Institute will elect a councillor for each student chapter from among the active members of the Institute, who shall advise the student chapter in its relation to the parent society, and who shall transmit with his recommendations the report of the chapter called for in section 4.

4. Each student chapter shall submit an annual report, not later than the last day of May of each year, which shall include:

(*a*) A summary statement of the meetings held during the calendar year; giving the date of each, the attendance, the principal speaker and his subject, and other pertinent information;

(*b*) Names of the officers, and number of members, by classes, at the date of the report.

5. The annual dues of each student chapter shall be $15 per year, subject to any regular assessment or increase of dues of active members of the Institute, which, under provisions approved by the Council, shall entitle it to the following:

(*a*) A copy of each issue of the *Bulletin* and *Transactions* of the American Institute of Chemical Engineers and of all papers and discussions printed as separates and programs of meetings;

(*b*) Attendance at meetings.

The annual dues shall apply to the current fiscal year and shall be payable in advance, due Jan. 1. The secretary of the American Institute of Chemical Engineers shall send out bills for dues each December for the following year. Student chapters admitted on or after July 1 of each year shall pay $7.50 only for the balance of the current fiscal year.

6. Among the privileges offered to the members of student chapters are:

(*a*) Individual subscription to the *Transactions* of the American Institute of Chemical Engineers at a special price of $4 per volume;

(*b*) To receive at cost, on request, copies of such separate papers as may be printed in pamphlet form;

(*c*) The right to attend the meetings of the American Institute of Chemical Engineers;

(*d*) The opportunity to hear, on special occasions, speakers whose personal experience qualify them to speak with authority upon the many questions which are of particular importance to the student during his college course.

7. Application for admission of student chapters to the American Institute of Chemical Engineers shall be in the form prescribed by the Council.

8. A student chapter may be disbanded upon its own request and with the approval of the Council, provided its annual dues for the current calendar year have been paid. The Council may discontinue a student chapter if its annual dues are not paid promptly, or if it becomes inactive, or if its continuance is considered not for the best interest of the Institute.

This step represents an attempt to supplement curriculum activities with advice and instruction which should be of value to the students in their professional work. Contact with the activities of the Institute should prove stimulating to the student groups.

Push Dam Construction at Muscle Shoals

Every effort is being made at Muscle Shoals to complete the excavation in cofferdam No. 2 and get the concrete in before high water. At present the work is being delayed somewhat by the difficulties of obtaining cement, sand and gravel. Progress would have been halted almost entirely had the Corps of Engineers not owned about 80 box cars. These box cars were handled in solid trains accompanied by convoys of Corps of Engineers men and used exclusively to bring in cement supplies. In this way it has been possible to avoid any serious slowing down of the cement work. Sand and gravel for this job come from a point down the river. Owing to the unusually low stage, great difficulty has been experienced in getting the floating equipment over the shoals.

COMPLETE IN 1925

As early next season as the water will permit it is planned to close the south channel and work actively in that cofferdam and in the powerhouse cofferdam. Unless unforeseen difficulties should arise, it is believed that the dam will have been completed early in 1925.

At the present time 1,100 men are at work at Muscle Shoals. To date there has been no difficulty in getting all the labor needed. The force, however, is to be expanded to about 2,000 and as the local labor supply already is under employment, some difficulty is expected in recruiting the additional labor which will be needed.

New York University Plans Courses in Ceramics

New York University has arranged to include the subject of clay products and clay products manufacture in a series of lectures on the geology of commerce and industry, soon to be started. The discussion will cover brick, tile and kindred products of the ceramic industry, dealing with the fundamental facts regarding the raw material situation, character and source of supply, methods and costs of preparing the raw materials for market, relation to other lines of industry, etc.

Iron and Steel Institute to Meet in New York

The twenty-second general meeting of the American Iron and Steel Institute will be held at the Hotel Commodore, New York City, on Friday, Oct. 27, 1922. A distinguished list of speakers have prepared papers to be read at the morning and afternoon sessions. Discussions from the floor will follow the reading of the paper. The complete program follows:

Address of the president, Elbert H. Gary, chairman, United States Steel Corporation, New York.

Modern Methods of Mining Coal, H. Foster Bain, director, Bureau of Mines, Washington, D. C.

The Storage of Bituminous Coal, H. H. Stoek, professor of mining engineering, University of Illinois, Urbana, Ill., and J. V. Freeman, director, coal and coke research laboratory, United States Steel Corporation, Joliet, Ill.

Present Status of the Electric Furnace in Refining Iron and Steel, J. A. Mathews, Crucible Steel Co. of America.

Economic Importance of the Power Plant in the Steel Industry, E. F. Entwisle, Bethlehem Steel Corporation, Steelton, Pa.

The Steel Requirements of the Automotive Industry, C. H. Wills, president, C. H. Wills & Co., Marysville, Mich.

Heating Furnaces for Blooms, Slabs and Billets, W. P. Chandler, Jr., fuel and experimental engineer, Carnegie Steel Co., Duquesne, Pa.

Use of Liquid Fuel in Metallurgical Furnaces, R. C. Helm, director, Worcester research laboratory of the American Steel & Wire Co., Worcester, Mass.

The Thermal Efficiency of the Open-Hearth Furnace, C. L. Kinney, Jr., superintendent No. 1 open-hearth department, South Chicago Works, Illinois Steel Co., South Chicago, Ill., and G. R. McDermott, fuel engineer, South Chicago Works, Illinois Steel Co., South Chicago, Ill.

Fluorspar and Its Uses, G. H. Jones, president, Hillside Fluorspar Mines, Chicago, Ill.

Chemical Experts Needed on Tariff Commission

The Tariff Commission under the new law has greatly increased responsibility with respect to many import matters. A considerable number of experts will be required to carry out this work, and, among others, several chemists will be needed. At an early date it is desired to add specialists on heavy chemicals and essential oils. Such men should, of course, be graduate chemists with some years of industrial experience and should be competent to prepare reports on domestic production, international movement of chemicals, competitive conditions, costs, etc.

Persons interested in such positions should take the matter up with the Tariff Commission, Washington, at once, as some of this work must be undertaken at an early date.

Some Impressions of European Chemical Industries

New York Section, A.C.S., Hears Interesting Talks by Parsons, Hendrick and Brooks—British Editor Also Speaks

The fall season of society activities in New York City was opened last Friday by an enthusiastic meeting of the local section of the American Chemical Society. A fair proportion of the section's 2,100 members were on hand to listen to the stories brought back by our recent European travelers —Parsons, Hendrick and Brooks—and to an engaging talk by our distinguished visitor, Frederick E. Hamer, editor *Chemical Age* (London).

Preceding the program scheduled for the evening, Dr. Charles L. Parsons, as secretary of the national society, was given an opportunity to tell of the plans now being made for educating the public to the vital importance of chemistry in our economic life. Two proposals have been made. The first is that each section of the A.C.S. should appoint a member whose duty shall be to interview every Congressman and Senator from the district and see to it that they have a proper appreciation of the relation of our science to the country's industrial and social progress. The second plan, reported to have been proposed by Mr. Garvan, was that the society should interest chemical and allied manufacturers to give the industry national publicity in all of their advertisements by including the sentence: *"This Is a Product of Our American Chemical Industry."*

Dr. Parsons Banquets and Dines

Later in the evening in describing his recent trip to Europe, Dr. Parsons gave a detailed account of the Lyons meeting of the International Union of Pure and Applied Chemistry, in which as a vice-president he represented the United States. His constantly recurring references to the many banquets, dinners and lavish entertainments at Lyons and later at Marseilles brought forth many a hungry and thirsty sigh from his audience. A more serious comment on these entertainments, however, was the fact that in contrast to some of our own scientific meetings, they were always attended by Cabinet members and other high officials of government and state.

From a technical viewpoint nitrogen fixation is still the most important subject of industrial research in Europe. In England the Dillingham plant is about to be put in operation to produce 100 tons of ammonia a day. The big problem at the Badische works in Germany, according to Dr. Parsons, is not in the fixation reaction itself but in the economic production of hydrogen. Because of difficulties and expense connected with the carbon-steam method, a great deal of study has been given to electrolytic hydrogen. This process is believed by them to be the coming method. Claude in France is said to have developed a process of taking hydrogen out of such gases as illuminating and coke-oven gas, by means of high pressures and low temperatures. Because of the quantitative recovery of such byproducts as benzol and ethylene it believed that the hydrogen can be obtained practically without cost.

British Chemical Industries

Mr. Hamer, who is in this country as a delegate to the meeting of the Associated Business Papers, Inc., declared that there is a growing feeling in England that the commercial and professional opinion of the industrial press offers better guidance to the government than does the manufactured politics of the daily papers.

Economic conditions in the British chemical industries have practically paralleled those in this country, according to Mr. Hamer's observations. Politically, however, he has reason to believe that they are better off in England than we are here. At least the government has definitely kept its promises to the chemical industries. The safeguarding of industries act, even with its shortcomings in administration and a strong opposition from the merchant class, has recently received a decidedly favorable vote of confidence by the British Parliament. Much of the credit for the general active condition of the British industry is due, Mr. Hamer believes, to the virile work of the Association of Chemical Manufacturers and its secretary, Mr. Woolcock; to the Chemical Engineering Group, the Chemical Industry Club, and various kindred organizations.

Personalities and Processes

Ellwood Hendrick's talk was mostly a bunch of anecdotes—interesting reminiscences of personalities and gossip about pleasant acquaintances made during his stay in London and his attendance at the meeting of the Society of Chemical Industry in Glasgow. He described the quaint customs, appearances and characteristics of some of England's foremost chemists, including such men as Sir J. J. Thomson, Sir William Pope, Professors Armstrong, Donnan and Ruttan, E. V. Evans and Stephen Miall. Finally, after threatening to exhaust his bountiful supply of superlatives, Dr. Hendrick described the interesting and business-like manner in which the Society of Chemical Industry conducted its annual meeting. There was the implication that some of our own societies could do well to emulate this excellent example.

Dr. B. T. Brooks closed the meeting with brief reference to a number of technological developments which had come to his attention while abroad. Most significant, perhaps, is the work in Germany on the hydrogenation of coal to produce liquid fuels resembling crude petroleum and yielding corresponding products on distillation. Over $5,000,000 has already been spent in developing this process, which by simple hydrogenation under high pressures is said to result in an 80 per cent conversion of bituminous coal to liquid and gaseous products.

Another interesting reaction is the British process of hydrogenating CO to methyl alcohol. With a yield attained of 80 per cent, methanol can be produced at a cost of 1s. per gallon.

Dr. Brooks also referred to the Anglo-Persion Co.'s new process for using hypochlorite solutions instead of sulphuric acid in petroleum refining. A paper on this subject which was presented by Dr. Brooks at Pittsburgh will shortly appear in *Chem. & Met.*

Literature Needed by Russian Engineers

The need of Russian scientists and technologists for American literature is well known. The division of engineering of the National Research Council is constantly receiving requests from various institutions in Russia for recent American scientific literature. It is urged that persons having extra copies of scientific books, periodicals, publications of government and state scientific bureaus and scientific institutions, and authors' reprints of an original character or containing technical information, which have appeared since 1914, contribute them for this worthy cause.

All shipments for scientists in Russia should be sent by express, or if very heavy, by freight, to the American Relief Administration, care of Gertzen Co., 70 West St., New York City. Each consignment forwarded to New York should be accompanied by a list of the publications sent. This will enable the New York office and the committee to check up the shipment and its receipt and distribution in Russia. One copy of this list should be placed on top of the literature before the package is closed and five copies, together with all letters containing advices of shipment, express and shipping receipts, should be addressed to the American Relief Administration, Russian Scientific Aid, 42 Broadway, New York City. The cost of overseas transportation of all material forwarded to New York is borne by the American Relief Administration. Its distribution in Russia will then be arranged for by the Russian Academy of Scientists or a special committee representing recognized Russian scientific organizations in cooperation with local units of the A.R.A.

Australian Investigations on Tanning Materials

For some time past the Institute of Science and Industry has been carrying out investigations on tanning materials in Western Australia. Two of the more important of these investigations have now been completed. One relates to the Western Australian red gum, Marri kino. A suitable process has been devised for getting rid of the objectionable red color which this kino imparts to leather when tanned with it. The other relates to a comprehensive investigation of the tanning materials of Western Australia.

Trade Commission Cites Turpentine and Celluloid Concerns

The Federal Trade Commission has issued a formal complaint against the Clifford Smith Co., of Richmond, Virginia, distributor of paints.

The respondent is charged in the complaint with exploiting, by advertising and by other means, a substitute for turpentine under the name of "Argentine turpentine," thus deceiving the purchasers of such commodity into the belief that the product is turpentine when such is not the case.

The Atlantic Comb Works, of New York City, has also been cited in a formal complaint by the Federal Trade Commission. The concern manufactures and sells toilet articles composed of nitrated cellulose or pyroxylin plastic, known commercially as "celluloid," "pyralin," "fibreloid," "viscoloid" and by other names. This product resembles ivory in color and general appearance and the respondent, the complaint alleges, exploits the same under the title and designation of "White Ivory," thus deceiving the purchasing public into the belief that the articles so distributed by respondents are made of ivory in whole or in part.

Stockholders Ratify Merger of Electric Alloy With Atlas

Stockholders of both the Electric Alloy Steel and the Atlas Crucible Steel, of Dunkirk, N. Y., have formally approved a merger into the Atlas Steel Corporation, organized under New York charter. The capital structure of the new concern is $2,000,000 bonds, $1,000,000 debentures, $2,000,000 of bank loans, $500,000 of prior preference stock, $6,000,000 of 7 per cent cumulative preferred stock, of which $5,000,000 will be issued, and 100,000 shares of no par value of common stock.

The company will have an annual productive capacity of 45,000 tons of high-speed and special-analysis steel, and will be the second largest independent producer in its field in this country. L. J. Campbell, chairman of the board and chief officer, says the Youngstown offices of Electric Alloy will be closed and quarters established at Dunkirk.

New Cement Plants to Be Built in Birmingham District

The announcement by the Lehigh Portland Cement Co. that it will immediately construct a portland cement plant in Birmingham, Ala., on a block of land next to the Alabama byproducts plant assures the construction of two large cement plants which will cost approximately $2,500,000 each. The estimated production of the Lehigh plant will be 1,000,000 bbl. per annum and that of the Phoenix recently announced 1,500,000 bbl. per annum.

The Lehigh plant will be built on 480 acres of land that is completely underlaid with limestone, thus giving an almost inexhaustible supply of one of raw materials.

Former Carnegie Steel Men Organize New Company

The Greenville Steel & Iron Co., recently organized at Greenville, Pa., has awarded a general contract to the McClintic-Marshall Co., Oliver Building, Pittsburgh, for the initial buildings for its proposed new plant on site lately acquired near the city limits, comprising about 35 acres of land. The structures will include an open-hearth furnace building, 100x150 ft.; 1-story rolling mill, wire-drawing mill, machine shop, warehouses, power house, and other mechanical buildings. At a later date it is proposed to construct a 500-ton blast furnace, additional rolling mills, foundry and other structures, to develop a maximum output of 350,000 tons of material per annum. Production will be devoted to steel castings, general steel products, wire specialties, etc. The entire plant is estimated to cost about $2,500,000, including machinery. H. P. Bope, formerly connected with the Carnegie Steel Co., is president; H. E. McConnell, consulting metallurgical engineer, also previously associated with the Carnegie Co., will be managing director. The Greenville Chamber of Commerce is interested in the project.

Manufacturing Chemists Appeal for Regular Car Supply

Irregular car supply has so interfered with the handling of certain of the heavy chemicals and chemical raw materials that it has been necessary for the Manufacturing Chemists' Association to make formal representations on the subject to the car service committee of the American Railroad Association.

Personal

RAY W. AMES, professor of mining engineering, University of Illinois, gave an address at a recent meeting of the Dallas Technical Club, at the Mecca Café, Dallas, Tex.

RAYMOND K. BOWDEN, of Niles, Ohio, has been appointed instructor in metallurgy for 1922-23, at Carnegie Institute of Technology, Pittsburgh. Mr. Bowden leaves a position with the Crucible Steel Co. in Pittsburgh.

C. A. BROWNE was nominated as chairman of the New York Section of the American Chemical Society at the meeting on Oct. 6. C. E. DAVIS was nominated for vice-chairman and B. T. BROOKS for secretary-treasurer.

ROBERT S. BRADLEY has been elected chairman of the board of the American Agricultural Chemical Co., New York. GEORGE B. BURTON has been elected president.

F. E. HAMER, editor of *Chemical Age*, London, is in New York as representative of Benn Bros., Ltd., to the meetings of the Associated Business Papers, Inc., and the National Conference of Business Paper Editors. Mr. Hamer intends to visit Philadelphia, Wilmington, Baltimore and other Eastern industrial centers before his return to England, which he plans for about Oct. 28.

H. W. HARDINGE is returning from a 3 months' trip in Europe, on the S.S. Berengaria, which sailed Oct. 3. His trip was for the purpose of studying mining and industrial conditions in Italy, Switzerland, France and England.

I. M. JACOBSON, who has been at the University of Chicago doing graduate work, has returned to the Bureau of Standards, where he will be engaged on the problems of aviation chemistry. The work will include particularly the studies of balloon fabrics and dopes for treating airplane fabrics.

FRANK M. JONES of the research department, Brown Company, Berlin, N. H., will leave Nov. 1 to accept the position of chief chemist of the Durex Chemical Corporation at Sweetwater, Tenn.

A. L. PITMAN, until recently assistant director of the Bangor station of the Massachusetts Institute of Technology School of Chemical Engineering Practice, is now in charge of the institute's consulting work for the Tidewater Oil Co.

JOHN F. PRICE has been appointed vice-president of the George T. Trundle, Jr., Engineering Co., 118 St. Clair Avenue, Cleveland, Ohio. Mr. Price was formerly comptroller of the Brown Hoisting Machinery Co., Cleveland, Ohio.

DAVID J. PRICE, engineer in charge of development work in the Bureau of Chemistry, has been designated by Secretary Wallace to represent the United States Department of Agriculture and co-operate with the Chamber of Commerce of the United States in the nation-wide fire-prevention movement now being undertaken by that organization. In this campaign considerable attention will be given to industrial dust explosions and fires, and Mr. Price will serve on the National Fire Waste Council.

W. S. RUGH, Montreal, Que., gave an interesting illustrated lecture on the smelting industry before the members of the local Rotary Club, at a recent meeting at the Windsor Hotel.

E. P. SAWHILL has been placed in charge of conveyor sales of the Brown Hoisting Machinery Co., of Cleveland.

Obituary

HERBERT C. FOLLINGER, manager of the Chicago office of the Chain Belt Co., died of pneumonia at his home in Chicago, on Sept. 27. Mr. Follinger was 38 years of age at the time of his death. He was born at Fort Wayne, Ind. He became associated with the Chain Belt Co. in 1914, and in 1916 was appointed district manager for the Chicago territory.

JAMES LUND, vice-president of the Merrimac Chemical Co., who had been with the company 38 years, died at his home in Malden, Friday, Sept. 29, 1922.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Present Trend of Coal Production and Prices

rogress Made Since Settlement of Coal Strike Indicates That a Possible Industrial Fuel Shortage Turns on the Question of Transportation Rather Than Mine Production

SLIGHTLY lower prices for soft coal and the widespread publicity iven to Henry Ford's advice that coal uyers "delay purchases, as prices must op further" have combined to bring out a situation in the coal market hich may entail grave responsibilities industry. In the opinion of the coal ade, as voiced by *Coal Age*, this can ean nothing but higher prices, "espe- ally with transportation conditions as ey are and will be this winter," and is on the question of distribution ther than production that the issue sts.

It is estimated that at present 25 r cent of the motive power of e railroads is out of commission, and is is at a time hen they are at- mpting to handle e peak of the ear's coal busi- ess. The general elief is that pres- nt delayed pur- hases will result a congestion fol- wing the resump- on of business on scale greater than an be cared for roperly by the arriers.

Production Leveling Off

roduction of both ituminous coal nd anthracite ap- ears to have eached a tem- orary level, bi- uminous at around 9,750,000 net tons nd anthracite at 1,850,000 tons a week. ccording to the reports of the Geologi- al Survey, "the total of all coal raised about 11,600,000 net tons, which is ill somewhat less than the amount re- uired to meet current consumption and e heavy movement up the Lakes, and t the same time to rebuild consumers' ocks."

Output of Anthracite and Bituminous

The output of anthracite during the eek ended Sept. 30 was estimated to e between 1,800,000 and 1,900,000 net tons, as against 1,856,000 tons in the preceding week.

The total production of bituminous coal, which is shown by weeks since 1919 in the accompanying chart, was estimated at from 9,600,000 to 9,900,000 tons. From these curves it will be observed that the present weekly rate of production is nearly a million tons above that of the year of depression, 1921, but is from one and one-half to three million tons below the years 1919 and 1920. Recent returns and figures for the cumulative production during 1922 for bituminous and anthracite coal and beehive coke will be found in Table I, prepared from data issued each week by the Geological Survey.

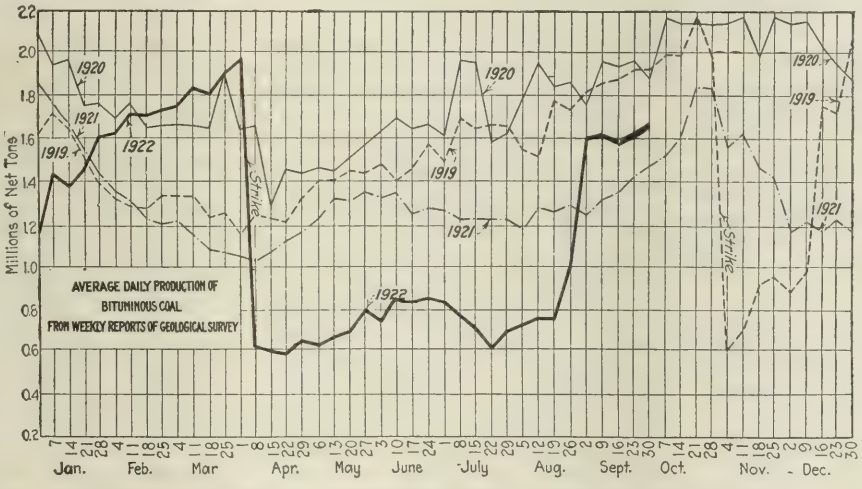


FIG. 1—ESTIMATED AVERAGE TOTAL DAILY PRODUCTION OF BITUMINOUS COAL

TABLE I—ESTIMATED PRODUCTION OF COAL AND COKE

(Net Tons)

Week ended:	1921	1922
Bituminous Coal		
Sept. 9 (*b*)	7,083,000	8,791,000
Sept. 16 (*b*)	8,187,000	9,737,000
Sept. 23 (*a*)	8,527,000	9,702,000
Daily average	1,421,000	1,617,000
Calendar year	286,550,000	261,149,000
Daily average, cal. year	1,280,000	1,162,000
Anthracite Coal		
Sept. 9	1,483,000	50,000
Sept. 16 (*b*)	1,749,000	1,107,000
Sept. 23 (*a*)	1,725,000	1,856,000
Calendar year	67,759,000	25,224,000
Beehive Coke		
Sept. 16 (*b*)	64,000	123,000
Sept. 23 (*a*)	70,000	135,000
Calendar year	4,034,000	4,625,000

(*a*) Subject to revision. (*b*) Revised from last report.

Beehive Coke Production

Late returns for the week ended Sept. 16 reduced the estimates of beehive coke production in that week to 123,000 tons. Reports for the following week (Sept. 18-23) indicated an out-turn of 135,000 tons. This was nearly double the out-turn of the corresponding week in 1921, but was only one-third of the average weekly rate in 1920. Reports more recently received from the principal coke carriers indicate that during the last week of September the output jumped to 162,000 net tons, an increase over the preceding week of 18 per cent.

Cumulative production during 1922 stands at 4,625,000 tons. In the corresponding periods during the 4 years immediately preceding it was as follows:

1918	22,489,000	1920	15,695,000
1919	14,485,000	1921	4,034,000

Thus 1922 is 79 per cent behind 1918, 68 behind 1919, 71 behind 1920, and but 14 per cent ahead of 1921.

Coal Prices

The *Coal Age* index of spot bituminous prices declined on Oct. 5 to 404, as compared with 418 for the preceding week. This corresponds to an average spot price of $4.89 at the mines.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	150.78
Last week	150.14
October, 1921	151
October, 1920	263
April, 1918 (high)	286
April, 1921 (low)	140

Practically all of the gains reported last week were maintained and there were a few additional advances. Citric acid, borax and cottonseed oil quotations were somewhat higher and more than compensated for the slightly lower prices of caustic soda and linseed oil.

The General Rise of Commodity Prices

Wholesale prices, as measured by most of the general commodity indexes, have shown a distinct rising tendency except perhaps for August and September. The Bureau of Labor Statistics figure based on 404 commodities—including both raw materials and finished products—stood at 150 for June, increased to 155 for July and continued without change in August. The trends of the various groups are shown in Table II.

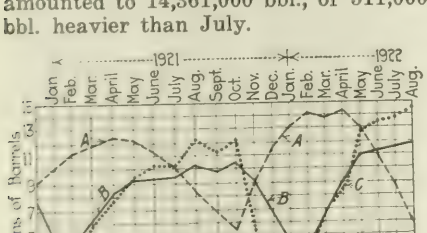
TABLE II—INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES
(1913=100)

	June	July	Aug.
Farm products	131	135	131
Foods	140	142	138
Cloths and clothing	179	180	181
Fuel and lighting	225	254	271
Metals and metal products	120	121	126
Building materials	167	170	172
Chemicals and drugs	122	121	122
House-furnishing goods	176	173	173
Miscellaneous	114	114	115
All commodities	150	155	155

The twenty-five representative chemicals included in *Chemical & Metallurgical Engineering's* weighted index of chemical prices have declined for the most part during the past few months. There is reason to believe, however, that September's average of 147.70 marks the low point in the present movement and barring unfavorable developments at present unforeseen, a gradual and consistent improvement may logically be expected during the fall and winter months.

More Cement Made and Shipped in August Than in July

Cement production in the United States during August, according to the Geological Survey, totaled 11,864,000 bbl., an increase of 107,000 bbl. over the preceding month. Shipments amounted to 14,361,000 bbl., or 511,000 bbl. heavier than July.


1921
1922
Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. April May June July Aug.
Millions of Barrels
A
B
C
MONTHLY FLUCTUATIONS IN
A Stocks of finished portland cement at factories
B Production, C Shipments from factories

PRODUCTION, STOCKS AND SHIPMENTS OF PORTLAND CEMENT, BY MONTHS, 1921-1922

Despite the fuel and car shortage, both production and shipments during August show improvement over July records. In fact, the August output exceeds that of the corresponding period in 1921 by 1,420,000 bbl. Shipments in August, 1922, showed an increase of 2,021,000 bbl. over the same month last year. A rate of shipment in excess of production left only 5,737,000 bbl. in reserve at the end of August, which was 2,696,000 bbl. under the stocks on hand July 31.

The Iron and Steel Market

PITTSBURGH, Oct. 6, 1922.

The recent curtailment in pig iron and steel production proves to have been no more than an episode. The rate of production in June had been the highest of the year and that rate is now practically regained. The deficiency in production in the three intervening months, from production that would have occurred with the June rate, is less than half a month's output at the June or the current rate. Undoubtedly a material part of the steel shipped up to Aug. 1 had been ordered as a safeguard against the coal strike interfering with steel production and the provision may easily have been ample to cover the slight restriction that occurred. Of late steel buyers have been menaced with transportation restriction. Now the restriction is a fact and there is danger of there being somewhat greater restriction.

TRANSPORTATION DIFFICULTIES

Car shortages, for shipping finished product, are experienced at most steel plants, and in some cases the shortages are very severe. The noteworthy item is that the Carnegie Steel Co. has piled 100,000 tons of finished and semi-finished steel, all of which should have been shipped as made. The American Sheet & Tin Plate Co. is motor trucking sheet bars from Duquesne to McKeesport and Monessen, and even at that has had approximately a 10 per cent reduction in its finishing mill operations, from lack of steel. Box cars have been scarce for many weeks, but by dint of effort the company has been able to ship nearly all its product.

Open-top cars are now even scarcer than box cars, this being attributed to the coal movement. While much is being said, the exact situation cannot be appraised. There is no ready explanation of the fact that cars are so scarce when it is seen that the total car loadings in the week ended Sept. 16 were only 6 per cent under the record week, for if one attempt to explain by reference to there being a heavy coal movement he is confronted by the Geological Survey's report that bituminous coal production in that week was less than 10,000,000 tons, whereas in many weeks in 1920 there was production of more than 12,000,000 tons. The fact simply remains that there is loud complaint that steel mills do not obtain enough cars to load all their product, while hitherto the complaint has been that not enough coal and coke was being received.

Advances in basis prices of finished steel products, for late delivery, appear to have ended. At the same time delivery premiums are tending to diminish. The prospect seems to be that within a few weeks all delivery premiums will have vanished. Later, it is likely that basis prices may decline somewhat. The swing is more easily predicted than the time. The general buying movement ended recently, present activity being in early deliveries only. Another general buying movement will scarcely come until after there has been a period of quietness, during which some declines in basis prices can barely be avoided. The chief question is as to the extent of the prospective declines. The low point of early this year cannot be attained, as wage rates are much higher. Furthermore, it is impossible that sellers will again quote below cost, as it was claimed they did early this year. The experience then does not encourage a repetition now.

Events confirm the wisdom of the rail mills in their recent offer to book rails for the first half of 1923 at the old price of $40, in anticipation of the advance to $43, effective at the beginning of this week. Exact figures are not obtainable, but it appears that rails ordered will total considerably more than a million tons, while there has also been heavy buying of joints, bolts, spikes and tie plates, making a total business put under cover of about one and a half million tons. When the offer was first made it was not clear in all quarters that the mills would have spare production in the winter, but it is now plain that the orders will be needed in winter and probably in spring.

STEEL AND IRON PRICES

Bars and shapes are 2@2.25c. in the open market, depending on delivery and character of order, plates being 2.15@2.50c., but with little tonnage at above 2.25c. The Steel Corporation price seems to be 2c. on all three products, but buyers are no longer interested in such deliveries as the corporation can make, its order books being very well filled. The 3.35c. sheet price of the corporation is nominal, as the corporation is sold out until it opens books for first quarter. Independents are getting 3.50@3.60c., according to tonnage and delivery. Nails are uniform at $2.70. Pipe prices are practically uniform, on a 68 per cent basing discount, and all mills are far behindhand in deliveries of merchant pipe, particularly butt weld galvanized. Tin plate demand is seasonally poor, with $4.75 remaining the regular market.

Valley merchant furnaces have scarcely any pig iron to offer. For Pittsburgh delivery the market seems to be in control of the Cambria Steel Co., which is quoting $33 on bessemer, $31 on basic and $32.50 on foundry, f.o.b. Johnstown, with $1.77 freight to Pittsburgh, the same as from the valleys.

Connellsville furnace coke is up 50c., at $12@$12.50, and foundry, still quotable at $13.50@$14, is stronger at that range. Offerings in the open market are very limited, although production on the whole continues to increase. The limiting factor is car supply, rather than the strike, this having been the case for about a month.

The Pittsburgh district coal market is lower, good grades of steam coal being available at $3.50@$3.75, or about 50c. less than a week ago. Gas coal is off about 25c. Byproduct coal is barely quotable and cannot be said to be easier.

The St. Louis Market

ST. LOUIS, MO., Oct. 5, 1922.

Trading in the industrial chemical market has been along very active lines during the past two weeks, and from present indications should continue at this pace. Some of the heavy chemicals which have only been marking time for the past few months have now shown a remarkable improvement. This is particularly true of such items as phenol and some of the potash salts. Prices have been on the upward trend since the new tariff became effective, but are gradually firming up, and it is hoped that in a very short time the market will again be stable.

ALKALIS

Nothing beyond the ordinary has happened in the alkali market since our last report. Only a routine business is being transacted, but prices are firm at former levels. *Solid caustic soda* in 5- to 10-drum lots is still being quoted at $3.90 per 100 lb. delivered buyer's door, with the usual differential prevailing for the flake. *Soda ash* is moving only through the normal channels, with prices the same as previously reported. In 5- to 10-bag lots $2.20 per 100 lb. for the regular 58 per cent light is being quoted. *Bicarbonate of soda* has advanced slightly and is now being quoted at $2.50 in 5-bbl. lots. In some instances this is being shaded slightly, but such is the exception and not the rule. *Sal soda* business is only routine, with prices a little weaker if anything.

GENERAL AND SPECIAL CHEMICALS

Heavy mineral acids are going very well, with a noticeable increase in the demand during the past month. Prices on all grades have been very strong with the exception of *muriatic*, which has been sluggish. Manufacturers report, however, that the former large stocks of this acid are now about depleted and that a firmer market will again be established. *Phenol* has been moving in large volume in spite of the sharp increase in price, and further advances would not prove surprising. Trading in *citric acid* since our last report has been quiet, but sales are still being restricted by manufacturers, which would indicate that spot stocks of domestic goods are very small. Prices are firm. Spot goods of *oxalic acid* are still difficult to locate and are being quoted at 17½@18c., St. Louis. The demand has been exceedingly active. *Ammonia water* continues to move in a routine way, prices remaining the same. *White arsenic, powdered,* is ruling at 9c. per lb. f.o.b. New York in carload lots, with a very strong market and a scarcity of supplies. The demand for *carbon bisulphide* has been along steady lines and prices very firm, which is explained by the fact that supplies have not been heavy and no surplus stocks accumulated this season. There has been very little change in the *copperas* situation—that is, so far as supplies are concerned—but since our last report producers have advanced their prices $2 per ton and now quote $20@$21 per ton in bulk, f.o.b. factory. *Glycerine* is going strong and the market is safely in the hands of producers. Our prediction of two weeks ago has been more than fulfilled and prices of 18½c. in drums are being firmly maintained. *Sulphur* has eased up a bit in price and is now being quoted at $1.90 in 50-bag lots. There is no natural cause for this decline in price, since the demand is at least normal. Price cutting among producers is probably the explanation. The market for *zinc dust* is very quiet with no change in prices, which are now being quoted at 9½c. in carload lots, St. Louis. The *zinc sulphate* market is very strong at 3½c. in carload lots, f.o.b. St. Louis. It would not be a surprise to see an advance very shortly.

VEGETABLE OILS AND NAVAL STORES

Castor oil has shown no inclination to weaken and the best that can be done now is 14c. per lb. in drums for U.S.P. No. 1. This item is moving strong with a good demand and producers are in control of the market. *Turpentine* has wavered very little since our last report and is now quoted at $1.41 per gal., as against $1.40 when we last reported. *Linseed oil* has done little in the way of price changing and users are limiting purchases to immediate demands.

The New York Market

NEW YORK, Oct. 8, 1922.

Many of the chemicals imported in largest quantity have continued in the advance noted last week in these columns. Although transactions in the aggregate have not been materially greater than during the past few weeks, the general tone of the market has improved considerably. The industry, on the whole, is quite optimistic concerning future business.

An interesting comparison can be made with the market one year ago and at present. Then buyers were quite cautious on surplus material due to the downward tendency of prices and purchases were mostly of a hand-to-mouth nature. The capital issue in the present market is not how low prices are going, but to what extent the upward trend will continue. Yellow prussiate of potash was offered during the latter part of 1922 at 24c. per lb. Present quotations range around 38c. Citric acid sold at 42c. during January and is bringing 52c. per lb. on the spot market. Barium chloride was offered quite freely at $50 per ton in 1922. The present market is exceedingly strong at $105 per ton. The same sort of comparison also holds for acetic acid, acetate of lime, formaldehyde, oxalic acid, nitrite of soda, prussiate of soda, permanganate of potash and various other chemicals.

The most important feature of the week's activities was the advance by producers on all varieties of lead acetate. Imported caustic potash continues to head the list of most active imported items. Dealers are very firm in their demands for higher prices. Yellow prussiate of potash recorded a late advance for spot goods. Commercial white arsenic has also been advanced and goods are very scarce for spot or nearby shipment. Lower prices were heard at the works on oxalic acid, the quotations for which had already discounted the effects of the new duty.

GENERAL AND SPECIAL CHEMICALS

Acetate of Lead—Manufacturers advanced prices on all varieties 1c. per lb. White crystals are now being quoted at 11½c. per lb. The demand continues to improve.

Arsenic—Prices for the white powdered are high and considerable activity has been reflected during the interval. November-December shipment sales have been made at 9½c. per lb. The insecticide industry has again come into the market and contracted as far ahead as March. Spot goods range from 9½@10c. per pound.

Bleaching Powder—Producers are quite firm in their views at 2c. per lb. f.o.b. works in large drums. Small containers were bringing up to 2¼c. per lb. Demand is generally active.

Caustic Potash—Imported 88-92 per cent is being sold around 6½c. per lb. The tone of the market is very strong and some dealers quoted higher figures. Consumers have shown added interest and leading factors recorded several carlot sales.

Caustic Soda—Export quotations were somewhat lower at $3.45@$3.50 per 100 lb. Goods for domestic consumption are bringing 3¾@4c. per lb. Contract prices remain quotably unchanged.

Chlorate of Soda—Domestic makers are quoting 6½c. per lb., f.o.b. works. Imported material is held around 6½@6¾c. per lb. A firm market with an advancing tendency is noted.

Nitrite of Soda—Imported material is obtainable in very limited lots at 9½c. per lb. The inquiry has shown considerable improvement and the general tone of this market is much firmer.

Prussiate of Potash—Spot prices have been very firm during the week and all indications point to higher levels. Several transactions were reported at 38@38½c. per lb. Supplies are very scarce and shipments seem to be around the same level as the spot market.

Prussiate of Soda—Dealers are holding stocks firm at 24@25c. per lb. The demand is very active for moderate sized quantities. Shipment prices for November-December are offered at 24½c. per lb., duty paid.

Sal Ammoniac—The white granular imported goods was quoted at 6¾@7c. per lb. Domestic factors continue to quote 7¾@8½c. per lb. The gray variety is very scarce at 7¾@8½c. per pound.

WAXES

Beeswax — Conditions surrounding this market have been of a quiet nature and prices were somewhat irregular during the interval. Supplies were around the market in larger volume, with the pure white quoted at 36@40c. per pound.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	—	$0.38 – $0.40
Acetone	lb.	$0 16½ – $0 16½	.17 – .17½
Acid, acetic, 28 per cent	100 lb.	2.80 – 2 90	2.95 – 3.50
Acetic, 56 per cent	100 lb.	5.60 – 5.75	5.80 – 6.25
Acetic, glacial, 99½ per cent, carboys,	100 lb.	11.00 – 11 25	11.50 – 12.00
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	—	.52 – .52½
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11¾ – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04½ – .04¾	.05 – .05½
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg	lb.	.06 – .06½	.06¾ – .07
Nitric, 42 deg	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.16 – .16¼	.16½ – .17
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	—	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9 50 – 10 00	
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.		.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	—	.31 – .31¼
Tartaric acid, imported, powdered	lb.	—	.31⅝ – .31½
Tartaric acid, domestic	lb.	—	— .32
Tungstic, per lb. of WO	lb.	—	1.00 – .110c
Alcohol, ethyl (Cologne spirit)	gal.	—	4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	—	.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.	—	.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03½ – .03½	.04 – .04½
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08½	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	—	2.35 – 2.50
Arsenic, white, powdered	lb.	.09½ – .09¾	.10 – .10½
Arsenic, red, powdered	lb.	.12 – .12¼	.12½ – .13
Barium carbonate	ton	80.00 – 82.00	83.00 – 85.00
Barium chloride	ton	105.00 –107.00	108.00 –110.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate		.09 – .09¼	.09½ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	
Blanc fixe, pulp	ton	45.00 – 55 00	
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)			
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	.27 – .38	.28½ – .35
Calcium acetate	100 lb.	2.75 – 2.85	2.90 – 3.25
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	—	1.40 – 1.50
Calcium phosphate, tribasic	lb.	—	.15 – .16
Camphor	lb.	—	.87 – .88
Carbon bisulphide	lb.	.06¾ – .07	.07½ – .07¾
Carbon tetrachloride, drums	lb.	.10 – .10¼	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	—	.60 – .75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	.04½ – .04½	
Chalk, precip.—domestic, heavy	lb.	.03½ – .03½	
Chalk, precip.—imported, light	lb.	.04½ – .05	
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.	—	.25 – .32
Cobalt oxide	lb.	—	2.00 – 2.10
Copperas	ton	20.00 – 22 00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.20 – .20½	.20½ – .21
Copper cyanide	lb.	—	.58 – .600
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.504
Cream of tartar	lb.	—	.26 – .27
Epsom salt (see magnesium sulphate)			
Ethyl acetate com. 85%	gal.	—	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	—	.90 – .95
Formaldehyde, 40 per cent	lb.	10½ – 10¾	.11 – .11½
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	
Fullers earth—imported powdered	net ton	30 00 – 32.00	
Fuse oil, ref	gal.	—	2.75 – 2.90
Fusel oil, crude	gal.	—	1.65 – 1.85
Glauber's salt (see sodium sulphate)			
Glycerine, c.p. drums extra	lb.	—	.18 – .18½
Iodine, resublimed	lb.	—	4.40 – 4.50
Iron oxide, red	lb.	—	.12 – .18
Lead acetate, white crystals	lb.	—	.11½ – .12½
Lead arsenate, powd	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	—	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	06 – 06½	.06¾ – .07¾
Magnesium sulphate, U. S. P.	100 lb.	2 00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	—	1.00 – 1.80
Methanol, 95%	gal.	—	.70 – .71
Methanol, 97%	gal.	—	.71 – .72
Nickel salt, double	lb.	—	.11 – .11½
Nickel salt, single	lb.	—	.12 – .12½
Phogene (see carbonyl chloride)		—	—
Phosphorus, red	lb.	—	.40 – .45
Phosphorus, yellow	lb.	—	.30 – .35½
Potassium bichromate	lb.	.10 – .10½	.10½ – .11
Potassium bromide, granular	lb.	—	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06½	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07½ – .07¾	.08 – .08½
Potassium cyanide	lb	—	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6 60	6.65 – 7.00
Potassium iodide	lb.	—	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.18 – .18½	.18¾ – .19
Potassium prussiate, red	lb.		.95 – 1.00
Potassium prussiate, yellow	lb.	.38½ – .38¾	.39 – .39½
Rochelle salts (see sodium potas tartrate)			
Salammoniac, white, granular	lb	.06¾ – .07	.07¼ – .07½
Salammoniac, gray, granular	lb.	.07¼ – .08	.08¼ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.08 – .08¼	.08½ – .09
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12 00 –13 00	
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09½	.09¾ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.45 – 3.50	3.55 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09½ – .09¾	.10 – .10½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03¾ – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	—	.18 – .21
Sodium prussiate, yellow	lb.	.24½ – .25	.25½ – .25½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 –20 00	
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	—	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	
Talc—domestic powdered	ton	18 00 –25 00	
Tin bichloride	lb.	.10 – .10¼	.10½ – .10¾
Tin oxide	lb.	—	.39 – .40
Zinc carbonate	lb.	.14 – .14½	.14½ – .15½
Zinc chloride, gran	lb.	.06 – .06½	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.60 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.53 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.72 — .75
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15	$0.10
Para-W acid	lb.	1.15	1.30
Ortho-amidophenol	lb.	2.10	2.15
Ortho-dichlor-benzene	lb.	.17	.20
Ortho-nitro-phenol	lb.	.80	.85
Ortho-nitro-toluene	lb.	.10	.13
Ortho-toluidine	lb.	.12	.14
Para-amidophenol, base	lb.	1.20	1.25
Para-amidophenol, HCl	lb.	1.25	1.30
Para-dichlorbenzene	lb.	.17	.20
Paranitroaniline	lb.	.72	.80
Para-nitrotoluene	lb.	.55	.65
Para-phenylenediamine	lb.	1.55	1.60
Para-toluidine	lb.	.85	.90
Phthalic anhydride	lb.	.35	.38
Phenol, U. S. P., drums	lb.	.21	.22
Pyridine	gal.	1.75	2.75
Resorcinol, technical	lb.	1.50	1.55
Resorcinol, pure	lb.	2.00	2.10
Salt	lb.	.55	.60
Salicylic acid, tech., in bbls	lb.	.25	.27
Salicylic acid, U. S. P	lb.	.29	.30
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12	.14
Sulphanilic acid, crude	lb.	.24	.26
Sulidine	lb.	1.20	1.30
Toluidine, mixed	lb.	.30	.35
Toluene, in tank cars	gal.	.25	.28
Toluene, in drums	gal.	.30	.35
Xylidines, drums, 100 gal	lb.	.40	.45
Xylene, pure, in drums	gal.	.40	.45
Xylene, pure, in tank cars	gal.	.45	....
Xylene, commercial, in drums, 100 gal	gal.	.33	.35
Xylene, commercial, in tank cars	gal.	.30	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.19½	$0.20
Beeswax, refined, dark	lb.	.30	.32
Beeswax, refined, light	lb.	.34	.35
Beeswax, pure white	lb.	.36	.40
Candellila, wax	lb.	.34	.36
Carnauba, No. 1	lb.	.40	.42
Carnauba No. 2, North Country	lb.	.25	.26
Carnauba, No. 3, North Country	lb.	.19	.19½
Japan	lb.	.15	.15½
Montan, crude	lb.	.03¾	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04	.04¼
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½	.02¾
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼	.03¼
Paraffine waxes, refined, 125 m.p.	lb.	.03¼	.03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04	.04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05	.05¼
Stearic acid, single pressed	lb.	.09	.09½
Stearic acid, double pressed	lb.	.09½	.09¾
Stearic acid, triple pressed	lb.	.10½	.10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.45	$6.55
Rosin E-I	280 lb.	6.60	6.65
Rosin K-N	280 lb.	6.70	6.80
Rosin W. G.-W. W	280 lb.	7.75	8.25
Wood rosin, bbl	280 lb.	6.25	....
Spirits of turpentine	gal.	1.27	1.28
Wood turpentine, steam dist	gal.	1.15	....
Wood turpentine, dest. dist	gal.	1.12	.70
Pine tar pitch, bbl	200 lb.	.....	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	9.50
Retort tar, bbl	500 lb.		9.00
Rosin oil, first run	gal.	.38	....
Rosin oil, second run	gal.	.41	....
Rosin oil, third run	gal.	.48	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Prices remain quotably unchanged

Crude Rubber

Quotations same as previous report

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½	$0.13
Castor oil, AA, in bbls	lb.	.13	.13½
China wood oil, in bbls	lb.	.12½	.12¾
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¼	.08⅜
Cocoanut oil, Cochin grade, in bbls	lb.	.08⅜	.09
Corn oil, crude, in bbls	lb.	.09¼	.10
Cottonseed oil, crude (f. o. b. mill)	lb.	.07¼	.07½
Cottonseed oil, summer yellow	lb.	.11½	.11⅝
Cottonseed oil, winter yellow	lb.	.12	.12¼
Linseed oil, raw, car lots (domestic)	gal.	.87	.88
Linseed oil, raw, tank cars (domestic)	gal.	.84	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90	.91
Olive oil, denatured	gal.	1.15	1.17
Palm, Lagos	lb.	.06¾	.07
Palm, Niger	lb.	.06	.06¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08½	.08¾
Peanut oil, refined, in bbls	lb.	.12	.12¼
Rapeseed oil, refined in bbls	gal.	.78	.80
Rapeseed oil, blown, in bbls	gal.	.86	.87
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09½	.09¾

FISH

Light pressed menhaden	gal.	$0.51	....
White bleached menhaden	gal.	.54	.55
Blown menhaden	gal.	.61	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45	.48

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$600.00	$800.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65.00	80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00	17.00
Shellac, orange fine	lb.	.61	.62
Shellac, orange superfine	lb.	.63	.64
Shellac, A. C. garnet	lb.	.62	.63
Shellac, T. N	lb.	.56	.57

All other prices remain quotably unchanged

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	69.00	72.00
Spiegeleisen, 19-21% Mn	gross ton	38.00	39.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00	2.50
Ferrosilicon, 10-15%	gross ton	38.00	40.00
Ferrosilicon, 50%	gross ton	63.00	65.00
Ferrosilicon 75%	gross ton	115.00	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.75	.80
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19.00	20.00
Coke, foundry, f.o.b. ovens	net ton	13.50	14.00
Coke, furnace, f.o.b. ovens	net ton	12.00	12.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45	.....
Manganese ore, chemical (MnO_2)	net ton	70.00	75.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y	lb.	.80	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12	.13¼
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	7.25	7.50
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	7.00	7.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25	2.50
Vanadium pentoxide, 99%	lb.	12.00	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½	.13¼

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent	21.00
Antimony, wholesale lots, Chinese and Japanese	7.00–7.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.75
Lead, New York, spot	6.35–6.50
Lead, E. St. Louis, spot	6.25
Zinc, spot, New York	7.05–7.10
Zinc, spot, E. St. Louis	6.75

OTHER METALS

Silver (commercial)	oz.	$0.69⅜
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.20
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$112.00
Iridium	oz.	275.00@300.00
Palladium	oz.	55.00
Mercury	75 lb.	72.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arizona

PHOENIX—The Southwestern Portland Cement Co., El Paso, Tex., has preliminary plans under way for the erection of a new plant on site selected near Phoenix, to consist of a number of buildings, with power house, etc., estimated to cost about $1,200,000, including machinery. The new mill will give employment to a working force of about 200 men, and will be operated as a branch of the main plant at El Paso. O. J. Binford is secretary and general manager.

Alabama

BIRMINGHAM—The McWane Cast Iron Pipe Co., Birmingham, has awarded a contract to the Ingalls Iron Works, Birmingham, for the erection of the first unit of its proposed new plant on property recently acquired at East Birmingham, to be 105 x 340 ft., and equipped as a foundry for the production of cast iron pipe of small size. Other foundry units will be built at a later date. J. R. McWane is president.

Arkansas

MCRAE—The Reynolds Brothers Co. has tentative plans under consideration for the erection of a new plant on local site for the manufacture of brick, tile and other burned clay products.

California

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg., San Francisco, has plans nearing completion for the erection of the initial unit of its proposed new plant in the harbor district, on site recently acquired, to be 2-story, 250x400 ft., with foundations to provide for the constructionn of three additional stories at a later date. With other projected structures, the plant will cost close to $1,000,000, including machinery. Albert C. Martin, Higgins Bldg., Los Angeles, is architect.

Connecticut

NORWALK—The Meeker Union Foundry Co. has awarded a contract to the T. J. Pardy Construction Co., Bridgeport, for the erection of a new 1-story foundry, for the manufacture of iron castings.

Georgia

ATLANTA—The Vulcanite Roofing Co., Beaver Rd., Buffalo, N. Y., a subsidiary of the Beaverboard Companies, same address, has tentative plans under consideration for the erection of a new local plant for the manufacture of composition roofing products. A site is being selected.

Illinois

CHICAGO—The Benedict Stone Corp., 33 West 42nd St., New York, N. Y., manufacturer of composition stone products, has preliminary plans in progress for the erection of a new branch plant at Chicago. It is proposed to organize a subsidiary company to operate the works. The parent organization is arranging to increase its capital, the proceeds to be used for general expansion.

ELGIN—Construction has been commenced on a new 1-story foundry at the plant of the Woodruff & Edwards Co., State St., manufacturer of hardware products, to be 50x100 ft., and estimated to cost approximately $100,000, including equipment.

Louisiana

MONROE—Thomas Stilwell, Anderson, Ind., associated with interests connected with the Lippincott Glass Co., Hartford City, Ind., is perfecting plans for the operation of a local plant for the manufacture of chimneys and kindred blown glass products. Another plant will be operated at Cedar Grove, La. The operating companies will be of co-operative character.

Maryland

BALTIMORE—The Solarine Co., Emerson Bldg., manufacturer of metal polishes, etc., has awarded a contract to Frainie Brothers & Haigley, 19 West Franklin St., for the erection of its proposed 1-story plant at Eagle and Smallwood Sts., estimated to cost close to $100,000, including machinery. E. H. Glidden, American Bldg., is architect. Harry A. Allers is president.

Massachusetts

EVERETT—The Stone & Forsyth Co., 67 Kingston St., Boston, manufacturer of paper products, has awarded a contract to the Blake & Pope Co., 50 State St., Boston, for the construction of an addition to its mill on Spring St., Everett, to be 2-story, 41x75 ft.

MALDEN—In connection with its new local plant building, for which contract recently was let, Wadsworth, Howland & Co. Inc., 139 Federal St., Boston, manufacturer of paints, varnishes, etc., is arranging an appropriation of approximately $600,000 for the construction of a number of other plant units. Plans will be prepared at an early date. A research laboratory will be established in connection with the plant. The company has acquired the Ocean Paint Works, Inc., 211 47th St., Brooklyn, N. Y., and will operate this factory as a subsidiary; the plant has a capacity of about 1,000 gal. per day.

Michigan

MUSKEGON—The Central Paper Co. is completing plans for the construction of a new 3-story addition to its mill on Richard St., estimated to cost approximately $200,000, with machinery. E. J. Gaddes is secretary.

DETROIT—The Austin-Kelly Ink Co., 2270 Franklin St., has filed plans for the construction of a new 2-story plant on Bellevue Ave., near Sylvester St., estimated to cost approximately $30,000.

MONROE—Plans are being completed for the construction of a new 1-story foundry addition at the plant of the Monroe Auto Equipment Co., to be 40x60 ft. Bids will soon be asked. A. F. Meyer is president.

SAGINAW—The Saginaw Chemical Co., 1618 North Michigan Ave., has preliminary plans under consideration for the construction of a plant on South Michigan Ave., consisting of two 1-story buildings, 68x100 ft. and 30x40 ft. respectively, estimated to cost about $50,000. It is expected to call for bids early in the coming year. James C. Graves is vice-president.

Missouri

ST. LOUIS—The Reardon Co., 2200 South 2nd St., manufacturer of glue, paints and kindred products, has awarded a general contract to Hirsch & Co., Wainwright Bldg., for the construction of a 3-story and basement plant addition at 2nd and Clinton Sts., 40x80 ft., to cost approximately $50,000. H. G. Clymer, Wainwright Bldg., is architect.

SPRINGFIELD—The Springfield Tanning Co., 214 Holland Bldg., formerly known as the Southwestern Tanning Co., has awarded a contract to the Pauly Construction Co., 741 South Ave., for the erection of its proposed 1-story and basement leather tanning plant, 100x135 ft., on West Commercial St. Work will be placed under way at once. W. R. Wolfe heads the company.

New Jersey

TRENTON—The New Jersey Porcelain Co., Pennsylvania and Mulberry Sts., has acquired a tract of property, fronting on New York Ave., extending from Strawberry to Plum St., as a site for the construction of a new plant. Plans will be prepared at an early date.

STOCKTON—The B. C. Tillinghast Rubber Mfg. Co., recently organized under state laws, has acquired the local plant of the Stockton Rubber Co., which has been under control of a receiver for more than a year past. The new owner will make immediate improvements, including the installation of new machinery to cost about $25,000. Employment will be given to about 50 persons for initial operations. Williams J. McLaughlin is vice-president and general manager; and Dominick Price, secretary and treasurer.

New York

NEW YORK—The Corn Products Refining Co., 17 Battery Place, has plans under consideration for extensions and improvements in its refining plants at Edgewater, N. J., and Pekin and Argo, Ill., to include the construction of new buildings and the installation of additional equipment. It is said that a fund of about $3,000,000 has been arranged for the expansion. The company will also enlarge its plants in France and Germany, estimated to cost in excess of $1,000,000, with equipment.

GOUVERNEUR—The Aldridge Paper Co., First National Bank Bldg., is considering plans for the construction of a new local plant, to cost about $35,000. N. R. Caswell is head.

NEW YORK—The J. Spaulding & Sons Co., 484 Broome St., manufacturer of fiber products, will soon break ground for addition to building at its plant on Wheeler St., Tonawanda, to cost about $150,000, including machinery. The new structures will supplement a plant addition now practically completed, representing a cost of close to $250,000. Plans are being prepared by George F. Hardy, 309 Broadway, New York, is engineer.

BUFFALO—Robert J. Gray, Dart St., near Bradley St., has made application to the city council for permission to equip a building at the location noted for a sherardizing plant, for zinc galvanizing and kindred work.

Ohio

NEWCOMERSTOWN—The Canton Brick & Tile Co., New Philadelphia, O., is completing plans and will soon break ground for the construction of a 1- and 2-story plant on the Hardy Asher estate property recently acquired. It will consist of a number of buildings, estimated to cost about $250,000, with machinery. W. H. Demuth heads the company.

BEDFORD—The Mason Tire & Rubber Co., Kent, O., has plans in progress for enlargements at the plant of the Owen Tire & Rubber Co., Bedford, recently acquired. It is proposed to increase the capacity from 500 to 1,500 tires a day. The company has arranged for a bond issue of $2,000,000, a portion of the fund to be used for the expansion.

NILES—The Brier Hill Steel Co., Youngstown, O., has plans in progress for the construction of proposed additions to the Thomas plant at Niles, to increase the capacity approximately 25 per cent. The installation will comprise new annealing furnaces, rolling mill equipment and other machinery, and is estimated to cost about $1,000,000, including buildings. A fund of this amount has been appropriated.

Oklahoma

BLACKWELL—The Tower Gasoline Co., Oklahoma City, has preliminary plans under consideration for the construction of a new oil refinery on local site, to include a gasoline absorption plant. It is also proposed to construct additions to a number of present gasoline works in other districts. L. Z. Harrison is general manager.

HOLDENVILLE—Charles Morris, Holdenville, is organizing a company to construct and operate a local plant for the manufacture of brick, tile and kindred burned clay products.

Pennsylvania

PITTSBURGH—The Stroh Steel Hardening Process Co., Westinghouse Bldg., will construct by day labor its proposed new plant at Chateau and Ridge Sts., to consist of a number of buildings, including foundry for the production of steel castings. The plant will cost about $250,000, with equipment. W. Y. Stroh is president.

CLARION—The Berney-Bond Glass Co. is said to have tentative plans under way for the rebuilding of its local plant

estroyed by fire, Sept. 24, with loss estiated at close to $400,000, including equipent. The works have been giving mployment to about 200 operatives.

PHILADELPHIA—The Wilmot Fleming Iron Steel Co., recently organized by Wilmot leming, 956 Foulkrod St., has preliminary lans in progress for the construction of a ew 1- and 2-story plant on site selected at ottman and G Sts., estimated to cost in xcess of $50,000. It will be equipped for he manufacture of general steel products. Ir. Fleming heads the company, and will ct as engineer for the works. Others inerested in the company are Paul E. Good nd Joseph J. Carr.

PHILADELPHIA—The Paper Manufacturrs' Co., 526 Cherry St., is razing the uilding at 5th, Willow and Randolph Sts., o make way for the construction of a ew 5-story mill, estimated to cost in xcess of $75,000. Clarence C. Wunder, 415 Locust St., is architect. Francis A.)'Neill is president.

EPHRATA—The Borough Council is aranging an ordinance providing an appro- riation of $30,000 for the construction of filtration plant at the municipal waterorks.

Tennessee

KINGSPORT—The Mead Fibre Co. has warded a general contract to W. A. Allen, Kingsport, for the construction of its proosed 2-story and basement mill addition, 5x275 ft., to be equipped for the manuacture of paper products and for finishing work. . The structure is estimated to cost bout $350,000, with machinery. The Management, Engineering & Development Co., Callahan Bank Bldg., Dayton, O., is rchitect and engineer, and will prepare lans for other future extensions estimated o bring the investment close to $1,000,000.

CHATTANOOGA—The Debois Tube & Rubber Co. has preliminary plans in progress or plant enlargements to more than double he present capacity. The expansion is stimated to cost in excess of $75,000.

Texas

HEARN—The Travis Cottonseed Products Co. is reported to be planning for the ebuilding of its oil mill, destroyed by fire, Sept. 17, with loss estimated in excess of 100,000, including machinery.

HOUSTON—The Armstrong Steel Co., Fort Worth, is selecting a local site for the construction of a plant for the manufacture of steel products, to consist of an open-hearth urnace, mills and other structures, estinated to cost approximately $1,000,000. The plant will be equipped for an annual roduction of about 60,000 tons. The present Fort Worth mills, with rated capacity f 40,000 tons per year, will be continued n operation. R. L. Van Zandt is president.

Utah

NEPHI—The Nephi Plaster & Mfg. Co. as plans under way for enlargements in ts mill, to include the construction of a omplete plant unit for the manufacture f agricultural gypsum products. The equipment installation will comprise grinding nd crushing machinery, screening apparatus, power equipment, etc. The work is stimated to cost in excess of $50,000.

Virginia

FREDERICKSBURG—The National Tanning Extract Corp. has acquired a local building, formerly used by the Wilson Dye Works, nd will occupy the structure for the manufacture of tanning extracts. Improvements will be made and equipment installed at an early date.

HOPEWELL — The Hummel-Ross Fibre Corp. has awarded a contract to the Wise Granite & Construction Co., American Bank Bldg., Richmond, for the construction of a 1- and 2-story plant, estimated to cost close o $100,000, with machinery. The Joseph H. Wallace Co., 5 Beekman St., New York, N. Y., is architect and engineer.

Washington

SEATTLE—The Washington Iron Works, Inc., has awarded a contract to the Austin Co., Smith Bldg., for the construction of a 1-story foundry approximating 65,000 sq.ft. f floor space, to be equipped for the production of steel and gray iron castings.

MICA—The American Firebrick Co., Mica, near Spokane, has plans under way for the rebuilding of the portion of its No. 2 plant, recently destroyed by fire, with loss of about $35,000, including equipment.

MT. VERNON—The Star Brick & Tile Co., Bay View, near Mt. Vernor, will soon commence the rebuilding of the portion of its plant, recently destroyed by fire, with loss approximating $25,000, including equipment. C. B. Mayhew heads the company.

West Virginia

CHARLESTON — The Libbey-Owens Co., Nicholas Bldg., Toledo, O., has plans in progress for the construction of six new additions to its local plant, ranging from 2-story, 45x240 ft. in size to smaller structures. The expansion is estimated to cost close to $300,000, including equipment. A complete cutter shop will be installed. The DeVore Co., 908 Nicholas Bldg., Toledo, is architect and engineer. E. D. Libbey heads the company.

Wisconsin

GREEN BAY—The Fort Howard Paper Co. has commenced excavations for a new 2-story and basement building, 100x140 ft., at its plant, to cost about $75,000. The general building contract has been let to the H. J. Selmer Co., McCartney National Bank Bldg.

MILWAUKEE — The Jelinek - Krueger Leather Goods Co., 416 4th St., is planning for the rebuilding of the portion of its plant, destroyed by fire, Sept. 9, with loss estimated at about $25,000.

Canada

CALGARY, ALTA.—The Imperial Oil Corp., 347 Madison Ave., New York, N. Y., has tentative plans under consideration for the construction of a new oil refinery at Calgary, with gasoline extraction plant, designed for a capacity of about 2,500 bbl. per day. The initial plant will give employment to more than 200 men, and is estimated to cost close to $2,000,000, with machinery. It is expected to commence construction early in the coming spring.

Capital Increases, Etc.

THE TRENTON LIME CO., Remsen, N. Y., has filed notice of increase in capital from $40,000 to $625,000, for proposed expansion.

THE LUDINGTON RUBBER CO., Ludington, Mich., has filed notice of dissolution under state laws.

THE MCLAURIN-JONES CO., Brookfield, Mass., a consolidation of the Ideal Coated Paper Co., Brookfield; Ware Coated Paper Co., Ware, Mass.; and the Samuel Jones Co., Newark, N. J., specializing in the production of gummed papers, has arranged for a bond issue of $400,000, the proceeds to be used for expansion and additions to working capital.

THE PEEL CHEMICAL CORP., 19 North Moore St., New York, N. Y., has filed notice of increase in capital from $200,000 to $450,000.

THE ENAMELED STEEL SIGN CO., 190 North State St., Chicago, Ill., has filed notice of increase in capital from $50,000 to $100,000.

THE ATLAS STEEL CORP., Dunkirk, N. Y., has been organized under state laws with a capital of 1,000 shares of stock, no par value, to take over and merge the Atlas Crucible Steel Co., Dunkirk, and the Electric Alloy Steel Co., Charleroi, Pa. Plants will be operated at the two places noted, and at Welland, Ont. Louis J. Campbell is head of the consolidated company.

THE EASTERN SUGAR CORP., a subsidiary of the Cuba Cane Sugar Corp., 112 Wall St., New York, N. Y., operating a refinery in Cuba, known as the Violeta Mill, has arranged for a bond issue of $10,000,000, a portion of the proceeds to be used for expansion and additions to working capital. W. E. Ogilvie is president.

R. RICHARDSON HILL & CO., INC., Saginaw, Mich., a Delaware corporation, has filed notice of change of name to the Old Hickory Dye-Chemicals Co., at the same time increasing its capital from $300,000 to $650,000.

THE GRAND RAPIDS GLUE CO., Grand Rapids, Mich., has filed notice of dissolution under state laws.

THE WHITELEY MALLEABLE CASTINGS CO., Muncie, Ind., has filed notice of dissolution under state laws.

THE SEAMAN PAPER CO., 208 South La Salle St., Chicago, Ill., has filed notice of increase in capital from $3,000,000 to $4,000,000.

THE GILL & HALL CO., Salem, Mass., manufacturer of leather products, has filed notice of dissolution.

THE CHOCTAW COTTON OIL CO., Ada, Okla., is planning for an increase in capital to $2,500,000 for proposed expansion.

THE SUGAR ESTATES OF ORIENTE, INC., affiliated with the West India Sugar Finance Corp., 129 Front St., New York, N. Y., operating three sugar refineries in the Province of Oriente, Cuba, has arranged for a bond issue of $6,000,000, for general operations, expansion, etc. Thomas A. Howell is president.

THE TRI-STATE PULP & PAPER CORP., High Bridge, N. J., has filed notice of increase in capital from $8,000,000 to $13,200,000.

THE MAGNA METAL CORP., Doremus Ave., Newark, N. J., has been reorganized with a capital of $100,000, to manufacture a special metal similar to aluminum, and said to be lighter and stronger than such material. The operation of the present plant will be continued.

THE ARMSTRONG CORK CO., Pittsburgh, Pa., has called a special meeting to approve an increase in capital from $17,000,000 to $30,000,000.

THE UTILITY COLOR & CHEMICAL CO., 700 Broad St., Newark, N. J., has filed notice of dissolution.

THE DUNLOP RUBBER CO., River Rd., Buffalo, N. Y., is said to be planning for a bond issue of $10,000,000, for general operations, expansion, etc.

C. G. Ludvigh has been appointed receiver for the FLOROME CHEMICAL CORP., 24 Wooster St., New York, N. Y.

THE ARMOUR LEATHER CO., Chicago, Ill., has taken title to the plant and business of Alexander Brothers, Inc., Philadelphia, Pa., manufacturer of leather products, for a cash consideration said to be $806,000.

Robert A. Messler has been appointed receiver for the TRENT BRICK CO., Brunswick Ave., Trenton, N. J.

Industrial Developments

LEATHER—The American Hide & Leather Co., New York, has adopted a full-capacity schedule at its side leather plant at Ballston Spa. N. Y. The Woburn, Mass., tannery of the company, devoted to patent leather production, has been advanced to about 75 per cent of normal. The Western plants are increasing their operating schedules, with the Sheboygan, Wis., tannery running on a 70 per cent production basis.

Howe Brothers, Boston, Mass., are arranging for increase in operations at their sole leather tanneries.

The American Oak Leather Co., Boston, Mass., is said to be arranging for the removal of its cutting plant from South St. to a building on Congress St., for immediate increased production.

The Crescent Leather Co., Woburn, Mass., manufacturer of patent leather, has advanced operations to a working basis of about 1,000 sides a day.

RUBBER—The Dayton Rubber Mfg. Co., Dayton, O., is running full at its local plant, with monthly averages higher than ever before in the history of the company.

The Republic Rubber Co., Youngstown, O., is advancing production at its local mills. It is expected to resume operations in full at the tire-manufacturing department within a few weeks. The Canton, O., mill of the company is now running on a normal basis, with regular working force.

After a number of weeks idleness, John P. Hill, receiver for the Hydro United Tire Co., Pottstown, Pa., has reopened the plant on a basis of 600 tires a day, giving employment to a working force of about 300 persons.

The Goodyear Tire & Rubber Co., Akron, O., is resuming normal production at its No. 2 plant, devoted to the manufacture of tires for Ford automobiles, following the recent curtailment.

PAPER—The York Haven Paper Co., York Haven, Pa., is running under heavy production, giving employment to a regular working force. A 10 per cent wage increase has been made at the mill, effective Oct. 1.

The American Writing Paper Co., Holyoke, Mass., has advanced production at its different state mills, and is now operating in excess of 85 per cent of capacity.

The Castanea Paper Co., Lock Haven, Pa., has increased the wages of operatives at its local mill. All departments are running full.

The Alaska Pulp & Paper Co. has resumed operations at its Speel River, Alaska, mill, following a suspension for some time past. It is expected to keep the plant in service throughout the winter.

The New York & Pennsylvania Co., Lock Haven, Pa., is maintaining active production in all departments at its local mill. A wage advance of 3c. an hour has been granted employees.

OIL—The Wortham Refining Co., Wor-

tham, Tex., is planning for the early resumption of operations at its local petroleum refinery, following a curtailment for a number of weeks past.

The Mexico Petroleum Co., New York, is operating its refining plant at Tampico, Mexico, at maximum capacity, and expects to continue on this basis for an indefinite period.

The Skelly Oil Co., Midland, Okla., is operating in all departments at its refineries and byproducts plants. An average of 75,000 bbl. of crude oil per month is being run through the stills, with output devoted to fuel oil, kerosene, gasoline, naphtha distillate, gas oil and lubricating oils.

IRON AND STEEL—The Cleveland-Cliffs Iron Co., Cleveland, O., is arranging for the resumption of operations at its iron and chemical plants at Gladstone, Mich., on Oct. 15, following a suspension for some time past. This will be the last charccal furnace to be placed in blast in the state, making 100 per cent operation of such furnaces for the first time since 1920.

The Carnegie Steel Co., Youngstown, O., has placed its Lower Mill furnace in blast, bringing production to close to 100 per cent in this district. Only one company furnace is now idle.

The United States Steel Corp. is increasing production at its mills in the Wheeling, W. Va., district to close to normal. The Wheeling Steel Co. and the Whitaker-Glessner Co. mills in this section are also running full. The Yorkville, O., plant of the Wheeling company is now on a 75 per cent operating basis.

The Gulf States Steel Co., Birmingham, Ala., has advanced the wages of employees at its Gadsden, Ala., plant, 10 per cent. About 2,000 men are affected. This makes the second such increase within the past three months. The mill is running full.

The Nagle Steel Co., Pottstown, Pa., recently organized with a capital of $300,000 by George H. Heck, 518 Commercial Trust Bldg., Philadelphia, Pa., and associates, has taken over the plants of the company of the same name at Pottstown and Seyfert, Pa., secured from the receiver. The new company has resumed production at the Pottstown mill under double shift working force, and plans to reopen the Seyfert plant before the close of the month.

The Republic Iron & Steel Co., Youngstown, O., is making ready for operation at the fifth furnace at its Hazleton plant. Four units are now in blast. Work is also under way at its Hanna furnace, and this unit will soon be blown in.

The Reading Iron Co., Reading, Pa., has placed its local sheet mill in operation, giving employment to about 250 men. The plant has been idle for about 6 weeks past.

The Midvale Steel & Ordnance Co. is arranging for the immediate blowing in of the second blast furnace at its Coatesville, Pa., plant.

New Companies

THE ASTOR CHEMICAL CORP., New York, N. Y., care of Bickerton, Willenberg & Fleischer, 220 West 42nd St., representatives, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are L. E. Meyers, B. White and E. Weisberg.

THE SOUTHERN TANNING & MFG. CO., Punta Gorda, Fla., has been incorporated with a capital of $50,000, to manufacture leather products. J. T. Swinney is president; T. C. Crosland, vice-president; and W. W. Knight, secretary-treasurer, all of Punta Gorda.

THE COLONIAL BRICK CO., Cliffwood, N. J., care of Fred Hankins, Cliffwood, representative, has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. The incorporators are Orman W. Ketchum, Frank J. Bell and George M. Craigen, all of Cliffwood.

THE FIXEM MFG. CO., Detroit, Mich., has been incorporated with a capital of $35,000, to manufacture special powders, chemical specialties, etc. The incorporators are Carl Wrobel, M. Peters and Alfred P. Norton, 3066 Van Dyke Ave., Detroit.

THE AMERICAN JAPANNING CO., Woburn, Mass., has been incorporated with a capital of $10,000, to manufacture japanned metal products, etc. James J. Finnegan is president; and Samuel Gorin, 9 Allen St., Boston, treasurer.

THE INTERCONTINENTAL RUBBER PRODUCTS CORP., New York, N. Y., care of the Registrar & Transfer Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $6,040,000, to manufacture rubber products.

THE FIMA LABORATORIES, INC., Rochester, N. Y., care of G. B. Wesley, attorney, Rochester, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are W. Mathie, R. J. Fisher and H. E. Moore, all of Rochester.

THE MICHIGAN STEEL CORP., Jersey City, N. J., care of the Corporation Trust Co., 15 Exchange Place, Jersey City, representative, has been incorporated under state laws to manufacture steel sheets and other steel products. The capital is 22,000 shares of stock, no par value.

THE EAST-WEST FEFINING CO., Los Angeles, Calif., care of James Westervelt, 522 Citizens National Bank Bldg., Los Angeles, representative, has been incorporated with a capital of $100,000, to manufacture refined petroleum products. The incorporators are Fred S. Wilson and George B. Clark, Santa Monica, Calif.; and S. R. Harding, Los Angeles.

THE OSTRO PRODUCTS CORP., Jersey City, N. J., care of the United States Corporation Co., 15 Exchange Place, Jersey City, representative, has been incorporated under state laws with capital of 500 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are William E. Lake and James B. L. Orme.

THE EMPIRE DRAWN STEEL CORP., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $3,750,000, to manufacture steel products.

THE SWIHALL MFG. CO., 410 Rush St., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture rubber specialties. The incorporators are A. E. Anderson and Oscar W. Anderson.

THE WIRE FIBROUS PRODUCTS CO., Jersey City, N. J., care of the Corporation Trust Co., 15 Exchange Place, representative, has been incorporated with a capital of $1,000,000, to manufacture fiber products.

THE LIBERTY PAINT PRODUCTS CO., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated with a capital of $100,000, under Delaware laws, to manufacture paint, varnish and kindred products.

THE Z. G. V. CHEMICAL PRODUCTS CO., Kearny, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are Robert E. Van Order, John E. Zellers and Lovett A. Grant, Jacobus Ave., Kearny. The last noted represents the company.

THE OSWEGATCHIE PAPER CO., Gouverneur, N. Y., has been incorporated with a capital of $200,000, to manufacture paper products. The incorporators are S. B. and A. F. Wardwell and E. B. Sterling. The company is represented by Cobb, Cosgrove & Kimball, Watertown, N. Y.

THE LIMESTONE BRICK CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture sand-lime brick and kindred products. Robert J. Cram is president; and Drew B. Hall, 20 Georganna St., Braintree, Mass., treasurer. The last noted represents the company.

THE SENECA PETROLEUM CORP., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $1,000,000, to manufacture petroleum products.

THE BURKE-HUMPHREYS PRODUCTS CO., New York, N. Y., care of F. A. McKenzie, 305 Broadway, New York, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are C. Humphreys and J. H. Burke.

THE AUTOCESSORIES CHEMICAL CO., Waterbury, Conn., has filed notice of organization to manufacture special chemical products for automotive service. W. B. Price and R. W. Belfit, both of Waterbury, head the company.

THE WAVERLY RENDERING & BYPRODUCTS CO., Newark, N. J., care of the New Jersey Registration & Trust Co., 525 Main St., East Orange, N. J., representative, has been incorporated with a capital of $125,000, to manufacture greases, lubricating products, etc.

THE LITTLEFIELD-SEGAL LEATHER CO., Peabody, Mass., has been incorporated with a capital of $20,000, to manufacture leather products. Arthur S. Littlefield is president; and Chapin Segal, Abington, Mass., treasurer. The last noted represents the company.

THE MINTER CITY OIL MILL, INC., Minter City, Miss., has been incorporated with a capital of $30,000, to manufacture cottonseed oil products. The incorporators are M. F. Sturtivant and T. C. Buford, both of Minter City.

THE FUSETITE CORP., Watertown, N. Y., has been incorporated with a capital of $100,000, to manufacture cement products. The company is a subsidiary of the Northern New York Utilities Co., Watertown. The incorporators are H. and N. A. Young, and F. A. Rogers, Watertown.

THE DUNBAR CANE PRODUCTS CORP., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws with capital of $11,000,000, to manufacture sugar products.

THE BACON HILL BRICK CO., Atlantic City, N. J., has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. The incorporators are S. A. Burris and John C. Slape, 446 Guarantee Trust Bldg., Atlantic City. The last noted represents the company.

THE WILLIAMS LIME MFG. CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $100,000, to manufacture lime and kindred products.

THE CO-OPERATIVE CUT GLASS WORKS, 446 Ash St., New Bedford, Mass., have filed notice of organization to manufacture glass produces. G. G. Enos, 46 Holden St., New Bedford, heads the company.

THE FOURLOCK TILE CORP., Ridley Park, Pa., has been incorporated with a capital of $20,000, to manufacture ceramic tile products. The incorporators are David Hennis, James G. Cooke and William R. Calligan, 15 East Felton St., Ridley Park. The last noted represents the company.

THE ALLEN COUNTY OIL CO., Scottsville, Ky., has been organized under state laws to manufacture petroleum products. The incorporators are Guy S. Amos and E. J. Lee Rust, Birmingham, Ala.; and C. W. Hill, and B. A. Hale, both of Scottsville.

Coming Meetings and Events

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

TANNERS' COUNCIL will hold its annual meeting Oct. 19 and 20 at the Congress Hotel, Chicago.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, 52 East 41st St., New York City: Oct. 13—Société de Chimie Industrielle, regular meeting. Oct. 20—Society of Chemical Industry, Grasselli Medal. Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

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ne Chemical Exposition, or Two?

RESENT indications are that two chemical expositions will bid for the favor and patronage of the emical industry in 1923. As intimated in our litorial comment of September 27, a rival exposition as proposed even before the Eighth National Exposion of Chemical Industries was closed. And now the ew project has been formally launched as the Chemal Industries Exposition, sponsored in its organizaon by ADRIAAN NAGELVOORT. Briefly, it is based on he co-operative principle, the exhibitors being *ipso acto* members. A board of directors is to manage the usiness.

Holding no brief for any particular exposition comany or organization, and having in mind only the est interests of the industry, we are glad to give space sewhere in this issue to a statement by Mr. NAGELOORT in which he gives the reasons, as he sees them, at call for an exposition modeled on new lines. With uch that he says we are in hearty accord. An exposion management should be in lively contact with the xhibitors, and the chemical industries *per se* should be ell represented in a chemical exposition. Further, the emical industry still needs an exposition as a great ducational force in driving home the interrelation and nterdependence of its constituent parts, and its bearng as a whole on the national welfare.

Following Mr. NAGELVOORT thus far, we come to a oint of divergent opinion when he holds that a coperative body is essential to a well-rounded, successful xposition, and that a commercial enterprise under proessional management cannot, or is not likely to, achieve is end. There is room for a difference of opinion, ecause there are successful co-operative expositions, lthough they are conducted along slightly different nes than those hitherto adopted in the National Expoition of Chemical Industries. Our own opinion has een previously expressed on two occasions, following he seventh and eighth expositions respectively. And us far we see no reason for changing our fundaental position. Mr. NAGELVOORT may prove us wrong, ut as a matter of policy we should prefer to labor ith the present management in an effort to improve s methods and results, rather than force a division f the industry by opening a rival show. This would eem to be the part of wisdom, at least until the resent management proves so utterly incompetent, r so stiff-necked and obstinate, as to make success mpossible. And since, in our judgment, we have not egun to approach that point, we deprecate the posibility of two expositions.

For eight years the chemical show has been an anual affair. The current intervening year is still oung, and no man can foresee what it will bring forth. Is it hopeless to believe that subsequent events will point the way to a unification of interests and a happy acceptance of ideas that will give us one great exposition representative of the chemical industry of the United States? We think not.

European Conditions As We See Them

WORD pictures of conditions in Europe have almost become the order of the day. With each returning ship fresh travelers add either to the clarity or confusion of ideas, according as their experience has been deep or casual, biased or disinterested. Each attempts, and no doubt achieves a measure of success in his efforts, to portray conditions as he saw them; but the criterion of the value of his conclusions must be the facilities he enjoyed for observation, the extent to which he was able to delve beneath the superficial aspect of affairs and fortify his judgment with essential and significant facts.

At the risk of adding one more note to the concert of American opinion on Europe, but with confidence that it will prove enlightening as well as harmonious, we begin publication in this issue of a series of short articles, impressions of European conditions, by Mr. J. S. NEGRU, Managing Editor of *Chem. & Met.* For six months, from February to August of this year, he traveled the central European countries, Belgium, France, Italy, Switzerland and Germany, as a representative of this magazine for the purpose of learning at first hand the facts in the technical, economic and social affairs of those countries. Our purpose was to afford the business and professional clientèle of *Chem. & Met.* an opportunity to view through an engineer's eyes the things about which merchants, bankers, economists and other groups of our population had been writing from their respective points of view. There is value and advantage in getting opinions on moot questions from one having the same background and fundamental training as ourselves. There is confidence in the methods of observation and the processes of deduction—a feeling that various factors have been properly evaluated so that the final conclusions are comparable to those which we ourselves would have reached under similar circumstances and with similar opportunities.

A significant fact in the outcome of Mr. NEGRU'S trip is that while he set out hopeful of obtaining much in the way of new technical information, of research, of new and improved products and processes, the field proved so barren in this respect as to have yielded little or no fruit. On the contrary, he found European industry so deeply involved in economic distress as to lead him almost to abandon the search for technical matters and turn his attention to the business and financial situation as it affects personnel, processes and

products in the chemical and related industries in Europe, and incidentally in this country. This aspect, then, will characterize the articles which we hope will prove helpful in getting a correct view of European conditions.

Recognizing a Community of Interest

SOME waning of interest in the Chemical Warfare Service is becoming manifest even within the chemical industry itself. Just as those who live behind levees are inclined to forget about floods when the river is low and neglect protective measures, so it is, observers in Washington point out, with the work of the Chemical Warfare Service in peace time. It is thoroughly understood that such a tendency is the natural one. It applies to all branches of the military service. The Ordnance Department, for instance, is having the greatest difficulty to induce manufacturers to co-operate in the design of their materiel so that equipment may be planned that offers the minimum of manufacturing difficulties.

As to the Chemical Warfare Service, however, there is a feeling that the chemical industry should be careful to keep alive its co-operation and to maintain all its contacts with the organization. This is regarded as imperative, since the Chemical Warfare Service has not been thoroughly "sold" to the American public. More than that, the industry is under particular obligations to the Chemical Warfare Service, since its officers boldly took a course in defense of the dye embargo which was known to be unpopular with a majority of the members of Congress—the body to which the Chemical Warfare Service must look for its funds and for its very existence. In view of that disregard of its own selfish interest, there is a feeling that the chemical industry should be unusually observing in keeping alive its co-operation with the Chemical Warfare Service in an effort to solve its problems.

Chemical Imports And Reparations

PERSISTENT reports by the newspapers that chemicals would be accepted on the reparations account have caused a stir which now appears to have been wholly unjustified by the real facts in the situation. Nevertheless this bogey will doubtless bob up again at intervals as some enterprising newspaper man runs onto a new angle or a new possibility of the story. It is worth while, therefore, to have clearly in mind a few of the facts involved.

The State Department has unquestionably been considering the proposal that the government be paid for the expense of maintaining the American army of occupation in Germany by means of imported dyes and chemicals. The amount due the United States is approximately $250,000,000. If that debt be regarded as interest-bearing and 4 per cent be assumed as a cost of money to the government, then $10,000,000 per year will have to be paid on account simply to keep up the interest. To make any appreciable inroads on the principal would require several times that sum annually.

In the past, import of dyes and chemicals through the Textile Alliance was made without direct participation of the government. The government simply sanctioned the proceedings and handled none of the money or commodity. The new proposal would necessitate either money or commodity or both being handled by the government at some stage of the proceeding. There is at first sight no legal ground for entry of the government upon such a proceeding without specific additional approval through new legislation by Congress. Furthermore, to permit such import would be contrary to the entire spirit of a protective tariff policy. Therefore, if Congress should be asked and should grant permission for establishing such an importing agency, it doubtless would be limited to one that could bring into the United States such dyes or chemicals as would not compete with domestic products. But if one limits the import to non-competitive commodities, then the quantities involved would be small. Estimates as to how small they would be vary considerably, but no one seems to feel that the amount would be greater than three or four million dollars per year and, what is more probable, only about one million dollars per year.

Considering these figures, it is evident that no material progress can be made in payment of reparation accounts by the import of chemicals unless an entire change in our foreign trade policy is adopted by Congress, or by the State Department without the consent of Congress. In view of these facts, there is certainly nothing alarming about the rumors even though they seem to have very credible source and backing.

We should not lose sight of the fact that the appointing of an import agency might establish precedent for the importation of other commodities than dyes and fine synthetic organic chemicals. There is no doubt that this country will eventually have to take its payment for the expenses of the army of occupation in commodities, for it is not conceivable that we would be granted any cash payment while other reparation accounts for Belgium, France and other European countries remain unpaid. There will be great temptation therefore, for legislative and administrative officials who desire to make a good financial showing for government affairs to look forward to some arrangement for the regulated import from Germany of commodities the sale price of which can be credited to the United States Government instead of going to the German exporter. This is a tendency and a possibility which deserve careful study. That there is likely to be any such development seems improbable, but in forecasting future developments it is worth while to consider even so remote a contingency as this.

Making Use of Facts and Figures

BUSINESS judgment in the long run can be no better than the information on which it is based. This simple truth is the real evidence on which that very practical scientist HENRY S. DENNISON is willing to rest the case of "Facts and Figures" vs. "Hump and Hunch." In a talk last week before the National Conference of Business Paper Editors he gave it as his opinion that many of the hard-headed old fellows who have opposed the scientific management of industry and the use of facts and figures really carry around just this sort of data with them and don't know it. Their "hunches" are based, in a sort of subconscious way, on sound knowledge and ripe experience tucked away somewhere in the backs of their heads. Charts and graphs, they say, will eliminate judgment and make business merely the Punch-and-Judy show of automatons. On the contrary Mr. DENNISON avers that these facts and figures are

sponsible for the most exacting demands on judgment. is when a man is in possession of all the facts in a se that he is most likely to ponder the consequences his decision.

Take, for instance, the problem of facilities. How do ou know when to order machinery, or additional equipent, or a new building? Right now you may be badly need of one of these things, but how about six months a year from now when the piece is installed or the uilding completed? Here it is that the executive with finite knowledge of his business, of its normal line of rowth and of the records of the past and present inustrial situation can gage his purchase with precision nd foresight.

The past is our only yardstick for measuring the uture, and it can be put to work in no more useful way an in helping to solve the problems of buying and elling. The long-time price curve of a commodity lotted along with warehouse stocks is a most reliable uide to the buyer. He needs but to establish some iedian line of "normalcy" and when prices are above hat line to buy relatively less, when prices are below he median line to buy relatively more. Such a policy onsistently pursued must mean a dollars-and-cents savng to the buyer. Furthermore, it relieves him of that rain which accompanies the frantic endeavor to find he exact bottom of the market or, what is more comorting, he avoids the disastrous tumble from the top.

Business, because it is such a multifarious thing, can ever be charted with the certainty and fairness of an ngineering project. There will always remain breaches nd gaps which will not be bridged by facts and figures. abor policies, employee selection, promotion, etc., are stances in which we must always lean heavily on huan judgment and appraisal. But even if our data are ragmentary and incomplete, it is no reason why we hould not use what we have to best advantage. The hysician knows but a surprisingly small fraction of the ndamental facts of health and disease, yet it is on he judicious utilization of these facts that the medical rofession has made its remarkable progress. The govrnment, the trade associations and other agencies are t work gathering data, the completeness of which will epend in the last analysis on whether or not it is put practical use. Are you, as an individual, making the ost use of the facts and figures of your business? f not, you are the loser.

The Coal Users' Part

T WILL not be coal production but rather coal transportation that will limit fuel supply during the comng winter. It is almost certain, even with an open inter, that there will be distressing shortages at some oints and if we have a severe winter the shortage will e very serious in many localities. Anything that the al user can do to relieve this situation even slightly s a duty to the community as well as to himself.

One very obvious but often neglected responsibility f this sort is the prompt loading and unloading of cars. ot alone coal cars but cars of all types must be moved s expeditiously as possible if the railway systems of he country are to function even fairly well this winter. t behooves the chemical industries which are large sers of freight cars to make adequate preparation for eir part in this work. When a car is placed for loading, it should be filled at once and billed by the most direct route to destination. When a loaded car arrives at a siding, it must be unloaded immediately. No excuses should be permitted to interfere with this part of rail traffic handling.

The difference between immediate and only "fair" handling of this situation may make the difference between adequate and inadequate fuel supply. The price which one may pay in current inconvenience or bonus for overtime in order to accomplish these results will be a splendid investment. It will pay to get ready now and not wait until bad weather or traffic congestion makes the problem even more serious than it already is.

From One High Position to Another

IT IS with mingled feelings of pleasure and regret that we receive the announcement that Dr. S. W. STRATTON is to leave the Bureau of Standards to assume the presidency of Massachusetts Institute of Technology. The change will represent a great loss for the bureau. That institution will for many years stand as a monument to the vision and constructive ability of the man who has been its chief from the beginning until now when, twenty-one years old, it stands a mature evidence of well-nurtured growth.

Nor is there doubt that M.I.T. should receive our congratulations. It is an institution in which any man may find large opportunity for service and for constructive effort and hence to Dr. STRATTON also go our congratulations on the opportunity in this new field which that institution will afford.

May his work there prove as successful as has his public service in the Bureau of Standards. One could scarcely wish him greater success than that.

Any Size Is Standard

INQUIRY was made at the booth of one of the exhibitors at the recent Chemical Exposition for a catalog of stock sizes and shapes. The answer to the query was that any size or shape desired is gladly made for customers and that no standard sizes of the material were listed or carried in stock. This represents for the particular industry rather an unfortunate situation, and yet one all too common at present in many lines of business.

In this particular case, each new size or shape requires new dies or new tools. Yet the company stands ready to deliver any size as standard. It would be interesting to know how much this really costs the purchasers of the material, for certainly it would be vastly more economical if a reasonable number of standards were maintained and effort made to limit purchasers to these as far as their needs really could be served thereby. The saving might be a substantial sum in dollars per year and probably an appreciable percentage of the cost of any shipment of special sizes.

In a vast majority of cases there is considerable latitude in choice of sizes for such materials as the one in question. A designer is perfectly willing to vary a few hundredths of an inch, and if given adequate data will find it quite as convenient to design his equipment to use the sizes which the maker carries regularly in stock as a standard. It is surprising in this modern day of efficient management to find that a prominent concern apparently ignores the advantages of simplification in production. Doubtless there are many others. All should stop and consider the folly of the policy.

Readers' Views and Comments

Black Fractures in Carbon Tool Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—We have recently had opportunity of examining a small piece of steel, sent us by Mr. Green and described by him in your columns for Aug. 9 (p. 265). Some comments written primarily from the standpoint of men working with malleable cast iron may be of value.

Under the microscope the graphite in the piece sent us is present in thin flakes and not nearly as much spheroidized as is the temper carbon of malleable casting. I have never in the past seen such a flaky condition in any graphite which was precipitated below about 1,050 or 1,100 deg. C. There is here some suggestion that the observed graphite came out early in the history of the specimen, yet the fact that the graphite does not exist in the surrounding ring is scarcely consistent with the precipitation of graphite in the ingot before rolling. May we suppose that the ingot was graphitic and that the pressure exerted by the rolls assisted the recombination of graphite, due to the contraction in volume assaociated with the formation of cementite, as suggested by Heike? If this assumption is not tenable, then it would seem that the only possible explanation is that such stresses are set up in the surface layers during rolling which have prevented graphitization during the anealing period. There is here another anomaly.

It is well known that even in the high-silicon, high-carbon alloys of the malleable cast iron industry graphitization is a matter of many hours. The times may run from 40 to 80 hours above 1,500 deg. F., followed by at least an equal time in cooling. How graphite should form in but slightly hypereutectoid steels in a time as short as is involved in the annealing of tool steels has always been a mystery to me. I have frequently heard the experience mentioned, but Mr. Green's sample is the first which I have personally seen.

H. A. SCHWARTZ,
Manager of Research,
The National Malleable Castings Co.

Cleveland, Ohio.

The Record of Science

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have just read with considerable interest and enthusiasm the address of William Warner Bishop before the Michigan Chapter of Sigma Xi on "The Record of Science." There is one very significant statement in this address: "Bibliography is the foundation of research." Mr. Bishop gives a very clear brief for his premise, and the case could not be argued by a single man better equipped to argue the case.

Mr. Bishop further shows that we are placing too much stress on the laboratory side of research and not enough on the fact side.

Facts support Mr. Bishop in his assertion. In the second edition of the National Research Council's "Research Laboratories in Industrial Establishments of the United States" we find over 526 organizations supporting research laboratories. In *Science* for Jan. 13, 192[illegible] on page 51 we find that there is invested in this countr[illegible] alone 565 funds for research, yielding annually ove[illegible] $22,000,000. Yet I venture to assert that not 50 pe[illegible] cent of these same institutions provide adequate fund[illegible] if any at all, for a good foundation in research—namely, what I choose to call " laboratories for researc[illegible] fact-oring"; to put it in Mr. Bishop's phraseology[illegible] laboratories in the "book sciences." To illustrate th[illegible] relative importance given to the laboratory for ordinar[illegible] research and the laboratory for fact research, or library[illegible] I know of one industrial firm that invested over $400,00[illegible] for research laboratories, and yet the sum invested i[illegible] book equipment was less than one-tenth of that amount[illegible]

Why not establish endowments for laboratories i[illegible] research fact-oring and fellowships in the "boo[illegible] sciences?" The need is here and should be met.

Pittsburgh, Pa. K. WALKER.

A New Vessel for the Absorption of Hydrochloric Acid

To the Editor of Chemical & Metallurgical Engineerin[illegible]

SIR:—I note in "Readers' Views and Comments" i[illegible] your Aug. 23 issue M. A. Laury of Rockville Center L. I., has misunderstood a statement in my article whic[illegible] appeared in your Aug. 2 issue, and I am writing you t[illegible] clear up this point in case other readers have give[illegible] it the same interpretation.

My statement to the effect that it was only possibl[illegible] to produce acids of low strength from towers was in[illegible] tended to convey the idea that only low-strength aci[illegible] can be produced if the absorbent is permitted to flo[illegible] through the tower absorption system by gravity onl[illegible] and is not recirculated and applies more especially t[illegible] the gases of higher strength than those of lowe[illegible] strength.

The point which I intended to bring out was tha[illegible] in order to obtain acids of higher strength by singl[illegible] exposure of the absorbent to the gases it is neces[illegible] sary to use absorption equipment which will permi[illegible] rapid removal of the heat generated and that the con[illegible] struction of a tower to accomplish this is not, in genera[illegible] practicable.

Acid of much higher strength than 20 deg. Bé. ha[illegible] been obtained from towers, but only by cooling the aci[illegible] produced in the tower and recirculating this throug[illegible] the tower repeatedly until the strength is increase[illegible] to the desired point. STEPHEN L. TYLER.

New York City.

Correction

In one of the "Sidelights on the Chemical Exposition[illegible] appearing in the Sept. 27 issue, the "Dow" tray thick[illegible] ener was mentioned as having been applied to th[illegible] clarification of raw cane juice by the firm of "Petree[illegible] Dow." This of course should have been called the Do[illegible] tray thickener and the firm is Petree & Dorr.

Mechanical Improvements vs. Fundamental Research in the Leather Industry

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your issue of Aug. 30 (page 465) you publish an article from the versatile pen of John Arthur Wilson, entitled "Mechanical Improvements vs. Fundamental Research in the Leather Industry." The writer has made an exhaustive study of the mechanical end of the leather business and while he agrees thoroughly with Mr. Wilson that opportunities for increased production efficiency lie less in mechanical improvements than in fundamental research, he feels bound to impress on the tanner that 6 months' tanning of sole leather is not only an unnecessary waste of time and money invested, but almost a commercial crime for which all users of leather have to pay.

The fundamental chemical research under Professor Thomas of Columbia and that of Mr. Wilson have been of inestimable value to the tanning industry, and they have gone far toward a campaign of industry to show the tanner what the possibilities—yes, certainties—of chemistry can accomplish, yet I feel sure that neither of these accomplished men would agree with me that sole leather can be tanned in 5 or 6 days with but one handling, producing fine, light-colored, plump, smooth grain leather of great toughness. The apparatus that produces this result is very simple of construction and "foolproof" in operation.

I am not writing this to draw attention to my patents or to describe in detail the apparatus that is in daily operation at our laboratories, but simply to give my views as to why the tanners do not abandon the antiquated and senseless method of tanning they now pursue.

It has been my experience that tanners, as a rule, are too slow and even unwilling to adopt what seems to them a revolutionary process of tannage, but it must be known that the two largest producers of sole leather are now tanning a part of their product in less than a week's time and are fast approaching complete installation of rapid tanning machines.

I want to assure Mr. Wilson that while it is true that the rate of tanning, the rate of penetration of tan liquor into a hide, the degree of plumpness of the leather and its color and smoothness are all controllable chemically, it is just as true, and more understandable, when leather is tanned in a machine where every individual hide gets the same treatment in 5 or 6 days.

The great drawback to the English Wilson machine lies in the fact that the sides, as they come from the trenches, are in a very tender state and will not withstand constant falling and folding as they revolve in the machine, as such flexing produces tan wrinkles and raised grain. Sole leather, to be properly tanned and plumped, should have practically no movement that will bend or wrinkle the hides.

The writer spent two long years in developing apparatus that would automatically tan 144 sides in a machine having 1 minute periods of immersion and emersion, permitting the hides to slip gently into the tanning liquor and to float through the same in a natural position, emerging from the liquor without sharp bending or unfolding. As before stated, we are able to get the best results in 5 and 6 days.

While the industry needs the most highly trained chemists available, it also needs men who will accept facts as against theory, and who will awake to the fact that "layaways" should be obsolete and that a vast amount of money can be saved to the industry if tanners will develop a spirit of investigation and acquaint themselves with development that may be theirs for the asking.

MATTHEW M. MERRITT.

Salem, Mass.

The Chemical Industry and Its Exposition

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is reassuring to find in *Chemical & Metallurgical Engineering* the admission that criticism—adverse criticism—of the Chemical Exposition as now conducted does exist and is finding expression in several quarters. As noted in your editorial, this criticism has been diverse and confusing; but out of all the clamor and discussion one point stands out clearly—namely, that the management needs closer contact with the exhibitors.

It is admitted quite generally that the producers of our chemicals, chemical equipment and raw materials, as well as the chemists, engineers, plant managers and salesmen, were not in sufficiently close touch with the management to make an entire success of this national exposition.

Hence has arisen the need for a new enterprise, a Chemical Industries Exposition managed by the industries themselves, such as is now proposed. By its name, the Chemical Industries Exposition, the new organization is pledged to serve the interests of chemistry. It promises to show what industries chemistry has built up and how chemistry works in those industries.

Our first chemical show was a brave attempt to fulfill such a promise. The time was propitious and the show was considered a success, while the expositions that succeeded the initial show were also considered successes; but now that the novelty has worn off and we can scrutinize conditions more closely we find that a true exposition of our chemical industries has never been held, what we have had being only a heterogeneous mixture with an overwhelming number of exhibits that would fit in a machinery show or a show by any other name as well as in a chemical show.

A true exposition of our chemical industries is as necessary today as it was in 1915. To borrow the language of the salesman, it is the ideal way of "selling" the chemical industries to the country at large. It should be the ideal way of demonstrating that in our chemical industries lies the possibility of our greatest industrial development.

This is what is proposed by the new Chemical Industries Exposition, which will be a purely co-operative organization for the advancement of our American chemical industry. An exposition under the management of professional showmen such as we have had in recent years cannot be considered representative, neither can it be arranged as an exclusive, orderly and well-balanced exposition of the chemical industries as was originally intended and as is now proposed.

In view of the foregoing it is hoped that *Chemical & Metallurgical Engineering* will yet see its way clear to support the new enterprise.

ADRIAAN NAGELVOORT.

New York City.

To Study Fuel Economy in District of Columbia

At the request of the director of the budget, the Bureau of Mines is conducting a fuel economy survey to investigate the conditions under which fuel is used in the various government fuel-using plants in the District of Columbia, and to determine what economies, if any, can be made in the use of such fuel.

European Conditions as I Saw Them

Epitome of Six Months' Study in Germany, Belgium, France, Switzerland and Italy—Failure of Germany's Economic War the Fundamental Cause of Present Financial Collapse and Its Effect on Other Nations

By J. S. Negru

Editor's Note: Mr. Negru, managing editor of *Chem. & Met.*, has just returned from a 6 months' trip to Europe, where he studied the industrial, technical and economic conditions in the principal countries of the Continent. This article is the first of a series that will portray intimately the results of his interviews with financial, political and industrial leaders. Other articles will deal with detailed observations on which this summary is based.

A SIX months' trip through Belgium, France, Italy, Switzerland and Germany for the purpose of getting first-hand information and impressions on the technical and economic status of those countries may seem at first sight a simple and agreeable undertaking. As a matter of fact, it proved to be a very trying task when it came to the actual performance. Although many circumstances and conditions were anticipated and taken into consideration well in advance, many more unforeseen circumstances were encountered during the trip which sometimes made it necessary to alter quite radically the plans laid down while still in New York City.

Plans of Trip as Outlined and as Carried Out

It was quite easy to outline a plan covering places to visit, persons to see and subjects to study. In fact, this was done to a nicety. The places to visit were those generally regarded as the leading industrial regions of the above-mentioned countries. The persons to see were obviously the leaders in the industries, the presidents and secretaries of the leading technical societies, the editors of the well-known technical papers for the different industries covered by the thirteen McGraw-Hill engineering and industrial papers, with special attention to those covered by *Chemical & Metallurgical Engineering*. Incidentally, there were other important sources of information—economists, labor leaders and just plain folks. The subjects to be studied were mainly the actual technical progress during the last few years, scientific research, the economic conditions as to production, and relations between employer and employee. Incidentally, I was to get some ideas on everyday working conditions with respect to machinery, apparatus and processes in European plants compared with those in the United States.

A schedule covering this broad program was carefully made out, advance information was sent abroad regarding my contemplated trip and its purpose and the anticipated trend of events and interviews were sketched out as fully as possible. With plans thus matured and with a deep feeling of the importance of the trip to the readers and advertisers of *Chem. & Met.* and other McGraw-Hill publications I embarked on the good ship Finland sailing from New York Feb. 11 and arrived in Antwerp Feb. 22.

In the interim of the past 6 months I have visited the places scheduled and many more; I have interviewed the persons originally selected and many more of equal importance. But unforeseen conditions arose when it came to the subjects to be studied. The economic status of the countries visited was so abnormal and so differently interpreted by interested parties that I was led to dwell far more in detail on this part of the program than on anything else.

My first intention was to edit my notes in chronological sequence, but the present upheaval in all the industrial countries of Europe, particularly in Germany, leads me to believe that it were more timely first to outline what I regard as the very fundamental cause of the breakdown in Germany, with the result that all of the other countries are feeling acutely the repercussion of such an unhealthy economic condition.

Obedient Germans

The German possesses as a general rule a highly developed obedient mind, and few are those who, being sufficiently emancipated, dare assert their individuality. The German Government created during the so-called revolution shortly before the armistice is a sort of emergency organization like the receiver of a bankrupt business concern, with a beautifully written constitution as a guide, but with no self-asserting leaders, and hence extremely weak.

To this very day practically the entire German people are still lulled with the belief that Germany, more than any other belligerent country in the World War, acted as a civilized nation, and do not yet know the extent of the wanton destruction engineered by their military and industrial leaders in the occupied French, Belgian and other allied countries. The Germans, as I have learned to see them, consider themselves persecuted for no reason whatever. They were not given to understand that they must make good, partly at least, what they call incidental war destruction. They were fed from the beginning, and still are fed, with an abnormal hate toward France, and more recently with an even more abnormal so-called friendship toward England. Thus they have been led to the point where they typify to the very letter the cartoon "Vox Populi" printed in the June 2, 1922, issue of *Fliegende Blätter*, which is here reproduced.

The German Economic War

With a weak government on one side and a meek people on the other, it will be seen how very easy it was for wolves in sheep's clothing to bring about what really happened—namely, to involve Germany in a disastrous war before, so to speak, the ink was yet dry on the signature of the Versailles treaty.

Many are the interpretations of the causes leading to the present pitiful condition in Germany, but all of them seem to be attempts to place the blame on the other fellow and not in the least on the Germans themselves. The Versailles treaty stipulations are being represented as demanding far more than Germany can fulfill. All such interpretations by bankers and others are, to my judgment, dictated strictly by egoistic business considerations. But when analyzed in the light of many conversations I had with leading German intellectuals and plain people in many German districts, the break-

From *Fliegende Blatter*, June 2, 1922.

VOX POPULI

down seems to be a normal consequence of losing the economic war which she has been waging against all the world for nearly the past 3 years.

Briefly stated, the specific plan of this economic war was to flood all foreign countries with German finished products, especially those requiring a large amount of manual labor, at prices far below their intrinsic value. It was to be a super-dumping policy in the expectation of spreading unemployment in other industrial countries, thus creating an atmosphere and undercurrent of opposition to the Versailles treaty, and offering as a condition of truce the cancellation of that treaty and a status quo ante bellum 1914.

Such an economic war was conceived by a few Germans of the Stinnes type as the best means of evading the fulfillment of the conditions of the peace treaty. This was not because Germany could not fulfill them, but because primarily the German honor must be saved. And the worst that could happen to tarnish the good name of Germany, according to their peculiar psychology, would be to submit to the treaty stipulations. They were not able to bring themselves to act as good losers.

Failure of Germany in Its Economic War

When the German soldiers returned to their homes after the war, they were treated as unconquered *Helden* and still are considered as such. They found their houses, fields and factories open, in full prosperity and ready to engage them in productive work. It is well known that the Germans are very industrious. Before 1914 the intrinsic value of domestic production in Germany was many thousands of millions of gold marks per annum. The more so could have this been the case after the war if the new government and the masses had not been led astray by the then few powerful Germans who thought to evade the stipulations of the Versailles treaty by means of an economic war. How very simple such a war looked to them is proved by the readiness with which it was approved and carried on. That it was hastily conceived and badly fought is proved by the dire distress now confronting the German Government and the German people in a Germany which is still eminently rich.

The German mark, which in 1918 was worth 25 cents, has recently been quoted at a little less than 0.05 cent, and everything points to its further decline. And yet Germany is working at full capacity in all her industrial lines, the German people are among the most industrious in the world and German agriculture is sufficient to supply at least 70 per cent of the people's food requirements.

As in their conceited war policy of imposing peace negotiations by methods of frightfulness, so in the present economic war they hoped to reach their goal without counting on the psychology of the other nations. They expected that the foreign buyers of their products, who would purchase them at far below their intrinsic value, would content themselves with, say, a maximum of 100 per cent profit. But they did not count on the rapacity of the newly arisen middlemen who, not content with such profit, succeeded in placing in foreign countries the cheaply bought German wares at prices a trifle below those of similar domestic products. This fulfilled only part of the German aim—namely, the spreading of temporary unemployment. But it was done at the cost of breaking down the German fighting power by bringing the government near to the point of fraudulent bankruptcy, and this in spite of the fact that the tonnage of products exported and their true intrinsic value are so very high. Neither the total amount of gold marks

which Germany has paid to the Allies up to date nor the status of the Saar district and Upper Silesia warrants the bankruptcy of a country which only about 4 years ago regarded itself as the very leader among the world's nations and rattled the saber in an attempt to make everybody else admit it.

Germany Can Regain Her Place in the Community of Nations

The gradual losing of their economic war and not the hair-splitting notes to and from the Allies and the various conferences is the cause of the German breakdown. Fortunately this could be easily mended if only the German people could be brought to realize that just as in 1918 their armies did not return to their homes as unconquered *Helden*, so now their economic war is lost forever. Honest work with honest competition, coupled with a sincere resolution gradually to fulfill Germany's signed promises at Versailles, must be henceforth their guiding policy if they are to regain their new place in the community of nations.

The next of this series of articles will be published in the issue of Oct. 25, 1922.

Electrosmosis and Electrophoresis, Two Definitions*

By Oliver C. Ralston
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THE purpose of this note is to call attention to an exasperating confusion of terms in the literature that deals with electro-capillary phenomena, the electric double layer at phase boundaries and in colloid chemistry. The four following words should cover all general cases where an electric current is passed through a fluid medium, with or without a diaphragm, with or without the presence of other solid, liquid, or gaseous particles other than the electrodes or on the electrodes:

Electrolysis.	Electrophoresis.
Electrosmosis.	Electrostenolysis.

Nearly all the roots used in these words are of Greek origin. Electrolysis, for instance, is divided into electro and lysis from roots meaning "by means of electricity" and "loosening, dissolution or destruction" respectively. It is therefore well to consider first the meanings of portions of a few words.

Cath-	down or away.	Endos-	within.
-ode	way or path.	-mosis	push or impulse.
An-	up or toward.	Cata-	down or away.
-ode	way or path.	-phoresis	bearing or carrying.
Os-	mouth or pore (Latin).	-sis	suffix meaning process or state.
-mosis	push or impulse.	-osis	suffix meaning process or state.

With these few roots and their meanings it is now possible to discuss the above four words, which are proposed in the interest of obtaining uniform nomenclature, with a minimum of change from present practice and without inventing completely new words.

Object of Words Proposed

Electrolysis is a term universally accepted as meaning the act or process of chemical decomposition by means of the electric current.

Electrosmosis is proposed by the writer to supplant such terms as electric osmose, electrical endosmose, electric endosmosis, electro-osmosis, etc. All of these terms mean the passage of liquids through diaphragms (osmosis), due to the application of electrical forces. They are all in use, but all are somewhat awkward when used otherwise than as nouns. If the noun "electrosmosis" is adopted, it can be modified to the verb "electrosmoze" to correspond to the verb "electrolyze."

Electrophoresis is proposed to supplant a number of words that have been sadly misapplied but whose use has almost become correct through common (mis)usage. By electrophoresis is meant the travel, transport or "wandering" of a particle of solid, liquid or gaseous matter suspended in a mobile medium, liquid or gaseous, when a unidirectional electric stress is applied. At the present time "cataphoresis" is the word usually heard in this connotation, although "electrophoresis" has been used by a few discriminating writers.

The objection to the use of the word "cataphoresis" is that most of the particles suspended in aqueous solutions are negatively charged and migrate toward the anode, whereas the prefix "cata" or "cath" is already associated with "cathode" and "catholyte." A few writers have therefore tried to apply "cataphoresis" only in cases where particles wander toward the cathode, and have invented "anaphoresis" to apply to the usual case of wandering toward the anode. They were the ones who invented "electrophoresis" as the general phenomenon. Due to the wide use of "cataphoresis" it would seem unwise to try to force its use for a case of "electrophoresis" in which the particle wanders toward the cathode, a direction which is just the opposite of 90 per cent of the cases of so-called cataphoresis. Rather it seems wiser to adopt a term somewhat different in spelling, enough different to force recognition of the true meaning, and yet not enough different to need definition. Therefore:

Cathodophoresis is proposed to mean migration of suspended particles toward the cathode when under the influence of a unidirectional current.

Anodophoresis is proposed to mean migration to the anode.

Usefulness of the Term "Electrophoresis"

A further discussion of the possibilities of the use of the term "electrophoresis," as defined above, will show its great usefulness. It need not apply alone to colloidal solutions, but it can also apply to smokes, mists and fumes. The Cottrell electrical precipitation process has long lacked a single word to describe correctly its prenomena. It is permissible to speak of "electrophorizing" these suspensions of solid or liquid particles in gases. We can also "electrophorize" emulsions of water in crude petroleum, a process which has long wanted a name and is now in such large-scale use that a less accurate name is likely to be attached to it if we do not act to embody properly these ideas in suitable words.

Electrostenolysis is a term used to designate the deposition of certain metals in small capillary pores of certain diaphragms when solutions of these metals are electrolyzed. This is a rather obscure phenomenon, but its name is fortunately quite correctly derived and used. However, the definition should not be restricted to the deposition of metals in pores of diaphragms, as someone may discover methods of depositing other elements or groups in like manner.

*Paper presented at the forty-second general meeting of the American Electrochemical Society in Montreal, Sept. 21, 22 and 23, 1922.

Handling the Finished Products of Industry—VI

The Handling Problem in Sugar Manufacture Consists of Packing and Shipping a Single Finished Product in Many Ways—Solution of This Problem Illustrated by the Layout of the Baltimore Refinery of the American Sugar Refining Company*

By Graham L. Montgomery

ONE of the most difficult problems met with in handling finished products is that condition where a large bulk of product is to be packed in many packages and shipped in several ways. This type of problem is one encountered particularly in the sugar refinery.

Because of this difficulty, many plants of this type have never attempted the installation of a real handling system. Others have placed as much handling equipment as could well be worked in with their existing layouts, but have not been able to make their system a unified whole. This particular industry has been one where it has been necessary to wait for the construction of a real up-to-date plant in order to find the possibilities which lay in handling the finished sugar completely by automatic equipment.

Keeping these two facts of diversity of package and diversity of shipping-means in mind, together with the additional fact of large total output, let us consider the new refinery at Baltimore recently placed in operation by the American Sugar Refining Company. This plant is the most modern in the country. In designing it, the American Sugar Refining Company pooled the best of its knowledge and experience—forming a consulting board, made up of expert sugar men, refinery operating engineers, construction engineers and others, which worked out for the Baltimore plant a comprehensive handling method, one which provides ample opportunity for expansion when that becomes necessary.

The product is placed in every conceivable type of wholesale and retail package, and is shipped by all available means over a wide territory.

Where the Finished Product Handling Occurs

For the purpose of the study of the handling system used here, a good starting point can be made at the place where the granulated sugar leaves the screens which separate the coarse sugar and the dust from the commercial grade. There is, in the case of powdered sugar, one further manufacturing process—that where the granulated sugar goes through pulverizing mills. With this exception, all operations beyond the screen consist of handling and packing operations. These operations do not increase production or add to the quality of the product, but they are necessitated by the exigencies of marketing and involve what we classed as non-productive labor in the first article of this series.

This would hold for any sugar refinery. The Baltimore refinery here described illustrates the nearest approach to perfection that has been obtained in this work, the nearest approach to elimination of non-productive labor that seems at the present time possible; and the rendering of as many operations as can be automatic.

As a basis of study of the handling system, the following tabulation is given for methods of packing and types of shipping:

Packing

1. Granulated sugar packed in bulk barrels.
2. Granulated sugar packed in bulk sacks.
3. Powdered sugar packed in bulk barrels.
4. Granulated sugar packed in cotton bags.
5. Granulated sugar packed in paper cartons.
6. Powder sugar packed in paper cartons.

Shipping

1. Local shipment by gasoline or electric trucks.
2. Water shipments on lighters to ships or to piers.
3. Railroad shipment in box cars.

General Handling Considerations

From the screens, the desired grade of sugar may take two paths. Immediately below the screens are large maple-lined concrete bins to which the sugar may be fed directly by spout. These bins serve to supply the sugar for filling bulk barrels and sacks, the filling of these containers taking place immediately under the bins. They also serve as a storage reservoir to take sugar from the manufacturing department when the packing department is not working, and to keep the packing department supplied should the manufacturing department shut down for any reason.

When these bins are filled with sufficient sugar for loading the bulk barrels and sacks, the sugar is led from the screen by spouts on to a trough belt conveyor. This conveyor discharges into a vertical spout, which delivers the sugar in one of two ways. First, to the conveyor which supplies the packing department for paper cartons and cotton sacks, and second, to the conveyor system which feeds the powdered sugar department.

Packing Bulk Sugar in Barrels

Before describing the methods used for filling barrels with bulk sugar, it is of interest to consider how the barrels are handled from the cooperage.

The cooperage is housed in a building 465 feet away from the point where the barrels are to be filled. In this cooperage the lumber from which the barrels are constructed is received from the company's own lumber mills in cars and made up into the barrels—the heads being made separately and delivered to the packing department in the same quantity as the barrels.

It is interesting to note in passing that the American Sugar Refining Company owns its own forests, does its own lumbering, has stave and lumber mills, owns various railroads, due to this lumber work, which are even equipped in some cases to carry passengers—in fact, owns many similar adjuncts which make it practically independent of others for the necessary accessories, such as cartons and barrels.

The conveyor which carries the barrels from the cooperage to the packing building is particularly worthy of note. It is made up of two chains running parallel, just as in the ordinary slat conveyor; but, in place of

*Previous articles in this series have appeared in *Chem. & Met.* as follows: Article I, vol. 26, No. 18, p. 823, May 3, 1922; Article II, vol. 26, No. 19, p. 885, May 10, 1922; Article III, vol. 26, No. 24, p. 1,114, June 14, 1922; Article IV, vol. 27, No. 5, p. 199, Aug. 2, 1922; Article V, vol. 27, No. 15, p. 731, Oct. 11, 1922.

slats, ball-bearing rollers are used. The barrels ride forward on these rollers just as they would on a slat conveyor. But if the conveyor load is stopped for any reason, the conveyor continues on underneath the load without any particular amount of friction because of the ball-bearing rollers

This type of conveyor is particularly adapted to just such operations as filling or packing. It permits the production of barrels to go on at the cooperage regardless of the rate at which the barrels are filled, the long conveyor acting as a storage if filling is held up for any reason. There are many other cases where the operation at the loading end of the conveyor must run at a different speed from the operations at the discharge end. For this type of service, the conveyor described above, which is called a driven-roller conveyor, is in many cases ideal.

Handling Empty Barrels in the Packing Building

This straight run of conveyor from the cooperage enters the floor of the packing building on which barrels are packed at a point near the ceiling, and delivers through a gravity roller spiral to a second driven-roller conveyor, which runs the length of the barrel-loading dock and at the same level. By means of this conveying arrangement, a constant supply of empty barrels is kept handy at the loading dock. Reference to Fig. 1 shows the approximate arrangement of this system.

The workers who are doing the barrel filling take the barrels as needed fromthe last conveyor and after lining with paper place them on shakers under the filling spouts which lead from the large concrete bin previously mentioned. These shakers, by keeping the barrel agitated while it is being filled, insure its full loading.

Handling Filled Barrels

After the barrel is filled, it is rolled off of the shaker on the opposite side from the empty barrel conveyor and the head is placed in position. On this side of the barrel loading dock is another driven-roller conveyor similar to the others described. This conveys the filled barrels to the scale, where their weight is noted. So that the scale operator may have absolute control of the rate at which barrels pass over his scale, a pneumatic device has been installed at the end of the driven-roller conveyor, which causes the barrels to pile up here until wanted. By means of this penumatic device,

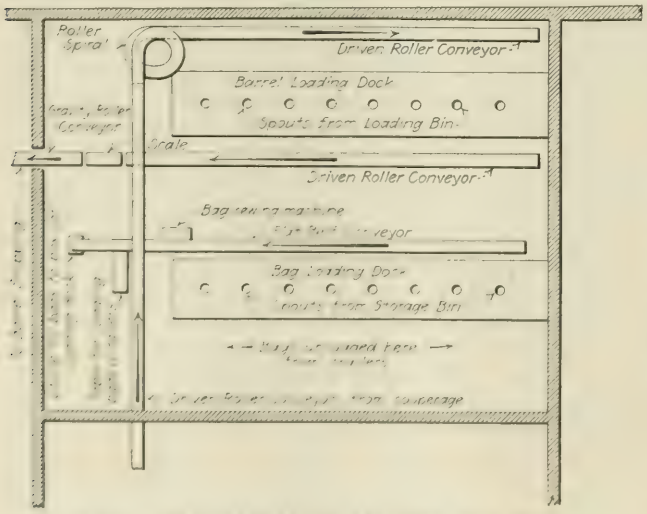


FIG. 1—DIAGRAMMATIC LAYOUT FOR BULK PACKING DEPARTMENT

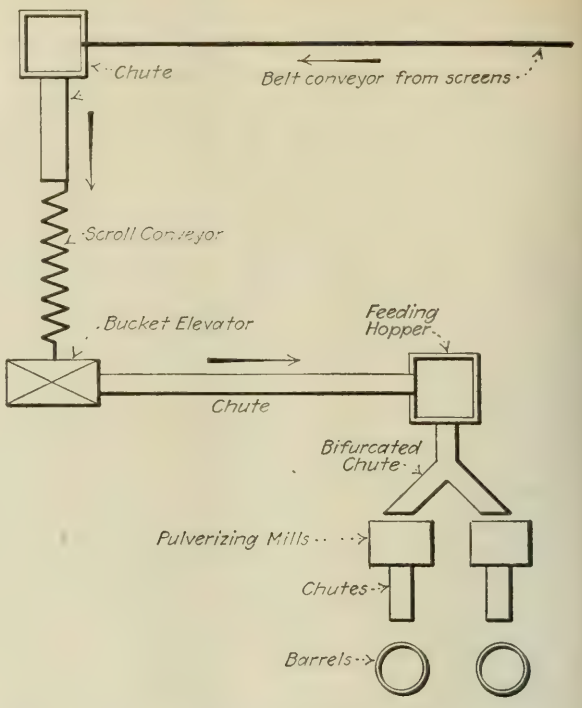


FIG. 2—DIAGRAMMATIC LAYOUT OF POWDERED SUGAR DEPARTMENT

he can release them one at a time onto the gravity conveyor which carries them over the scale. After their weight is noted, the barrels continue on this gravity roller conveyor, which discharges them on a loading dock, where they may be either loaded onto trailers or onto the barrel elevator and distributed as described under the heading of shipping.

Loading Bulk Sugar in Bags

Fig. 1 also shows the layout of the loading system for bags of bulk sugar. The routine is as follows: The empty bags are brought to the bag-loading dock on trailers. The workers place them as needed under spouts coming from the large concrete storage bins. Each of these spouts is provided with a weighing hopper, so that each sack receives a definitely weighed amount of sugar. After filling the sacks are placed on the conveyor shown in Fig. 1 running alongside of the bag-loading dock. This conveyor is a flat belt running on a bed of closely spaced ball-bearing rollers which insure a smooth-riding, flat surface for the bags to ride on. A rail has been placed along the far side of the conveyor against which the bags lean, so that they will not tip over. In this way, the bags are conveyed to the sewing machine, where they are closed; and they are then disposed of in one of two ways. First, for placing on trailers, they are deflected from the belt onto a loading table by a plow. From this loading table, they are placed on trailers as desired. Second, for box-car shipment, they discharge over the end of the bulk conveyor into a chute which conducts them to a point near the railroad shipping dock. The further disposition of these bags will be taken up under the subject of shipping.

Packing Powdered Sugar in Bulk

Reference to Fig. 2 will give the reader an outline of the conveying system used in handling powdered sugar. The bulk conveyor which receives the granulated sugar from the screen discharges into a straight

chute. Part way down this chute there is a deflector which, when in operation, delivers sugar to a branch chute. This chute delivers the sugar into a scroll or open-screw type conveyor. This latter feeds a small bucket elevator, which raises the sugar to a bin at the ceiling of the floor above. This bin in turn feeds the pulverizer mills, which discharge into a hopper, from which the powdered sugar may be loaded into barrels as desired. This hopper is also arranged to feed the automatic packing machinery, by which powdered sugar is placed in cartons.

As the demand for this particular kind of sugar in this particular package—that is, bulk barrels—is not great, there has been no necessity for installing an elaborate fixed handling system here. Instead, the empty barrels are brought to the proper position on trailers filled and then taken to the shipping or storing point on the same trailers.

Delivering Sugar to the Automatic Package Equipment

Mention has been made above of the conveyor which supplies the package department. When the granulated sugar storage bins are filled, this conveyor is fed directly from the screens—that is, if the manufacturing department is producing sugar at that time; on other occasions this conveyor may be fed by spout from the storage bins. These spouts are provided with hand-operated slide gates, and in this way can only be opened by the personal attention of the operator, so that there is little possibility of causing sugar to be fed to the conveyor when it is not desired to do so.

When sugar is fed to this conveyor directly from the screen, it is delivered from the belt conveyor under the screen to the vertical chute mentioned above. Both this vertical chute and the spouts from the bin deliver to the conveyor in the same manner. This is through an automatic loading hopper which is operated by the motion of the conveyor and which delivers to each bucket of the conveyor a certain definite amount of sugar—such an amount that the conveyor is carrying at its most efficient rate, each bucket being filled with the maximum which it will hold without any spillage.

Special Buckets Used for Sugar Handling

The conveyor used here is a pivoted bucket carrier of the type ordinarily used in power plant work for handling coal. There is one innovation here, however. The buckets are all aluminum, as is every other part of the conveyor which might come in contact with the sugar. This prevents any discoloration of the sugar by contact with iron.

The system of handling here used is shown in outline on Fig. 3. The pivoted bucket carrier may be discharged at either of two points. These discharges deliver the sugar to scroll conveyors, provided in the bottom of their casings with a series of rack-and-pinion operated gates. Under each of these scroll conveyors is a large maple-lined concrete storage bin. One of these feeds the automatic packing machinery which packs the sugar in paper cartons, while the other feeds the machinery which fills cotton bags.

Packing Sugar in Cotton Bags

There are various sizes of cotton bags such as 2 lb., 5 lb. and so on, into which sugar must be packed for the purpose of the retail trade. On the floor below the bin mentioned above, then, are located a series of bag-filling machines on which these various sizes of bags are filled. These machines are of a semi-atuomatic type. The operator takes a bag from the supply of empty bags which is placed near at hand and holds it under the filling spout of the machine. The machine automatically takes from the supply spout, through a weighing hopper, the amount of sugar desired to be placed in the bag. When the weighing hopper is filled, the supply is cut off and the contents of the weighing hopper is discharged into the bag. The operator repeats this operation, having under the filling spout an empty bag to receive each weighed discharge at the time of its occurrence.

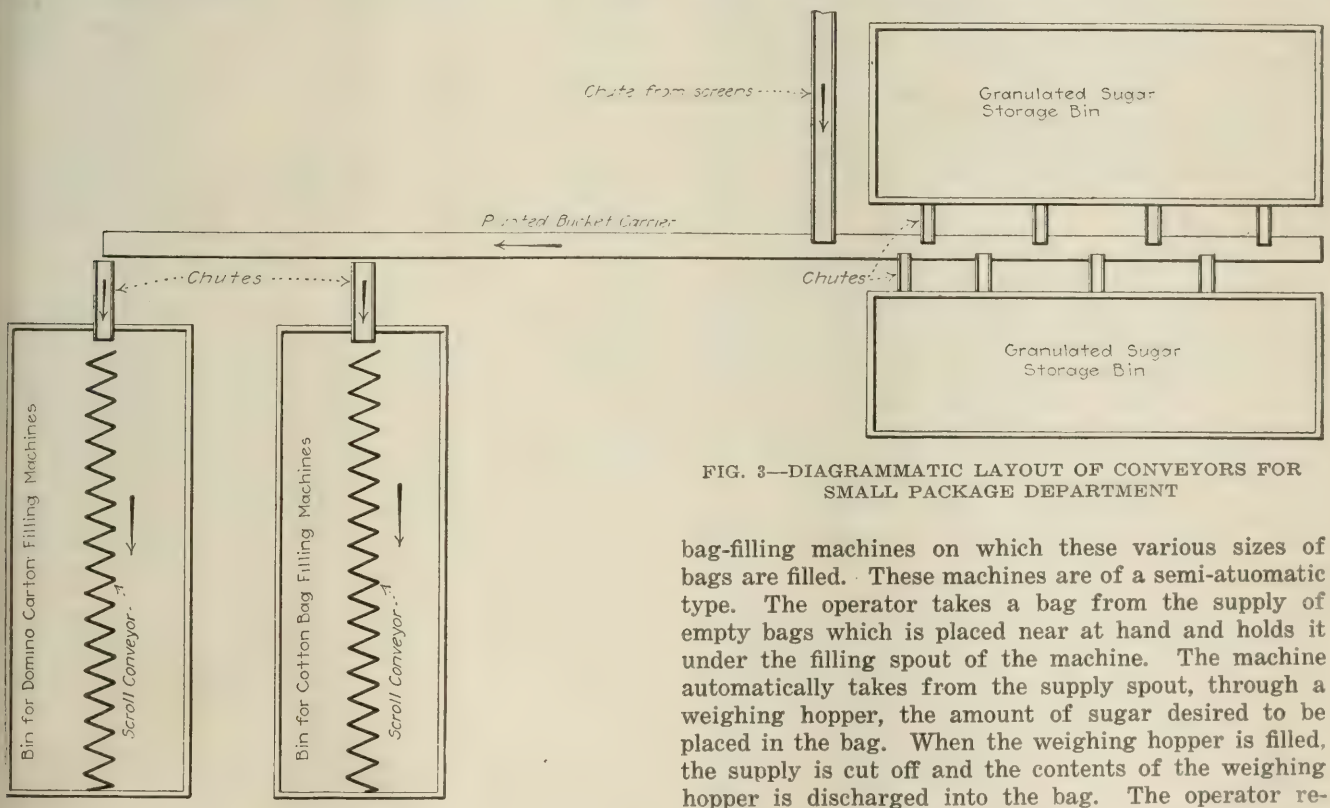


FIG. 3—DIAGRAMMATIC LAYOUT OF CONVEYORS FOR SMALL PACKAGE DEPARTMENT

The portion of the machine on which the bag rests under the filling spout is a rotating table, and after the bag is filled this carries it to a second operator. This operator is provided with a sewing machine, which is part of the filling machine, and with which the bag is closed. The rotating table then carries the finished

bag to a point where it is discharged and drops down a chute, for further disposition.

Automatic Filling of Paper Cartons

The machinery used for filling paper cartons with sugar is entirely automatic. In this machine, cartons are fed flat as shipped and the machine opens these cartons, finishes the bottom of them fast with glue and feeds them upright to the filling head. This filling head is in two parts, the cartons passing under it on a small rotary conveyor or carrousel. When the empty carton comes under the first filling spout, it is stopped by the mechanism and receives about nine-tenths of the load which it is to contain. The conveyor then carries it on under the second filling spout. The portion of the conveyor under this spout consists of an adjustable scale, which may be adjusted for various weights which the finished carton is to contain. The spout here is automatically connected with the scale and discharges a fine stream of sugar into the carton until the scale just balances, when the supply is shut off.

The carrousel then carries the filled carton beyond the spout and discharges it on to a straight conveyor which takes it through the sealing machine. In the sealing machine the top of the carton is folded down and pasted shut. An additional straight run of conveyor—flat belt type—takes the sealed carton to a packing table.

At these packing tables, operators stand who fill packing cases or large paper containers with the cartons of sugar. When these cartons are filled they are placed on a driven slatted conveyor, which conducts the cases under a nailing machine and the paper containers to a sealing department, where they are glued shut. From the nailing machine or the sealing department the filled containers are delivered to loading tables, where they may be loaded on trailers as desired. The empty containers are delivered to the packing tables by trailers also.

Packing Powdered Sugar in Cartons

The machinery used for packing powdered sugar in cartons is exactly the same as that used for packing granulated sugar in cartons except that when the carton is opened and the bottom glued shut an additional operation is introduced. This consists of forming and placing within the carton a paraffine paper lining. The general routine of handling after the cartons are filled is exactly the same as that used for cartons of granulated sugar.

Efficiency Developed in the Packing Department

The efficiency of the machinery for filling cotton bags could be determined only after a long period of observation. These machines are only semi-automatic and the rate of production from them depends entirely on the skill and willingness of the operators. The main advantage lies in the fact that they make a repetition job out of the filling—a job which may soon become automatic routine to the operator and at which high speed can easily be developed. It does not seem possible that anyone would question the increased efficiency of this filling method over a complete hand method.

The automatic equipment for filling cartons, on the other hand, presents a very definite picture of increased efficiency. The average production of these machines is twenty-eight filled cartons per minute.

The difficulties to be overcome in shipping material from this plant lie in the many points of origin of the various packages to be shipped and the fact that shipping must in no way be tied up to production, the production being free to go on without any reference to the amount of material which is shipped from the plant. For this reason all sugar shipped is placed in large sacks, in barrels or in good-sized wooden or paper containers.

This necessitates the further packing of the cotton bags in which granulated sugar is loaded. The chute which takes the cotton bags from the filling machine can deliver in two ways. One of these deliveries is made to a large sloping collecting table underneath the filling machine, and the other delivery is made to a similar collecting table a short distance away from the first one and parallel to it. At one of these collecting tables the sacks are loaded into barrels. Here the barrels are placed on shakers just as if they were to be loaded with bulk sugar and the sacks are thrown in and shaken down into a compact load. After a barrel is loaded the head is placed and the barrel is then taken to storage or shipping on a trailer.

The other collecting table is used for loading the cotton bags into burlap sacks. These sacks take 100 lb. as a complete load, and for convenience they are rested on scales during the time in which the sacks are placed in by hand. Along the side of this collecting table is a belt conveyor. This belt conveyor is exactly similar to that used at the point where bags are filled with bulk sugar and is operated in the same way, the bags being placed on it after they receive their required weight of small cotton bags and then, after passing through the sewing machine, are delivered to a table where they are loaded on trailers.

Storage With Reference to Shipment

Because of the fact that the production must go on without reference to the shipping, large storage spaces have been arranged. These storage spaces are sufficient to permit the storage of barrels, bags and containers as they are produced, until such time as they are shipped.

For this type of handling, from point of package origin to storage, and from storage to shipment, there is only one kind of conveying equipment which is thoroughly adaptable and flexible. This is the electric storage battery tractor and trailer—the system which has been adopted in this plant, and which is in general used for similar service in other industries.

As a special service for the handling of barrels the filled barrels may be delivered from the barrel-loading dock to a barrel elevator and elevated to the desired point.

This is a specially built barrel elevator which can raise and lower barrels to the various storage floors of the storage space. The trailer system is also used for barrels, however, and is used entirely for the bags and for the other containers.

In connection with the use of the trailers there have been installed large elevators of a capacity of 8 tons, with a platform about 17x17 ft. These elevators are provided with an automatic micrometer leveling device so that the operator stopping anywhere near the desired floor has to pay no further attention to his elevator, which automatically adjusts itself to the correct floor level. As the load is removed from the elevator or as the load is placed on it, this device serves to compensate for the change in loading and to keep the elevator in exact position.

The various loads are taken to the points of ship-

ment—that is the railroad car loading dock, the dock for loading trucks for local shipment, or the pier at which lighters are loaded—in every case by tractor and trailer.

The upper floors of the building, in which storage takes place, are not served generally by tractors, although this can be done if desired. The trailers are mounted on ball-bearing wheels and may be shoved easily by hand to their position on the floor or to the elevator as desired. When they are delivered by the elevator to the ground floor, they are picked up by the tractor and taken to the proper loading dock for shipment. In all cases the loading docks are as near as possible level with the carrier into which the load is to be placed, so that the trailers may be run directly into the car, lighter or truck. In this way all rehandling is eliminated and the only handling that occurs is when the container is placed on the trailer at its point of origin and when it is removed from the trailer to the proper place in the carrier in which shipment occurs.

Noteworthy Points of This Installation

The particular point worthy of note in this handling installation is the fact that it forms a unified whole. The sugar is delivered to the various packing operations, all from one central storage bin, to be carried through many diversified operations and into several forms of final shipping containers. The handling system used in connection with shipments is so arranged that all of these various containers may be handled in exactly the same way by a completely flexible system. It is readily seen that no matter how the plant may be extended the same method of packing can be duplicated, and the methods of handling to shipment would be exactly the same as at present, with the addition of possibly a few more tractors to the fleet now in use.

The large number of trailers necessitated by this system of storage and handling has been brought up many times as an objection to its use in other industries. This objection does not hold good in practice, because the use of this multiplicity of trailers absolutely eliminates any rehandling, and the non-productive labor entailed in shipping is cut to about one-third the amount which would be necessary if the usual two rehandlings were indulged in.

The writer wishes to acknowledge the courtesy of the American Sugar Refining Company in making available the date on its handling system, which solves so well a problem so often encountered.

Natural Indigo in Java

The classification of indigo in the Soerabaya market is dependent upon the percentage of indigo blue, which varies from 60 to 70 per cent. The production of indigo in Java has been rapidly declining, owing to inability to compete with synthetic indigo.

English Rail Specifications

According to a revision of the British Standard Specifications for bull head railway rails, issued in June, 1922, the chemical composition of the steel may be specified by the purchaser from the following classes (where range is not given, the figure is a maximum):

	Open-Hearth				Bessemer		
	Acid		Basic		Acid		Basic
	Ordinary	High-Carbon	Ordinary	High-Carbon	Ordinary	High-Carbon	Ordinary
C	0.45–0.55	0.50–0.60	0.45–0.60	0.55–0.65	0.40–0.50	0.45–0.55	0.40–0.50
Mn	0.90	0.80	0.90	0.80	0.70–1.00	0.90	0.70–1.00
Si	0.15	0.10–0.30	0.15	0.10–0.30	0.15	0.10–0.30	0.15
P	0.06	0.05	0.05	0.04	0.075	0.06	0.07
S	0.06	0.05	0.06	0.05	0.07	0.06	0.07

Carbon and phosphorus analyses must be made from each heat before rolling. Complete analyses must be made from every 100 tons of rails. Arsenic and copper must also be reported if desired. The rail to be analyzed is selected by the purchaser, and the drillings are taken from a ¾-in. hole driven longitudinally in the left center of the head.

One impact test (with a falling tup weighing 2,240 lb., which is described in detail) is made from every heat. A 5-ft. piece from the top rail may be selected by the purchaser, or the crop itself may be used if the maker consents. After two blows of specified height (5 to 7 ft.), the permanent set must not exceed 3.7 to 4.3 in., depending upon section and carbon content.

Furthermore, if the purchaser desires, he selects a rail from each 100 tons of material and a tensile test specimen is cut from the left center of the head. Retesting without prejudice is permitted if the fracture occurs outside the middle half of the gaged length. Tensile properties must conform to these relations:

	Ultimate Strength	Minimum Elongation in 2 In.
Ordinary carbons of any process	94 to 112,000*	15 to 12*
	112 to 119,000	10
Higher carbon open hearth	103 to 112,000	12
	112 to 123,000	10
Higher carbon bessemer	99 to 112,000	12
	112 to 119,000	10

* The minimum elongation for intermediate breaking strengths are in arithmetic proportion.

Retesting is permitted as follows: Two additional chemical tests may be made from the same heat or cast; if both pass, the entire 100 tons of rails is acceptable. If one or both fail, that individual heat is rejected, and the remainder of the lot of 100 tons treated and tested as a new lot. In this way the remainder of the lot is accepted as soon as a "cast" is found which passes the chemical test or retest. If the impact test fails, two additional tests may be made from two other rails. The heat is acceptable if both tests pass.

Retest for tensile properties follows the same procedure as retesting for chemical properties.

Ingots must be at least 200 sq.in. cross-section at the big end. They must be rolled bottom end ahead. All cold-straightening "shall be done by gradual pressure."

Storing Turpentine in Galvanized Tanks

Iron drums or tanks in which turpentine is to be shipped or stored should not be galvanized on the inside, but should be properly shellacked. This persistent white turbidity in turpentine was caused by a finely divided zinc compound held in suspension and a certain quantity of dissolved zinc. Iron oxide is also sometimes found in suspension. Shellacking instead of galvanizing will do away with this trouble.

It might be possible to ship or store freshly distilled turpentine, free from water, in iron or galvanized drums or tanks without producing this objectionable condition, but the smallest quantity of water will develop acids which partly dissolve and loosen either the iron itself or the zinc with which the iron has been galvanized. Turpentine stored over winter is practically certain to separate some water during the cold weather and any unshellacked metal surface will be attacked.

Modifications of the Sand Test For Detonators

By William M. Dehn

THE SAND TEST, as initiated by Snelling[1] and developed by Storm and Cope[2], is a rapid and practical method for measuring the explosive strengths of detonators and is based on the weights of 20- to 30-mesh standard sand crushed by their explosions. The fuse or electric detonators are imbedded in 100-gram masses of Ottawa sand contained in a suitably constructed bomb or explosion chamber of heavy steel. After the explosions, the weights of sand finer than 30 mesh are separated and weighed and the physical constants thus obtained are interpreted as the quantitative effects, or strengths, of the respective detonators.

Having had occasion recently to use the sand test and a number of questions relating to it having arisen, the writer was led to make a closer study of its operation and its principles. For example, Table I, calculated from a great volume of data of U. S. Bureau of Mines Technical Paper 125, shows remarkable regularities and raises a number of questions.

TABLE I—RESULTS OF SAND TESTS BY U. S. BUREAU OF MINES

Detonator No.	Average Weight of Charge	Percentages of Sand Retained on				Per Cent Sand Through 100-Mesh	Average Weight Sand Crushed	Sand Crushed by 0.1 g. of Charge
		40-Mesh	60-Mesh	80-Mesh	100-Mesh			
3	0.4953	14.93	18.11	10.64	6.94	49.38	22.03	4.44
4	0.6358	13.66	17.02	9.93	6.49	52.90	27.44	4.32
5	0.7220	13.11	17.06	10.10	6.61	53.12	30.90	4.27
6	0.9842	12.56	15.60	9.32	6.44	56.13	36.61	3.73
7	1.4377	11.89	15.07	9.27	6.04	57.73	47.16	3.28
8	1.8345	9.64	14.41	8.79	5.92	61.24	54.53	2.97
10	2.8691	8.12	12.69	8.64	6.16	64.39	68.74	2.40
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*

Why are the strengths[3] apparently not proportional to the weights of the detonators used? Why are they apparently less and less per unit of weight, as the total weights are increased? Then, on the other hand, with increase of size of detonators, why are larger percentages[4] of sand broken up more finely? Conversely, with decrease of charge of detonators, why are relatively larger fragments[5] obtained? These and other questions were raised by earlier experiments with the sand test. Much light on these questions has resulted from an extensive study of the test, especially from use of the modified form of apparatus described herein.

Modified Testing Apparatus

The essential features of improvement in the new form of explosion chamber are shown in the figure. The metal tripod support and the heavy frame carrying the screw to hold down the cover at the point *G* are omitted. The apparatus is a transformed autoclave[6] whose interior dimensions are 4 and 9 in. The only novel feature involved is the cylindrical steel weight, 5 in. in height and nearly 4 in. in diameter; it is centrally perforated by a ¼-in. bore *DC* and weighs 6 kg. In its final and most efficient form, the lower part of the weight was bored out hemispherically as indicated by the line *C*. Earlier forms, such as the flat-bottom form *A* and the partly cupped form *B* are indicated in the figure. The detachable hook is used to lower and to raise the weight.

Methods of Using Detonation Bomb

A 500-gram charge of Ottawa sand, freshly standardized to the 20-mesh and 30-mesh sieves to be used, is placed in the detonation bomb. The fuse or the wires of the attached detonator are passed through the hole of the weight at the cup end and the detonator is adjusted so as to touch the weight and maintain a vertical position. The weight with attached detonator, is then lowered by means of the hook *E*. After detaching the hook the weight is pressed down by hand so that the sand fills the cupped bottom; then the detonator is adjusted in the sand to a height estimated to be centrally and symmetrically located. By means of a gas pipe the weight is tamped down until the character of the sound of the blows indicates that the sand under the weight is uniformly and completely packed. This tamping should begin with moderate force and should not disturb the upright position of the weight. Finally, stronger blows of the pipe will give the desired compactness. The fuse or the wires are next run through the tube *F* of the cover, the latter is screwed down tightly and the charge is fired, preferably with the apparatus resting on a concrete floor. The explosions usually impart "kick" to the apparatus, but no sand is ejected therefrom. The cover of the bomb is taken off and the steel weight is elevated by the hook. The sand is then poured and brushed onto a stout piece of paper. No special precautions need be taken to collect the dust finer than 100 mesh.

Since only sand larger than 30 mesh and 100 mesh

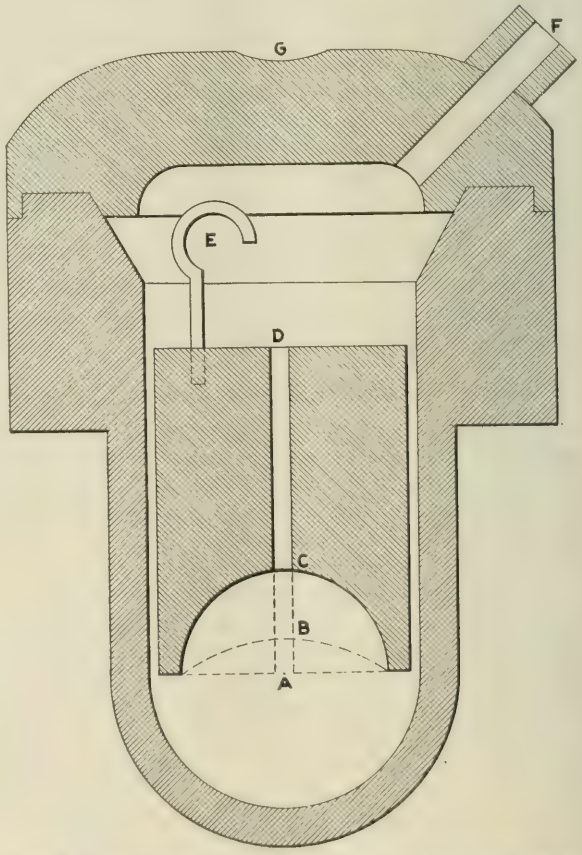


FIG. 1—CROSS-SECTION OF DETONATION BOMB

[1] *Proc.* Eng. Soc. Western Pa. p. 673 (1912).
[2] U. S. Bur. Mines Tech. Papers 125 and 162.
[3] Compare columns *b* and *i*.
[4] See column *h*.
[5] See columns *c* to *f*.
[6] The digestor or autoclave is supplied by the Palo Co., New York City, and is described as "made of copper, with bronze cover, cast steel yoke, sheet steel mantle for gas burner, with 3 legs, for 50 atmospheres working pressure."

respectively are weighed—the sand finer than 100 mesh being calculated by difference—no attention needs to be given to the dust inevitably lost to the air during the explosion or while transferring and sifting. The sand is first run through a 20-mesh sieve for the purpose of removing some of the pure white, extremely fine sand found to be in a packed condition, also to remove fragments of the fuse and detonator cap. All of this material is thrown away. Next the sand is poured onto a 30-mesh sieve. Since many masses of white crushed and packed sand are found, they are powdered on the sieve by means of a cork attached to a stick, using it as a flat-bottom pestle. These compact masses of powdered sand give trouble during the stages of sifting, but their removal is necessary to secure accurate and concordant data. After all of the 30- to 100-mesh sand has been collected, it is again run through the 30-mesh sieve by shaking but not by using the cork pestle. In this manner a quantity of 20- to 30-mesh sand will be recovered and this must be returned to the main bulk of 20- to 30-mesh sand, because the cork will always force through the sieve some sand which will not pass through by ordinary shaking.

In this connection it is of interest to note that under the microscope Ottawa sand is observed to be spherical or spheroidal in form, with no flat or conchoidal surfaces; but after explosions, unchanged sand, sand with one flat or conchoidal surface, and sand with two or more such surfaces are observed. The original round sand is extremely resistant to comminution by friction with the cork pestle; the sharp edges of the broken fragments are quite easily broken off. Hence the total sand crushed is subject to little effect by the pestle, but the percentage of the sand finer than 100 mesh may be varied through long-continued rubbing with the pestle. A blank run to determine the sand crushed by tamping in the bomb and by the rubbing with the cork under the above conditions gave less than 0.5 gram of sand from the 500 grams used.

Features of Improved Apparatus

The essential improvements of the detonation apparatus over that of Storm and Cope are as follows:

1. A heavy weight is superimposed on the charge of sand so as to subject the latter to more of the explosive strength of the detonator.
2. The weight is cupped at its bottom so that the detonator explodes in the center of a ball of sand, thus giving a more symmetrical distribution of the explosive effect of the detonator.
3. The charge of sand is 1 lb., or preferably 500 grams, instead of 100 grams, so as to supply a sufficient excess of material upon which the detonator can exert its power.
4. Only two fractions of sand finer than 30 mesh are determined; hence the practical application of the sand test is greatly simplified.

Other incidental details of improvement of this test are obvious or will be indicated.

Function of Weight of Bomb

In connection with the use of the weight over the sand subjected to the force of detonating charges, it may be observed here that 100 to 200 per cent more crushed sand can be obtained by this means than Storm and Cope obtained in their experiments. For example, their average for a No. 6 cap was 36.61 grams of sand, while the improved apparatus gives a value for the same cap of 85 grams. From these data and others given in the accompanying tables, it is evident that the greater confinement of the sand under a weight permits of utilization of more of the power of the detonator than could be secured in the Storm and Cope bomb with only 100 grams of unconfined sand. In their experiments most of the power of the detonators was dissipated in a sand bombardment of the walls of the bomb without subjecting all of the grains to the critical intensity force necessary to shatter.

Whereas, on the one hand, it is admitted that no known test for the strengths of detonators can measure all of the energy liberated, yet, on the other hand, any modification of a test like the sand test which gives a closer approximation to the total and true value is likely to be the more accurate and useful.

The mass of metal superimposed on the sand—namely, 6 kg.—in the apparatus described can be increased with accompanying increase of sand crushed. The total mass of metal thus used must be limited by estimates of the strength of the detonation bomb and of economy of the standard sand to be used, with incidental attention given to the control of gases developed so as to avoid blow-out of sand.

It was found that the cupped-out bottom gave substantially 25 per cent more crushed sand than the heavier but flat-bottomed weight. The effects of this form, therefore, is not only to lessen the ballistic effect on the weight but also to supply a symmetrical distribution of force lines of the explosive.

Details Regarding Sand Used

The quantity of sand to be used in the detonation bomb may be varied, but it has been found that 500 grams gives the desirable ball-like form in the bomb and for purposes of economy of sand and of reduction of labor in sifting this mass may be considered a good practical limit. The writer believes Storm and Cope used far too little sand in their experiment, since a No. 7 cap can break up more than the total sand used by them.

Tamping of the sand under the weight was found to be necessary to give concordant and maximum effects of detonation. Such tamping not only assures elimination of relatively large air spaces under the weight but also gives a packed condition of the sand amounting to about 5 per cent. Increase of compactness was obtained by mixing with small percentages of water. The incompressibility and capillarity of the water, as well as its displacement of air, increase the "hammer and anvil effect." Too much water, however, causes a decrease of demolition owing to diversion of explosive energy to heat of vaporization.

The convenience of measuring only two fractions of broken sand is obvious not only in lessening the labor of analysis, but the two fractions empirically chosen have been found to serve a definite and useful purpose. For example, it will be observed that the percentages of sand finer than 100 mesh as determined by Storm and Cope varied for the respective detonators from 49 to 65. The percentages of sand finer than 100 mesh as determined in accordance with the method of this paper have fallen usually between 40 and 55.

Why are there such wide differences, especially in the case of the large detonators as used by Storm and Cope? The answer is obvious—namely, incomplete detonation effect on the sand is indicated by a high percentage of sand smaller than 100 mesh. Evidently the

sand next to the detonator will be broken most finely, hence limited and incomplete effects will be indicated by higher percentages of the finer sand. Conditions that will produce this effect are: too little sand; too big a detonation charge; faulty confinement in the detonator capsules; imperfect exterior compression resulting in local blow-out; asymmetric installation of the detonator in the mass of sand, resulting in irregular distribution of the force lines of the explosive; variations in the shape and size of the detonators used; variations in the size and shape of the sand used.

The first of these two conditions are illustrated by the data of Storm and Cope; the effects of most of the other conditions are obvious; the effects of variations of the size and shapes of the detonators and of the sand used introduce a number of interesting questions.

Demolition Values Depend on Surface as Well as Weight

Since masses vary as the cubes and surfaces as the squares, it is possible that different weights of the same explosive cannot reveal by the sand test, or indeed by any test, strengths directly proportional to such weights. For example, assume that the explosive spherically occupies 1 c.c. and 2 c.c. respectively. Then the surfaces exposed will be in the ratio of 1 : 1.59 instead of 1 : 2, and the explosive power cannot be exerted under identical conditions of space distribution. Now, because the gas generated by an explosive, especially of the detonating type, exerts its power most intensely at the surfaces confining the explosive, while ballistic pressure effects are conducted to varying distances in advance of the expanding sphere of gases, it is evident that the total area of such surfaces initially exposed is a very important factor as influencing the final total effect. This is especially true when small weights are involved or when the explosives are highly brisant. Under these conditions, as the spheres of gases expand, the intensity factor falls off rapidly for a number of reasons, chief of which are the cube-square relation and the cooling by adjacent materials. Since a critical intensity factor is necessary to crush sand and other materials, it is evident that under adverse conditions of space distribution much of the energy of detonating explosives may be dissipated as heat or by transformation to ballistic effects. For example, in Table II it

TABLE II—RELATION OF DEMOLITION TO SURFACE AND WEIGHT

Det. No.	Ratios of Surfaces	Ratios of Weights	Sand Crushed Surfaces	Sand Crushed Weights	S. and C.	Dehn	Relative Strengths S. and C.	Relative Strengths Dehn
6	4.50	0.9842	1.00	1.00	36.61	85	1.00	1.00
7	5.77	1.4377	1.28	1.46	47.16	111	1.29	1.30
8	5.95	1.8345	1.32	1.86	54.53	135	1.49	1.59

is obvious that the sand test does not give values for demolition strictly proportional to the weights used, but values intermediate to the ratios of surfaces and the ratios of weights. It is further obvious that that test best measures the strength of an explosive which gives values most nearly proportional to the weights used. The cube-surface relation of explosives will be investigated further.

Study of Optimum Size of Sand

Investigation of the size of the sand used in this test brought out some very interesting observations which are shown in Table III. In study *A*, rounded Ottawa sand differing slightly in diameter gave more demolition with smaller grains—that is, with sand pos-

TABLE III—STUDY OF MAXIMUM CRUSHING EFFECT, USING NO. 8 DETONATORS

Study	No.	Condition of Sand Used	Total Sand Used	Total Sand Crushed	30 to 120 Mesh	Held on 120 Mesh	Per Cent Held on 120 Mesh
A	1	20 to 30 mesh. Through 20 mesh easily	500	135	79.5	55.5	41.11
	2	20 to 30 mesh. Through 20 mesh with difficulty	500	128	73.0	55.0	42.95
	3	20 to 30 mesh. Barely passes 20 mesh screen	500	117	66.5	50.5	43.16
B	4	30 to 40-mesh sand, fractured	500	251	....	80.0	31.87
	5	40 to 50-mesh sand, fractured	500	240	....	95.0	39.58
	6	50 to 80-mesh sand, fractured	500	154	....	83.0	53.89
	7	80 to 120-mesh sand, fractured	500	101	....	101.0	100.00

TABLE IV—ADDITIONAL RESULTS OF SAND TESTS

Study	No.	Conditions	Detonator No.	Sand Used	Sand Crushed	30 to 100 Mesh	Held on 100 Mesh	Per Cent Held on 100 Mesh
A	1	Detonators too long to be inserted completely in the masses of sand used. All detonators were old stock, somewhat deteriorated by storage in the moist air of the laboratory.	*a*	8	100	11.0	5	66	54.54
	2		*a*	8	200	69.0	26.5	42.5	61.60
	3		*a*	8	300	104.0	48.5	55.5	53.36
	4		*a*	8	400	109.0	51.0	58.0	53.21
	5		*a*	8	500	116.0	54.5	61.5	53.02
	6		*a*	8	600	123.5	57.0	58.0	53.79
	7		*a*	8	700	123.0	62.0	61.0	49.59
	8		*a*	8	800	118.0	58.5	60.0	50.85
B	9	New stock detonator	*b*	6	500	88.0	49.0	39.0	44.32
	10	14 c.c. H_2O added to sand	*b*	6	500	103.5	60.0	43.5	42.03
	11	100 c.c. H_2O added to sand	*b*	6	500	87.0	48.0	39.0	44.94
C	12	Detonator not inserted deeply, but next to weight.	*b*	6	500	75.0	40.5	34.5	46.00
	13		*b*	6	500	76.0	43.0	33.0	43.42

TABLE V—ADDITIONAL DATA ON SAND TESTS

Study	No.	Conditions	Detonator No.	Sand Used	Sand Crushed	30 to 120 Mesh	Held on 120 Mesh	Per Cent Held on 120 Mesh
D	14	Bomb on concrete floor	*b*	6	500	85.0	50.5	34.5	40.58
	15	Bomb on wooden floor	*b*	6	500	83.5	50.5	33.0	39.64
	16	Bomb without heavy frame and resting on tin can	*b*	6	500	70.5	40.0	30.5	43.26
E	17	Extra weights in bomb	*b*	6	500	86.5	49.0	37.5	43.35
F	18		*b*	7	500	111.0	63.5	47.5	42.80
	19		*b*	8	500	135.0	79.0	56.0	41.50

sessing the greater surface exposed to the power of the explosive. This study emphasizes the necessity of using sand of narrow mesh variation; certainly if 20- to 30-mesh sand is used, it should be thoroughly mixed after running through the sieves.

From study *A* it may be concluded that sand finer than 20- to 30-mesh can be advantageously used for the sand test. This is neither proved nor disproved by study *B*, since only sand previously crushed by detonators was used therein. However, study *B* does prove that a limit to such fineness of sand is reached for maximum crushing effect and that this maximum probably lies between 30- and 120-mesh. It must be remembered that the crushed sand possesses flat conchoidal surfaces and partly cracked texture; hence the optimum fineness cannot be estimated accurately from the data given.

Since the total surface of a given mass of sand can be increased thousands of times through comminution, while the explosive intensity factor remains a constant, it is easy to understand that too fine a division of the sand will result in the following: Dissipation of energy over too large a surface, a lowering of the critical intensity factor below the value necessary for crushing, and in a conversion of such crushing force to heat and ballistic effects. Furthermore it may be assumed that the

optimum sand size will differ for different explosives, since the explosives themselves possess different intensity factors for crushing.

If this prove true, then the strengths of detonators of different compositions cannot be compared accurately on the basis of the values obtained with the same quality of sand. This and other related questions will be investigated. Miscellaneous data, illustrating the foregoing discussions and conclusions are given in Tables IV and V.

Summary

Sufficient sand should be used to yield a practical maximum of crushing. It should be rounded and of a diameter practically uniform and sufficiently small to approximate the optimum fineness for the detonator used. Sand recovered from one test should not be used for a second test.

Confinement of the sand should be effected by a heavy weight of special design and the whole should be tamped down to a maximum compression.

The detonator should be inserted symmetrically in the ball-like mass of sand.

Different weights of the same detonator, or indeed equal volumes of the same differing in density, cannot exert crushing effects on sand directly proportional to the weights used.

Comparisons of the strengths of different detonators, as determined by the sand test, are only approximate.

Seattle, Wash.

Legal Notes

By Wellington Gustin

Rule of Implied Warranties in Sales Enlarged by Uniform Sales Act

In the case of H. Klaff & Co. versus Luria Bros. & Co., Inc., Klaff brought suit to recover a balance alleged to be due for several carloads of metal sold and shipped between March 15 and June 5, 1920. The amount of this balance was admitted, the dispute being only as to the validity and amount of Luria Bros.' claim of set-off arising out of a previous sale of five carloads of steel shells by Klaff to Luria Bros., shipped from the Naval Proving Ground at Aberdeen, Md., to Luria Bros. at its yard in Reading, Pa., and reconsigned by them to the Carpenter Steel Co., also at Reading. The Carpenter company rejected three of the five cars and Luria Bros. tendered a return of same to Klaff, who refused to receive them. The claim of set-off was for the purchase price paid by Luria Bros. for the rejected cars, together with demurrage charges.

In this case the seller of the steel shells was a broker or dealer and not the manufacturer. Defendants defended on the ground that they were purchased as scrap steel for remelting and were unfit for that purpose. They further contended that the seller knew the purpose for which they were purchased, and therefore there was an implied warranty that such material was reasonably fit for that purpose.

Former Law of Implied Warranties

Much confusion arose over a rule of law established in most of the states prior to the uniform sales act and now modified by this act. In a suit of the Queen City Glass Co. against the Clay Pot Co. (97 Md., 429), the law of implied warranties was laid down. This was cited in a subsequent case (114 Md., 172) as follows:

"Where a manufacturer contracts to supply an article which he manufactures to be applied to a particular purpose so that the buyer necessarily trusts to the judgment or skill of the manufacturer, there is in that case an implied term of warranty that it shall be reasonably fit for the purpose to which it is to be applied. In such a case the buyer trusts to the manufacturer or dealer and relies upon his judgment and not upon his own."

Seller Included Under Uniform Sales Act

Now the uniform sales act puts the seller, who is not the grower or manufacturer of the thing sold, in the position which was formerly held by the manufacturer or grower only, in reference to the implied warranty of the goods sold.

Section 36 provides: "Where the buyer, expressly or by implication, makes known to the seller the particular purpose for which the goods are required, and it appears that the buyer relies on the seller's skill and judgment (whether he be the grower or manufacturer or not) there is an implied warranty that the goods shall be reasonably fit for such purpose."

In a former case it was held that "when the seller is not the manufacturer of the article sold and the buyer has an opportunity of examining it there is no implied warranty, in the absence of fraud, that it shall be fit for the purpose for which it was bought. In such cases, if there be no express warranty, the doctrine of *caveat emptor* applies, and the buyer not having seen fit to exact a warranty, takes upon himself the risk as to quality."

Distinction Between Dealer and Manufacturer Eliminated

The sales act in effect qualifies this doctrine of *caveat emptor*. Goods thus sold may be found to be merchantable and yet not reasonably fit for the purpose for which they were required and if the buyer relies on the seller's skill and judgment in selecting the goods the doctrine does not apply. The important distinction between the dealer's and manufacturer's implied warranties as to the quality of their goods was apparently wiped out and they now stand on common ground.

In Pennsylvania the question arose in the case of Griffin vs. Metal Products Co. and the Supreme Court of that state declared the law there to be settled. It construed a contract for the sale of high-speed steel; and the question whether there was an implied warranty that the steel should be reasonably fit for the purpose for which the seller knew it was to be used was decided in these words:

"Before the passage of the act [the uniform sales act] it had been repeatedly so held, so far as relates to the grower or manufacturer of the goods sold, and the only change made thereby was to extend the rule to every seller 'whether he be the grower or manufacturer or not.'"

The contrast is well set forth in Benjamin on Sales (6th English Edition), page 716: "The distinction taken at common law between cases where the buyer had an opportunity of examining the goods and those in which he had none . . . has been abrogated by the code [referring to the uniform sales act]. Instead of a presumption that a buyer, who might have in-

spected the goods, bought on his own judgment, in future whether he so bought or not will be a question of fact, and an opportunity of examination and even an actual examination will be immaterial. And no distinction is drawn by the code between contracts of sale of specific as distinguished from those of unascertained goods. At common law the buyer of a specific thing for a particular purpose took the risk of the fitness of the thing bought."

Further, it was contended by the seller that since the buyer had used two carloads of the steel shells it could not then rescind the contract and return the part unused, since it was admitted that there was no difference between the material in the cars used and that unused. But the court points out that the price of the goods was not a lump sum for the five carloads, but $25 per ton; and there was no evidence to show that the price per ton depended upon the quantity ordered, or that the seller was in any way injured by the failure of the buyer to return all the cars. The court says under these circumstances the failure to return all the shells would only bear on the buyer's good faith.

Rights of an Owner of a Trade Secret

Some of the rights of an owner of a trade secret are set forth in the recent case of the Cameron Machine Co. against the Samuel M. Langston Co. and others (115 Atlantic, 212). Here the complainant sought an injunction to restrain the defendant Sieg from divulging secret features of certain machines manufactured by it, and to restrain the defendant company and Samuel M. Langston from using any information respecting such secret features which they, or either of them, obtained from Sieg.

The two companies were competitors. From time to time each company placed upon the market new and improved types of their own special make machines. From 1915 to 1919 complainant had in its employ an erector named Schatten; and about October, 1919, Schatten entered the employ of the Langston company. The defendant Sieg was employed by complainant from March, 1917, to May, 1920, when he also entered the employ of the Langston company.

Claims Secret Features Were Disclosed to Competitor

The bill charged that the Langston company induced Sieg to leave the services of complainant for its own employ for the purpose of obtaining from him knowledge of the secret features which complainant had embodied in the design for two certain improved machines which Sieg had designed for it. It further charged that Sieg, in violation of his duty to complainant, disclosed to the defendant company the secret features of its own machines, which he had designed for it, and that the defendants thereupon designed and manufactured a similar machine, copying and making use of all the secret features of complainant's machines.

Defendants denied the charges against them and asserted that there were no secret features in complainant's machines; that most if not all of the so-called secrets were old in the art; that such had been used in their own machines years before the new types of complainant's machines. And they further asserted that the complete designs for complainant's new machine were not in existence at the time Sieg left its employ; and that the exhibits used to establish such similarity are fictitious designs made solely for the purpose of the case, and after it had become possessed of a completed design for defendant's machine.

From the evidence the court could not say with certainty that there were any secret features or elements of complainant's designs which Sieg appropriated and divulged to the defendant company and which are used or embodied in its new machine. Neither was there satisfactory proof that any such secret features existed. On these facts the Chancellor dismissed complainant's bill of charges.

Otherwise the case brought out an interesting proposition. A "trade secret" was defined to be "a plan, or process, tool, mechanism or compound, known only to its owner and those of his employees to whom it is necessary to confide it."

Injunction Will Lie Against Employee Divulging Trade Secrets

Now, if the employee comes into possession of such trade secrets through a confidential relation with his employer, the law will raise an implied contract to prevent him from divulging any information he may have obtained as to the trade secret.

In Stone versus Graselli Chemical Co. (55 Atlantic, 736), the court held that a manufacturer whose goods are made under an unpatented secret process is entitled to protection by injunction against the divulging of his secret in any proper case.

This case, as well as others, also adopts the principle that employees of one having a trade secret, who are under an express contract, or a contract implied from their confidential relationship to their employer, not to disclose that secret, will be enjoined from divulging the same to the injury of their employer, whether before or after they have left his employ, and that other persons who induce the employee to disclose the secrt, knowing of his express or implied contract not to disclose the same, will be enjoined from making any use of the information so obtained.

Secrecy in Industry Fools Only the Secretive, Says Geological Survey Head

"Experience in dealing with producers of different commodities has shown that secrecy is largely a method by which producers have been fooling themselves," says George Otis Smith, the director of the U. S. Geological Survey, who has had long contact with production statistics. "Those who really wish to know the scope of competitors' activities have plenty of ways to find out. Secretive operators, who eventually decided to change their methods, have been surprised very much on disclosing their secrets to find that these secrets already were well known to their competitors."

This comment was occasioned by correspondence with S. K. Colby, the president of the American Magnesium Corporation. There was some hesitancy as to whether the Survey's annual chapter on magnesium should be written, as there is only one company active in its production. Presumably the company is entitled to keep its results to itself. An effort was made, however, to get permission to use these figures so that the Survey's records would be continuous. In his reply furnishing the figures, Mr. Colby expressed his hope that the chapter would be printed, so as to record the progress in the industry. He stated that his company had nothing to lose by having the quantity of metal produced by it made public.

Mechanical Properties As Affected by Grain Size

Grain Boundaries Add a Certain Stiffness to the Metallic Aggregate — Fine Grain Therefore Generally Involves Higher Tensile Strength and Hardness, and Greater Reduction of Area — Maximum Elongation Requires Medium Grain Size

By Zay Jeffries and R. S. Archer

TWO recent contributions[1] have defined, in a general way, the mechanical properties of pure metals. It was also remarked that the structure of the metal had a very profound effect on the results to be had from various physical tests. The simplest type of structure, of course, is that where the entire sample consists of one huge crystal, consequently the properties of the individual crystalline grain were given.

We now purpose to discuss how variation in the average size of the crystalline grains comprising the metal may be expected to influence the mechanical properties of the aggregate.

Support at Grain Boundaries

The continuity of the planes of easy slip is broken at grain boundaries. Any movement of blocks or fragments of one grain is opposed by adjacent grains which because of their different orientations cannot yield easily in the same direction. Disorganized or amorphous metal which is probably present at the grain boundaries acts as an additional source of rigidity (at low temperatures). Above the recrystallization temperature flow takes place at the grain boundaries, so that they are sources of weakness rather than of strength.

The mutual supporting action of adjacent grains is shown clearly in Sykes' molybdenum wires, Fig. 1, where the grain boundaries stand out like joints in a piece of bamboo. It is evident that the supporting action is effective to a considerable distance within the grains. We should therefore expect a shortening of such grains to result in an increase in strength, even though they still extended across the entire section of the wire. When the number of grains on the cross-section is also increased, the supporting action becomes still greater. Thus at 300 deg. C. Sykes obtained the following values for tensile strength vs. grain size:

Average Grain Diameter	Tensile Strength Lb. Per Sq.In.
Single grain	32,000
0.0011 in.	51,000
0.0002 in.	96,000

This increase in strength (and hardness) with decrease in grain size is characteristic of metals below their recrystallization temperatures. The quantitative relation of strength to grain size varies with the metal involved, the temperature of test, the rate of loading and the size of the piece, since it is not only a question of absolute grain size but also of the number of grains on the cross-section. When the number of grains on the cross-section is fairly large, however (say 1,000 or more), the absolute grain size is the important thing.

In the tests reported by Carpenter and Elam,[2] which were carried out at room temperature, the tensile strength of single crystals of aluminum of 99.6 per cent purity was found to vary from 6,270 to 9,180 lb. per sq.in. The same material treated to produce an average grain diameter of 0.0667 in. had a tensile strength of 10,440 lb. per sq.in., an increase of 66.5 per cent over the lowest and 13.7 per cent over the highest value for the single grains.

A most thorough correlation of grain size and Brinell hardness, measured at room temperature, has been worked out for alpha brass (68:32) by Bassett and Davis.[3] This alloy consists structurally of a single homogeneous solid solution, and is quite comparable to a pure metal. Some typical values obtained in one series were:

Average Grain Diameter	Brinell Hardness
0.014 in.	41.7
0.0046 in.	49.2
0.0030 in.	52.4
0.0014 in.	62.4
0.00093 in.	77.4

Observers are sometimes surprised to find that a very apparent difference in the grain size of two specimens is not accompanied by any marked difference in hardness. Referring to the second and third specimens in the table above, it will be seen that an increase in grain diameter of over 50 per cent has decreased the hardness only about 6 per cent. The difference in grain size would be quite apparent under the microscope, while the difference in hardness would be noticed only by measurements made with rather more than ordinary care. On the other hand, a similar increase in grain size between the last two specimens is accompanied by a marked difference in hardness. The effect of a given percentage difference in grain size is greater the smaller the grains.

Grain Size vs. Hardness at Higher Temperatures

When ductile metals are broken "cold"—that is, below their recrystallization temperature—fracture normally takes place through the grains and avoids the grain boundaries. At temperatures just under the melting point, metals are quite weak and fracture is intergranular. There is a range of temperature above that of recrystallization in which either transcrystalline or intergranular fracture may be produced at will by varying the rate of loading and duration of load. Slow loading and prolonged application of load favor intergranular fracture at low unit stress.

[1] "Mechanical Properties of Commercial Iron," *Chem. & Met. Eng.*, vol. 27, No. 14, p. 694, Oct. 4, 1922. "Effect of Temperature, Pressure and Structure on the Mechanical Properties of Metal," *Chem. & Met. Eng.*, vol. 27, No. 15, p. 747, Oct. 11, 1922.

[2] "The Production of Single Crystals of Aluminum and Their Tensile Properties," *Proc. of Royal Society*, A, vol. 100, 1921; abstracted in *Chem. & Met. Eng.*, vol. 26, p. 514, March 15, 1922.

[3] "A Comparison of Grain Size Measurements and Brinell Hardness of Cartridge Brass," W. H. Bassett and C. H. Davis, *Trans.*, A.I.M.E., vol. 60, p. 428.

Under these conditions the grain boundaries are sources of weakness rather than of strength. Accordingly at high temperatures the relation between strength and grain size is reversed, and the large-grained specimens are the harder. There must then be an intermediate temperature at which strength and hardness are little affected by grain size. This is the "equicohesive temperature." The following account of some experiments is taken from a paper by one of the authors:[4]

"Tests have been made on iron, tungsten, platinum, gold and silver. Small wires of these metals were drawn to a diameter of 7 to 8 mils in such a manner that the structures were fibrous—that is to say, a considerable amount of working on these metals was performed at temperatures below their annealing temperatures. Some pieces of each of the wires were heated by the passage of electric current, the temperature and time conditions being maintained in such a manner as to cause recrystallization and to produce one set of each of the metals composed of small equi-axed grains and another set composed of large equi-axed grains. The fine-grained and coarse-grained samples of the same material were compared with respect to the resistance to bending at various temperatures. Small hairpins were formed from each of the wires. Let us take the pair of silver wires as an example. The arms of each hairpin were 2 in. long and the distance between the two ends was $\frac{3}{4}$ in. A clamp consisting of two steel bars was used to hold the hairpins. Two hairpins, one of fine-grained and the other of coarse-grained silver wire, were put in the clamp a short distance apart. It was found that a rider weighing 0.2 gram suspended on the ends of the hairpins would not cause a permanent deformation in either the fine-grained or coarse-grained samples at room temperature, but would cause permanent deformation of the wires at slightly higher temperatures. The steel clamp holding the two silver hairpins in a horizontal position was inserted in a muffle furnace and the temperature was gradually raised. At temperatures lower than 250 to 275 deg. C. the fine-grained silver wire was the stronger—that is, it would hold the given weight with less deformation or bending than would the coarse-grained silver wire. Above 275 deg., however, the fine-grained silver wire had been deformed or bent to a greater extent than the coarse-grained one. The conclusion is that the fine-grained and coarse-grained silver had the same resistance to deformation at 250 to 275 deg. C.; that at temperatures less than this the fine-grained silver has the greater resistance to deformation, while at higher temperatures the coarse-grained silver has the greater resistance to deformation. These tests were performed with the other metals named and the results are given in Table I. The iron and tungsten wires were heated with electric current in an atmosphere of hydrogen in order to prevent oxidation. The temperatures were measured with an optical pyrometer. The gold and platinum wires were heated in a muffle, the same as the silver, and the temperatures were measured with a thermocouple.

TABLE I

Kind of Wire	Diameter, In.	Equicohesive Temp., Deg. C.
Iron	0.007	550 to 600
Tungsten	0.007	1350
Silver	0.0075	250 to 275
Gold	0.0085	275 to 300
Platinum	0.0075	525 to 550

"The wires used for the hairpin tests were examined microscopically to make certain that the heat-treatment had produced the desired grain size. The fine-grained wires were made by heating the cold-worked wires quickly to a temperature considerably above that of recrystallization and the coarse-grained samples were produced by heating slowly through the recrystallization range followed by heating to a temperature near the melting point. The heating was done by passing electric current through the wires."

It will be noted that the equicohesive temperatures found for these metals correspond closely with their respective temperatures of recrystallization. This relation is a general one, having been found to hold for all metals investigated. Some experiments on zinc, lead and tin, which recrystallize at or below room temperature, are interesting. Quoting again from the paper mentioned above:

"Some pure zinc, lead, tin and aluminum were cast in such a manner as to produce coarse-grained structures. One piece of each of the castings was tested for Brinell hardness as cast and one piece of each was cold-hammered, after which the Brinell hardness was determined. The cold-hammering of the zinc was continued until cracks began to form at the edges of the piece. In testing for hardness, 500 kg. pressure was used with the zinc and aluminum, 200 kg. with the tin, and 100 kg. with the lead.

"It was noticed with all of the samples with the exception of the aluminum, that when the load was brought up to the required amount the beam of the balancing mechanism of the Brinell machine would very quickly fall. When the pressure was again brought up to that required, say for the zinc 500 kg., the beam would again drop. This means that the pieces of lead, zinc and tin were gradually deforming under constant load. The pressure was maintained at the required amount until the beam at a constant position of the specimen table would remain in a substantially constant position.

"With both cast and cold-hammered aluminum, the beam remained in a substantially constant position after the load was first brought to the required amount. A very slight lowering was noticed, but the effect of increasing the time of exposure of a given load was practically nil on the resulting hardness.

"This slow deformation was the most marked in the tin. It was more pronounced in the cold-hammered samples than in the cast samples and the maximum effect was found in the cold-hammered tin. When the hardness tests were carried on in such a manner that there was substantially no further deformation in the pieces of metal with constant load, it was found that the cold-hammered aluminum was harder than the cast aluminum, whereas the cold-hammered lead, tin and zinc were all softer than the same metals in the cast state.

"To obtain an idea of the rate of deformation of the pieces of lead, tin and zinc, the diameter of the impression of the ball of the Brinell hardness machine was measured on each of the samples after the load had first registered the required amount. For example, the tests on zinc were made as follows:

"The piece of cast zinc was put in the Brinell machine and the pressure raised quickly to 500 kg. Then the piece of cold-hammered zinc was inserted in the machine and the pressure raised to 500 kg., the rate of application of the load being the same in both cases. The hardness numbers were then calculated. It was found that the hardness of the cold-hammered pieces of aluminum, zinc, lead and tin was greater when determined in the above manner than that of the same metals in the cast state. The results of the hardness tests are given in Table II.

TABLE II—HARDNESS OF WHITE METALS, CAST AND HAMMERED

		Load Sustained		Quick Release of Load	
Material	Pressure in Kg.	Diam. of Impression in Mm.	Hardness	Diam. of Impression in Mm.	Hardness
Cast aluminum	500	4.75	26.5	4.75	26.5
Cold-hammered aluminum	500	3.70	44.8	3.70	44.8
Cast zinc	500	4.15	35.3	3.65	46.2
Cold-hammered zinc	500	4.20	34.5	2.90	74.0
Cast lead	100	4.85	5.10	4.70	5.44
Cold-hammered lead	100	5.05	4.66	4.30	6.54
Cast tin	200	5.65	7.30	5.10	9.12
Cold-hammered tin	200	6.8	4.72	4.6	11.32

"It is known that the equi-axing temperature of zinc after severe cold-work is not far below room temperature, and the hardness results would indicate that the equicohesive temperature of zinc would be only slightly below room temperature. The equi-axing temperatures of severely cold-worked lead and tin are considerably below room temperature, and the hardness results given in Table II would indicate that their equicohesive temperatures would also be considerably below room temperature. The equi-axing temperature of severely cold-worked aluminum is about 200 deg. C. with 1 hour's exposure at that temperature. The hardness results in Table II show that the equicohesive temperature of aluminum must be considerably above room temperature."

The lead and tin referred to as "cold-hammered"

[4] "The Amorphous Metal Hypothesis and Equicohesive Temperatures," Zay Jeffries, *J. Am. Inst. Metals*, vol. 11, p. 300.

were found by microscopic examination to be fully recrystallized, and therefore representative of normal fine-grained metal as distinguished from the coarse-grained cast specimens. It may be added that the duration of "sustained" load in the tests reported in Table II was about 15 minutes for the aluminum and about 1 hour for each of the other metals, while "quick release" was in each case after approximately 10 seconds.

These results bring out in a striking way the fact that the equicohesive temperature, as well as the recrystallization temperature, is dependent on the time factor. The temperatures at which the Brinell hardness is independent of the grain size are, for lead and tin, above room temperature for rapid loading but below room temperature for slow or prolonged loading. The equicohesive temperature of copper has been found to lie above 950 deg. C. for rates of loading producing rupture in about 3 seconds, whereas for very slow loading it is in the neighborhood of 300 deg. C. In general the equicohesive temperature is higher the more rapid the application and the shorter the duration of load.

Grain Size vs. Elongation

The elongation found on single-crystal test-bars of aluminum by Carpenter and Elam ran up to 87 per cent, as compared with about 37 per cent on bars with an average grain diameter of 0.0067 in. When there were two or three crystals on the cross-section, the elongation was less than 87 per cent, but greater than the elongation on the fine-grained bars. In Sykes' tests on molybdenum wires[5], on the other hand, the elongation was less on the wires composed largely of single crystals than on other wires of smaller grain size. These results are not contradictory, as the conditions of test were different. The gage length of the molybdenum wires was eighty times the diameter, and the elongation measured was the general elongation. Furthermore, the gage length included several grain boundaries, at which, as we have seen in Fig. 1, the deformation was relatively slight. Carpenter and Elam used test-bars in which the ratio of gage length to cross-section was relatively small, so the measured elongation was greatly increased by the high reduction of area, and the gage length consisted entirely of a single crystal. If the elongation on the molybdenum wires had been measured over the single crystal in which the break occurred, the per cent elongation would have been much higher. Unfortunately no tests have been made on single crystals having a sufficiently great ratio of gage length to diameter so that the general elongation could be measured, unaffected by the local stretch.

FIG. 1—SINGLE GRAIN MOLYBDENUM WIRE BROKEN IN TENSION (SYKES)

In general the grain size conducive to maximum elongation is neither extremely fine nor extremely coarse. The actual grain size which will give the highest elongation for any particular metal depends on the size and shape of test-piece, the temperature of test, and rate of loading. Curves given in Fig. 2 show how the relation between grain size and elongation in molybdenum depends on the temperature. The fine-grained wire, which had the greatest elongation at temperatures below 200 deg. C., had the least elongation at 900 deg. C.

The effect of grain size and diameter of test specimen on the elongation and reduction of area of Armco iron is shown in Table III.

TABLE III—EFFECT OF DIAMETER AND GRAIN SIZE ON TENSILE PROPERTIES OF ANNEALED ARMCO IRON

Diameter, In.	Grains Per Sq.In.	Tensile Strength, Lb. Per Sq.In.	Elongation, Per Cent in 2 In.	Reduction of Area, Per Cent	Number of Grains Across Diameter of Wire
0.204	400	41,000	30.0	76.0	100
0.025	810	48,550	12.5	76.0	18
0.023	2680	48,200	23.7	78.0	30

Table IV shows the required tensile strength and elongation of annealed copper wires of various diameters as specified by the American Society for Testing Materials.

TABLE IV—TENSILE STRENGTH AND ELONGATION REQUIRED IN SOFT ANNEALED COPPER WIRE

Diameter, In.	Tensile Strength, Lb. Per Sq.In.	Elongation, Per Cent in 10 In.
0.460 to 0.290	36,000	35
0.289 to 0.103	37,000	30
0.102 to 0.021	38,500	25
0.020 to 0.003	40,000	20

Lower elongation in small wire and thin sheet or strip is a general observation in metals. But as shown in Table III, a small grain size seems conducive to high elongation in small wire or thin strip.

Brittleness

Brittleness in metals may be due either to brittleness of the grain boundaries or to lack of plasticity in the crystals themselves. Equi-axed tungsten breaks in a brittle manner at temperatures below 200 deg. C., the

[5] "Effect of Temperature, Deformation, Grain Size and Rate of Loading on the Mechanical Properties of Metals," W. P. Sykes, *Trans.*, A.I.M.E., vol. 60, p. 780.

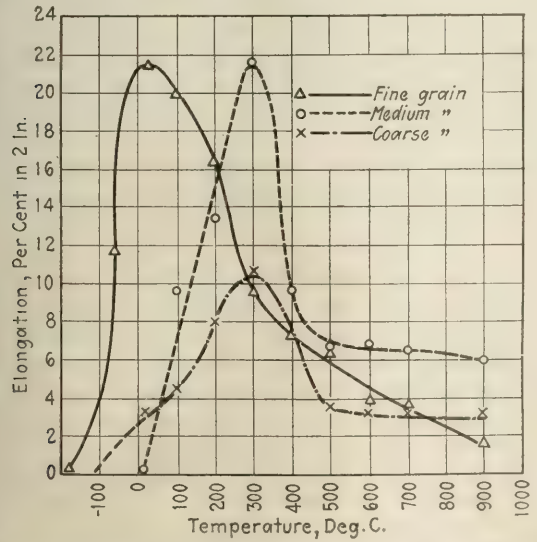


FIG. 2—EFFECT OF TEMPERATURE AND ELONGATION OF ANNEALED MOLYBDENUM WIRE. (SYKES)

fracture taking place almost entirely at the grain boundaries. Individual crystals of tungsten appear to be somewhat plastic. The low-temperature brittleness is therefore due to brittleness at the grain boundaries, a condition which is consistent with the view that the grain boundary metal is amorphous and that the amorphous metal increases in hardness and brittleness, as the temperature is lowered, more rapidly than does the crystalline. Coarse-grained zinc is but slightly ductile at room temperature, whereas fine-grained zinc may have an elongation as high as 90 per cent. In the coarse-grained zinc, the fracture takes place largely through the grains. Both fine-grained and coarse-grained zinc are brittle in liquid air, the fracture again taking place chiefly through the grains. Brittleness in this case is therefore due to lack of plasticity in the crystalline grains themselves. In either case small grain size favors the retention of ductility at low temperatures.

Reduction of Area

The first yielding of a tensile test-bar of a ductile metal involves a local reduction in the cross-sectional area. The stress intensity at this point is then higher than in the rest of the bar, which has not yet yielded. If it were not for the work-hardening effect of this slight local deformation, the reduced section would not be able to sustain a load sufficient to deform the remainder of the bar, so the section would continue to reduce and rupture would finally occur at this point, without any general extension of the bar as a whole.

A certain minimum rate of work-hardening is necessary for general extension to take place. Suppose the first local yielding reduces the cross-section of the bar by 1 per cent. Then unless the yield point of the metal is raised slightly more than 1 per cent by this deformation, the reduced section will not be able to sustain even the load which originally caused it to yield, and which was *insufficient* to cause yielding in the remainder of the bar. If the yield point is raised more than 1 per cent, then an increase in load will cause further deformation to occur at some other point in the bar. This process results in general extension, or general elongation.

Usually a stage is reached at which the rate of hardening is not sufficient to shift automatically the location of the yielding. The bar then necks down and breaks.

As long as general extension is taking place, the *load* on the bar must be increasing. When necking begins, the load can no longer increase. It may remain fairly constant for a while and must then decrease. The load per unit area of the reduced section, however, may continue to increase.

The total reduction of area at fracture is thus made up of two parts: (1) A reduction corresponding to the general extension before necking begins; the volume of the metal remains practically constant. (2) A local contraction at the point of fracture.

It will thus be seen that a rapid rate of hardening by deformation favors general extension rather than local reduction of area. Manganese steel is a typical example of a material which shows a high general elongation with little local reduction. It is also characterized by rapid hardening under deformation. Bronze behaves in a similar manner. Brass shows a greater tendency to neck down, but much less so than pure copper, which hardens less rapidly by deformation.

An extreme case is represented by glass at such a temperature that it is fairly soft. Pulling a glass rod in this condition results in a break with practically 100 per cent reduction of area and little general elongation. The glass does not become harder as a result of the deformation. If a hot rod of glass is withdrawn from the source of heat and pulled apart, there is apt to be very high general extension, because the points which are reduced in cross-section strengthen themselves by becoming cooler. If they remained at the same temperature, rupture would occur at the first point to yield and general drawing out would not be possible.

At high temperatures metals somewhat resemble soft glass, since the hardening effect of the deformation is removed by spontaneous annealing. Some annealed copper wires tested at room temperature showed a general elongation of 24.5 per cent with a reduction of area of 76 per cent. When broken at 950 deg. C. at such a rate that rupture occurred in 5 seconds, the elongation was 17 per cent and reduction of area 98 per cent, a considerable increase in reduction of area with a decrease in elongation.

Reduction of area of single crystals tested in the intermediate zone of temperature is very high, approaching in some cases 100 per cent. On the other hand, when there are a small number of grains to the cross-section of a test-piece, conditions appear to be unfavorable for high reduction of area. If the grain size becomes still smaller, the reduction of area increases. Extremely small grain size, such as probably exists in hardened steel, is unfavorable to plasticity of any kind, so that theoretically a point must be reached where further reduction of grain size no longer results in increased reduction of area in the tensile test. This point is apparently not reached in recrystallized metals; ordinarily the reduction of area is greater the smaller the grain size.

Increase in Oil-Refining Capacity

The oil-refining capacity of the United States has increased 813 per cent in 16 years, according to the American Petroleum Institute. The increase has, of course, been brought about largely by the demand created by the internal combustion engine.

In 1906 the refineries of the United States, running to capacity, could handle about 219,000 bbl. of crude petroleum a day. The principal demand was for kerosene. Gasoline was a byproduct and only about 8,000,000 bbl. of it was produced during the entire year.

On Jan. 1 of this year, the refinery capacity was over 2,000,000 bbl. a day. The principal demand is for gasoline which, according to the latest official figures, was produced during July at the rate of about 160,000,000 bbl. a year.

The present refineries in Mexico alone have a capacity nearly as great as the refineries in this country had 16 years ago.

Japanese Pulp Industry

In 1921 there were thirteen Japanese companies, with twenty-eight mills, engaged in the pulp industry, as compared with seventeen companies and thirty-one mills in 1920, according to Trade Commissioner H. A. Butts, Tokyo, to *Commerce Reports*. The total output of pulp amounted to 268,261 tons in 1920 and 250,027 tons in 1921. This decrease was caused, however, by the financial depression in Japan last year. The 1922 output is expected to be 30 per cent greater than that of 1920, and in the near future the Japanese production of pulp will probably exceed 400,000 tons annually.

Modern Practice In Manufacture and Applications of Steamed Ground Wood

The Present Status and Practical Possibilities of This Process of Paper and Board Manufacture—Part I, in Which the Theory of the Process Is Discussed and the Equipment Is Described

By A. O. Bragg

THE SCANDINAVIANS and Germans, and other European paper makers to a smaller extent, have made papers and boards from steamed mechanical pulp alone or with other pulps for over 25 years. In fact, certain kinds of papers made entirely from this material form important lines in their domestic and foreign trade. Fry, in Germany, seems to have been the first to steam wood in the log before grinding and the first to discover that the action is largely one of hydrolysis. Since that time, in 1867, refinements and improvements have been made so that some American mills, even with the higher labor costs, are carrying out the process with success. However, there seems to be a scarcity of information available in the pulp and paper literature regarding modern practice of this kind of ground-wood manufacture, and it is the object of this article to discuss the theoretical considerations on which its economical and effective operation must be based and to detail successful American practice in equipment, operation and applications. In Scandanavia and Germany the practice is to handle the wood by manual labor. Moreover, the equipment used is not particularly adapted to large production. For these reasons, European methods are not applicable here.

Unless the various methods of heat-treating wood with water before grinding are well defined and differentiated, there is likely to be confusion in referring to them, especially in view of the limited practice of this operation in America. Certain literature mentions as a variety of this process the simple soaking of the logs in hot water for a short time for loosening the bark, whereas in purpose and effect it is totally different, in that no appreciable hydrolysis or chemical change is effected in the wood. Such changes are essential to obtain pulp with the characteristics of the true steamed ground-wood pulp. This soaking process is simply a well-known preliminary operation to barking, often carried out to melt ice as well as loosen the bark. Treating logs in boiling water at 212 deg. F. for several hours causes hydrolysis and chemical changes, but to a much smaller degree than those brought about by steaming the wood—the most efficient and practical method for causing such changes.

Tests on Cooked Spruce

Thickens and McNaughton[1] from their extended grinding tests on spruce at the Forest Products Laboratory presented the following summary:

1. Cooking spruce prior to grinding results in a stronger fibered pulp, although at least 25 per cent more power per ton is required than is used for grinding untreated woods. The horsepower consumption per ton when grinding under conditions of varying cylinder pressure decreases to a minimum at approximately 65 lb. pressure on a 14-in. cylinder; this holds for dull or sharp stones.

2. When wood is cooked under conditions of constant pressure and varying lengths of time, the maximum power consumption per ton of pulp is obtained after cooking for 6 hours. This holds true, regardless of the pressure at which the cooking takes place, between zero and 75 lb. pressure.

3. Wood which is cooked at high pressure requires more power per ton of pulp when ground under the same conditions of cylinder pressure, speed and surface of stone than wood which is cooked at lower pressure, if the duration of the cook is the same. Likewise, the production of pulp in 24 hours is materially less when the wood has been cooked at high pressure than if it had been cooked at low pressure.

4. The yield per cord is influenced very greatly by the length of time the cooking is carried on and the pressure of the cook, being much lower for high pressures than for low and also for long cooking periods than for short.

5. The power to the grinder increases with speed and pressure of grinding and decreases with the degree of sharpness of stone. There is also a very slight increase in the power required with increases in temperature, other conditions remaining constant, while the thickness of stock in the grinder pit has almost no influence. Under like conditions of all other factors, the power to the grinder is less for steamed wood than for green or seasoned wood untreated.

6. With a fixed amount of power to the grinder and a fixed grinding pressure, the speed of the pulp stone will vary greatly, depending on the length of time the wood has been steamed and the steaming pressure. Unsteamed wood will grind at low speed, while that steamed a long time will grind at high speed with the same amount of power in the grinder.

7. There is little if any difference in the quality of pulp obtained as a result of using either the boiling or steaming process. The color, length of fiber and yield are practically the same if the boiling or steaming is carried on at the same temperature.

8. The amount of pulp produced in grinding cooked wood with a fixed amount of power to the grinder is less at high pressure and low speed than it is at low pressure and high speed. This results in a greater horsepower consumption per ton of pulp at high pressure and low speed.

Steaming Versus Boiling

It will be noted (paragraph 7) that similar results are obtained either by boiling or steaming the logs, at the same temperature. For practical reasons, steaming is practiced almost to the exclusion of boiling. In the first place, whether the water be added to the cooker already heated to 212 deg. F., or added cold and then heated in the cooker, much steam must be wasted in either case in heating it. In cooking with steam alone, its heat is given up directly to bringing the logs to its

[1]Bulletin 343, U. S. Department of Agriculture, 1916.

temperature. Secondly, while the steam left in the boiler after steaming can be blown off and its heat reclaimed by absorbing in boiler feed water, the water remaining from the boiling process is too contaminated with acids and dissolved matter to permit its being used for steam generation by the power plant. While it is possible to save hot water from a boiling and use it for the next batch, this involves expense for pumping and mechanical complications which makes the scheme too expensive.

The Enge and Bache-Wiig methods (see below) involve the use of auxiliary vacuum and compressing machinery which adds to the cost from investment, power, maintenance, labor and the low mechanical efficiency of vacuum and compressing machinery. However, these inventors claim to produce white or natural-colored ground wood. If the increase in strength effected in the pulp by these methods is comparable with that produced by simply steaming the wood, the extra cost would be to a large extent compensated, though in installing these or any other kind of ground-wood treating methods, all the pertinent factors would have to be considered. It will be evident that as a practical and economical mill proposition, the steaming is much superior to the boiling method.

Theory of the Process

When wood is treated in water, either as steam or in the liquid state, at temperatures of 212 deg. F. or over, several effects are produced more or less simultaneously. These include partial solution of the water-soluble materials, organic acids, alcohol, gums, mucilage, sugars, tannin, etc., amounting to 4.83 per cent in spruce and 1.88 per cent in yellow birch (Griffin and Little), and the softening into a gelatinous, adhesive condition of the remaining gums and mucilages. Hydrolysis by the water of the lignine components of the wood, aided by the organic acids liberated, also takes place, which in fact is the action described in Fry's patent referred to above. This hydrolysis is only partial and its extent is determined by the reverse reaction which is aided by oxidation. This oxidation, which occurs along with the hydrolysis, not only slows up and finally stops it but produces the brown color characteristic of the pulp. These coloring matters would be rendered soluble in the sulphite process and would not discolor the pulp, but with steaming alone they are not removed and cannot be removed subsequently without injury to the wood and excessive loss.

These reactions, with the rosin and pitch removal and the temperature actions noted below, cause a loosening of the fibers in the wood structure, so that the stones do not disintegrate them so much. That is, the grinding is more an action of shredding and pulling the fibers from the wood in more nearly their original length, and less of cutting them out of the wood as in the grinding of untreated wood. This greater average length of fibers and their greater pliability caused by the softening effect, the smaller amount of wood flour and torn pieces of fiber formed, together with the cementing effect of the gelatinized incrusting matter—gums, mucilage, etc.—give the pulp its unusual toughness and tensile strength.

Steaming, carried far enough, will entirely remove the rosin and pitch from even the most resinous and pitchy woods, such as Southern pines, jack pine and balsam fir; whereas if such woods are simply boiled in water at atmospheric pressures or are understeamed, much will still remain in them and cause trouble by clogging the paper machine wire. Rosin is now being completely eliminated from scrub pine and white pine by steaming for 9 to 16 hours at 13 to 20 lb. pressure according to the moisture content of the wood. During these cooks there is a pronounced resinous odor present, especially when a charge is dumped and steam escapes. Rosin softens at 212 deg. F. and melts at 307 deg., while steam at 13 to 20 lb. gage ranges from about 250 to 260 deg. F. After steaming, the logs are found to be split and cracked lengthwise. Considering these facts and the insolubility of rosin in water or organic acids, it would seem that at these temperatures all or part of the rosin must be hydrolyzed by the steam, perhaps assisted by the organic acids liberated, the product obtained from this reaction being volatile at these temperatures. It would seem, furthermore, that rosin, softening at 212 deg. F., would be sufficiently softened at 250 to 260 deg. F. to seep out of the wood through the seams and cracks which are opened up by the heating. Moreover, these openings probably permit much more penetration of the steam and thus expedite the reactions, no matter what wood is being treated. Experience proves that boiling the wood at 212 deg. F. (atmospheric pressure) will not remove the rosin and pitch, and understeaming does not permit complete penetration of the steam, so that some rosin still remains in the wood.

Another factor seems to be of great and even fundamental importance. This is the density of the wood, in weight of bone dry wood per cubic foot. On this basis, the density is, of course, independent of the greenness or dryness of the wood and is practically a constant for any given species. The necessity for careful consideration of the density of the wood steamed will be evident from the citation of an actual experience which came under the writer's observation.

Importance of Density

It was desired to discover the most effective steam pressure and cooking period to apply to loblolly pine in order to eliminate all rosin and obtain an extremely tough board. Certain of the Southern pines are being successfully steamed commercially for 9 to 16 hours at 12 to 20 lb. pressure, but the species cooked are unknown; in fact in this case it is not known whether one or more than one species are used. The best that could be done, therefore, was to treat the wood under the same conditions in expectation of obtaining similar pulp. However, after so treating a carload of the supposed loblolly pine, grinding and making into laps, instead of the strong brown pulp desired, a comparatively weak, brittle, reddish-cream colored pulp in which there was still much rosin was obtained.

A compilation of the densities of the different Southern pines from the data of the Forest Products Laboratory showed that they varied widely as follows:

	Density, Lb. Per Cu.Ft.
Loblolly pine (*Pinus tæda*)	30
Longleaf pine (*Pinus palustris*)	34
Pitch pine (*Pinus rigida*)	29
Scrub pine (*Pinus virginiana*)	26
White pine (*Pinus strobus*)	22

Considering that good results are being obtained by steaming "Southern pine" under the above conditions and that their duplication on loblolly pine failed to give the same quality of pulp, the only explanation is that the wood alone must have caused the divergence in

results and that the same species of wood was not used in both cases. The wood tested experimentally weighed 4,800 lb. per cord and had a density of 28.45 lb. per cu.ft., which, allowing for the probable better sampling by the Forest Products Laboratory in its determinations, corresponds to the density of pitch pine instead of loblolly pine, which it was supposed was being cooked. Moreover, from obtaining such different results from steaming Southern pines of similar moisture contents under similar conditions, it seems logical to attribute this divergence solely to the difference in densities of the woods in the two cases.

Accordingly, it would seem in general that to obtain pulp of the same average fiber length and color, the greater the density of the wood the more drastically must it be cooked, either by an increase in the steam pressure or temperature, or in the time of cooking, the former plan being the more practical. It would seem logical that the heavier and more dense the structure of the wood the higher the steam pressure necessary to effect penetration, expand it and open up seams and cracks, thus permitting complete action of the steam and temperature on all parts of the interior of the logs and also the escape of volatile and softened matter. It is the writer's opinion that woods of about 27 or 28 lb. per cu.ft. density should be steamed with a minimum of 35 lb. pressure for 20 hours, and higher density woods in proportion.

However, other factors besides the density must be considered in deciding on any cooking policy. Since, like any digestion process, the action takes place in two stages, the greener the wood the more drastic must be the cook for any given species. The first stage is that in which the wood is brought up to steam temperature and the second that in which the actual digestion and chemical changes occur and the steam supplied simply replaces the heat lost by radiation. The large amount of water in green wood must be heated up to steam temperature before any hydrolysis takes place, and this consumes time and steam. The moisture content of the wood can be regulated to some extent by felling it in the fall when sap is down and letting it season thoroughly before use.

Equipment

Wood Room

Nothing unusual is necessary in the way of wood-preparing equipment, any standard machinery for cutting the wood into 2-ft. lengths being used. This machinery should preferably be on the same floor level as the rotary boilers when these are used, or as near the top of vertical digesters as possible, to reduce power and investment required for conveying and elevating wood. Barkers may or may not be required according to conditions. See "Operation."

Steamers, or Digestors, and Conveyors

Two types of steamers are used commercially in America—the spherical rotary boilers such as are used for rag boiling, and stationary vertical cast-iron cookers. All digestors to be used for pressures over 20 lb. gage should be constructed according to the requirements of the A.S.M.E. Steam Boiler Code, be inspected regularly and preferably insured. In any case where it is desired to operate grinders continuously on steamed-wood logs, two steamers should be installed for the following reasons: First, to have one steamer in reserve in case of breakdown; second, to permit of continuous operation of the grinders by compensating for the long time needed for cooking one charge and thus keeping the grinders supplied with wood. Two cookers of either type described below will be ample to keep two three-pocket grinders supplied for a cooking period of 15 to 20 hours, which is long enough for most requirements. Finally, by using two cookers, the steam left after a cook can be utilized by blowing it down into boiler feed water before discharging the wood; whereas with only one steamer the delay involved makes it uneconomical.

Rotaries are best mounted on concrete piers and as closely together as possible to economize space and simplify the wood-conveying equipment layout. Too small foundations are false economy in this case, because, during the rotation of a boiler when filled with logs, severe and sudden stresses are set up by piles of logs clinging together during part of a revolution and suddenly becoming loosened. Fig. 1 is an elevation of a good layout for two rotary boilers showing the uncooked wood conveyors to grinders. Fig. 2 is a vertical section through the boilers and discharge pit. This arrangement is particularly adapted to installations where space is limited and the use of water canals to grinders is impracticable. It will be understood of course that canals may be substituted for the cooked-wood handling arrangement shown and vice versa.

The whole equipment occupies a space of approximately 40 by 21 by 25 ft. high. The boilers are 16 ft. in diameter and each will hold about 6 cords of rough wood or 7½ cords of peeled wood, as irregularly discharged into them from the conveyor and not as carefully packed. They are placed over the steamed-wood discharge pit and can be rotated once every 4 minutes by a vertical worm which engages a circular rack fastened around them, as shown. Lining, while desirable, is not absolutely necessary, as the small amount of corrosion is extremely slow if all rivet holes and joints are kept calked. Each cooker has a manhole about 2x3 ft. for filling, emptying and permitting interior repairs and is also provided with a small bleeding pipe and valve for removing condensate and relieving air while heating up. In common with all rotary boilers, steam enters through the hollow shaft after passing through a reducing valve.

The 2-ft. logs from the wood room are carried by a

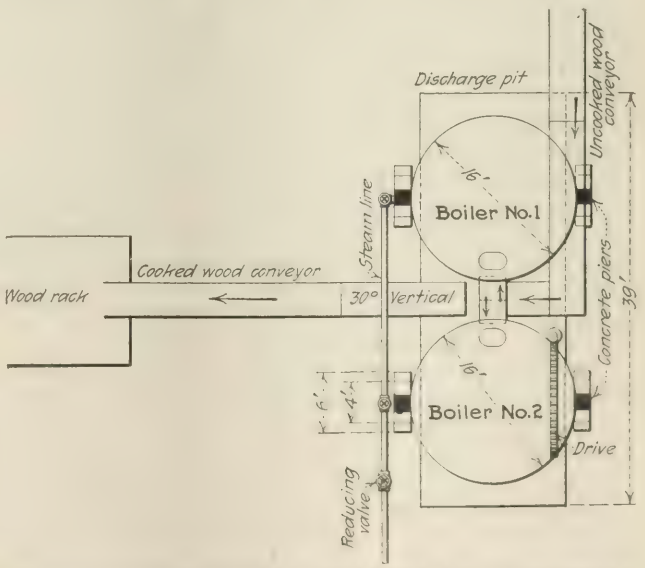


FIG. 1—PLAN OF ROTARY STEAMERS AND CONVEYORS

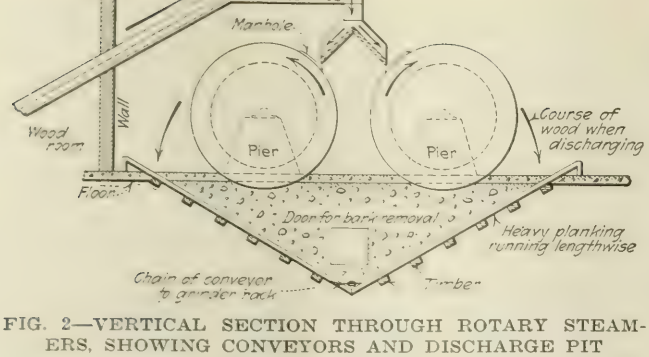


FIG. 2—VERTICAL SECTION THROUGH ROTARY STEAMERS, SHOWING CONVEYORS AND DISCHARGE PIT

chain trough conveyor at approximately a 45 deg. vertical angle to the level conveyor section over the boilers, which discharges into a chute above and between the two boilers, which in turn discharges at will into either of two smaller chutes directly into the manhole of the boiler being filled.

A Triplex block is used for handling the manhole cover, while a system of stairs and runways permits access to all parts of the filling system. Upon falling from the manhole in emptying a boiler, the wood drops into a steamed-wood discharge pit located beneath the two boilers (Fig. 2). The wood tends to roll down to the middle point, where it is put on a chain conveyor, which takes it to the grinders. This conveyor drops the wood into a wooden rack, a fenced-off portion of which is used as storage.

In general, rotary boilers have the advantage that, because of their shape and the closeness with which they may be placed together, they can be erected in some empty corner of a wood room or grinder room, as they do not require the heavy foundations and tall buildings necessary with vertical steamers. Moreover, they can be used very effectively as a drum barker, by rotating after steaming is completed, thereby softening and loosening the bark. Wood for the vertical type must be barked previously unless it is to be ground in the rough. The vertical type requires less calking and attention to keep tight and the maintenance cost is much less than with the rotary, in which the joints are loosened by the movement. The stationary type can be effectively lagged with heat-insulating material to reduce radiation and steam consumption to a minimum, while a rotary is difficult to keep properly lagged. A stationary cooker dumps practically instantaneously, while about an hour is required to empty 7 cords out of the manhole of a rotary. For this reason the daily production from two digestors of equal volume is slightly more with one of the vertical design, though by using a rotary as a drum barker the heavy losses in knife-barking wood are avoided. Taking everything into consideration, it would seem that, while each type offers advantages for particular conditions, in general the best and cheapest installation to operate is the combination of vertical, stationary steamers with drum barkers when barking must be done.

A good arrangement for vertical cookers is shown in Fig. 3, which adopts some features of sulphite digestor towers. The wood bin consists of very heavy planking on steel I-beams, and inside has heavy steel plates on which the logs strike when falling from the conveyor. The wood, in 2-ft. lengths, is dropped into the cookers through trap doors, operated from a distance by a lever system to prevent injury to the workmen. The steamers are supported, as shown, on three legs, which rest on the concrete floor of the discharge pit. This is kept filled with water, except when emptied to clean out, and connects by an underground canal to the grinder feeder canals. The bottom of the cookers is conical in shape so that all the wood will fall out when the bottom is lowered by the action of a hydraulic ram on the floor beneath, whereby a tight joint is normally maintained.

These cookers are now made of cast iron, tested for 50 lb. working pressure, and have 1½-in. walls to compensate for the slow chemical deterioration and the mechanical wear from the logs. They are made up of four cylindrical sections superimposed upon one another, and a top dome-shaped section bolted together with the proper gasket. The cost of a digestor is about $5,000.

The manhole cover is provided with a ring for handling with a chain block and is fastened down by lag bolts to the dome-shaped top section. This dome-shaped section has a boss in it which may be drilled out if desired for the insertion of a thermometer.

The log conveyor over the wood storage bin has a baffle, so arranged that it can be put in position and cause the logs to fall over the first cooker, or left open, permitting the logs to discharge over the second.

The unit log capacity of rotary and stationary digestors—i.e., the cubic feet of digestor volume required

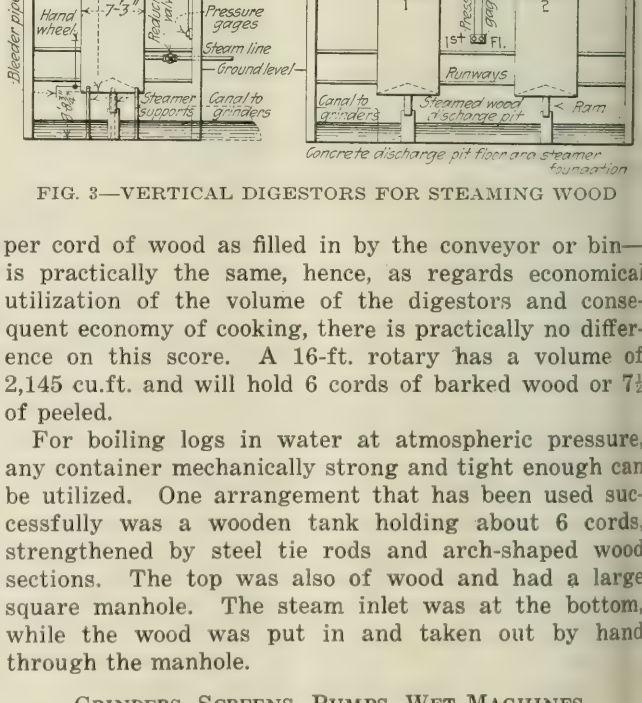


FIG. 3—VERTICAL DIGESTORS FOR STEAMING WOOD

per cord of wood as filled in by the conveyor or bin—is practically the same, hence, as regards economical utilization of the volume of the digestors and consequent economy of cooking, there is practically no difference on this score. A 16-ft. rotary has a volume of 2,145 cu.ft. and will hold 6 cords of barked wood or 7½ of peeled.

For boiling logs in water at atmospheric pressure, any container mechanically strong and tight enough can be utilized. One arrangement that has been used successfully was a wooden tank holding about 6 cords, strengthened by steel tie rods and arch-shaped wood sections. The top was also of wood and had a large square manhole. The steam inlet was at the bottom, while the wood was put in and taken out by hand through the manhole.

GRINDERS, SCREENS, PUMPS, WET MACHINES

Some mills make no provision for corrosion during and after grinding, although it is more severe than dur-

ing the cooking, owing to the soluble matter and acids remaining in the logs. The best modern practice is to have all the grinder pockets lined with bronze and to use solid bronze centrifugal pumps, screen plates and wet machine cylinder mold wires. Piping is also preferably of this material, but wood is used with success. Cast-iron valves and fittings have been used, but these corrode considerably.

Because of the slowness of the pulp and its greater fiber length—more on the order of sulphite than the untreated news ground wood—coarser screen plates are required or greater screening surface with finer slots.

Beaters, Jordans

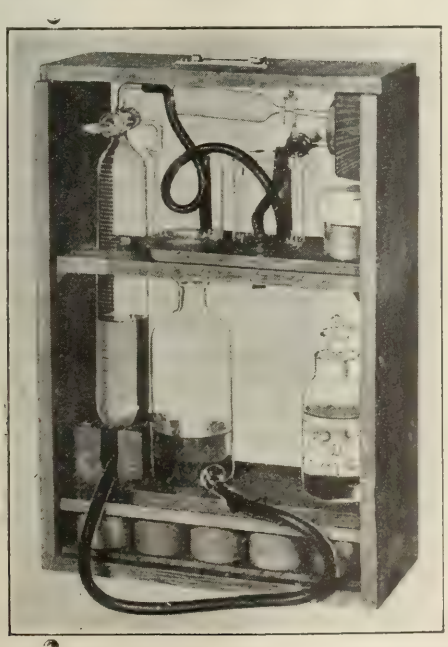
By the time the stock reaches the beaters or mixing tanks and jordans, every trace of acid is washed out so that any standard equipment can be used without modification, bearing in mind that, in common with natural or untreated ground wood, beating cannot materially change it, except to shorten the fibers, once it is ground.

The concluding installment of this article, describing the operation of a modern plant for steamed ground wood, will be published in a subsequent issue.

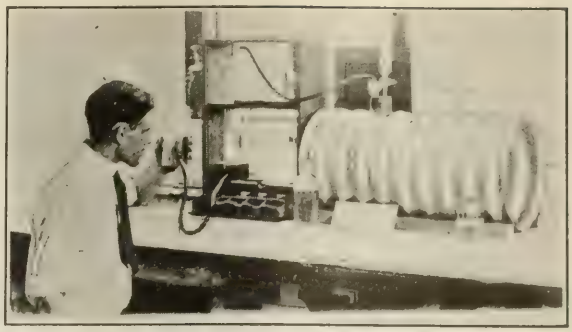
A Testing Device for Weighing Galvanized Coatings

IN PURCHASING galvanized sheet metal and wire for manufacturing various products, the manufacturer's specifications include the weight of spelter coating in ounces per sq.ft. An interesting device for measuring this spelter has been developed recently and may be used in the laboratory as well as in the field. The device determines the weight of galvanized coating on a unit area regardless of any convolutions or corrugations.

The weight determination is based on the action of hydrochloric acid on the galvanized coating, collecting and measuring the hydrogen gas evolved. By using differently shaped rings, which are shaped to fit the surface to be tested, the weight of coating is determined on flat sheets or formed culverts. Wire coating is determined by placing a definite length of wire on a glass plate under the flat ring. The rings are made to resist acid, nickel or tinned iron being used. The rings are fitted with three-hole stoppers. One hole carries the filling tube provided with a glass stopcock, while the other holes carry exit tubes. For collecting and measuring the hydrogen evolved, a measuring burette and leveling bottle are used.



THE TESTING DEVICE PACKED IN ITS CASE



THE APPARATUS IN USE

How the Determination Is Made

To make a determination the proper ring is sealed to the surface to be tested with acid-resistant cement. The leveling bottle, glass burette, tubes and ring are filled with water by manipulating the leveling bottle and stopcock. About 30 c.c. of concentrated hydrochloric acid is then placed in the filling tube and about 5 c.c. admitted to the ring. When the liberation of gas ceases the apparatus is rid of gas by filling the ring and connecting tube with water, thus forcing all the gas into the burette.

The number of cubic centimeters of hydrogen measured at 20 deg. C. multiplied by the factor provided with each ring gives the ounces of spelter coating per sq.ft. of actual surface on one side of the culvert.

Improved Heroult Furnace

A 7-ton basic Heroult furnace has been installed by the American Bridge Co. in the International Nickel Co.'s new plant at Huntington, W. Va., to melt Monel metal.[1] It has a round shell and flat bottom—a combination of great structural strength. It tilts both front and back on rockers; both rocker and track are curved. This does away with the counterweights necessary for the hinged type, it permits the furnace to be set lower than though the track was curved, and the center of gravity can never go above the rolling center.

Large copper pipes act as current conductors. Since this form is the best for carrying alternating current, and permits of water cooling, the amount of copper necessary is reduced two-thirds. Cooling water passes through the transformer, then by the conductor pipes to the electrode holders, through flexible connectors to electrode coolers, and thence to waste. Another unique feature is the placement of the electrical apparatus in a room immediately under the furnace.

The three electrodes are held by stiff cantilever jib cranes whose masts are quite short and operate in guides attached to the side of the furnace shell. In general, the design is very compact, requiring the minimum of headroom.

Furthermore, there are no flexible cables obstructing the surroundings.

[1]The *Iron Age*, Aug. 10, 1922, p. 342.

Petroleum Asphalts in the Roofing and Waterproofing Industries

By Dozier Finley
Director of Technical Research, The Paraffine Companies, Inc.

Development of the Use of Petroleum Asphalts in Roofing and Waterproofing Industries—How This Material Is Used in Making the Various Types of Commercial Product Is Described

IT IS IMPOSSIBLE for this topic to be treated properly from the point of view of the experience of any one person who is connected with the roofing and waterproofing industries. The history of these industries spans more years than are comprehended in the active business or professional life of any individual. However, the existence of some of the companies operating in this field extends back so far they may be said to have been present at practically the birth of the industry; their records afford valuable data on the subject.

Development and research in waterproofing and roofing manufacture lie largely in the selection and combining of ingredients and components and in the seeking for and development of new raw materials.

Development Through Use of Coal Tar

As the industries existed prior to 1885 most of the work revolved around the use of coal tar. For roof work it was found that certain coal tars were adapted to the laying of comparatively flat roofs; one or more layers of paper or felt were applied to the roof by means of pitch produced by a partial distillation of the coal tar; a surfacing of the tar pitch was given to the paper layers and into this surfacing was sprinkled gravel, shells or similar granular material. Much of the tar was not satisfactory for such roof work and various devices for improving its quality were practiced, as, for instance, heating it with lime or with wood or coal ashes.

Admixtures with a large range of other materials were tried and even used to a considerable extent; for such blendings were used rosin, pine tar, tallow, "pitch," asphaltum, dead oil and, in fact, anything which showed any tendency to mix with the tar when cold or when heated. Aside from tar, fabrics saturated with linseed oil, with other oils or with oils and gums combined, were proposed for roofing. Many roofing mixtures were designed to be spread like mastic without the support of a paper or fabric, apparently with the childlike faith that the elasticitiy of the coating so formed would respond to every movement of expansion and contraction on the part of the sheathing boards.

Failings of Early Products

Viewed in the light of present-day knowledge, the things which the inventors and manufacturers before the early '80s did not attain were:

1. The manufacture of standardized bituminous roofing and waterproofing materials in large quantities.
2. The manufacture of prepared or ready-to-lay roofing in a form and weight convenient for marketing, with a substantial weather-resisting coating and adapted to being laid on flat areas, on slopes and even on vertical surfaces, and possible of use under any condition of climate from torrid to frigid.
3. The manufacture of bituminous roofing materials of attractive appearance to compare in artistic value to slate, shingles or tile.

Along with this, of course, was a lack of proper mechanical appliances to manufacture roofing and waterproofing materials in the vast quantities used today. This, naturally, is not strange, since growth in any industry brings with it the development of machinery of greater capacity and lower unit cost of operation.

Generally speaking, the development of these industries has been seemingly slow; this may be ascribed to two reasons: First, the tardy discovery and slow recognition of suitable raw materials; and secondly, the inability to predict accurately the durability of any particular combination of materials; a new or improved product has had to pass through a long period of service test before the manufacturer, the dealer and the consumer, each in turn, have been convinced of its merit.

It is true that some opposition has been brought to bear on these industries. Metal roofings, shingles, slate and tile have been in competition with bituminous roofing. Soap compounds mixed with concrete, surface treatment of masonry walls, and structural devices have been used instead of bituminous waterproofing and methods. The engineering world and the general user, however, have always given due recognition to the merit of the bituminous products. As a result these materials have established a definite and not unimportant place for themselves in modern building and engineering.

What Bituminous Roofing and Waterproofing Are

Strictly speaking, the term "bituminous roofing" is limited to the well-known types of ready-to-lay roofings either in roll or shingle form and to built-up roofs of several plies of roofing felt cemented together with bituminous material. Associated with these roofings are certain related products such as bituminous roof paints and bituminous plastic compounds used for maintaining roofs of this type.

"Waterproofing" is accomplished by a variety of materials and methods. Layers of felt may be cemented together to form a water-resisting dam or membrane not dissimilar to a built-up roof; paints or combinations of paint and coatings of bituminous compounds applied in heated condition are often used on walls or under floors to exclude water; bituminous materials have been used in the form of an emulsion mixed with concrete; between the separate elements of large structures, such as dams, asphaltic compounds are often poured in masses; a modification of this last use, in part a waterproofing method, is the use of asphalts or asphaltic materials for the expansion joints of concrete highways; a limited type of waterproofing, really a dampproofing, is accomplished by using saturated felts, or saturated and coated papers, between the walls of buildings—the so-called "building papers."

Application of Petroleum Asphalt to Roofings

A retrospect of this entire field might be expected to reveal a single definite "line of descent" along which

ll development proceeded. Following closely the commercial and manufacturing history of the industry, it s an impressive fact that its growth has held absolute ace with the advance made in the production of petroeum asphalts. A certain production of roofing may e claimed to have followed the increased output of natural" asphalts, and it is true, without question, a arge development of coal-tar roofing materials has ccompanied the growth of the coke-oven industry and he more careful collection and marketing of gas tars. But it remains a fact that the constantly growing roduction of the most widely adopted types of roofing as been in strict correspondence with the production, or general purposes, of residual asphalt from the disillation and treatment of petroleum.

The first commercial productions of asphalt from etroleum were from California oils, which yielded asphalt as a normal product of distillation. Asphalt from he oils of Pennsylvania, Ohio and Indiana was practically unknown until well into the twentieth century; hen it was produced by methods of treatment apparently unknown to the earlier refiners—it was produced by what might be termed abnormal processes rather han the old, and previously well-known, methods of listillation.

The first application of California asphalt to the manufacture of ready-to-lay roofings was made by Truman J. Pearce and Melvin W. Beardsley as set forth in the patent granted them Sept. 14, 1886. From a historical point of view it is unfortunate Pearce and Beardsley did not more specifically state in their application that they preferred to use a "maltha" which was the residue of petroleum distillation. However, at the time their work was in progress many "natural" asphalts containing much mineral matter were obtainable in California. To these early inventors it seemed possible to use these interchangably with asphalt produced from petroleum. Indeed, the apparently limited possibilities of the then known petroleum territory in California and the seemingly extensive natural asphalt deposits possibly inclined them to the use of the natural product.

But, as might be expected, when asphalt from petroleum distillation outstripped the quarried material, Pearce and Beardsley, or rather the Paraffine Paint Co., which manufactured under their patents, fixed on the material which could be obtained in larger quantity and of more uniform quality and greater purity.

Work of Pearce and Beardsley

Pearce and Beardsley employed the residual asphalt as a saturant for burlap which then was given a further coating of a firmer asphalt; to the back of the coated fabric, while the coating was hot and adhesive, was affixed a layer of paper or felt to give the roofing stiffness during handling and shipment and also to afford additional waterproofness. Probably this was the first distinctly successful ready-to-lay roofing which had been produced. It established records of service reaching well beyond 20 years, in many instances with the material exposed on slopes so steep as to draw forth a dogmatic "it can't be done" from the roofers of that day. It became a practice to supply this roofing without change of formula to the coldest climates of the North and to the hottest parts of Arizona and Mexico. No limits were placed on the angle of the slope to be covered, no matter what the sun heat might be.

Large quantities of the roofing were readily sold to the smelter plants in Arizona and Montana—two extremes of climate, but in both involving an exposure to acid fumes so corrosive that the paint and the very nails were eaten from the boarding of the buildings. The service rendered by the roofing under such conditions is well illustrated by a letter received over 20 years ago from the United Verde Copper Co., Jerome, Ariz., telling of a sagged portion of roof on which condensed exhaust steam, flue dust and dissolved fumes had combined into a little lake of highly concentrated acidity; though this condition had obtained over a period of several years, the roofing had not leaked a single drop. One of the most successful large pieces of work carried out with roofing made according to this plan was the covering of the entire Midwinter Exposition at San Francisco in 1893-4.

Substitutes for California Petroleum Asphalt

So successful was the roofing made from California petroleum asphalts that the Standard Paint Co. of New York, under the instructions of Beardsley, began the manufacture of similar roofing in the East. Petroleum residuum of quality similar to California asphalt was not obtainable in the East and it was necessary to bring material from the Pacific coast. However, William Griscom, of the Standard Paint Co., hit on the scheme of using the residual products of Eastern petroleums in conjunction with very thick sheets of felts. In this way a very large portion of Eastern residuum tempered with rosin could be used as a saturant; the saturated sheet was given a coating which consisted of a California asphalt blended with a large measure of weather-resisting gums and pitches.

Thus was produced in the East the first successful, standardized, ready-to-lay roofing made in large part from Eastern materials. It came almost at once into great popularity, which it retains to the present day. Its name, "Ruberoid," was caught up by the public and applied as a type name to all ready-to-lay roofings regardless of the manufacturer's name or any other relationship to the original in manufacture, formula or even appearance.

It is now recognized that the materials which are best adapted to the manufacture of ready-to-lay roofings must conform in a great measure to the standards established by the early work of Pearce and Beardsley in California. Of course the developments which have taken place in the last 20 years in the processes of oil refining and asphalt making have been reflected in the improved quality of the asphalts and the products made from them; the roofings made today will withstand conditions of exposure which would not have been possible for roofing made from the original petroleum asphalts, though this does not gainsay the very excellent quality of the roof coverings made with the earlier types of California asphalts.

The oils of Ohio and Indiana, and later the oils of Kansas and successively those of Texas, Oklahoma and Mexico, have been made to yield asphalt. Originally oils such as those from Ohio were supposed to be incapable of giving asphalt in the refining process. In those days refining consisted essentially of heating the oil in closed containers, or stills, and thereby driving off the volatile portions, the temperature being gradually raised till the distillate had attained a high boiling point and the residue in the still had been reduced to a coke, or, in the case of asphalt-yielding oils, to an asphalt of the desired hardness. Steam was admitted

at the latter part of the distillation to reduce the vapor pressure or, in the language of the stillman, "to carry the vapor over."

Obtaining Asphalt From Paraffine Base Oil

F. X. Byerley obtained a patent in 1894 for a process of asphalt proluction which accomplished two things: first, the production of an asphalt from oil and oil residuum which would not yield asphalt under former methods of refining; and secondly, the production of much higher yields of asphalt from oil or residuum which normally yields asphalt. The process is carried out by blowing air through the petroleum residuum at elevated temperatures and is conducted in the ordinary still; a reduced amount of distillate is produced, the greater part of the residuum being converted into asphalt through complex chemical reactions, among which there is certainly an oxidation, as hydrogen is eliminated with the formation of water which appears in the distillate. If the process can be regarded as accomplishing, in a measure, the equivalent oxidation which would otherwise be brought about through a term of weathering, it will be seen that the asphalt oxidized in the still, and refined to the proper consistency for use, has conferred on it something of an immunity from the destructive action of continued oxidation when exposed to the weather.

Many modifications of the original process have been brought about, so that it is now possible not alone to produce asphalt from a nominally non-asphaltic oil and to increase the yield of asphalt from asphaltic oils, but it is even possible for the skilled refiner to make a series of asphalts of widely varying characteristics, though of substantially the same "hardness," from a single crude oil or oil residuum. This contrasts strongly with the possibilities of the old, or "steam run," process, wherein there was practically no control of the character of the product, aside from its "hardness."

The production of standardized asphalts from these widely differing oils is indeed a testimonial to the ability of the refiner. From each of the sources named now comes asphalt which would admirably do the work of the original Pearce and Beardsley process. The California asphalt, at one time alone in filling these requirements, has been improved, as might be expected, by the research work of some of its producers to a point of excellency never conceived by those who first used it in roofings.

Manufacture of Roofing and Waterproofing

The standardization of roofings and waterproofings has really preceded the standardization of the asphalt. At the present day roofing materials are almost exclusively built on a felt base, the burlap base being used in an extremely small volume, relatively speaking. The felt falls into three classes: *rag felt,* composed entirely, or almost entirely, of cotton rags, with a small percentage of wool and usually a small amount of burlap; *asbestos felt,* or paper, composed almost entirely of asbestos fiber with a minor percentage of other fiber and a sizing binder to give strength; and *paper based felt,* used entirely in the cheap grades of roofings and sheathings, containing as high as 70 per cent of waste paper.

The materials entering into the composition of these felts are disintegrated in paper mill beating engines until the ultimate fibers are individually afloat in water, the mass is passed on to a type of paper-making machine adapted to the work; the fibers are here felted, pressed and dried. The finished felt, in large rolls, is transferred to the roofing-making machine; here it is passed through a bath of saturant, squeezed by wringing rolls to remove the excess of saturant, and pressed through another set of rolls which spread on it a bituminous coating of varying thickness according to the purpose intended. Either a dusting of a fine mineral powder is now given the product, making the so-called "smooth surface roofing," or a sprinkling of crushed shale or slate of usually a red or green color is applied to the side designed to be exposed to the weather, making a "slate roofing." This in only "slate" in so far as it is surfaced with a thin layer of mineral particles, which may even be marble or serpentine in some instances; but these particles, no larger than a match head, are so firmly fixed in the bituminous coating that the roofing will last upward of 20 years without apparent deterioration.

Smooth surface roofing is sold in roll form only. The slate roofing may be sold either in roll form or cut into shingles, which again are divided into "individual shingles" and "strip shingles," the latter usually comprising four shingles attached together by a common upper portion. Variant forms of these roofings are sold, as for instance a sand-surfaced roofing, or a mica-surfaced roofing, but their use is secondary, though this does not argue against their quality, which may be excellent if they are made of good materials.

Asbestos Roofings

Asbestos roofings usually are made by cementing together two or more sheets of asphalt-saturated asbestos felt or paper. This may be done in the plant and the product shipped ready to lay; in this event the topmost sheet is often unsaturated, which is productive of a white roof. On the other hand, saturated sheets may be supplied to the contractor and applied by him in a manner similar to "built up" roofs, though asbestos roofs are rarely given a gravel or mineral dressing.

Asphalt-saturated rag felts of various weights are supplied to roofing contractors for laying "asphalt and gravel" roofs. The saturated sheets are cemented together on the roof deck, the topmost sheet receiving a flood coat of the bituminous cementing compound; gravel, crushed slag, crushed brick or other desirable or readily obtainable mineral matter of pea size is imbedded in this flood coat to procure a final finish. Using the proper quality of cementing asphalt, such roofs may be applied on slopes so steep the workmen have to be secured by ropes. In this respect, at least, asphalt-saturated felt cemented by asphalt has an advantage over tar-saturated felt and coal-tar pitch; excellent though "tar roofs" are on flat and slightly sloping roof decks, they cannot compete with asphalt on steep slopes.

Many roofers use, and some manufacturers advocate, one or more layers of smooth surface roofing to be built into a roof of the "asphalt and gravel" type. One sheet of medium weight smooth surface roofing can take the place of two sheets of the heavier grade of asphalt-saturated felt. As a better and stronger felt with a greater percentage of saturation is used in the smooth surface roofing, the resultant roof naturally has an enhanced value. Gravel or like matter is usually used as final finish as on the parent type of roof.

It is interesting to note the built-up roof of asphalt-saturated rag felt, or roofing, as above described, has a

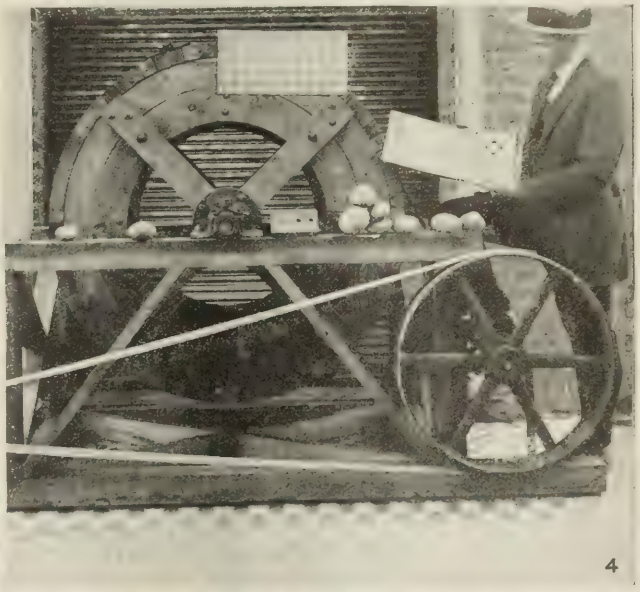


Fig. 1—California Refinery for Production of Petroleum Asphalt

Fig 2—Test Rack for Weathering Tests on Petroleum Asphalt Paints

Fig. 3—Concrete Tower for Testing Concrete Waterproofing Material

Fig. 4—Revolving Drum in Which Pebbles and Bits of Steel Are Used to Test Wearing Qualities of Petroleum Asphalt Floor Coverings

Fig. 5—Mechanical Manufacture of Insulating Tape Using a Water- and Weather proofing Petroleum Asphalt Compound

degree of fire resistance which places it on an equal basis with asphalt-saturated asbestos roofings.

Asphalt in Waterproofing

The standardization of roofing materials did much to standardize asphaltic waterproofing. The asphalt felt of the roofing industry became the basis for felt for building membranes of several felt layers around the walls and in the floor of the structure to be protected from the entry or exit of water. Modifications have been made as, for instance, the surfacing of the waterproofing fabric with wood flour instead of fine mineral matter in the case of coated fabrics—a change made to obtain better adhesion of the cementing medium.

Asphaltic building papers of three types were developed along with the several types of roofings; these were: paper saturated with asphalt, paper coated with asphalt and paper both saturated and coated. Such papers were designed to prevent entry of moisture and drafts through walls and floors of buildings. Both asphaltic roofings and these buildings papers were made, generally speaking, by the same manufacturers; indeed, in small plants, often on the same machine. To the three above is now added a light saturated felt. The four types are standard with many manufacturers and may be obtained at retail in almost any town in this country in a variety of weights and qualities at, of course, prices in accord with their respective values. They are all superior to that cheapest form of so-called "building paper" known as "rosin-sized sheathing" of a red, gray or greenish color and made of the cheapest grade of waste paper, reworked and waterproofed more by title than in fact.

Asphalt in Paints

Bituminous paints and compounds to be applied in molten condition for damp-proofing and waterproofing have come to the distinctive position of having been the subject of tentative specifications by the American Society for Testing Materials. Treatment of expansion joints in concrete highways also is subject to fairly definite specification by the engineering departments in charge; materials and methods vary from prepared products marketed in strip form to asphalt which may be poured into the open joint.

Bituminous emulsions for waterproofing concrete have been on the market for several years. In general it would seem that a water emulsion of asphalt is an extremely interesting product—emulsification with water makes an asphalt mobile without application of heat at the time of use, and also avoids the hazard attached to bituminous paint with volatile, flammable solvents; the evaporation of the water, which takes only a short time, brings about a breaking of the emulsion and a deposit of the asphalt in a form little different from that obtained through the use of an actual solvent or through hot application.

In waterproofing, where exposure to the weather is not involved, where the waterproofing material may be below grade (and hence at a fairly uniform temperature) and where there may be little vibration of the structure, coal tar is a strong rival of asphalt. The coal tar, of course, is used in conjunction with a tar-saturated felt when the work involves the use of felt.

Grades of Asphalt Used

The type or grade of asphalt most generally used in all this work takes its origin from the old California "D" grade, this was the grade used by Pearce and Beardsley in their work. Without the use of testing instruments the grading of this asphalt was never accurate; in the early days of refining in California the usual test was that of chewing a small portion. Pearce and Beardsley used in their roofing a "D" asphalt which offered considerable resistance to chewing but which would not crumble in the mouth. Samples of this examined since the advent of testing instruments and standard testing methods give a penetration of about 15 at 77 deg. F. and a melting point—i.e., softening point—of about 150 deg. F., both by the methods of the American Society for Testing Materials, standards 1921.

Improvements in refining now permit of the use of asphalts somewhat softer at ordinary temperatures—they offer little resistance to chewing. The penetration will range from 12 to possibly 45 according to the properties of the material itself, as defined by source and preparation, with melting points from 150 to 225 deg. F. or occasionally higher. Most manufacturers of roofings set narrow limits between which their compounds must test—these, except for saturants, are between the limits here given in practically every case. Many manufacturers of roofings also blend the asphalt with fatty acid pitches, natural asphalts, mineral fillers, etc., to obtain increased weather resistance, to economize in the use of asphalt or for other reasons of minor importance.

Of course other tests than melting point and penetration are applied to asphalts. These include volatility, hardening under heat, ductility, ash, solubility in carbon bisulphide, penetration at other temperatures than 77 deg. F., flash point and others less frequently applied.

How Other Grades May Be Utilized

Nor can it be considered that asphalts falling within the ranges above given will accomplish all the things set forth in this article. Asphalts within those ranges form, as it were, the backbone of the asphaltic roofing and waterproofing industries, but much of the work herein described would have to be accomplished through the fluxing, or softening, of an asphalt falling within the above given range, an operation easy of accomplishment. Softer asphalts ranging down even to a stiff, practically liquid material are to be had on the market. These are used for saturants for felts or for fluxing harder grades.

Hard asphalts—so hard they will be powdered in the chewing test—are necessary for other work; while their melting points may not be materially higher than the highest of the medium hard asphalts, their penetration may be as low as 2. They are used in paint making, in the glaze coating of building papers and may be used in compounding roofing coatings to counteract the effect of softer constituents such as soft fatty acid pitches, soft asphalts, etc. It is of interest to note Pearce and Beardsley prior to 1890 used "B" and "C" California asphalt for the making of "P & B" paint and "P & B" building paper—the "B" and "C" asphalts having penetrations of about 3 and 8 and melting points of about 195 deg. F. and 175 deg. F., respectively.

Place of Natural Asphalts and Coal Tar

It would be unfair for the asphaltic roofing and waterproofing industries to fail to acknowledge the immense value of the contributions which have been made to them from the field of mined asphalts. Without question the industries started with those asphalts as

their only raw materials of asphaltic nature, and have used large quantities down to the present date—gilsonite, grahamite and wurtzilite, in addition to the true native asphalt of the medium grade of hardness and associated very often with large percentages of mineral matter. Also these industries owe much to the coal-tar industry, which has been a helpful rather than a harmful rival, and to the asphalt-paving industry, which has been untiring in the development of new sources of raw material and has contributed much scientific data to the entire subject.

The amount of asphalt this country consumes in roofing and waterproofing is not easy to estimate, as it is difficult to separate it from the figures giving total importation and production. It is not amiss to say, however, that the amount has grown in the last 30 years from a few hundred tons per year to well over a quarter of a million tons.

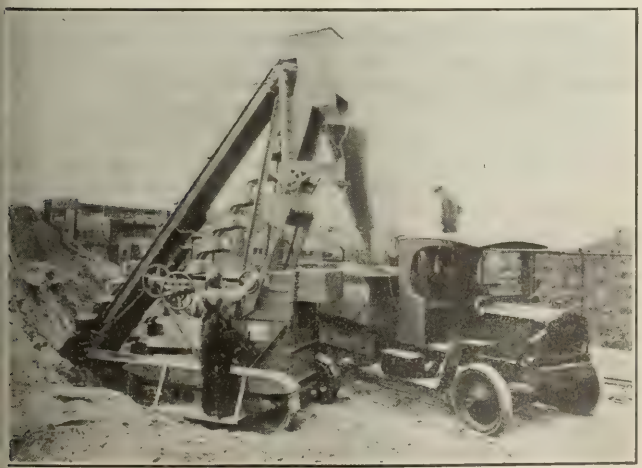
A New Portable Loader

In many plants where it is necessary to handle sand, gravel, crushed stone, coal, coke, cinders, slag and other loose material from ground storage, the portable loader has found wide use. This extended use and the interest shown by many who do not as yet use this machine has been the cause of bringing forward many improved types during the last few years. The latest of these, shown in the accompanying illustration, is called the "Tanktred" and is manufactured by the Jeffrey Manufacturing Co., of Columbus, Ohio.

Among the advantages claimed for this loader attention is called to the fact that the foot of the elevator is so constructed that the buckets are wider than any other part, so that the whole machine can be advanced several feet into the pile with nothing but the clean cutting edge of the buckets coming in contact with the material. For this reason the loader will handle fairly hard material which will not flow.

Another advantage claimed for this loader is a relatively large foot wheel, which, by reducing the centrifugal force, enables the buckets to pick up the material and especially the large lumps without kicking them away. A flexible wood boom keeps the buckets digging, but will spring enough to release them from overload strain when they encounter a cave-in or an obstruction.

Two speeds, a traveling speed for moving the machine from place to place, and a feeding speed for driving the machine directly into the pile, give a wide flexibility of operation.



NEW PORTABLE LOADER

As a result of these various features of design and construction the operator, the only man required in connection with the operation of the loader, can readily manage his machine so that the buckets are always full.

Hair Cracks

During the war many alloy steel forgings were discarded because of "hair cracks" (Fig. 1) usually about ½ to ¾ in. long, a few thousandths deep and almost zero thickness. They are rarely found singly, and if machined off by a fine cut, more will usually be found in new positions.

Dr. Leslie Aitchison[1] believes that they are relics of very small contraction cavities in the original ingot.

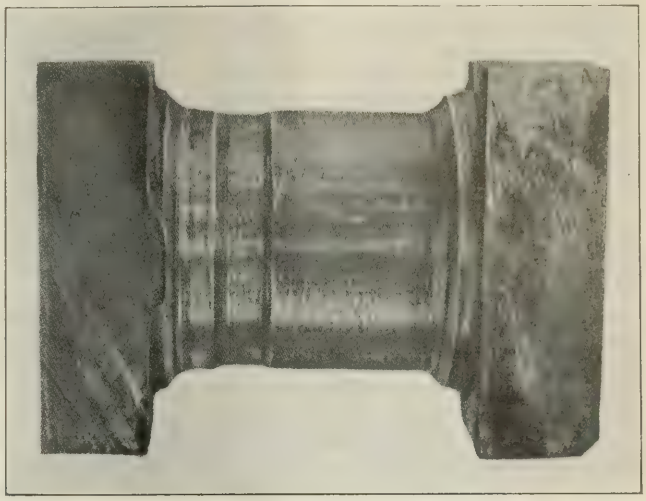


FIG. 1. HAIR CRACKS APPEARING AS HORIZONTAL FINE WHITE LINES IN CENTER OF PARTLY FINISHED CRANKSHAFT JOURNAL

Correct forgings welds these up to some extent, but the utmost care should be exercised during steel making and ingot pouring to reduce the number of contraction cavities to a minimum. Also, the part of the ingot which shows the defect most markedly should be cropped.

While it is impossible to say whether these tiny flaws are harmful to such a thing as an airplane crankshaft, "it is fairly certain that they are practically harmless unless they occur in very vital parts. It is quite certain, owing to the difficulty of detecting the cracks, that a large number of cranks have been used in which they have existed and that no trouble has resulted."

Rubber Manufacturing Industry in Egypt

The Société des Industries Egyptiennes, Sahel El Ghelal, Boulac, Cairo, operates a factory for the manufacture of rubber goods. This factory started operations as a private concern about 11 years ago. Raw rubber and other materials are imported from England and Belgium, and a small quantity from France. Of late years the Sudan has been able to supply a small quantity of plantation rubber, there being 40 acres planted. The company sells mainly to the Egyptian Government departments, but also to private dealers; and in addition to selling wholesale, it accepts retail orders. It is claimed that the products are successfully competing with foreign manufactured rubber goods.

[1]Quoted by C. F. Jenkin on p. 22, "Report on Materials of Construction Used in Aircraft and Aircraft Engines," Aëronautical Research Committee, London.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Flaws in Chemical Schedule Crop Out

Officials Encounter Difficulties in Applying Rates, Particularly in Case of Dyes

MEN in official circles of Washington familiar with the chemical industry express the opinion that there will be, or should be, revision of several paragraphs of the chemical schedule of the new tariff act. It is also believed that the Customs Division of the Treasury Department will have to set up rather elaborate machinery, at considerable expense, to administer properly the duties on coal-tar products, particularly dyes. Some of the rates are entirely inadequate, if the domestic industry is to be given protection sufficient to encourage its development, and there are other rates which could be lowered without harm, in the opinion of these officials after studying the new act thoroughly.

The case of synthetic organic chemicals and medicinals from other than a coal-tar base has been cited previously as one where development probably will be retarded unless higher rates are granted. The duty in the new law is 25 per cent ad valorem. Several acids and salts of large consumption are among those which it is believed should have higher protection and may receive it under the flexible tariff section when that is put into operation.

On the other hand, it is pointed out that several of the common coal-tar dyes do not require the protection of 7 cents per pound and 60 per cent ad valorem, American selling price, given by the new act, while other higher priced dyes need greater protection.

Difficulty of Comparing Dyes

In adminstering the coal-tar rates, the difficulties of determining whether an imported dye is comparable to an American product are pointed out in official circles. It has been suggested that the Customs Division will require the services of an expert chemist, with several assistants and a first-class laboratory, and this is being considered by Ernest W. Camp, chief of the division.

One of the difficulties foreseen is the case of an imported dye which may be comparable to an American product for some purposes and not for others. For instance, a case arose during existence of the dye and chemical control act where two blues, domestic and imported, produced substantially the same results excepting in one instance, the imported blue being fast to salt, whereas the domestic product was not. For ordinary dress goods the two dyes were comparable, one as good as the other, but if a manufacturer wished to use the dye in a bathing suit he would have to take the imported product. The question to be decided is if, in such instances, all the imported dye is to be assessed on the basis of American selling price, as a comparable product, if all shall be considered as non-competitive and assessed on United States value, or if part shall be assessed one way and part another, according to the use for which it is intended by the consumer under special regulations which might be drawn.

The difference in the basis of assessment, in the case of dyes heavily consumed, would run into the thousands of dollars a year. It is realized that these questions involve technical tests of many products and that customs regulations must be drawn carefully.

Other Imperfections

What is to be done to give greater protection to the coal-tar products of higher grade has not developed beyond the report that a bill for this purpose will be introduced at the next session of Congress. There are difficulties of drafting a measure which would meet the favorable consideration of Congress. If the higher products are to be given greater protection, there must be a separation of the paragraph, because admittedly some of the products do not need the rate already given. Government experts foresee many difficulties of phraseology in such a separation, with different rates for different products. However, they believe it is possible by a combination of designation by name and designation by constitution, application and price.

Another flaw in the coal-tar paragraph has been discovered by the experts in the clause providing that assessments shall be on the basis of strength in ordinary commercial use prior to July 1, 1914. Since then some strengths have been changed and others have not, so that the effect of the application of this provision gives a high concealed protection to some products and denies it to others which may need it equally as much, creating a badly balanced rate.

Rapid Development of French Water Power

Hydro-Electric Power Developed More Than Doubled Since 1913

French public sentiment is strong for the utilization of water power to overcome the dependence upon foreign imports of coal. The extent of this interest is shown by the fact that in 1913 only 930,000 hp. was generated by water, while in 1921 the total of 2,100,000 hp. of hydro-electric energy was being produced.

Important individual projects include the Rhone development, which has the navigation and irrigation phases as well as its power feature; the project for harnessing the hydro-electric forces of the River Dordogne, involving seven generating plants; the world's largest dam at Chambon, and other miscellaneous projects such as those of the Rivers Ossau and Aspe.

The use of hydro-electric power in connection with the electrochemical and electrometallurgical industries of the Isere Department is important where the production of such ferro-alloys as ferromanganese, ferrosilicon, ferro-uranium and spiegel give promise to large development. It is expected that the ferro-alloy output of France will be largely accomplished by electric furnaces within a few years.

Of a total of 2,100,000 hp. of electrical energy at present used, 650,000 hp. is for lighting, heating and minor motor force, 1,300,000 hp. for industrial use and 50,000 for traction purposes.

Power Company's Lease of Muscle Shoals Renewed

Renewal for another year of the lease under which the Alabama Power Co. operates the government's steam plant at Muscle Shoals, Ala., has been announced by Secretary Weeks.

The contract was renewed on the same terms as originally negotiated, a step which Secretary Weeks said was necessary to "enable a number of cotton mills and other industries in Southern states, including North and South Carolina, to continue operations, and which otherwise would have been compelled to close down or materially curtail production because of disturbed conditions in the coal and transportation industries and lack of developed hydro-electric power."

This renewal has no bearing on the Ford or other offers for the plant, since the contract may be canceled on 30 days' notice.

S. W. Stratton Chosen Head of M.I.T.

irector of Bureau of Standards Accepts Presidency of Institute of Technology—Hoover Regrets Inability to Hold Men With Government

DR. SAMUEL WESLEY STRATTON, for 21 years director of the ureau of Standards of the Department Commerce, has resigned to become esident of the Massachusetts Institte of Technology. The Institute has een without an executive since the eath of Dr. Richard C. MacLaurin in nuary, 1920. Dr. Ernest Fox Nichols as elected president in 1921, but was rced by ill-health to resign a few onths later without having served in fice. A committee of faculty and corration members has carried on the dministrative work.

Photo copyright by Harris & Ewing.

DR. SAMUEL WESLEY STRATTON

Government Can't Hold Best Men

In connection with Dr. Stratton's signation, Secretary Hoover issued a atement condemning the "desperately or pay allowed scientific and technical en by the government." He pointed t that the Massachusetts Institute of echnology, an educational institution, s no difficulty in paying men of r. Stratton's caliber three times the lary which the government allows em. "The inability of scientific men the government to support themlves and their families properly under e living conditions in Washington," id Secretary Hoover in his statement, nd to make provision for old age, akes it impossible for any responsible partment head to secure such men r public service at government salies."

Built Organization

As the director of the Bureau of tandards, Dr. Stratton built up an stitution. He took over the directorip of the bureau when it was created 1901. The bureau sprang from a vision in the Coast and Geodetic Surey concerned with the standardization weights and measures. During the st year of its existence the bureau as intrusted with the expenditure of appropriation of $200,000. From at small beginning Dr. Stratton was le to built up a great scientific labratory which has been intrusted with e expenditure of more than $2,000,000 a year's work. Under Dr. Stratton's rection, the bureau has grown until is the largest physical laboratory the world and employs more specialts in research than any other single ency in this or any other country.

Those who have worked for many ars with Dr. Stratton declare his rongest point is his ability to direct e work on a large number of diversid technical problems in a way so as insure maximum results. Despite e widely varying character of the perimentation conducted by the Buau of Standards, Dr. Stratton's assotes declare that he always has kept reast with the work and invariably uld be relied upon for a practical suggestion as to its conduct. He is credited with being particularly apt in recognizing when sight of the objective was being lost and when the work was being permitted to proceed along a tangent—one of the most difficult tendencies to combat in research work.

Long Record of Achievement

The high points of Dr. Stratton's career as prepared for "Who's Who in America" are as follows: Born in Litchfield, Ill., July 18, 1861. He received his B.S. degree at the University of Illinois in 1884. He was an instructor in mathematics, physics and electrical engineering at the University of Illinois from 1885 to 1892, and instructor in physics at the University of Chicago from 1892 to 1901.

Dr. Stratton has received the honorary degree of Doctor of Engineering from the University of Illinois and that of Doctor of Science from the Western University of Pennsylvania, from the University of Cambridge and from Yale. He was made a Chevalier of the Legion of Honor in 1909.

In the war with Spain he served as a Lieutenant in the navy. During the world war he was a member of the Interdepartmental Board of the Council of National Defense and of the National Advisory Committee for Aëronautics.

New York Customs Laboratory to Be Enlarged

Material enlargement of the customs division's chemical laboratory in New York has been recommended to provide facilities for the careful and painstaking chemical determination so necessary to the proper evaluation of dye and chemical imports. It is the plan of the customs division to concentrate all dye tests in New York.

Lecture by Bingham Opens Season for New Jersey Chemical Society

The attendance at the first meeting of the season of the New Jersey Chemical Society would indicate that the members have lost none of their enthusiasm during the summer recess. The meeting room was filled to the doors on Oct. 9, when Prof. Eugene C. Bingham began his address on "Fluidity and Plasticity." Dr. Bingham's talk was practically a summary of his recently published book on the same subject, and it was illustrated with a great many lantern slides.

Dr. Bingham defined his conception of fluidity using as an analogy a pack of cards lying face down on the table and slid upon one another by a horizontal force. This analogy, he said, is fundamental in the proper conception of fluidity. Mathematically, the fluidity is the reciprocal of the viscosity, but determinations of viscosity as a measure of fluidity are apt to be misleading. Instances were quoted in which a 10 per cent difference in the viscosity was observed in the same sample, using different shearing force.

The speaker continued, pointing out the relation between fluidity and plasticity, describing a series of experiments conducted with suspensions of clay in water. Up to a 12 per cent suspension the mixture was obviously a fluid, but at this concentration the fluidity was zero, and it was therefore concluded that above this point the flow of the mud took place in accordance with the laws of plastic flow. If a substance has a definite yield value it is classed as a plastic. The yield value is defined as the force necessary to start movements or flow.

Dr. Bingham described his plastometer, an instrument for determining the plasticity of a substance by forcing it through a small orifice with a definite pressure in a measured time. In the course of his experiments he found that a very small amount (0.1 per cent), of potassium carbonate lowered the yield point about 20 per cent. It was also found that as the temperature of the material was lowered the yield value reaches zero at a transition point somewhat similar to a melting point.

Fertilizer Men Ask for Data on Acid and Phosphate

Collection of statistics of sulphuric acid and acid phosphate as of Nov. 30 for the 6 months previous, with comparative data for 1921, has been suggested to the Department of Commerce by the National Fertilizer Association.

The suggestion carries with it the idea that hereafter such statistics be compiled on May 1 or June 1 and on Nov. 30, giving the trade a semi-annual census. A census for the 6 months previous was compiled last June. Change in data has been suggested so that manufacturers on Nov. 30 may have the benefit of the information in preparing for the spring business.

Reminiscences of a Consulting Chemist

Informal Talk by William Hoskins Before New York Section of Société de Chimie Industrielle

Characterized by a delightful informality and a wealth of personal reminiscences was William Hoskins' talk before the New York Section of the Société de Chimie Industrielle in Rumford Hall on Oct. 13. In introducing the speaker, Dr. Ellwood Hendrick remarked on the policy of the New York Section of this society in characterizing its meetings by a certain human interest which is lacking in the majority of technical society meetings in this country. And certainly this meeting was as full of human interest as one could ask, for Dr. Hoskins gave an intimate sketch of his own career as a consulting chemist, including numerous amusing experiences as a laboratory consultant and his early struggle to gain a livelihood in the profession.

"Analyzing a Race Track"

One of the most amusing incidents told by Dr. Hoskins was that of a client who came to him with the problem of "analyzing a race track." It developed that this client, an engineer, had been commissioned with the project of constructing a race track in Chicago, and he was frank to admit that he knew nothing about the subject. He had heard, however, that the race track at Louisville, Ky., was one of the best in the country and consequently he determined to build the Chicago track as much like it as possible. Dr. Hoskins became interested in the problem and obtained a number of samples of the clay, sand and loam from the Louisville track and by a combination of analytical chemistry, common sense and good luck the race track was finally built and proved to be fully as good as its renowned model. Another of the interesting problems which Dr. Hoskins has encountered was that of studying the smoke problem in Chicago and its relation to the possible electrification of the local railways. In this investigation he and an assistant spent several months in an automobile, sampling air in various sections of the city and finally turned out a very comprehensive report on the subject which was accepted as a piece of pioneer work of its kind.

Dr. Hoskins is extremely modest and was inclined to belittle the work he has done and the friends he has made by his generous advice and help. One could not fail to gather an impression of some of the characteristics of the man which have contributed to his success. For instance, he told of how he built a $5,000 house on a $500 equity, at a weekly salary of $15. He paid for the house by the work he did in his spare time in the basement on the oxy-hydrogen blowpipe.

A client once came to him with a sample of ore. Dr. Hoskins surprised him by asking him from what part of Alaska it came. Pressed for an explanation, he explained that the large number of samples of ores that were brought to him in the course of a year had given him enough experience to be able to tell fairly definitely from what part of the world any particular ore was brought. As a matter of fact, he added confidentially, it was quite simple. The sample was wrapped in a Sitka newspaper.

Experiments With Nickel-Chromium Alloy and Thermit

Dr. Hoskins traced the events in his career which led to the development of the nickel-chromium alloy which he has commercialized for use in pyrometers. When he was 14 years old he saw in a popular magazine a procedure for making synthetic diamonds. He followed the directions and carried on the experiment for 2 years, but, of course, was unsuccessful as far as producing diamonds went. This, however, gave him an interest in synthetic precious stones. Some time later, when he was interested in the oxy-hydrogen blowpipe, he attempted to continue work on this hobby by fusing ruby chips into large rubies. The main difficulty in the way of this ambitious scheme was the lack of funds to purchase small rubies, and he finally gave up the idea of them until Goldschmidt perfected the Thermit process This discovery stimulated his imagination again, and he determined to attempt to make synthetic rubies from ferric oxide and granular alumina. He, therefore, laboriously made up 200 lb. of Thermit and a graphite crucible in which he mxied the ingredients. He conducted the experiment in a blacksmith shop over which lived a colored family. Having made all the preparations he ignited the 200 lb. of Thermit. The colored family upstairs moved out and the fire department appeared on the scene. Needless to say, no rubies resulted from the experiment. This experience with Thermit, however, was recalled to mind when he began working on a nickel-chromium alloy for a thermopile. He successfully applied Thermit to the manufacture of various alloys, but after developing the thermopile it turned out that the practical application of it was very remote, but far from being discouraged with this failure the enthusiastic experimenter applied the very properties of the alloy which made it objectionable for its intended use to other uses. The problem of drawing the new alloy into wire was a long and tedious one, and the inventor encountered many obstacles which, amusing as they seem today, must have been extremely discouraging.

Chapter Officers Elected

Officers of the chapter for the coming year were elected as follows: President, Ellwood Hendrick; vice-president, Raymond F. Bacon; secretary, Arthur W. Thomas; treasurer, T. V. N. Dorr; council, Jerome Alexander, Leo H. Baekeland, M. T. Bogert, George F. Kuns, Charles F. Chandler, Charles H. Herty, D. D. Jackson, Ralph H. McKee, William H. Nichols, Paul Wack, H. C. Parmelee, A. H. Peter, J. E. Zanetti.

C. R. Richards Inaugurated President of Lehigh

Proposes to Extend Engineering Research Activities Without Neglecting Instruction

Before an audience of delegates fro other colleges, alumni and undergra uates of Lehigh and friends of t university which crowded the spacio Packer Memorial Chapel, Dr. Charl Russ Richards, former dean of the co lege of engineering of the Universi of Illinois, was inaugurated preside of Lehigh University on Oct. 15.

In the course of his speech Dr. Ric ards expressed his idea of the relati between industry and science as fo lows:

> Since the development of technological science and of technical education has followed rather than preceded the development of the basic industries, it was necessary to build these industries by emperical methods and procedures. Naturally such methods were expensive and wasteful. Only during recent years have we come to understand that there is a limit to our resources and that they must be conserved by every method which modern science can devise.
>
> Undoubtedly the solution of many of the problems of the industries can best and most economically be undertaken through co-operation with the universities and technical schools, in so far at least as these problems involve the discovery of scientific information of basic importance. Educational institutions are interested in the establishment of facts, and work conducted by them is therefore less likely to be affected by prejudices. Furthermore many of these institutions have facilities in apparatus and men which cannot readily be duplicated by any private laboratory. Thus those engaged in engineering research in a modern university have advantages which accrue to them through association with professors of physics, chemistry, bacteriology and other branches of pure science which may have a direct bearing upon engineering investigations in progress.

President Richards struck the no which told his audience that Lehigh, f 60 years a teaching college, was embark in the great work of enginee ing research when he stated that "whi teaching is the obvious and apparent the chief function of a university, should be its purpose to place scientif research in a position of equal impo tance with the work of instruction, f the world must largely depend upon to extend the boundaries of knowled and to show its applications to t affairs of life."

Steel Works Offers Jobs to Carnegie Students

To assist students working their wa through Carnegie Institute of Tec nology, the Jones & Laughlin Ste Co., of Pittsburgh, has arranged to en ploy students in the steel mills on Fr day and Saturday nights or all da Saturday. The shifts are of 10 hou length. Jones & Laughlin is the fir large concern in Pittsburgh to come t the aid of students in need of fina cial aid. The arrangement is pleasin to the administration at Carnegie Tec because of the opportunity it gives t the students in the College of Enginee ing to acquire practical as well a theoretical knowledge.

No Immediate Shortage of Industrial Coal

As a part of its campaign to stabilize the fuel situation through co-operative effort between the government and business, the Chamber of Commerce of the United States has made a survey of coal supplies in the states east of the Mississippi and north of the Ohio River. This part of the country has been regarded as the critical territory in the event of a coal shortage this winter.

The information gathered by the chamber which was obtained through local Chambers of Commerce, has been summarized as follows:

There are practically no supplies in the hands of local dealers.
Public utilities, about 45 days.
Byproduct coke plants fairly well supplied.
Steel works fairly well supplied.
General industries about 45 days.
The bituminous situation is becoming easier.
There seems to be no general complaint as to price.
The critical situation is that of obtaining a sufficient domestic supply in advance of cold weather, especially for the Great Lakes states, and the populous areas of New York State, New England and the Central Atlantic states.
There is much interest being taken in the use of oil.
There is a general increase in the use of coke for domestic fuel.
Certain cities have very effective systems of gathering information and distributing their coal, while others have nothing.

One of the first steps taken by the chamber in its campaign was to call on industries throughout the country to co-operate by confining purchases of coal to current needs as far as possible.

Petroleum Institute and A.C.S. Co-operate on Fuel Problems

First efforts to insure future supplies of motor fuels and oils have been started by the American Petroleum Institute, in co-operation with the special committee of the American Chemical Society which has undertaken the task. A list of problems was submitted at the recent meeting of the society in Pittsburgh, before the Petroleum Section by W. F. Farragher of Mellon Institute, and several of the most important, from a standpoint of immediate needs, have been chosen for immediate attack, as follows:

1. Thorough scientific investigation of fractionating columns. The study will be directed toward greater yields, purity, efficiency of operation, etc.
2. Preparation of rational specifications for petroleum products, such specifications to be based on actual research work. More rational volatility specifications for gasoline, and tests for "oiliness" of lubricants.
3. Investigations as to the actual need of highly refining gasoline for motor fuel; is it necessary to remove bad smelling sulphur compounds completely in order to obtain efficient service from the gasoline? Will these compounds injure the engine?
4. A study of the fundamental causes of carbon formation in cylinders; study effect of addition agents.
5. A thorough study of lubrication from a colloid chemical standpoint.
6. The chemistry of petroleum hydrocarbons, particularly of the higher homologs.
7. The chemistry of the sulphur, nitrogen and oxygen compounds in petroleum.
8. The chemistry of sulphuric acid refining of oils.
9. The causes and mechanism of color changes in oils.

British Prepared for Gas

Significance is attached in Washington to the fact that the British army being landed to protect the Dardanelles is equipped with gas masks. Despite the fact that it is highly improbable that the Turks have any supplies of gas or facilities for using it, each British soldier carries his gas mask ready for instant use in exactly the same way that he did on the western front during the World War.

The work is to be directed by the American Petroleum Institute, the Petroleum Section of the American Chemical Society helping in an advisory capacity only.

The Petroleum Section's committee on petroleum research was appointed to co-operate with Van H. Manning, director of research for the American Petroleum Institute. The following are members: R. R. Matthews, Roxana Petroleum Corporation; R. E. Wilson, Massachusetts Institute of Technology; C. E. Waters, Bureau of Standards; N. A. C. Smith, Bureau of Mines; R. P. Anderson, United Natural Gas Co.; E. W. Dean, Standard Oil Co. of New Jersey; and W. F. Farragher, Mellon Institute of Industrial Research, chairman.

Several Novelties at Ordnance Tests

Demonstrations to Engineers and Technical Men Regarded as Success

Engineers and technical men in the army service regard the demonstration of ordnance material at the Aberdeen Proving Ground on Oct. 6 as the most successful exhibit of this type yet conducted. The principal benefit from the army point of view is to bring home to men of technical experience, who can appreciate the exacting requirements of military prepardness, the destructive agents which may be brought against us. By actually visualizing the engines of war, it is possible to obtain a more precise conception, army officers believe, of the engineering and technical requirements for their production.

While the manipulation of the big guns always constitutes the most interesting portion of the programs at the Proving Grounds, it is believed that the greatest interest centered around the semi-automatic shoulder rifle, which made its first public appearance at the Aberdeen demonstration. The weapon was developed at the Springfield Armory, under the Garand patents. It is believed to be the most notable step forward in rifle production in recent years.

Much interest also centered on a new 14-in. gun on a railway mount. This weapon was displayed publicly for the first time at the meet. It is regarded as a notable achievement to mount on a railroad car a gun 50 ft. in length, capable of hurling a 1,500-lb. projectile a distance of 23 miles.

Another of the Ordnance Department's recent achievements which was on display was a new supersensitive fused shell which will burst on the slightest contact, even if nothing more substantial than the cloth of an airplane wing is pierced.

Radio was successfully employed in directing tank operations. A tractor for reconnaisance purposes was demonstrated publicly for the first time. Special provision is made to facilitate observation on the part of the two officers which the tractor is designed to carry. It has a speed of 12 miles across country and is equipped so as to float when it is necessary to cross streams.

Salesmen Enthusiastic Over Chemical Courses

The tower banquet hall of the College of the City of New York was the scene of the opening fall meeting of the New York Chapter of the Salesmen's Association of the American Chemical Industry on Oct. 13. The annual election of officers of the New York Chapter resulted in the appointment of John A. Chew, sales manager of the Warner Chemical Co., as president, George Ashworth, of the Dow Chemical Co., as treasurer, and D. H. Killeffer, of the *Journal of Industrial and Engineering Chemistry*, as secretary.

The excellent dinner which was arranged through the co-operation of Drs. Breithut, Robinson and Moody, was thoroughly enjoyed as was attested by the fact that the members lingered around the table until 9 o'clock. The meeting then adjourned to the Doremus chemical lecture room, where Dr. F. E. Breithut presented a series of experiments with liquid air which were exceedingly interesting. Dr. Breithut then outlined a proposed series of lectures on "The Chemistry of Common Things," which he plans to organize for the association. He outlined the scope of the course and the facilities for co-operative work. It is planned to make the lectures of a very practical nature and to present information that will be of great value to salesmen in the chemical industry. The first lecture will describe how a chemist works. This will be followed by a series of talks on the chemistry of gases, liquids, solids, solutions, acids and alkalis, metals and their source, carbon and its compounds. The ninth lecture, on "The Language of Chemistry," will go into the nomenclature which is sometimes so puzzling to the layman. The final lecture will be on "Economic Chemistry," a subject which Dr. Breithut is especially well qualified to discuss.

The association membership received the proposal with great enthusiasm. From the fifty members who were present at the meeting, thirty-three subscriptions to the course were obtained, and it is practically assured that the necessary quota of fifty members will be made up in a short time and the course started.

To Educate Legislators on Importance of Chemical Industry

So that new members entering the Senate or the House of Representatives may be given an idea, in concise form, of the value of chemistry to the nation, the American Chemical Society is bringing out a syllabus which it will place in their hands. It also is to be circulated in a limited way to others with the idea of emphasizing the essential nature of an American chemical industry. The concise character of the production may be gained from the reference made to the importance of chemistry to the national defense. It follows:

"Chemistry is essential to the production of every type of material required for national defense. War involves the entire national resources of a country, and the nation best fitted to make full use of its resources is most likely to be the victor. Without far-reaching work by chemists, such ability to defend a country is negligible. The German general Ludendorff in an interview published in American newspapers Sunday, Oct. 8, 1922, declared that in the next great war airships, chemicals and a few regiments of highly trained men will be supreme. Chemistry produces explosives, materials for aviation from dope for airplane wings to helium for dirigibles, materials for camouflage, toxic gases and equipment for protection against gases. Many non-poisonous smoke-screens, tear gas and other materials for 'humane warfare' are due to chemistry. It is the controlling factor in ordnance, in medicine and in sanitation. Its importance in national defense can not be overestimated."

Synthetic Organic Manufacturers Consider Tariff Effects

A meeting of the Synthetic Organic Chemical Manufacturers Association was held on Oct. 13 at the Hotel Pennsylvania, New York, with sixty representatives of chemical manufacturers present. The morning session was devoted to a meeting of the general association and the afternoon to meetings of the Dyestuffs Section, Crudes and Intermediates Section and the Medicinal and Fine Organic Chemicals Section.

At the conclusion of the luncheon held after the adjournment of the general session, the manufacturers were addressed by Dr. John H. Finley of the editorial staff of the New York *Times*. Dr. Finley emphasized the importance of the industry represented at the meeting and the multiplicity of the products so essential to the other industries of the country, and commented especially on the work of the chemists and the chemical manufacturers in transforming crude material of but little value to such highly important compounds as dyes, medicinals, etc. He felt that the present stress of the industry was due to lack of public understanding and pointed out how important a role the press of the country could play in bringing about a full conception by the people of the entire country that in this industry lay a national asset which should be safeguarded in every possible way. Regardless of the general views of tariff protection, he unhesitatingly joined with the views which he quoted of the late Lord Moulton, the eminent free-trader of England, that such an industry is exceptional in its character and in its preservation all citizens should unite.

At the general session of the association the subject of prime interest was the probable effect upon the industry of the present tariff act. There was a unanimity of feeling that many important products were markedly unprotected and all felt the injustice of the situation which took from the President power to increase rates where it could be clearly shown that protection was inadequate. As to direct effects up to date of the bill, it developed that as yet but little of the material manufactured by this industry had been admitted into this country, as the Customs Division had not yet drafted its regulations for administering the many complicated features in the new bill. The manufacturers, therefore, would have to wait before they could determine very accurately how disastrous foreign competition would prove.

Personal

Dr. JOSHUA BERNHARDT, of Rochester, N. Y., has been appointed head of the Tariff Commission's Sugar Division. Dr. Bernhardt served during the war as a sugar specialist for the Food Administration and for the Sugar Equalization Board. He is the author of a two-volume work on "Government Control of the Sugar Industry and Trade" and of another two-volume treatise under the title of "A Statistical Survey of the Sugar Industry and Trade." For the past 18 months Dr. Bernhardt has been a member of the staff of the Institute of Government Research and has written monographs covering the work of the Tariff Commission, the Alaskan Engineering Commission, the Interstate Commerce Commission, the Railroad Labor Board and the Federal Reserve Board. He was educated at the University of Rochester and at Johns Hopkins University.

C. R. DELONG, who recently left the United States Tariff Commission to take charge of the Chemical Commodity Division for the Department of Commerce, has been selected to return to the Tariff Commission as head of its Chemical Division.

Dr. MARION DORSET, chief of the Biochemical Division of the Bureau of Animal Industry, Department of Agriculture, has been designated to cooperate in an unofficial and consultative capacity with the Anthrax Advisory Committee. Dr. Dorset has been connected with the Department of Agriculture since 1894, and has held his present office since 1904.

CHARLES R. DOWNS and JOHN M WEISS, of New York, were awarde the Howard N. Potts medal by the com mittee on science and the arts of th Franklin Institute. The award wa made "in consideration of their notabl achievement in the scientific and com mercial development of the catalyti vapor-phase oxidation of benzene t maleic acid and their pioneer work i developing a commercial process fo changing aromatic to aliphatic com pounds."

Dr. A. R. FORTSCH, of the Iowa State University, will become research chemist in the laboratory of the Standard Oil Co. at Whiting, Indiana.

W. S. LANDIS, chief technologist for the American Cyanamid Co., was given the degree of D.Sc. on Oct. 15 by Lehigh University. HARLAN S. MINER, chief chemist for the Welsbach Co., received the same honor. Both gentlemen are alumni of Lehigh.

C. C. LATUS gave an interesting address before the members of the Pittsburgh Paint, Oil and Varnish Club, Pittsburgh, Pa., on Oct. 5, on the subject, "An Economic View of Central Europe."

ERNEST T. TRIGG has been elected president of John Lucas & Co., Philadelphia, Pa., manufacturers of paints and varnishes, succeeding J. W. LUCAS, who has become chairman of the board of directors. JAMES F. LUCAS was elected vice-president to succeed Mr. Trigg.

Obituary

WILLIAM C. ALLEN, general manager of the Tarrant Co., manufacturer of chemicals, died at his home in Brooklyn, N. Y., Sept. 24, as the result of injuries received when struck by an automobile. He was born in 1844, and had been associated with the Tarrant Co. for the past 50 years.

T. K. MCKNIGHT, who represented Crane Co. in Cleveland and formerly held a similar position in the Detroit and Pittsburgh districts, died suddenly in Cleveland on Sept. 16.

FRANK SHERMAN WASHBURN, chairman of the board of directors of the American Cyanamid Co., a leader in American engineering, died at his home in Rye, N. Y., at 2:30 a.m. Monday, Oct. 9. Death was due to bronchial pneumonia. Mr. Washburn is survived by his wife, a son, a daughter and two sisters, Mrs. C. J. Swan and Mrs. G. R. Dean, both of Chicago.

DR. J. FLEMING WHITE, consulting chemist for the General Chemical Co. for the past 37 years, died at his residence in Buffalo, N. Y., on Sept. 25, aged 73 years. Prior to becoming connected with the General Chemical organization he was connected with Harvard University and engaged in research work for the government.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

How About Our Foreign Trade?

An Attempt to Answer This Question by a Study of the General Trend of Imports and Exports of Basic Commodities and of Chemical and Allied Products

WHAT influence will the new high-protective tariff have on our foreign trade? Can we continue to export if imports are shut off? What will become of our favorable balance of trade? Questions of this sort will not down even though their answers for the most part must wait for the tedious process of international readjustment. Certain it is, of course, that the great groups of commodities for which the world must depend on the United States will continue in demand, although the extent of this demand must be measured by the foreigner's ability to pay. Likewise this country will continue to import necessities and other materials not produced here. Certain commodities for which the preference is for the foreign product will also be imported in spite of higher duties. Here, however, the quantity will depend on our willingness rather than ability to pay the price. The first 6 months of the current year showed a very encouraging trend in our foreign trade. After our exports had reached a low point in February, 1922, there was a distinct upward movement as exports rose from the low of 251 million dollars to 335 millions in June. The lowest point reached in imports since the decline which began in 1920 was in July, 1921. Month by month since that time the value of our imports has increased from 178 million dollars in July, 1921, to 260 millions in June and to 281 millions in August, 1922. The latter month to a large extent reflects the flood of imported merchandise received in anticipation of the enactment of the new high tariff. The monthly totals for August, which have just been issued by the Bureau of Foreign and Domestic Commerce, are shown in Table I.

Our balance of trade—i.e., the excess of exports over imports, has been gradually dwindling. In the fiscal year 1921-22 it amounted to 1,163 million dollars, as compared with 1,976 millions in the calendar year 1921 and 2,862 millions in the fiscal year 1920-21. The Research Division of the Bureau points out that although the trade balance in 1921-22 was slightly more than one-fourth as large as that for the fiscal year 1918-19 and less than half that of 1917-18 and 1919-20, it was nevertheless two and one-half times as large as the balance for 1913-14—a typical pre-war year. In 1913-14 the excess of exports over imports was 11 per cent of the total trade; last year it was 18 per cent.

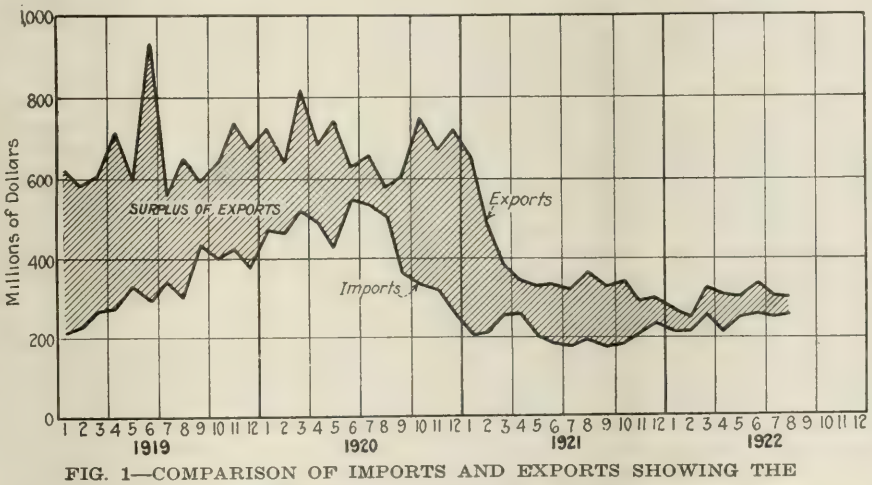


FIG. 1—COMPARISON OF IMPORTS AND EXPORTS SHOWING THE DIMINISHING BALANCE OF TRADE

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	153.77
Last week	150.78
October, 1921	151
October, 1920	263
April, 1918 (high)	286
April, 1921 (low)	140

Of the twenty-five commodities included in this index four advanced in price, there was one decline and the prices of the remainder did not change. Methanol, glycerine, formaldehyde and aniline oil caused an increase in the index number which more than offset the slight decrease caused by caustic potash.

The spread between imports and exports is shown graphically in Fig. 1. Its dwindling tendency is particularly significant in view of the commonly held theory that as a creditor nation our favorable trade balance must ultimately change to an unfavorable one. The new Chemical Division of the Department of Commerce has recently announced that since our export trade in chemicals and allied products is increasing so rapidly, it is quite probable that the total for 1922 will exceed that for 1921. This statement is supported by the fact that our exports for the first 7 months of 1922 showed a decrease of 3 per cent over

TABLE I—ANALYSIS OF FOREIGN COMMERCE FOR THE MONTH OF AUGUST, 1922

Groups	Month of August 1922	Month of August 1921	8 Months Ended August 1922	8 Months Ended August 1921
Imports				
Crude materials for use in manufacturing	$110,285,850	$71,525,960	$696,969,883	$563,733,290
Foodstuffs, crude, and food animals	22,489,316	18,921,616	211,856,654	202,007,847
Foodstuffs, partly or wholly manufactured	42,404,794	27,096,025	275,212,363	274,869,332
Manufactures for further use in manufact'g	48,430,514	25,160,325	328,283,585	227,588,260
Manufactures ready for consumption	55,858,174	49,889,223	430,881,213	408,745,339
Miscellaneous	1,944,262	2,175,602	9,752,898	11,460,167
Total imports	$281,412,910	$194,768,751	$1,952,956,596	$1,693,404,235
Exports				
Crude materials for use in manufacturing	$47,872,888	$65,278,951	$519,644,391	$615,798,544
Foodstuffs, crude, and food animals	61,339,609	105,877,509	292,791,310	525,643,525
Foodstuffs, partly or wholly manufactured	46,071,986	66,607,308	404,066,204	479,278,830
Manufactures for further use in manufact'g	35,708,965	25,050,067	309,005,058	275,884,025
Manufactures ready for consumption	104,871,560	97,318,160	847,925,438	1,241,888,759
Miscellaneous	407,071	493,641	4 296,754	4,666,999
Total domestic exports	$296,272,079	$360,625,636	$2,377,729,155	$3,143,160,682
Foreign merchandise exported	5,532,539	6,261,902	46,058,717	83,386,144
Total exports	$301,804,618	$366,887,538	$2,423,787,872	$3,226,546,826

the corresponding period of 1921, while the exports for the first eight months of 1922 showed only a very slight decrease—less than 1 per cent—over the same period in 1921. Going back over our exports month by month for the first 8 months of these 2 years, the rate of decrease has been gradually lessened, from 28 per cent for the first quarter to less than 1 per cent for the 8 months ended Aug. 31. Table II shows by monthly periods the gradual improvement in our export trade.

TABLE II—MONTHLY IMPROVEMENT IN CHEMICAL EXPORTS

Period	Decrease in Value of Exports in 1922 Over 1921 Per Cent
January	53
January – February	43
January – March	28
January – April	20
January – May	11
January – June	7
January – July	3
January – August	0.8

When it is taken into account that this table is based on value, it can be readily seen that with continued improvement our export trade in chemicals for 1922 will show an encouraging increase over 1921.

The total exports of chemicals and allied products for the first 8 months of 1922 were valued at $71,476,203, as compared with $72,081,335 in the corresponding period of 1921. Marked increases again occurred in our exports of fertilizers and fertilizer materials, and in naval stores, gums and resins.

Commodity Totals

Caustic soda and borax continued to show the largest increases of all chemicals, 360 per cent and 300 per cent respectively, 107,934,500 lb. and 10,361,250 lb., having been exported during this period. Other chemicals showing important increases were sodium silicate, bleaching powder, glycerine, acetate of lime, sodium bicarbonate, ammonium sulphate and copper sulphate. Of the 4,218,288 lb. of ammonia and ammonium compounds (excluding ammonia sulphate) exported, it is interesting to note that over one-quarter of the amount was exported in the month of August.

The shipments of fertilizers and fertilizer materials were 652,359 tons, valued at $12,032,707, in 1922, as compared with 561,666 tons, valued at $10,363,628, in 1921, an increase of nearly 20 per cent in quantity. Of a total of 111,676 tons of ammonia sulphate exported, over one-half was again shipped to Japan and one-quarter was sent to Spain.

Large increases are again noticed in the exports of naval stores, the combined exports of tar, pitch and wood turpentine increasing 260 per cent, while spirits of turpentine increased 67 per cent and rosin 58 per cent. The United Kingdom still continues to be our best customer for rosin and spirits of turpentine, taking nearly one-third and one-half respectively by value. The total exports of naval stores were $11,348,000 in 1922, as compared with $6,843,000 in 1921.

The exports of explosives more than doubled in this period, from 5,692,000 lb. ($1,361,000) in 1921, to 11,657,000 lb. ($2,121,300) in 1922. The amount of dynamite exported increased from 5,032,860 lb. in 1921, to 8,235,000 lb. in 1922.

Perfumeries, cosmetics and all toilet preparations increased over one-quarter from a total valuation of $3,000,000 in 1921 to nearly $4,000,000 in 1922.

Although the figures for the exports of "Pigments, paints and varnishes" still continue to indicate a decrease in exports from $9,009,000 in 1921 to $7,329,000 in 1922, there were marked increases in the exports of red lead and litharge and in zinc oxide, from less than 1,000,000 lb. and 3,000,000 lb., respectively, in 1921, to nearly 2,500,000 lb. and 5,000,000 lb. in 1922. Decreases are still evident in the exports of ready-mixed paints, white lead, and other paints.

Other noticeable decreases were in the exports of benzol, from $2,582,600 in 1921 to 1,994,000 in 1922, and coal-tar colors, dyes and stains other than color lakes, from $3,767,400 to $2,431,400.

The New York Market

New York, Oct. 16, 1922.

Inquiries by consumers have shown considerable diminution during the past week, due to the price advances which have occurred since the new tariff went into effect. Interest, however, has been keen among leading dealers, as the present market has reached the highest level since the beginning of 1921. The only disturbing influence was the announcement of a reduction in price by producers of oxalic acid. The new price was primarily made to meet the competition of foreign makers. Alkalis for home consumption showed an abundance of activity. Producers of formaldehyde again advanced prices, increased cost of manufacture being given as the reason. The acute shortage in commercial white arsenic is keeping the market in a very tight position on spot and immediate future shipments. There has been a slight decrease in quotations of caustic potash and barium chloride. Weak holders of these items have offered some round lots during the week at lower figures, but consumers have shown little desire to increase their stocks. Acetate of soda remains scarce and strong on spot. Prussiate of potash and soda are holding their late advances and several fair-sized lots have been sold. The market, in general, appears on the road to stable prosperity and some of the leaders are looking forward to the last quarter of 1922 with unusual optimism.

General and Special Chemicals

Arsenic—Spot material has been selling around 10c. per lb. This figure is the highest recorded since the early part of 1921. The consuming trade, largely producers of insecticides, are very active. Forward shipments are bringing 9½@9¾c. per lb.

Barium Chloride—Quotations among some dealers were slightly lower, with figures ranging around $100@$102 per ton. Leading producers are quoting $105. The demand has not, however, been active during the past week.

Caustic Potash—The 88-92 per cent imported material has been sold at 6¼c. per lb., but the majority of strong holders are asking 6½c. There was a fair inquiry in the market, although actual sales were not as extensive as recorded a week ago.

Caustic Soda—Export business has been quite dull of late and prices have reduced to $3.45@$3.50 per 100 lb. for standard brand goods. The only real activity is in the domestic consumption, where prices are holding at 3¾c. per lb. Contract price quotations remain unchanged.

Chlorate of Potash—Imported material is quoted at 7½@7¾c. per lb. The market has been quite firm at these figures and demand continued active. Domestic factors quote 8½c. per lb.

Chlorate of Soda—Domestic producers are firm at 6½c. per lb., f.o.b. works and report a moderate amount of new business at this level. Imported goods is strongly maintained at 6½c. per lb. on spot.

Formaldehyde — Manufacturers announced an advance to 11½c. per lb. on round lots and 12c. for smaller quantities. Increased price of methanol is chiefly the cause of the late advance. Demand is active.

Oxalic Acid—Sales of imported material are reported at 13¾c. per lb. for arrival, duty paid. American manufacturers have reduced prices to 14c. per lb., in an effort to meet foreign competition. Spot domestic goods are quoted at 16c. per lb., but the market is somewhat irregular.

Prussiate of Potash — Leading importers reported sales at 38½c. per lb. on spot for yellow material. Shipments are offered at 37½@38c. per lb., duty paid. The red variety is offered at about 95c. per lb.

Soda Ash—The spot market is firmly held at $1.75 per 100 lb., single bags, and $1.95 in barrels, carload lots. Contract business was reported quite active among producers at $1.20 per 100 lb., basis 48 per cent, f.o.b. works.

Coal-Tar Products

The market on crude coal-tar material presented a very strong appearance and acute advances were reported in several items. Phenol has been the feature of this market and spot goods were exceedingly scarce. Cresol, U.S.P., has been advanced 2c. per lb. by producers. Cresylic acid has also recorded gains ranging from 3@4c. per gal. The consuming trades have shown considerable activity of late and the increased prices are primarily on account of this demand. Aniline oil producers are quite firm at the recently advanced figures.

Naphthalene has remained quiet and several weak holders are shading prices in an effort to move stocks. Benzene and toluene are very strong and can only be quoted for future shipments.

Cresol — U.S.P. material has advanced to 14c. per lb. in bulk and to 20c. on smaller quantities.

Phenol — The spot market is very tight. Several sales have been made at 26c. per lb. for prime white U.S.P. crystals. Manufacturers are sold up well into the future and the general condition is very strong.

The Chicago Market

CHICAGO, OCT. 12, 1922.

The chemical market was in a much healthier condition the past 2 weeks and it appeared that this condition would be more or less permanent. Labor troubles have about ceased and transportation difficulties are gradually being adjusted, with the result that business in general is better than for some time past. Prices, as a rule, were very firm, with advances numerous. However, these advances were mainly on imported materials that were affected by the new tariff. Supplies were not heavy in any direction, but with one or two exceptions no serious shortages were in evidence.

General Chemicals

Caustic soda maintained its firm position and was reported to be moving in a good volume. The solid 76 per cent material was offered at $3.50@$3.75 per 100 lb., priced according to quantity and holder, while the ground of the same test was quoted at $4.25@$4.50. *Caustic potash* was available in one direction at 7¼c. for the 88-92 per cent material, but most factors held their prices firm at 7½c. *Soda ash* was in good demand and was quoted in cooperage at $2.25 per 100 lb. delivered to the buyer's plant. *Sal soda* moved in a routine way at $1.90 per 100 lb.

Potash alum was very firm, with 5½c. per lb. the inside price on the iron-free lumps. The powdered material of the same grade was scarce at 6½c. per lb. in large casks. *Sal ammoniac* continued firm, with 7¾c. per lb. the best price noted for the 98-100 per cent white granular. All barium salts were in a firm position, with only moderate supplies available. *Barium chloride* was quoted in small lots by one factor at $110 per ton but it was doubtful if a large order could have been taken care of. The carbonate was quoted for spot delivery at $90 per ton, but, like the chloride, only limited supplies were available. Bleach was firm, with $2.60 per 100 lb. the prevailing price for small or moderate lots. *Copper sulphate* was available in fair quantities at 6@6½c. per lb. *Carbon tetrachloride* was unchanged and apparently enjoyed good demand. The large drums were quoted at 9c. per lb. delivered to the buyer's store. *Carbon bisulphide* was scarce on spot and supplies were firmly held at 7½c. per lb. *Formaldehyde* was again sharply advanced, the new level being 12½c. for barrels in less than carload lots. *Furfural* was reduced to 25c. per lb. in ton lots. Glycerine was steady at 18½c. per lb. for the c.p. material in drums. *Magnesium* metal was quiet at $1.35 per lb. for the powder. *Phosphoric anhydride* was in poor demand and was offered in 1-lb. tins at 42c. per lb.

Bichromates were steady and moved in a fair volume. *Potassium bichromate* was quoted in single barrels at 12@13c. per lb. and the *soda* at 9@9½c. *Potassium permanganate* was easier and spot supplies of the U.S.P. crystals were available at 18c. per lb. *Red prussiate of potash* was offered in very small quantities by one holder at 92c. per lb. The *yellow prussiate of potash* was scarce at 38c. per lb.

Linseed Oil and Turpentine

Turpentine was considered high priced by most consumers and only small quantities for immediate consumption were sold. Today's price for single drums was $1.45 per gal.

Linseed oil moved in a better way, but very few consumers were taking on supplies beyond their immediate needs. The boiled oil was quoted today at 96c. per gal. in single drums and the raw at 94c.

The Iron and Steel Market

PITTSBURGH, Oct. 13, 1922.

Fundamental conditions in the steel market have turned distinctly soft, but in the actual current market there is little softness apparent, there being support, both real and sentimental, by the existing transportation difficulties, which prevent full shipments being made from mill in all cases and which also block delivery, more or less, to various consumers.

There are car shortages at the majority of steel plants, and there are probably few at which there is not some accumulation of finished steel. No large tonnage has piled up. Whether correctly or not, it was estimated in some quarters on July 1, 1920, that 3,000,000 tons of finished steel lay at mill, awaiting cars. An estimate now would not be a tenth of that amount.

Effects of Car Shortage

While the steel mills probably could make little if any more steel than they are making, there is no desire to make more, since it is impossible to ship all the steel that is being made. When the market has the physical and moral support of shipments restricted by transportation conditions and does not appear particularly strong at that, it is evident that it is on the verge of the general readjustment that was expected to follow at a longer or shorter interval the ending of the coal strike. In April and May it was a very common view that the coal strike, by its sentimental influence, was making the steel market stronger and more active than it would be otherwise.

Delivery premiums continue on some steel products, but are tending to narrow, and probably will shortly disappear entirely. Basis prices naturally could not be expected to yield when there is a premium market in some branches of the trade, but they may yield later, and unless circumstances that cannot now be foreseen should arise it is entirely probable that basis prices will eventually decline, before there is another general buying movement in steel. The experience of two years ago will be repeated on a smaller scale. Steel prices have very much less room for decline, but the character of the market will not be essentially different.

Bars, shapes and plates are quotable generally at 2@2.25c. Black sheets in the open market are at 3.50@3.60c. The Steel Corporation's price is 3.35c., but it is out of the market. One or two mills are asking 3.75c., but do not seem to be selling much tonnage. Nails are steady at $2.70.

The Steel Corporation's unfilled obligations increased by 741,502 tons in September, against increases of 173,944 tons in August and 140,630 tons in July. The September showing is not illuminating because it is not known how much of the large rail tonnage put under cover in the month got into actual form for entering before the close of the month. Some of the business remained to appear in the October statement. With rails eliminated the September showing would probably not be much different from those of the two preceding months.

Coke and Iron Prices

Connellsville coke and merchant pig iron have just begun an extensive price readjustment. Coke was strong for several weeks, at around $12, and furnaces desiring to buy in order to resume operations had to buy from several different plants to make up the tonnage. In the past few days prices have suddenly begun to weaken, and with its usual sensitiveness the market will probably decline sharply. A week ago the market was strong at $12, while now coke is offered at $11 with few takers. Coke has sometimes sold at less than the market price of the coal involved, plus cost of coking. The computation at present would be 1½ times $3.50 plus $1.25, or $6.50. By precedent, coke could sell for less than $6.50 or it could sell at double that figure, according to whether the balance between offerings and demand were disturbed a trifle one way or the other.

Cherry Valley furnace and McKeefrey furnace, both at Leetonia, Ohio, are about to get into blast. While merchant furnace resumptions have been only occasional, there has really been a fair measure of resumptions, and with pig iron scarcely salable in the past few weeks at prices asked, a substantial decline in the market is to be expected. The market now is quotable, roughly, at $31 for basic, $33.50 for bessemer and $32.50 for foundry, f.o.b. valleys or Johnstown, freight to Pittsburgh being $1.77 in each case. There are no definite bids, representing prices at which consumers would buy freely.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	-	$0.38 – $0.40
Acetone	lb.	$0 17½ – $0 17½	18 – .18½
Acid, acetic, 28 per cent	100 lb.	2 80 – 2 90	2.95 – 3 50
Acetic, 56 per cent	100 lb.	5 60 – 5 75	5.80 – 6.25
Acetic, glacial, 99½ per cent, carboys,	100 lb.	11 00 – 11 25	11.50 – 12 00
Boric, crystals	lb.	11 – 11½	.11½ – .12
Boric, powder	lb.	11 – 11½	.11½ – .12½
Citric	lb.	-	.52 – .52½
Hydrochloric	100 lb.	1 10 – 1 20	1.25 – 1 70
Hydrofluoric, 52 per cent	lb.	11 – 11½	.11½ – .12
Lactic, 44 per cent tech	lb.	09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	04½ – .04¾	.05 – .05½
Molybdic, c.p.	lb.	3 00 – 3.25	3.30 – 3 75
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg.	lb.	06 – .06¼	.06¾ – .07
Nitric, 42 deg.	lb.	06½ – .06¾	.07 – .07¼
Oxalic, crystals	lb.	15 – .15½	15½ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	-	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 – 10.00	-
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	-
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	-
Sulphuric, 66 deg., drums	ton	19.00 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	- -	-
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	-
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	-	.60 – .75
Tannic (tech.)	lb.	40 – .45	.46 – .50
Tartaric, imported crystals	lb.	- -	.31 – .31½
Tartaric acid, imported, powdered	lb.	- -	.31½ – .32
Tartaric acid, domestic	lb.	- -	- .32
Tungstic, per lb. of WO	lb.	- -	1.00 – .110c
Alcohol, ethyl (Cologne spirit)	gal.	- -	4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	- -	.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.	- -	.36 – .38
Alum, ammonia, lump	lb.	.03¼ – .03½	.03½ – .04
Alum, potash, lump	lb.	.03½ – .03¾	.04 – .04½
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1 50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	- -	2.35 – 2.50
Arsenic, white, powdered	lb.	.10 – .10½	.10½ – .10¾
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	100 00 – 102.00	103.00 – 105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate		.09 – .09¼	.09½ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	- -
Blanc fixe, pulp	ton	45.00 – 55.00	- -
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)		- -	- -
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		- -	- -
Bromine	lb.	.27 – .38	.28½ – .35
Calcium acetate	100 lb.	2.75 – 2.85	2.90 – 3.25
Calcium carbide	lb.	.04½ – .04¾	.05 – .05¼
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	- -	1.40 – 1.50
Calcium phosphate, tribasic	lb.	- -	.15 – .16
Camphor	lb.	- -	.86 – .87
Carbon bisulphide	lb.	.06¾ – .07	.07¼ – .07½
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	- -	.60 – .75
Caustic potash (see potassium hydroxide)		- -	- -
Caustic soda (see sodium hydroxide)		- -	- -
Chalk, precip.—domestic, light	lb.	.04½ – .04½	- -
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	- -
Chalk, precip.—imported, light	lb.	.04½ – .05	- -
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.	- -	.25 – .32
Cobalt oxide	lb.	- -	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.20 – .20½	.20¾ – .21
Copper cyanide	lb.	- -	.58 – .600
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.504
Cream of tartar	lb.	- -	.26 – .27
Epsom salt (see magnesium sulphate)			
Ethyl acetate com. 85%	gal.	- -	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal	- -	.90 – .95
Formaldehyde, 40 per cent	lb.	11½ – 11½	.12 – .12½
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	- -
Fullers earth—imported powdered	net ton	30.00 – 32.00	- -
Fuse oil, ref.	gal.	- -	2.75 – 2.90
Fusel oil, crude	gal.	- -	1.65 – 1.85
Glauber's salt (see sodium sulphate)		- -	- -
Glycerine, c.p. drums extra	lb.	- -	.18½ – .18¾
Iodine, resublimed	lb.	- -	4.40 – 4.50
Iron oxide, red	lb.	- -	.12 – .18
Lead acetate, white crystals	lb.	- -	.11¾ – .12½
Lead arsenate, powd.	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	- -	.15 – .20
Litharge	lb.	.07¼ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07¾
Magnesium sulphate, U.S.P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	- -	1.00 – 1.80
Methanol, 95%	gal.	- -	.82 – .84
Methanol, 97%	gal.	- -	.86 – .88
Nickel salt, double	lb.	- -	.11 – .11½
Nickel salt, single	lb.	- -	.12 – .12½
Phogene (see carbonyl chloride)		- -	- -
Phosphorus, red	lb.	- -	.40 – .45
Phosphorus, yellow	lb.	- -	.30 – .35¼
Potassium bichromate	lb.	.10 – .10¼	.10½ – .11
Potassium bromide, granular	lb.	- -	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06½	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07½ – .07¾	.08 – .08½
Potassium cyanide	lb.	- -	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.25 – 6.50	6.60 – 7.00
Potassium iodide	lb.	- -	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.17 – .17½	.17¾ – .19
Potassium prussiate, red	lb.	- -	.95 – 1.00
Potassium prussiate, yellow	lb.	.38½ – .38¾	.39 – .39½
Rochelle salts (see sodium potas. tartrate)		- -	- -
Salammoniac, white, granular	lb.	.06¾ – .07	.07¼ – .07½
Salammoniac, gray, granular	lb.	.07¾ – .08	.08¼ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 – 27.00	- -
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1 60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1 75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.08 – .08¼	.08½ – .09
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 – 13 00	- -
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09½	.09¾ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.45 – 3.50	3.55 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09¼ – .09½	.09¾ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	- -	.18 – .21
Sodium prussiate, yellow	lb.	.24 – .24½	.24½ – .25
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04¾ – .05
Sodium sulphite, crystals	lb.	.03¾ – .03¾	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 – 20.00	- -
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	- -	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 – 40.00	- -
Talc—domestic powdered	ton	18.00 – 25.00	- -
Tin bichloride	lb.	.10 – .10½	.10¾ – .10¾
Tin oxide	lb.	- -	.39 – .40
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15¼
Zinc chloride, gran	lb.	.06 – .06¼	.06¾ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.29 — .31
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.53 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.72 — .75
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15 —	$0.10
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.10 —	2.15
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.80 —	.85
Ortho-nitro-toluene	lb.	.10 —	.13
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.26 —	.27
Pyridine	gal.	1.60 —	1.75
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.29 —	.30
Salicylic acid, U. S. P	lb.	.32 —	.34
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12 —	.14
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices remain same as previous report

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.70 —	
Rosin E-I	280 lb.	6.70 —	
Rosin K-N	280 lb.	6.75 —	$6.85
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	
Spirits of turpentine	gal.	1.45 —	1.46
Wood turpentine, steam dist	gal.	1.15 —	....
Wood turpentine, dest. dist	gal.	1.12 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.38 —	....
Rosin oil, second run	gal.	.41 —	....
Rosin oil, third run	gal.	.48 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Quotations remain unchanged

Crude Rubber

Para—Upriver fine	lb.	$0.19 —	.19¼
Upriver coarse	lb.	.14 —	.14¼
Upriver caucho ball	lb.	.14 —	.14¼
Plantation—First latex crepe	lb.	.17½ —	.17¾
Ribbed smoked sheets	lb.	.17⅛ —	.17¼
Brown crepe, thin, clean	lb.	.15½ —	.16
Amber crepe No. 1	lb.	.15½ —	.16

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12½ —	.13
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¼ —	.08½
Cocoanut oil, Cochin grade, in bbls	lb.	.08¼ —	.09
Corn oil, crude, in bbls	lb.	.08¾ —	.09
Cottonseed oil, crude (f. o. b. mill)	lb.	.07¼ —	.07½
Cottonseed oil, summer yellow	lb.	.10 —	.10¼
Cottonseed oil, winter yellow	lb.	.11 —	.11¼
Linseed oil, raw, car lots (domestic)	gal.	.87 —	.88
Linseed oil, raw, tank cars (domestic)	gal.	.84 —	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.91
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07¼
Palm, Niger	lb.	.06½ —	.06¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08½ —	.09
Peanut oil, refined, in bbls	lb.	.12¼ —	.12½
Rapeseed oil, refined in bbls	gal.	.78 —	.80
Rapeseed oil, blown, in bbls	gal.	.86 —	.87
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.08¾ —	.09

FISH

Light pressed menhaden	gal.	$0.51 —	....
White bleached menhaden	gal.	.54 —	.55
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1, crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$600.00	$800.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65.00 —	80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24.00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) nground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	16.00 —	20.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, No. 1 pottery grade	long ton	7.00 —	7.50
Feldspar, No. 2 pottery grade	long ton	5.75 —	5.90
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00 —	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	....
Kieselguhr, f.o.b. N. Y	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00 —	15.00
Pumice stone, imported	lb.	.03 —	.05½
Pumice stone, domestic, lump	lb.	.05 —	.05
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.59 —	.60
Shellac, orange superfine	lb.	.61 —	.62
Shellac, A. C. garnet	lb.	.63 —	.64
Shellac, T. N	lb.	.57 —	.58
Silica, glass sand, f.o.b. Indiana	per ton	1.50 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00 —	16.00
Silica, building sand, f.o.b. Pa	per ton	2.00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00 —	17.00

Refractories

Prices remain quotably unchanged

Ferro-Alloys

Prices remain same as previous report

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19.00 —	20.00
Coke, foundry, f.o.b. ovens	net ton	13.50 —	14.00
Coke, furnace, f.o.b. ovens	net ton	12.00 —	12.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	....
Manganese ore, chemical (MnO_2)	net ton	70.00 —	75.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00 —	8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	7.75 —	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.95–14.00
Aluminum, 98 to 99 per cent	20.00–21.00
Antimony, wholesale lots, Chinese and Japanese	6.85–7.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	33.75
Lead, New York, spot	6.50
Lead, E. St. Louis, spot	6.30
Zinc, spot, New York	6.95
Zinc, spot, E. St. Louis	6.625

OTHER METALS

Silver (commercial)	oz.	$0.69¾
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.35@2.40
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$112.00
Iridium	oz.	275.00@300.00
Palladium	oz.	55.00
Mercury	75 lb.	73.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

GLASS—The Alliance Window Glass Co., Salem, W. Va., has arranged for the resumption of operations at its plant, giving employment to more than 150 men.

The Turner Brothers Glass Products Mfg. Co., Terre Haute, Ind., has resumed production in its bottle-manufacturing department, after an idleness of about 8 weeks. The company will give immediate employment to about 175 additional operatives, making a total working force of about 300 persons. It is expected to maintain capacity operations for an indefinite period.

The Salem Co-operative Window Glass Co., Salem, W. Va., has resumed production at its plant, after a curtailment for a number of weeks.

LEATHER—Tanneries at Wilmington, Del., are rapidly increasing their production schedules, and a number of plants have added to their working forces during the past few weeks. The Christiania Leather Co. has resumed operations after an extended curtailment on a basis of about 100 dozen skins per day; it is expected to increase this schedule to 200 dozen at an early date. The Standard Kid Mfg. Co. is running under heavy output, specializing in colored kid. The Amalgamated Leathers Co. is making machinery improvements and repairs and plans to resume active production at an early date. William Beadenkopf has opened his local glazed kid plant, giving employment to a good working force. The Union Leather Co. is maintaining active manufacture and expects to continue practically at capacity for an indefinite period. The Delmarvia Leather Co., specializing in the production of glazed kid, has recently resumed operations at its plant, with good working force.

The J. H. Ladew Co., Newark, N. J., is now running at about 80 per cent of normal, devoting the output to high-grade sole leather.

RUBBER—The Lambert Tire & Rubber Co., Barberton, O., has advanced production to about double that heretofore scheduled, and is now running on a basis of about 350 cushion tires per day. This is the second increase made in manufacture by the company since the first of the year. The working force has been materially enlarged.

The Hood Rubber Co., Watertown, Mass., is running under heavy capacity at its tire-manufacturing plant, giving employment to a normal working force. Unfilled orders on hand insure continuance on the present basis, it is said, for some time to come.

METALS — The Callahan Zinc-Lead Co., Cœur d'Alene, Idaho, is arranging for the immediate resumption of operations. The local mill is being made ready, with machinery and other repairs now nearing completion.

The Chino Copper Co., Silver City, N. M., is maintaining active operations at its local plant, giving employment to a large working force. Wages have been increased 10 per cent, effective Oct. 1.

The Utah Copper Co., Bingham, Utah, is advancing production at its plants in this section. The wage schedule has been increased for laborers and workmen 40 and 50 cents per day, respectively. Other wage advances for skilled men are expected to be made at an early date.

The American Steel Foundries, Inc., Chicago, Ill., has advanced production at its plants to about 80 per cent of capacity.

IRON AND STEEL—The Reading Iron Co., Reading, Pa., is continuing the resumption of production in its different plant departments and has now placed its local No. 1 puddling mill in service, following a suspension for almost 2 years. The plant has been completely rebuilt; it consists of 8 double furnaces and will give employment to about 150 men.

The National Tube Co., Pittsburgh, Pa., has blown in the fifth and last blast furnace at its Lorain, O., plant, placing the works on a 100 per cent operating basis for the first time in nearly 2 years.

The Shenango Furnace Co., Sharon, Pa., has blown in its No. 4 blast furnace, after a long period of suspension.

The Virginia Iron, Coal & Coke Co., Roanoke, Va., is arranging for the early resumption of its blast furnace at Max Meadows; the plant has been idle for more than 18 months. The company is also planning to blow in its other furnaces at Roancke and at Big Stone Gap.

The Bethlehem Steel Co. has blown in a fifth blast furnace at its Lackawanna plant at Buffalo, N. Y.

The Eastern Steel Co., Pottsville, Pa., is planning to blow in another blast furnace at its plant at an early date.

The Allegheny Ore & Iron Co., Irongate, Va., is planning to blow in its Buena Vista blast furnace before the close of the month.

The Wickwire Steel Co., Buffalo, N. Y., is completing the relining of a blast furnace at its local plant, and will place the unit in blast at an early date.

MISCELLANEOUS—The Edison Portland Cement Co., Edison, N. J., is running full at its local mills. A wage increase of 5c. an hour has recently been placed into effect, making a total advance of 60 per cent over the pre-war wage scale at the plant. About 600 employees are now on the payroll.

The U-Rub-It Chemical Co., Philadelphia, Pa., has completed the establishment of a new plant at 1208 South 23rd St., and has placed the factory in service on a full production schedule.

The Mexican Candelilla Wax Co., Torreon, Mexico, and a number of other candelilla wax-manufacturing plants in the States of Coahuila and Nuevo Leon, Mexico, have resumed operations after a shut-down for a number of years. The wax is extracted from the candelilla weed.

The Heyden Chemical Co., Garfield, N. J., manufacturer of salicylic acid, salicylate, etc., is completing the rebuilding of its local plant, destroyed by fire last year. The factory will be placed immediately in operation with a regular working force.

The Sherwin-Williams Co. of Canada, Montreal, Que., is advancing production at its paint and varnish plants. A 20 per cent increase has been recorded during the past year, as compared with the previous twelve-month.

Construction and Operation

Alabama

MOBILE—A 1-story foundry will be erected at the plant of the Mobile Pulley & Machine Works, to be equipped for the production of steel castings. Plans are being completed.

California

SAN FRANCISCO—The Los Angeles Soap Co., 633 East 1st St., Los Angeles, manufacturer of soap, washing powders, sal soda, etc., will take bids at once for the erection of a 2-story and basement plant at 2nd and Brannan Sts., San Francisco, estimated to cost about $80,000, including equipment. W. H. Crim, Jr., 425 Kearny St., San Francisco, is architect.

BERKELEY—The El Dorado Oil Co., University Ave. and 3rd St., will commence immediately the erection of a 2 story addition to its oil works, to cost about $13,000.

SANTA MONICA—The Santa Monica Brick Co. has construction in progress on a new plant at 24th St. and Michigan Ave., to be equipped for an initial production of about 40,000 bricks per day. The company was organized recently. M. J. Carlton is general manager.

HAYWARD—The Concrete Lumber Co., Los Angeles, has tentative plans under consideration for the establishment of a new plant at Hayward. A site will be selected at an early date.

Colorado

WHITE RIVER CITY—The Rio Blanco Carbon Co., 818 Symres Bldg., Erie, Pa., has plans under way for the erection of a new plant at Rio Blanco, White River City, consisting of three main buildings for carbon production, estimated to cost close to $75,000. O. D. Horton, 714 Commerce Bldg., Erie, is engineer. Thomas J. Dixon is president.

Connecticut

MILFORD—The Pruven Composition Products Co., recently organized under Delaware laws with capital of $250,000, is completing the remodeling of the local factory of the Askan Rubber Co., lately acquired, and will equip the plant for the manufacture of composition products, to be used as a substitute for hard rubber. It is expected to give employment to about 50 men for initial operations and this number will be increased at a later date. John J. Sharo is president.

Georgia

QUIMTAN — Construction has been commenced on an addition to the foundry at the plant of the Southern Machinery Co., to double, approximately, the present capacity. F. C. Underwood is president and general manager.

Kentucky

RUSSELLVILLE—The Independent Nitro Co., recently organized, has awarded a contract to John H. Berry, Union City, Ky., for the erection of a new local plant for the manufacture of nitroglycerine and kindred products. D. W. Kennedy, Richmond, Va., is president, and Stone W. Norman, secretary.

WILLIAMSBURG—The Iroquois Natural Gas Co., Iroquois Bldg., Buffalo, N. Y., is reported to be planning for the erection of a local plant for the manufacture of carbon black and kindred products, estimated to cost about $200,000, including machinery. Walter Simpson is president.

Louisiana

MONROE—The Monroe Glass Co., recently organized, has acquired property at Terminal Heights, a suburb of the city, as a site for the erection of its proposed new plant for the manufacture of blown glass products. The initial works will cost about $25,000, and are expected to be ready for operation by the close of the year. John Hartman, Alexandria, La., is vice-president in charge.

LAFAYETTE—The Peoples Cotton Oil Co., is planning for the rebuilding of the portion of its plant recently destroyed by fire. The new structure will be 150x200 ft. T. M. Biossat is vice-president and general manager.

Maryland

BALTIMORE—The United Lead Co., 827 South Howard St., has filed plans for the erection of a new 2-story building at its plant, 34x155 ft., estimated to cost about $40,000. The construction contract has been awarded to the Consolidated Engineering Co., Calvert Bldg.

Massachusetts

ALLSTON—The Atlantic Refining Co., 248 Boylston St., Boston, with headquarters at 3144 Passyunk Ave., Philadelphia, Pa., has awarded a contract to Metzger, Fisher & White, Otis Bldg., Philadelphia, for the erection of a new building, 2-story, 100x200 ft., at 52 Cambridge St., Allston, estimated to cost about $50,000.

SALEM—Baker & Kimball, 28 South St., Boston, have completed plans and will commence the immediate erection of their proposed new leather-manufacturing plant on property recently acquired at 5 Fort Ave., Salem, to be 2-story, 70x175 ft., and estimated to cost about $40,000.

Michigan

FLAT ROCK—The Ford Motor Co., Highland Park, is completing plans and will soon take bids for the erection of its proposed new plant at Flat Rock for the manufacture of sheet glass, for windshield and other service. It will be 1-story, 258x760 ft., and is estimated to cost close to $1,500,000, including machinery. Albert Kahn, 1000 Marquette Bldg., Detroit, is architect. The same architect is now taking bids for the construction of a new steel and steel alloy laboratory for the company at Dearborn, Mich.

Mississippi

CANTON—John T. Sharp, Jr., has preliminary plans under way for the establishment of a local plant for the manufacture of brick and affiliated burned clay products. Inquiries are being made for machinery and equipment.

Missouri

KANSAS CITY—The Vulcanite Roofing Co., 12th and Crystal Sts., manufacturer of composition roofing products, has construction in progress on a 1-story addition to its local plant, estimated to cost about $25,000. The company is a subsidiary of the Beaverboard Companies, Inc., Buffalo, N. Y.

MILAN—The City Council has plans in progress for the installation of a new filtration plant at the municipal waterworks.

New Hampshire

PLAISTOW—The Merrimac Clay Products Co., Inc., Room 609, 185 Devonshire St., Boston, Mass., will soon break ground for the erection of a new plant at Plaistow, for the manufacture of a line of burned clay products, to comprise a main 1- and 2-story works, 200x600 ft., estimated to cost about $250,000, including machinery. Morse & Chase, 25 Washington Sq., Haverhill, Mass., are architects.

New Jersey

EAST MILLSTONE—Fire, Oct. 2, destroyed a portion of the fertilizer mill of Fred Bascom, with other property in the immediate vicinity, resulting in a total loss of about $50,000. It is planned to rebuild.

JERSEY CITY—The Ault & Wiborg Co., 12th St., manufacturer of printing inks, etc., will make extensions in its tankage department at 307 13th St., estimated to cost about $12,000.

New York

PEEKSKILL — The Fleischmann Co., 701 Washington St,. New York, is taking bids for the rebuilding of the portion of its local yeast-manufacturing plant, recently destroyed by fire.

LONG ISLAND CITY—The Abbey Effervescent Salt Co., Inc., 1382 Broadway, New York, has leased a floor in the new building on Rawson St., near Queens Boulevard, Long Island City, for the establishment of a branch plant for the manufacture of effervescent salts and kindred specialties.

Ohio

AKRON—The Rote Leather Co., recently organized under Delaware laws with a capital of $1,000,000, has acquired the plant of the Doyle Rubber Co., near the city limits, erected about 2 years ago but never occupied. The new owner will commence immediately the installation of machinery for the manufacture of imitation leather products for automobile tops and other service, and purposes to have the works ready for operation by the first of the year. B. W. Rote is president, and J. W. Hildebrand, secretary.

LIMA—The Buckeye Casting Co., specializing in the production of gray iron castings, has construction in progress on a 1-story foundry addition, consisting of two adjoining structures, each 40x40 ft., estimated to cost about $75,000, including equipment. John Sonnerbaum is president.

NORTH AKRON—The International Lead Co., a subsidiary of the Anaconda Copper Co., 25 Broadway, New York, has completed foundations for its proposed new local plant for the manufacture of zinc oxide and affiliated products, and will commence superstructure work at once. The entire plant, with machinery, is estimated to cost in excess of $750,000.

Pennsylvania

TRAINER—The Sinclair Consolidated Oil Corp., 45 Nassau St., New York, will break ground at once for the erection of a new oil-refining plant at Trainer, near Chester, on a 300-acre site recently purchased. The initial plant will consist of a number of buildings, equipped to give employment to close to 700 operatives, with storage department to consist of 15 steel tanks, each of 55,000-gal. capacity. It will cost about $2,000,000, with machinery. At a later date it is proposed to extend the plant to practically twice the size, with aggregate investment to approximate $5,000,000.

PHILADELPHIA—The General Paper Products Co., 10th and Diamond Sts., is taking bids for the erection of a 2-story plant addition, 30x68 ft., to be located at 3430 Lancaster Ave. James C. S. Fernald, 5533 Wyalusing Ave., is architect.

PHILADELPHIA—The M. L. Shoemaker Fertilizer Co., Venango St. and the Delaware River, has completed plans and will commence the immediate rebuilding of the portion of its plant, recently destroyed by fire, estimated to cost about $100,000.

WHITE HAVEN—The Peerless Powder Co. is completing the erection of a new local plant, comprising a number of buildings, and purposes to commence operations at an early date. Employment will be given to about 100 persons.

PHILADELPHIA—The Franklin Sugar Refining Co. 125 South Orianna St., has acquired the group of buildings at Delaware Ave. and Reed St., heretofore held by the Spreckels Sugar Refining Co., for a consideration said to be $2,500,000. The plant will be used by the new owner for general production, providing necessary enlargements.

JEANETTE—The American Window Glass Co., Farmers' Bank Bldg., Pittsburgh, has awarded contract to the Heyl & Patterson Co., 51 Water St., Pittsburgh, for the construction of its proposed plant addition at Jeanette. The work will consist of a new 12-machine building and subsidiary departments, estimated to cost approximately $1,500,000. William L. Monro is president and general manager.

NEW CASTLE—The Grasselli Powder Co., Guardian Bldg., Cleveland, O., has commenced the construction of an addition to its dynamite-manufacturing plant at Covert Station, near New Castle, designed to double approximately the present capacity. The new extension will be equipped to give employment to about 100 operatives.

CASTLE SHANNON—The Pittsburgh Art Stone Co., 807 Jones Law Bldg., manufacturer of composition stone products, is taking bids for the construction of a new 1-story plant on local site, estimated to cost close to $30,000. D. C. Tabor is president.

South Carolina

GEORGETOWN—The former alcohol plant of the du Pont Powder Co., Wilmington, Del., was destroyed by fire, Sept. 26; an official estimate of loss has not been made. The plant has not been in operation for a number of months past, and it is not expected to rebuild.

Tennessee

CHATTANOOGA—The Abrasive Co., 30 Church St., New York, manufacturer of grinding wheels and other abrasive products, is reported to be planning for the construction of a new ore-reduction plant in the vicinity of Chattancoga. Raw material will be furnished from the company's mines at Adairsville, Ga. Henry M. Payne is consulting engineer.

Texas

EL PASO—The Tex-McCracken Concrete Pipe Co., 304 Trust Bldg., has plans under way for the construction of a new plant for the manufacture of concrete pipe and kindred products, on site selected on Stevens Ave., near Frutas St. It will consist of a number of buildings, and is estimated to cost approximately $75,000. H. E. Johnson is general manager.

HOUSTON—The Texas Tinners' Supply Co. is making inquiries for a quantity of machinery for the manufacture of seamless rubber products.

AMARILLO—F. J. Storm, Amarillo, and associates, are organizing a new company to construct and operate a gasoline extraction plant in the Amarillo gas field. A site has been selected and work will be begun immediately.

Virginia

GOSHEN—The Speer Sand Co. has plans under way for the construction of a new local plant for the manufacture of hollow cement blocks and other composition cement products. A list of equipment has been arranged. It is proposed to commence work at an early date.

Washington

TUMWATER—The West Coast Pulp & Paper Co., Salem, Wash., has acquired local buildings, heretofore occupied by the Phex Co., and will remodel the structure for the establishment of a new paper mill. Work will be commenced at an early date. C. M. Miall is president.

CONCRETE—The Superior Portland Cement Co. has awarded a contract to the Rounds-Clist Co., Walker Bldg., Seattle, for the construction of a 1-story plant addition, 125x250 ft., estimated to cost about $100,000.

West Virginia

WEIRTON—The Weirton Steel Co. has awarded a contract to the McClintic-Marshall Co., Oliver Bldg., Pittsburgh, Pa., for the construction of a new plant addition, estimated to cost approximately $1,500,000, with equipment. The work will consist of 12 new mills, for the manufacture of black and galvanized sheets; all equipment will be electrically operated. It is expected to have the plant ready for service early in May, 1923. D. M. Weir is vice-president.

Wisconsin

PORTAGE—The Ford Motor Co., Highland Park, Mich., is reported to be planning for the construction of a new zinc oxide plant in the vicinity of Portage, estimated to cost in excess of $500,000. The work will include a hydro-electric power plant to be located on the Wisconsin River. Preliminary surveys are in progress.

NEENAH—The Valley Paper Mills Inc., has awarded a contract to the Appleton Construction Co., Appleton, Wis., for foundation work for its proposed 1- and 2-story paper mill, 80x550 ft., on local site. Blair Springs district, estimated to cost about $100,000. Contract for superstructure will soon be let. G. W. Burnside is secretary and manager.

New Companies

THE DUCHARME CHEMICAL CO., INC., Bridgeport, Conn., has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are Charles D. Boyd, John J. Hennessy and John G. Flood, 1400 Stratford Ave., Bridgeport.

THE ACKERMAN RUBBER CO., Paterson, N. J., has been incorporated with a capital of $250,000, to manufacture rubber products. The incorporators are L. M. and Wallace W. Seed, and Frank P. Ackerman, 39 Paterson St., Paterson.

THE NORTHWESTERN POTTERY CO., 5220 Norwood Park, Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture earthenware products of various kinds. The incorporators are Richard C. Mazer, Edward C. Blanko and Albert W. Bookman.

THE ALBANY SOAP CORP., Albany, N. Y., has been incorporated with a capital of $90,000, to take over and merge the Three Points Products Corp. and the Christian Brothers Soap Co., both of Albany. The new company will manufacture soaps, washing powders, etc. The incorporators are J. H. Rea, J. Grober and J. Nicklas, all of Albany. The company is represented by Tobin, Wiswall & Walton, attorneys, Albany.

THE BENTON CHEMICAL CO., INC., 113 Water St., Baltimore, Md., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are Gordon Eaton, Eugene Frederick and Henry C. Meusel.

THE ROANOKE GLASS CO., Roanoke, Va., has been incorporated with a capital of $100,000, to manufacture glass products. R. H. Angell is president, and C. R. Williams, secretary, both of Roanoke.

THE M. D. OIL CORP., Rochester, N. Y., care of Albright & Mepham, E. and B. Bldg., Rochester, representatives, has been incorporated with a capital of $150,000, to manufacture oil products. The incorporators are B. and F. Seaman, and C. Clark.

THE WATKINS CHEMICAL CO., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated with a capital of $200,000, under state laws, to manufacture chemicals and chemical byproducts.

THE BLACKFORD WINDOW GLASS CO., Vincennes, Ind., has been incorporated with a capital of $1,000,000, to take over and consolidate the Blackford Window Glass Co. and the Indiana Window Glass Co., both of Vincennes. The new organization will continue in the manufacture of sheet glass.

THE ARUNDEL SHOPE BRICK CO., Pier 2, Pratt St., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture concrete and cement bricks, blocks, etc. The incorporators are Lawson L. Wagner, Richard A. Froehlinger and Walter C. Mylander.

THE HITS-IT MFG. CO., Camden, N. J., care of the New Jersey Corporation Guarantee & Trust Co., 419 Market St., Camden, representative, has been incorporated with a capital of $125,000, to manufacture insecticides, chemical specialties, etc.

THE LONGLEY CHEMICAL CO., 6747 Chappel Ave., Chicago, Ill., has been incorporated with a capital of 201 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are John Longley, James A. Sell and Benjamin Kaufmann.

THE DENNY-MEXIA OIL CO., New York, N. Y., care of the United States Corporation

Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws, with capital of $5,000,000, to manufacture petroleum products.

THE CONCORD LIME CO., Concord, Tenn., has been incorporated with a capital of $10,000, to manufacture lime and affiliated products. The incorporators are H. G. and M. L. Winfrey, and O. L. White, all of Concord.

THE FALK CO., INC., Pittsburgh, Pa., care of Sachs & Caplan, 328 Frick Bldg., Pittsburgh, representatives, is being organized by Arthur C. Trask, Victor J. Poll and Louis J. Reizenstein, to manufacture oils, greases, tanning materials, etc. Application for a state charter will be made on Oct. 30.

THE CLIMAX OIL CO., care of the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa., representative, has been incorporated under Delaware laws with capital of $1,500,000, to manufacture petroleum products.

THE COMMERCIAL TIRE CORP., Fort Wayne, Ind., has been incorporated with a capital of $75,000, to manufacture automobile tires and rubber accessories. The incorporators are Harold H. Bieber, C. Platt Squires and Morton M. Hathaway, all of Fort Wayne.

THE JOHN G. BEEKLER CO., 659 Hobbie St., Chicago, Ill., has been organized under state laws to operate a chemical research laboratory, manufacture chemical specialties, etc. The company is headed by Charles O. and Ralph Sethness.

THE PAN-AMERICAN PRODUCTS CORP., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws, with capital of $2,500,000, to operate a tannery and manufacture leather goods.

THE FLORIDA DEHYDRATION CO., Jacksonville, Fla., has been incorporated with a capital of $75,000, to construct and operate a local dehydration pant. Hugh S. Grainger is president; and M. H. Weaver, secretary, both of Jacksonvile.

THE BOYD OIL CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $2,000,000, to manufacture petroleum products.

THE SENECA FOUNDRY CO., Waterloo, N. Y., care of W. S. O'Brien, Geneva, N. Y., representative, has been incorporated with a capital of $25,000, to manufacture iron, steel and other metal castings. The incorporators are J. and J. F. Madia, and C. Cannull, Waterloo.

LOUIS F. GUERRE & CO., INC., New Orleans, La., has been organized under state laws to manufacture waterproof roofing cements, paints, etc. The incorporators are Louis Guerre and Fitch H. Kelly, both of New Orleans.

THE PERFECT PRODUCTS CO., of Huntsville, Ala., has been incorporated with a capital stock of $100,000, to manufacture oxalic acid. The incorporators are T. W. Pratt (president the West Huntsville Cotton Mills Co.), Dr. C. A. Grote, W. S. Dillworth, Kenneth Martin and H. D. Rankin. The main office and plants are located at 415 Meridian St., Huntsville, Ala.

H. B. BERCOW & CO., 15 Park Row, New York City, has been incorporated with a capital of $20,000, to trade in chemicals and allied products. The incorporators are H. B. Bercow, R. Josephi and A. Arendt. The attorney is B. F. Kraft, 59 Wall St., New York City.

THE URADINA CHEMICAL CORP., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture chemicals and chemical byproducts.

THE SEABOARD FOUNDERS, INC., Brooklyn, N. Y., care of Fowler & Lesser, 126 Liberty St., New York, representatives, has been incorporated with a capital of $110,000, to manufacture iron, steel and other metal castings. The incorporators are R. J. West, J. C. Garrett and H. W. Eldred.

THE PACIFIC BRICK & TILE CO., 4600 Alhambra Ave., Los Angeles, Calif., has filed notice of organization to manufacture brick, tile and kindred burned clay products. The company is headed by Carl B. Gallasch.

THE CONSUMERS' OIL CORP., Union Hill, N. J., has been incorporated with a capital of $100,000, to manufacture oil products. The incorporators are Charles Killcast, George and Herman Koch, 575 Jefferson Place, Union Hill. The last noted represents the company.

THE ERCUTO CORP., Rochester, N. Y., has been incorporated with a capital of $50,000, to manufacture chemicals, dyestuffs and affiliated products. George B. Tucker, 110 Harvard St., Rochester, is the principal incorporator.

THE WEBB-DIMMITT OIL CORP., San Antonio, Tex., has been incorporated with a capital of $150,000, to manufacture petroleum products. The incorporators are M. L. Cummings, P. W. Carbusier and J. J. Laas, all of San Antonio.

Capital Increases, etc.

THE PENNSYLVANIA INDEPENDENT OIL CO., Allentown, Pa., has filed notice of increase in capital from $200,000 to $1,000,000.

Frederick M. Woolley has been appointed receiver for the AMERICAN DYE INTERMEDIATES CO., Newark, N. J.

THE AMERICAN SPONGE & CHAMOIS CO., 47 Ann St., New York, N. Y., has filed notice of increase in capital from $150,000 to $500,000, for proposed expansion.

THE CONTINENTAL MINES, LTD., Toronto, Ont., operating gold and silver properties and plants, is disposing of a stock issue of $1,250,000, a portion of the proceeds to be used for expansion, etc. R. C. Warriner is president.

THE PRESTON CHEMICAL CO., 180 4th Ave., Brooklyn, N. Y., has arranged for an increase in capital from $30,000 to $50,000.

THE BRIER HILL STEEL CO., Youngstown, O., is disposing of a bond issue of $10,000,000, a portion of the proceeds to be used for plant extensions. James B. Kennedy is chairman of the board.

A petition in bankruptcy has been filed against the STANDARD MINING & CHEMICAL WORKS, INC., Newark, N. J. The liabilities and assets are not stated.

New Publications

MELLON INSTITUTE OF INDUSTRIAL RESEARCH has issued Bull. 1, Bibliographic Series, which gives a list of the books, bulletins, journal contributions and patents by members of Mellon Institute of Industrial Research, 1911-1922.

PETROLEUM POSSIBILITIES OF CERTAIN ANTICLINES IN SOUTHEASTERN IDAHO. By Virgil R. D. Kirkham. Bull. 4, Bureau of Mines and Geology, State of Idaho, Moscow, Idaho.

WOOD-PRESERVING TERMS. By Ernest F. Hartman and E. F. Paddock. Published by the Protexol Corp., New York. Price $1.

ELECTRICAL HEATING REFERENCE DATA. Published by the Electrical Alloy Co., Morristown, N. J. This copyrighted publication embodies the experience and suggestions of an expert on electrical heating.

WATER-GLASS (A Bibliography). Compiled by Morris Schrero. Published by the Carnegie Library of Pittsburgh, Pittsburgh, Pa. Price 15c.

THE EFFECT OF IMPURITIES ON THE OXIDATION AND SWELLING OF ZINC ALUMINUM ALLOYS. A research bulletin, issued by the New Jersey Zinc Co.

TRADE STANDARDS IN THE PUMP INDUSTRY, recommended by the Hydraulic Society, 1922, and prepared by C. H. Rohrbach, secretary, 50 Church St., New York City.

IMPERIAL MINERAL RESOURCES BUREAU PUBLICATIONS: Vanadium (1913-1919), price 6d.; Quicksilver (1913-1919), price 1s.; Iron Ore (summary of information as to the present and prospective iron-ore supplies of the world), price 6s.

NEW BUREAU OF MINES PUBLICATIONS: Bull. 192 Carbon Black—Its Manufacture, Properties and Uses, by R. O. Neal and G. St. J. Perrott; Bull. 199, Experimental Production of Alloy Steels, by H. W. Gillett and F. L. Mack; Tech. Paper 188, Corrosion Under Oil Films, With Special Reference to the Cause and Prevention of the After-Corrosion of Firearms, by Wilbert J. Huff; Tech. Paper 276, Safe Mechanical Equipment for Use in Shaft Sinking, by R. H. Kudlich; Tech. Paper 277, Application of the Geophone to Mining Operations, by Alan Leighton; Tech. Paper 285, Compressed-Air Illness and Its Engineering Importance, With a Report of Cases at the East River Tunnels, by Edward Levy; Tech. Paper 290, Inclusions in Aluminum-Alloy Sand Castings, by R. J. Anderson; Tech. Paper 292, Tests of Gas Masks and Respirators for Protection for Locomotive Smoke in Railroad Tunnels, With Analyses of Tunnel Atmospheres, by A. C. Fieldner, S. H. Katz and S. P. Kinney; Tech. Paper 302, Coal-Mine Fatalities in the United States, 1921, by William W. Adams; Tech. Paper 307, Permissible Explosives, Mining Equipment and Apparatus Approved Prior to March 15. 1922, by S. P. Howell, L. C. Ilsley, D. J. Parker and A. C. Fieldner; Tech. Paper 311, Factors in the Spontaneous Combustion of Coal, by O. P. Hood.

NEW BUREAU OF STANDARDS PUBLICATIONS (U. S. Government specifications): Circ. 82, For Linseed Oil, Raw, Refined and Boiled; Circ. 84, For Basic Carbonate White Lead, Dry and Paste; Circ. 85, for Basic Sulphate White Lead, Dry and Paste; Circ. 87, for Zinc Oxide, Dry and Paste; Circ. 88, for Leaded Zinc Oxide, Dry and Paste; Circ. 89, for White Paint and Tinted Paints Made on a White Base, Semi-Paste and Ready Mixed; Circ. 93, for Iron-Oxide and Iron-Hydroxide Paints; Circ. 103, for Water-Resisting Spar Varnish; Circ. 123, for White Floating Soap; Circ. 124, for Liquid Soap; Circ. 125, for Soap Powder; Circ. 126, for Salt Water Soap; Circ. 127, for Automobile Soap; Circ. 128, for Chip Soap; Circ. 129, for Ordinary Laundry Soap; Circ. 130, for Grit Cake Soap; Circ. 131, for Scouring Compounds (*a*) and (*b*), for Floors and Soap-Scouring Compounds (*c*); Circ. 132, for Hand Grit Soap.

OTHER BUREAU OF STANDARDS PUBLICATIONS: Sci. Paper 440, The Spectral Transmissive Properties of Dyes: Seven Permitted Food Dyes in the Visible, Ultra-Violet and Near Infra-Red, by K. S. Gibson, H. J. McNicholas, E. P. T. Tyndall and M. K. Frehafer of the Bureau of Standards, with the co-operation of W. E. Mathewson of the Bureau of Chemistry, price 15c.; Sci. Paper 443, Measurement of the Color Temperature of the More Efficient Artificial Light Sources by the Method of Rotary Dispersion, by Irwin G. Priest, price 5c.; Tech. Paper 211, Radiators for Aircraft Engines, by S. R. Parsons and D. R. Harper, price 50c.; Tech. Paper 212, Carbon Monoxide in the Products of Combustion From Natural Gas Burners, by I. V. Brumbaugh and G. W. Jones, price 10c.; Tech. Paper 214, Durability of Cement Drain Tile and Concrete in Alkali Soils (Third Progress Report, 1919-1920), by G. M. Williams, price 10c.

Coming Meetings and Events

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

TANNERS' COUNCIL will hold its annual meeting Oct. 19 and 20 at the Congress Hotel, Chicago.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, 52 East 41st St., New York City: Oct. 20—Society of Chemical Industry, Grasseli Medal. Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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German Reparations And the Chemical Industry

SOME years ago there was a question which agitated the American people: "How old is Ann?" The answers varied from $-\sqrt{3}$ to 1,087. New problems have come, but none with the same popular appeal. One question has, however, interested serious thinkers in recent months: "How much can Germany pay?" The answers vary more even than those to the earlier question. Individuals get so involved that they lose their perspective.

Therefore the speech of Sir REGINALD MCKENNA before the American Bankers' Association shone like a beacon light among the murky thoughts on this subject. The trouble with previous investigations, said the distinguished visitor, is that they have studied rather the question, "What wealth can Germany produce?" than "What amount can Germany pay as foreign debt?"

The ability to pay a foreign debt depends on two things: first, the extent of foreign investments and, second, the surplus of exports over imports. At the present time Germany has no export surplus. This is due to many circumstances, partly to the limiting of foreign markets on account of prejudice, tariff and embargo; partly to the loss of the productive areas, Silesia, Alsace-Lorraine, and the Sarre, which means inevitably more importing than formerly. But an export surplus is not now available for reparations.

Foreign investments Germany has, or rather the people of Germany have them individually. They have resulted largely from the sale of goods and of German marks in foreign countries. These investments could be sold to the German Government, which then could turn them over for reparations. Roughly a billion dollars could be realized. But is Barkis willin'? Would a German sell a foreign investment for German marks even with the mark more valuable in Germany than out of it? Sir REGINALD MCKENNA believes that he would. He believes also that if the demand for reparations should cease for three years after the foreign investments had been turned in, the mark would appreciate and that thereafter a definite annual payment could be made.

This is an economic message from a wise business man. There is no question that Germany should pay to the limit. The question is how can we get the most out of her. Sir REGINALD looks at economic facts dispassionately and therefore his message is timely. He dismisses the accusation that the German Government has not acted with firmness and good faith in taxing the people sufficiently, by saying that increased taxation does not increase foreign trade. Payment of reparations is possible only with increased foreign trade and an export surplus.

This has a significant message for all of us. No economic unit can be destroyed from this civilization without serious menace to every other unit. The whole structure is organically one, and a defection on the part of one injures all. This civilization is precisely analogous to the human body. The next fact to face is that Germany must be brought back to health not because of deserts or of misplaced humanity, but because if she dies we suffer severely and perhaps die too. A few years more of paralyzed Germany would be fatal and the only beneficiaries would be the speculators—the wolves of business.

So if we are to bring Germany back to health we must prepare for competition. More specifically, the American chemical industry should and must prepare for competition. A healthy Germany means an active chemical industry. There are happy examples of American firms which have competed with Germany under the most unfavorable conditions. It can be done. Is there enough of the pioneer left in the rest of us to do it?

The War Department Survey

AN OFFICIAL COMMUNICATION from the Medical Department of the Army announces that as a part of a comprehensive study under the direction of the Assistant Secretary of War an investigation will be made of sources of supplies needed in that department. Not only is the Medical Department concerned with the provision of the personnel necessary for the treatment of sick and wounded, but it is also charged with the supply of the necessary materials. Therefore it will be necessary, first, to undertake a careful determination not only of the items needed but of the quantity. Second, a roster must be compiled of the personnel skilled in the manufacture, inspection or purchasing of the various commodities and third, a study must be inaugurated of the facilities of the country to produce the essential and important items of supplies.

It is an effort to do beforehand what was attempted after the declaration of war in 1917. The plan is excellent, progressive, businesslike. It will have vital interest whether any national emergency arises or not. A survey of this kind gives a vast amount of valuable data which should be available not only to the War Department but to industry in general.

Take, for example, a simple list of the commodities needed in modern surgery and medicine, together with an estimate of the quantities which would be consumed in an emergency. Such a list would be very illuminating to the chemical industry of the country and would make available better and more extensive supplies of hundreds of articles. How many plants there are anxious to extend their field of manufacture, yet unable to determine certainly what products can be desirably

produced, and for what products there would be a consistent demand?

Other phases of the survey will doubtless be retained in the secret files of the War Department, and quite rightly so. A committee of the American Chemical Society would be appropriate to discover what chemists and chemical engineers in the country have had experience in the manufacture of the drugs and chemical products required for army medical work. Such a committee would be well equipped to weed out the ambitious youngster who had his eyes on high rank in case of national emergency and had overrated his ability and experience. The American Chemical Society is the appropriate medium through which action should be taken as far as the trained personnel for the production, purchase and control or inspection of these commodities is concerned.

The co-operation of the chemical industry, individually and collectivaly, will undoubtedly be assured the War Department in its far-sighted work. Our congratulations are extended to those responsible for its institution.

The Measure of Efficiency And the Creative Impulse

IN OUR Exposition number, issued August 30, appeared an article by WALTER POLAKOV, entitled "Measuring Administrative Efficiency." The author described the use of the now justly famous Gantt chart as an administrative aid. With a properly designed chart, the executive can follow the efficiency of man, machine or organization. In every chart the ideal or normal performance of the man or machine or organization is indicated by a line, and exactly parallel to it is the actual performance of the individual or unit. Thus, the man or the operator has before him the perfect performance and is striving constantly through interested effort to find what means can be adopted to lengthen the line of his own performance. So the chart can mean much more than a mere historical record of accomplishment; it conveys a definite message of inspiration. It appeals to and awakens the creative impulse in the operator. In satisfying that impulse it accomplishes the impossible, especially when the work is routine, for routine kills the creative impulse. Is it possible that here is a medium which would act as the leaven of modern industry, re-inoculating its mechanism with some of the old artisan spirit, which places achievement above returns and the task well done as the ideal of accomplishment? Perhaps!

But there are two great stumbling blocks that must be recognized and removed. The first is in the application of the principle itself. Unless such charts are installed by experts who are more than experts, men who are genuine humanizers with a keen insight into human psychology and human aspirations, the work will fall short. They must be very deft in their charting, for there is nothing more sterile than an idea of this kind which has missed fire. Charts which do not stimulate but draw only ridicule would be worse than none. Success on the part of real experts would lure imitators, and inevitably a wild yeast of dissatisfaction and distrust would spring up.

The second and even greater stumbling block in the way of such achievement is the cupidity of manufacturers. Such a system can be "sold" to an executive or to a board of directors on a basis of increased efficiency and decreased cost, but they would be inclined to ridicule the ideals which Mr. POLAKOV'S article suggests. They would think it got them nothing. That they are wrong would not alter the inevitable result, for without the sympathy and enthusiasm of the management the charts could only be efficiency charts. Even as such they are remarkable, but if the other were possible perhaps it would be the millennium.

A Chemical Ghost Story Without the Ghosts

IF, INSTEAD of Prof. HENRY E. ARMSTRONG, Sir OLIVER LODGE had written the original letter, we should have had a whole company of the ghosts of dead-and-gone chemists broadcasting over the Atlantic Ocean by this time. As it is, the best we can do is to give our readers the story, and let them supply the spirits.

It begins with a letter from Professor ARMSTRONG in which he asks about Dr. HENRY S. CARHART, who, in an address given in 1905 before the Electrochemical Society, mentioned two Dutchmen, VAN TREESTWIJK and DEIMAN, who did some work in 1789. He is writing on the general subject which includes this work, and he wants to get his early history straight.

The name CARHART sounded familiar to us, but we couldn't place it at the moment. The last issues of "American Men of Science" and "Who's Who in America" failed to enlighten us. But the previous issue of "American Men of Science" stated that Dr. CARHART was born in 1844, and was professor of physics at Ann Arbor. That was our cue, and straightway we repaired to the Chemists' Club in the hope of finding an Ann Arbor man. The first person we met was Professor WHITE of that university, who had arrived from Washington a few hours before and was leaving for Michigan within the succeeding two hours. Professor CARHART had died in California long ago, he said, but in reply to our question as to who might be informed about his work and his more particular interests and habits of research, he thought Professor HULETT of Princeton might know more than anybody else. They had worked together in Ann Arbor and were close friends. This was our second cue.

The next step would naturally be to write to Professor HULETT. But we had not the favor of his personal acquaintance, whereas we felt ourselves on terms of such friendship with his associate, Professor HUGH S. TAYLOR, as to seek a favor. So we ventured to ask him to ask Professor HULETT, if he would, to recall, if he could, the work of Professor CARHART and his reference to the two Dutchmen of 1789; and then to tell us about it.

Two days later the following letter was received from Professor TAYLOR:

> You are the fortunate victim of a curious coincidence. As I was reading your letter Dr. HULETT was preparing a lecture on electrochemistry, and was at that precise moment reading Section 328 of Volume I of Faraday's "Experimental Researches in Electricity." He was there reading of an article by Dr. PEARSON in the year 1797 published in *Nicholson's Journal*, Volume I, pp. 241, 299 and 349. This article, given by Faraday, deals with an experiment which had been previously carried out in a somewhat different manner by the two Dutchmen in the year 1789. Had it not been for this fortunate coincidence I am quite sure that neither Dr. HULETT nor myself would have been able to help you.

There's the story; now bring along your ghosts! Unfortunately they will not perform for us, and Professor ARMSTRONG is about the last one we could imagine as sitting in a circle in the dark, singing hymns, holding hands and listening while little Eva the Indian

Maiden inspires the medium to say that she is happy, very happy. And yet, observe these leadings: the timing of the visit to the Chemists' Club, the presence of Professor WHITE, the writing to Professor TAYLOR instead of to Professor HULETT, who was interested in another problem and would not have remembered if the letter had reached him at any other time except when he had open before him Section 328 of Volume I of Faraday's "Researches." Here we have everything to make up a ghost story except the ghosts.

Salt Baths For Heat-Treating

EVERYONE knows the difficulty of heating a piece of steel to a red heat without a certain amount of oxidation—scaling or coloring—on the surface, be the heating and quenching ever so brisk. The same damage follows annealing operations, the longer time required offsetting the reduced activity of lower temperature. Such difficulties become very real indeed when one heats high-speed tools of very intricate design to just under their melting point, or fine wire (which is nearly all surface) to quite moderate temperatures. Again, delicate and expensive engraving on dies requires that such pieces be hardened without the least scaling or decarbonization.

For such work the strictest control of furnace atmospheres is required. Heating in a forge fire is of course out of the question; the best muffle furnace is none too good. Many good heat-treaters argue that the gas-fired furnace is better than those electrically heated because a "neutral" atmosphere can be more readily obtained when a violet flame is permitted to blow out the door and the gas and air are regulated for a "hazy heat." But "atmospheres" are something we don't know a great deal about, and they are very likely to play tricks on the operator—like the one who packed some tools in charcoal and annealed them just below the transformation range for several hours, only to find the surface decarbonized!

For all these reasons, metallurgists have used liquid baths of various sorts for their heating operations. Oils are suitable for low temperatures, white metals for intermediate, and lead or salts for rather higher ones. Their function is to heat the metal uniformly at a rapid rate and entirely out of contact with air. Naturally they must not react with the metal—either corroding, pitting or decarbonizing it, discoloring the surface or sticking to it so that they cannot be easily rubbed or washed off. If the bath is of salts, they must be of a nature that traces of salt escaping the washing operation will not accelerate corrosion or cause other damage. The bath evidently must have a melting point 150 deg. or so below its working temperature; it should not throw off poisonous or corrosive fumes if superheated—for that matter, copious fumes of any sort are objectionable and involve rapid wastage. It must be stable, both hot and cold, and not attack its containers. Finally, it should leave only a thin protective film on the hot steel being transferred to the quenching bath.

Such an array of requirements is so long that one would almost despair of finding a molten bath which will fill them all—especially if it is to operate over a wide range of temperature. Nevertheless the problem has been attacked, and at present several mixtures sold under trade names are available. No one of them will do everything, but it is believed that an intelligent selection will provide a set of three or four baths which will cover the range 500 to 2,100 deg. F. in a satisfactory manner. In view of the many requirements of a good salt bath, it will doubtless be easier and cheaper for the user of small quantities to standardize on some satisfactory brand, rather than make his own.

R. B. SCHENCK and SAM TOUR have recently read interesting papers before the steel treaters, respectively discussing the art of heat-treating in lead and recounting some experiments with salt baths. Several eutectic mixtures of salts having low melting points are noted in the literature, and a number of them were tried by Mr. TOUR. In general, it was found that carbonates will either decarbonize tool steels or coat them with an immovable black layer, while sulphates (often in very small percentages) corrode metals rapidly. Nitrates oxidize the steel if operated above 800 deg. F. Satisfactory tempering baths working below this figure may be made of sodium and potassium nitrates (molecular ratio 1 to 1) or a similar mixture of sodium nitrate and nitrite. Charcoal and cyanides must be kept away from these nitrate baths, on account of the explosion hazard.

Mixtures of chlorides are ordinarily used for hardening baths. A eutectic mixture of calcium and sodium chlorides (72.5 per cent $CaCl_2$ by weight) melting at about 950 deg. F. is sold under different names. Such a mixture made of commercial salts must be heated to 1,600 or 1,700 deg. F. several times, else it will pit the steel. Furthermore, this pitting action persists if the salt is contained in a graphite pot! However, calcium chloride should be avoided because it is hygroscopic and a rust promotor—any fume which condenses in the building becomes sirupy and rapidly corrodes iron fixtures. Heat-treated articles must consequently be carefully scrubbed in hot sal soda and rinsed in water, to remove the last traces of the salt.

The Ford Motor Co. makes extensive use of salt baths operating at about 1,550 deg. F. for heat-treating gears. As originally made up it consists of 50 per cent sodium carbonate, 37½ per cent sodium cyanide and 12½ per cent sodium chloride. Apparently the oxidizing power of the carbonate and the carburizing tendencies of the cyanide counterbalance each other. Cyanide appears to decompose, by an obscure reaction, when its temperature reaches about 1,500 deg. F.; a bath which previously was quiet then acquires a vigorous, continuous circulation. This is of the greatest value in keeping the temperature uniform throughout the bath, even though it costs a handful of fresh salt at intervals.

Barium chloride has not the pronounced disadvantage of being so volatile, hygroscopic and a rust promoter, but it possesses a melting point (about 1,700 deg. F.) too high for any quenching baths except high-speed steel. Sodium chloride also appears to be quite harmless, when free from magnesium sulphate. A eutectic mixture of NaCl and $BaCl_2$ (containing 22 per cent of the former by weight and melting at 1,175 deg. F.) is probably the best home-made, high-temperature bath. Sodium chloride fumes badly at high temperatures; pure barium chloride may then be used.

As mentioned above, we now have some salt mixtures which will operate over limited ranges of temperature, and will be found to do excellent work in continuous operation. What is yet to be found is a mixture which will work satisfactorily on batches—that is, receive the work at a temperature below that which causes appreciable scale in the open air, say 1,000 deg. F., and be heated gradually to the annealing or quenching temperature. This slow heating is especially necessary on parts where growth, shrinkage and warpage must be eliminated.

Readers' Views and Comments

Technology of the Carbon-Electrode Industry

To the Editor of Chemical & Metallurgical Engineering

SIR:—In one of a very interesting series of articles regarding "The Technology of the Carbon-Electrode Industry," Charles L. Mantell in your issue of Aug. 23 makes a statement regarding the future developments of this industry. He draws attention to the fact that the National Carbon Co. is manufacturing 24-in. electrodes 180 in. long, which he believes to be the largest ever made.

In an article printed in your journal of June this year the writer was able to show that Söderberg self-baking electrodes are in operation in Europe in sizes up to 39 in. diameter and about 230 in. long. The weight of these electrodes are three to four times the weight of the mammoth electrodes of the National Carbon Co.

Söderberg's jointless electrodes have been in continuous operation in Norway during more than 3 years, during which time about 420 ft. of one electrode has been consumed in the furnace. These facts give a further look into the future of the carbon-electrode industry than Mr. Mantell has been able to offer. The "black art" is about to lose its secrecy through the possibility of affording every electric furnace man the opportunity of making his own electrode in the very furnace where the same is being used. M. SEM.

Christiania, Norway.

Chemists in Public Life

To the Editor of Chemical & Metallurgical Engineering

SIR:—Having followed with more than passing interest the various articles on "Chemists in Public Life," I think the articles of Mr. Bolling (Sept. 6) and Mr. Cornell (Sept. 27) have digressed widely from the original point in view. I should like to ask of your readers who employ industrial chemists and analysts how much opportunity they give them to participate in any public matters that would take them, even for a day, away from their laboratory.

Having had charge of laboratories in several large industrial corporations, I have found as a general rule that they will employ as a head chemist as low a salaried man as they think can possibly get away with the work and give him as few cheap assistants as possible. In return, they expect him to develop quick, accurate routine methods for control, do research work and improve processes, analyze and pass upon all raw materials and finished products. In other words, a responsibility is placed upon him as great as any in the factory.

Most chemists will conscientiously try to do what is required. In order to do this, they must work out methods after hours, digest a quantity of chemical literature to keep up with the rapid progress of the science, attend society meetings, etc. When do they get the opportunity to interest themselves in public life? Only a few corporations give their chief chemist a place on their executive council. He seldom knows what improvements or changes are contemplated. Then, at a moment's notice, he must select materials and work out new methods. Oftentimes he does not know the exact purpose for which the raw materials are to be used and is given no opportunity to follow through the process. If he insists upon knowing and seeing just how the materials are used, he is often told his place is in the laboratory; they can take care of the manufacture and he is only "butting in" and interfering with production. Still, if the material fails, he is responsible. Just about the time he has routine methods established and has broken in an assistant on whom he can rely, the assistant leaves, because he cannot obtain the salary he has become worth.

Then a Mr. Cornell comes along with a rush analysis involving $1,000 or $10,000 worth of material. The chemist knows that if the material is not up to specifications he will have to buck the laboratory of the manufacturer. He knows he will have to be right and he knows that a correct analysis cannot be made inside of 3 days, and it is wanted in 3 hours. If he rushes through an analysis and is wrong, he loses his position and, what is more, his reputation. A good chemist simply cannot be rushed beyond the degree of accuracy he knows he must attain.

I have found chemists as a rule to be just as human and just as much interested in public affairs as any other class of men. Mr. Bolling may prefer pure science, and the pure scientist has his allotted part in the general advancement of the world, but I do not think his ideas are representative of chemists as a whole.

What Mr. Redman says (Aug. 16) about applications from students for laboratory work is undoubtedly true. But after they are employed in the laboratory, do they have the opportunity to see and know what their work pertains to and become interested in applying their technical knowledge at some point of production or manufacture? Or are they so rushed with routine that their only thought is to catch up with the mass of work ahead and get enough experience to go somewhere else and obtain a better position?

At one time I was in charge of a laboratory for a company which made a practice of starting a man on routine laboratory work, fitting him technically for a plant position, and then giving him an opportunity to make good. Of many, only one man refused to leave the laboratory and only one failed to make good in an executive position in the plant.

It is not the chemist who makes a hermit of himself, but the manufacturer who forces the chemist to become a hermit. Let those who employ chemists give them a business standing with the company in accordance with the value of their work, give them an opportunity to meet, associate and consult with executives and they will soon discover that their most valuable executives have been drawn from the technically educated men who may have started in the laboratory.

Once the chemist feels that he dare leave the laboratory for a few hours without things going wrong, that he can afford to attend a public meeting in place of a chemical one, that he does not have to eat, drink, sleep and think chemistry 24 hours a day in order to keep a

laboratory going that is woefully undermanned and underpaid, he will gladly interest himself in public life and no doubt prove as efficient there as he already has in industrial work.

DELOS N. HICOK,
Research Chemist for the
Federated Engineers Development Corporation.
Jersey City, N. J.

Proteins and the Theory of Colloidal Behavior

To the Editor of Chemical & Metallurgical Engineering

SIR:—Replying to the letter of Dr. John Arthur Wilson in your issue of Sept. 27, I can only ask that those interested read Dr. J. Loeb's book and then read my criticism of it published in your issue of Aug. 23. Some of the questions involved will also be treated more at length in my forthcoming A.C.S. monograph on Glue and Gelatin. Dr. Wilson's statement that I have "failed to grasp Loeb's ideas" is in a way a comment on the book, because throughout my criticism, to avoid possibility of error, I quoted Loeb's own words.

Though I had selected ten points for adverse comment, Dr. Wilson takes up only one, saying that "Loeb's theory is quite independent of this assumption [that gelatin is a definite chemical entity]; it assumes only that a highly ionizable chloride of gelatin is formed when gelatin is brought into contact with an aqueous solution of hydrochloric acid," etc. To the ordinary chemist the statement that gelatin forms gelatin chloride and sodium gelatinate involves the assumption that gelatin is a definite chemical entity—otherwise we might talk of apple pie chloride and sodium tobacconate; and this assumption is with others involved in the Donnan theory of membrane equilibria, the applications of which, by Prof. H. R. Proctor, Dr. J. A. Wilson and their followers, have been supported and praised by Dr. Loeb. To those acquainted with the literature, it seems that gelatin is not a definite chemical entity—see, e.g., Bogue's recent book.

All theories must perpetually run the gantlet, and one adverse fact may bring destruction. The upholders of the theory cannot then take the position of the Irishman who, when confronted by a witness of unquestionable character who saw him steal the pig, said: "Sure, that's nothing. I can bring in twenty men who'll swear they never saw me take it."

Far be it from me to deprecate the excellent work done by Professor Proctor, Dr. Wilson, Dr. Loeb and their co-workers, even though I may take exception to some of their details and conclusions. And much praise is due to the Gallun Co., with which Dr. Wilson is connected, for its generous support of the work of Prof. A. W. Thomas and others at Columbia University. But when Dr. Loeb says (p. 278): "There is only one source of colloidal behavior—namely, the Donnan equilibrium—at least as far as the proteins are concerned," it is time to stop and consider. There comes to mind such a possibility as gelatin having a more or less definite average adsorptive surface which need not be identical with the possible stoichiometric surface.

Dr. Wilson, in speaking of "the flight of imagination of those who have tried to dodge the mathematics of the Donnan equilibrium," falls into the very pit warned against in my criticism: "The great danger in applying mathematics to chemical and physical problems lies in the fact that we may be blinded by the logical perfection of this mere tool and make erroneous assumptions, or else neglect important factors that so often crop up unexpectedly in nature." It is not the algebra and calculus to which exception is taken, but the chemical and physical assumptions which underlie them, and without which they could not function or exist.

JEROME ALEXANDER.
New York City.

EDITOR'S NOTE—We knew there would be trouble a year and a half ago when, at the Chemists' Club celebration, Dr. Loeb brought out his observation that, so far as proteins were concerned, the measure of adsorption may be determined by hydrogen-ion concentration. This seemed to indicate that the so-called phenomena of adsorption are really chemical phenomena rather than a kind of colloidal plastering—at least, so far as proteins are concerned. It is the thesis of his important and very interesting book.

His findings are contrary to the conclusions heretofore current in regard to colloids, and many chemists who have worked long and ardently within the domain of colloid chemistry feel that Dr. Loeb must be wrong. They stand pat on earlier observations and conclusions. Among these we may include Mr. Alexander. Dr. Wilson, among others, thinks Dr. Loeb is right and that he has blazed the trail to great enlightenment in this work. Each expresses his opinion with some gusto. We shall close the discussion in these columns for the present by leaving it open.

Inadequacy of German Press Subsidy

The German press, which has weathered numerous financial and economic difficulties in the past year, has succeeded in obtaining only partial relief through the passage of a subsidy law effective July 21, 1922, says *Commerce Reports* of Oct. 2. The hopes of receiving immediate financial assistance, which it was thought this new relief measure would provide for, have been shattered. It is stated that it will be months before the proposed machinery will be in operation, which, of course, will be too late to prevent many papers from closing down. The press also complains that the funds which are to be raised by this subsidy will be wholly inadequate for their needs. For instance, the German press is to receive 1½ marks per thousand on all export sales of print paper, but this income alone would amount to only 223,570 paper marks for the month of June, 1922, to be distributed among all German newspaper publishers. The application of this export tax at the present time is somewhat vague, as it will also possibly include paper pulp and pulp timber; however, the sum to be realized will be insufficient.

Originally it was proposed by the federal government that the various German states establish an emergency fund (*Notkasse*) whereby a tax of 8 marks per person was to be assessed, raising a fund of approximately 500,000,000 marks for the assistance of the press. This did not meet with the approval of the several states, so the Rueckverguetungskasse für die Deutsche Presse (reimbursement fund for the benefit of the German press) described in the law was established. The German press has also strenuously opposed the exportation of print paper, which is greatly needed at home. They have not, however, succeeded in obtaining a more stringent export prohibition.

As the proposed assistance is not immediately forthcoming and the relief fund will be very small, the German newspapers are compelled to increase subscription and advertising rates in order to meet their increased costs of printing, labor, freight, ink and paper.

European Conditions as I Saw Them

Impressions of Casual Travelers Are Not Always Safe Criteria of True Industrial Conditions — Smokeless Chimneys Do Not Mean Idle Power Plants — Examples of German Industrial Competition and Its Effect on Business in Other Countries

By J. S. Negru

IN A previous article I outlined what I regard as the fundamental cause of the turmoil now prevailing in all European industrial countries and particularly in Germany—namely, that the Germans have lost the economic war which they have been waging for nearly the past 3 years against all the other industrial countries. This is a sweeping statement as to cause and effect, and so different from those made by the Germans themselves, by casual travelers and by omniscient personages here and there, that strong proofs are required before it can be accepted.

No doubt many others would arrive at the same conclusion as I have were they to give due thought to an analysis of the question, What has become of the fruits of Germany's very intensive and steady production during the past 3 years? For the benefit of those who do not feel disposed to undertake such an arduous task, I will endeavor in what follows to point out some of the striking facts that contributed to my conclusion.

Misleading Impression

Impressions of Germany from casual travelers are now regarded as good copy by newspapers and literary magazines. Many of them carry in each issue more or less of this material, and even some technical papers get hold of it and print it in good faith. But the trouble with most of this material is that it represents one or two isolated observations which are not typical of general conditions, although assumed to be such. As an example I may cite the following fact, which, had it come to the notice of the casual traveler, would have given another twist to his impressions.

On March 16, 1922, I went to the office of H., located on the corner of Friedrichstrasse and Leipzigerstrasse, Berlin, which as to traffic can compare somewhat with that of New York City at the corner of Broadway and 42d St. In order to cross Friedrichstrasse I had to pass a temporary wooden crossing, as the street was all torn up, a subway being built, the roof of which was at most 3 ft. from the surface. The first impression I got from this sight was much to the advantage of the municipal government of Berlin, which, I thought, although confronted with the fact that citizens were struggling for the necessities of daily life, was still able to get together large sums for public utilities. The impression was fine.

Corrected Impression

On the 18th of May, two months later, after having visited other German, Belgian and French districts, I was again in Berlin and made another trip to the above-mentioned office. The temporary wooden crossing was still there, the street was torn up as before, and the few workmen that I could see on both sides of the crossing—I counted six—were busying themselves in a way that reminded me of a high-speed movie film slowed down in order to give opportunity to observe every detail. And as for my first impression that Berlin was still keeping up with public improvements and the construction of public utilities—it naturally died. I soon learned that the street had been torn up for a long time prior to March 16, when I first saw it, and that although the actual cost of filling that part of Friedrichstrasse until the city could again get money with which to continue its work would be relatively small, they preferred to impress the casual traveler with the fact that Germany was not neglecting the public utilities. This is a typical example of how badly misled the casual traveler can be when writing about Germany after a single hurried trip across the country.

Wrong Impression

It might not be out of place to cite here a typical example of the comments of some traveling impressionists.

I have before me a pamphlet which is an advance copy of a paper on European Economic Conditions, 1921-1922, by C. J. Warren, of the Remington Typewriter Co., presented May 11, 1922, at the National Foreign Trade Convention at Philadelphia. In this pamphlet, which was released for afternoon papers May 11, Mr. Warren states under the heading "Germany," page 2, that "I made it my business to note the number of chimneys smoking, and to size up in a general way the various industrial districts in that country." He goes on to say how remarkably close to the official figures was his personal guess of the present percentage of German pre-war production, all based on the assumption that smokeless chimneys imply idle plants.

Smokeless Chimneys Do Not Mean Idle Power Plants

I am sure that Mr. Warren could have seen in Germany thousands of chimneys not smoking, but he and those who listened to his address or read it in the press must not forget that smoking chimneys make a very poor showing for good power plants. And we all know well that there are many excellent power plants in Germany. Ringelmann's smoke chart may still find some use in minor power plants located in this country, but few, if any, of the German plants need it now. One must not draw the conclusion that boilers are not steaming merely because stacks are not smoking.

So much for impressions and impressionists.

Plan of Preliminary Trips

By giving a brief outline of my trip I will better enable the reader to follow my work while in Europe.

I arrived in Belgium on Feb. 22, 1922, and on the following day had my first interview with Octave Lepersonne, general secretary of the Association of Engineers Graduated From the University of Liége. Being myself an alumnus of this school, it was logical that I should start where I felt most at home. In the course of many long conversations with Mr. Lepersonne I obtained a preliminary impression of the industrial

This is the second of a series of articles by Mr. Negru on this subject, the first of which appeared in last week's issue.

and economic situation in Belgium. Further interviews with many other Belgian engineers and economists, and with Samuel Cross, acting commercial attaché of the United States at Brussels, served to corroborate or correct the impressions already received. Thus I was enabled to outline a plan for making personal observations and reaching my own conclusions. A similar method was followed in France, Italy, Switzerland and Germany, consuming my time until April 5, when I was back again in Belgium.

Main Reasons for Changing the Plan for Subsequent Trips

According to my original plans made in New York City, immediately after completing the preliminary trip just outlined I was to devote my attention to certain well-defined points, prepare articles on specific subjects while still in Europe, and make only casual trips into Belgian and other industrial districts. But while I was still in America I was quite unaware of the condition in which I would find central Europe, and consequently could not foresee that I was soon to become quite skeptical of the much-heralded European researches, great industrial improvements, and the like. Nor could I foresee that what I was really to gain during this preliminary trip was a group of impressions somewhat hazy and occasionally quite contradictory. The few impressions of which I was absolutely certain at the close of my preliminary tour were so striking, but also so devoid of what might be called legal proof, that they needed further study in the hope of gathering proofs that could be safely accepted as indisputable.

Final Plan Adopted

Accordingly I decided to cover again somewhat the same route, conferring with some of the persons I had already met, in an effort to confirm my personal preliminary impressions. Furthermore, I wanted to get in touch with other individuals with whom, I had discovered in the meantime, it was well for me to talk. This plan was carried out, but only for Belgium, France and Germany. A second trip was not made into Italy and Switzerland. In addition I had also the opportunity to visit plants in Belgium, France and Germany. I also took part in the excursions of the Société de l'Industrie Minérale de France in the French war-devastated districts, visited the Ludwig II potash mines and works at Stassfurt in company with a group of members of the Society of German Metallurgical and Mining Engineers, assisted at some of the meetings of the Verein Deutscher Chemiker and at their exposition Achema III (Ausstellung für Chemisches Apparatewesen) on the occasion of the annual general meeting in Hamburg. Finally, I took quite an active part at Liége in the Congress of Engineers Graduated From the University of Liége, and often visited their exposition during the latter part of June and first part of July. This occupied the remainder of my time in Europe until Aug. 10, the date of my sailing for America on the steamer Lapland.

Substantiating My First Impressions

It was during these latter months that I was able to get additional information which, when correlated with that obtained on my first trip, comprised the sum total of what I learned while in Europe.

As an example of how the subsequent trips enabled me to get more substantial impressions, I may cite the following: When I left Switzerland on March 14 I knew that Swiss industry was suffering much from German competition. Thus on May 30 I wrote in my diary, among other items, one about my meeting with Mr. G., a German jewelry manufacturer who was producing as rapidly as possible wrist watch locks at a cost of 15 marks apiece. These locks were sold at 80 marks apiece to a friend of his in Chaux-de-Fonds, the very center of the Swiss watch industry, whence they were exported to Sweden at 2.5 Swiss francs (over 150 marks) apiece. The explanation given for this circuitous transaction was very simple:

The Chaux-de-Fonds district enjoys a world-wide reputation as a watch-making center, hence a product from this district can find more readily foreign markets. The large amount of 80 marks he got for his 15 marks product is the result of a mutual understanding between old friends. The German manufacturer could not sell direct to Sweden because the latter is the customer of the Swiss watch manufacturer. But by selling through the Swiss dealer the German was not only able to get rid of his wares but also received in return therefor Swiss francs, which are not debased in value like the German marks.

I have no doubt that the German manufacturer regarded this as a perfectly normal and legitimate business transaction, just as he probably felt that the wage of 4.5 marks per hour, then less than 1.5 cents, which he paid to the girls in his shop, was very good for that kind of work. And as for the Swiss maker of wrist watch locks, one can readily imagine how he would fare in his beautiful Switzerland with this kind of German competition.

A Typical Example of the German Economic War Policy

Another case which brings us much nearer home is that contained in a letter from one of our American subscribers who asked me to look into a certain matter while in Europe. I quote as follows from his letter:

"We are vitally interested in knowing why the manufacturers of the equipment required for the production of chemical pulp, principally soda or sulphate, can deliver all of the machinery required for a 30-ton daily capacity pulp mill at Madras, India, for one-fifth of the amount we must receive for American-made equipment of similar design. We feel that the matter of exchange between the countries affected is not alone responsible for this, and we wish you would have your Mr. Negru investigate the true conditions which are responsible; also have him ascertain, if possible, whether contracts taken by German firms are actually filled."

The German economic war policy, outlined in the previous article, explains clearly why the Germans offered machinery for one-fifth of the amount Americans must receive. As to whether contracts taken by German firms are actually filled, that is a question of the individual firm. The impression prevailing in Belgium and in France is that few importers are now putting much faith in the business promises of German industrials and merchants, even when such promises are given in writing.

Other articles giving Mr. Negru's impressions of conditions in Europe will be printed in subsequent issues.

Handling the Finished Products of Industry—VII

What to Observe When Studying an Existing Handling System With a View to Applying the Methods There Used in Another Plant—How These Points Are Illustrated by the Systems Described in This Series—Suggested Procedure in Layout of New Systems*

By Graham L. Montgomery

IT WAS STATED in the first article of this series that the material-handling equipment available today for handling finished products brings results to those who use it which warrant study by those still using manual handling methods. These results justify the statement that the use of automatic equipment for handling finished products is a necessity for those who wish to keep costs low for competitive reasons and still to make a fair profit.

This series covers but a small part of the range of process industries where mechanical handling methods can be used. By no means all of these industries present examples of material handling worthy of study. The examples which are presented serve to demonstrate clearly the important points to be observed in such a study. We shall list these points and show how their observation can be made of service in the consideration of prospective installations of handling systems.

From time to time other articles will appear in *Chemical & Metallurgical Engineering* which will describe good handling methods for finished products and illustrate the principles laid down in this series. But enough ground has already been covered to make it worth while to pause and determine the benefits which may be derived from such studies as we have been making.

Principal Advantages Derived From Finished Product Handling Systems

Handling equipment is obviously of advantage to those who use it, or its use would not be continued. The sane business man places no equipment in his plant from æsthetic considerations. Each piece of apparatus must earn its keep. It is only reasonable to suppose that the advantages derived by the present users may also be realized by many others who do not as yet use this equipment.

There are many advantages which automatic handling of finished products gives. Of these there are three which appear in every system. These are:

1. The amount of non-productive labor is decreased.
2. The speed of the product in its movement through the plant is increased.
3. The burden of management is decreased.

If, in the attempt to decide whether or not to install a material-handling system, a study is made of existing installations in similar industries, these three points should be kept in mind. The study should be made with a view to determining how and to what extent these advantages are attained in the installation studied and whether the means by which they are obtained can be applied elsewhere.

How to Study Existing Handling Systems

The key to all handling systems is the flowsheet. As a method of procedure, then, a flowsheet should be drawn for each handling system which is to be studied, starting at the point where the manufacturing process is completed and tracing out the path that the product is to follow from that point until it leaves the plant. These flowsheets should be drawn in both plan and elevation. From them can be determined whether the product flows in a straight and continuous manner and whether the system used is the most economical possible.

The flowsheet plan will show the path the product flows, bringing out any crossings, interferences or breaks in the flow. The flowsheet elevation shows the amount of power required to operate a system as compared with any other system by giving a measure of the lifts. This elevation also shows the advantage taken of gravity flow. On these considerations rest the comparative simplicity and economy of a handling installation. The fewer the steps in which the handling is accomplished, the straighter the flow, the more use that is made of gravity flow, the simpler to control and cheaper to operate will be the system.

Where to Seek a Decrease in Non-Productive Labor

If we consider a handling system in which no mechanical equipment is employed, the most noticeable thing about it will be the large amount of labor which it requires as compared to the labor used in actual manufacturing processes. If mechanical equipment is installed to accomplish this handling there will be one of two possible results obtained: Either the same amount of product is turned out with less labor, or more product is obtained from the same amount of labor.

As an example of where these decreases in non-productive labor may be looked for, refer to the third article of the series, dealing with soap handling. It will be noticed that in the plants cited the saving in non-productive labor made varies from 30 to 50 per cent. In both of these installations, the soap must go through several processes of wrapping and packing between the completion of manufacture and the shipping platform. During these processes the same amount of labor is now used as was used before the handling apparatus was installed. Where the non-productive labor is eliminated is in moving the material from one of these operations to another. Instead of employing men to do this, the mechanical equipment effects the transfer and the labor of these men is dispensed with.

Eliminating Non-Productive Labor in a Brickyard

This same mechanical movement between operations is clearly illustrated in the ideal handling system for a brickyard described in Article V. Here, by the usual process, brick is man-handled from the kiln to the sorting department, from this department to storage, and from storage to the carrier in which it is to be shipped. In the ideal layout, conveyors dispense with all the wheelbarrow men at present used to accomplish this movement.

*Previous articles in this series have appeared in *Chem. & Met.* as follows: Article I, vol. 26, No. 18, p. 823, May 3, 1922; Article II vol. 26, No. 19, p. 885, May 10, 1922; Article III, vol. 26, No. 24, p. 1,114, June 14, 1922; Article IV, vol. 27, No. 5, p. 199, Aug. 2, 1922; Article V, vol. 27, No. 15, p. 731, Oct. 11, 1922; Article VI, vol. 27, No. 16, p. 779, Oct. 18, 1922.

Whether the handling is manual or mechanical, about the same number of workers is employed to unload the kiln, to sort the brick, to tend the storage and to load the carriers. The elimination of the men that handle the brick between the above-mentioned workers is the means of lessening the non-productive labor and reaching a lowered cost.

In studying flowsheets for finished products, seeking means of reducing costs, the points to watch, then, are the spaces which occur between the various operations which the finished product goes through. As shown by the study of existing installations, the conveyors employed cover the movement over these spaces. A similarity in size, shape, weight and physical condition of the product handled by these systems points the way from an existing installation to the establishment of a new system.

Automatic Machinery Eliminates Much Non-Productive Labor

Many plants are found where such operations as cutting, filling, wrapping and packing are still entirely hand operations. In a large number of such cases no machinery has yet been developed to accomplish these operations. Often the machinery successfully used in one industry can, however, be adapted to another industry.

That the use of these automatic machines pays well in decreasing non-productive labor is well brought out by the example cited in Article VI. Here it is shown how the same number of workers produced twenty-five times the amount of packaged sugar when using automatic filling machines than they formerly produced when filling these packages by hand. This decrease in filling cost may seem remarkable, but it is not at all unusual. Results at least equal to this have been accomplished by many other types of filling equipment.

When wrapping machinery is considered, we find results that produce an economy well up to this level. As a general rule, it can be stated that one man operating an automatic machine will replace from ten to twenty-five workers doing the same operation by hand methods.

Studying Flowsheets to Reduce Non-Productive Labor

When studying flowsheets to find the amount of non-productive labor employed, and to determine how much can be eliminated, note two things: First, whether movement between machines is all by conveyor or not, and whether these conveyors are of the most automatic type which can be used. Second, whether the operations which the finished product undergoes are done by automatic machines or not.

If the system is not as automatic as it could be, obtain the flowsheet for another and somewhat similar industry where the maximum economy seems to be attained. This will serve as a good indication of what can be expected from a completely automatic handling system in the industry which is being studied.

What Speed of Handling Accomplishes

A speedy handling system can accomplish several direct benefits for an industry. Without exception, greater speed of handling is obtained from mechanical equipment than could ever be reached by hand methods.

The advantages following attainment of speed are:

1. A clearer idea can be reached of the rate at which the manufacturing can be scheduled and hence it becomes easier to plan the sales policy.
2. There is a much lessened possibility of any department becoming clogged with goods in process or with finished products.
3. The inventory of goods in process or completed can be kept at a lower figure, which lessens the amount of capital necessary to run the business.
4. The space required for storage throughout the plant is reduced.
5. The foremanship and inspection cost per unit of production is less—due to more product per employee and the greater capacity of oversight by inspectors.

Handling Speed and the Flowsheet

The speed of handling does not directly show up on the flowsheet which is drawn from an existing system. It is a simple matter, however, to obtain this from knowledge of the total amount of product, the speed of various machines and conveyors and similar data. Comparative figures of speed in hand-operated plants are generally easy to obtain.

No figures on this subject have been brought out in the plants described in the series because of these facts. Such figures can be obtained as desired and the speed at which a new system is to operate should be so chosen as to accommodate best the manufacturing and sales department. Note that it is always possible to attain, in handling finished products, any speeds which these departments may indicate as desirable, and this with the use of existing equipment.

The Finished Product and Management

Among the things which management must accomplish in handling finished products are the following:

1. It must keep control of the product as it passes through the plant.
2. It must effect this passage through the plant at the least possible cost.
3. It must ascertain this cost so that the business may be conducted in an intelligent manner.

Material Handling Equipment Helps Management Control the Product

By the elimination to a large extent of the human factor in handling the finished product, the management is enabled to determine far more accurately the amount of this product which may be handled. This aids distinctly in determining the amount of the product which must be manufactured and the amount of the product which must be sold. It is obviously necessary that the management must know how much of the product to make, how much it can handle as finished product and how much it can sell, in order that the business may be conducted in an economical way. Anything that helps them determine these facts tends to make the operation of an industry more economical The problems which constantly confront management of adjusting manufacturing to the market are much more easily solved when the human factor enters as little as may be into their considerations.

Control over the finished product as it passes through the plant must be maintained through the use of foremen and clerks. The amount of work necessary from these workers is almost directly proportional to the number of stops which the product makes, and is also influenced by the complication of the path of the product. By the use of automatic equipment and handling

machinery all stops except at storage points may be eliminated and the path may be practically a straight line.

Cost Accounting and Material-Handling Installations

The price at which a product may be sold will be a function of the cost of producing that product. This cost involves the cost of all the various processes which enter into the complete production of the article. It is the function of the cost accountant to determine these costs so that the management is enabled to act intelligently.

Power costs of a finished-product handling system are easily obtained by power input figures. The amount of labor is small and can easily be kept track of. Such items as upkeep and maintenance do not present difficulties to the cost department. The records which must be kept are simplified by the use of mechanical equipment and the burden on this department of the management is much reduced.

Some Points Brought Out on Lessened Management Burden

In the second article of the series the point is made that in handling many food products the principal care of the management must be in maintaining sanitary conditions. Here we see the burden of management lessened by the application of this equipment, for the reason that its use eliminates the possibility of contact with human hands or other contaminating influences.

The fourth article presents an even clearer illustration of this. Here, by the complete use of automatic methods, all manual handling is eliminated. This makes the workers merely machine tenders and does away with by far the greater part of the cost for foremanship. By the use of the automatic equipment and the elimination of labor which follows, the problem of cost keeping is reduced to its simplest terms.

The Flowsheet and Management

After the flowsheet for the finished product has been studied and a determination has been made from it of the amount of labor which can be eliminated and of the path of flow and the speed with which the products flow along this path, this sheet may be studied with a view to determining the effect of the handling system on the management. This sheet will show the operations through which the finished products must go. It will show the number of men whose services will be involved in handling the product. It will show the points at which the products stop and any points where delay or confusion might occur.

Observing these facts, it then becomes possible to determine just what the effect of any particular system will be on the management. The amount of controlling effort necessary to guide production in accordance with the management's desires will be evident, as it is proportional to the points brought out in the preceding paragraph. The cost of moving the products can be predicted with fair accuracy and the relative difficulty with which these figures are obtained under different systems will be readily seen.

How to Proceed After the Study of the Flowsheet Has Been Made

In determining the advantages to be derived from the installation of handling equipment for finished products by the study of the flowsheets of existing installations, the procedure which the writer has found to be the most advisable is as follows: Study the flow of material in several plants which are analogous to the plant in which it is desired to make a new installation. From this study determine just what the available equipment can do for you. After this determination is made, you will have certain facts in hand.

These facts will give the number of men which must be used to handle a certain product in a definite quantity by mechanical methods. They will show the path which the product must follow and will give a clear idea of the number of stops which the product must make on this path. A fairly clear idea will also be obtained of the economy effected by the use of the equipment.

With these facts in hand, we have the story of what has been accomplished by others through the use of the equipment. Lay out then a new flowsheet for the industry to which it is desired to apply the automatic and mechanical handling equipment, indicating the path which the product must take; the stops it will make and why these stops are made, naming the automatic machines and giving data on them if any are used; and giving the amount of product to be moved in a given time.

Judging a Handling System

Without indicating on this flowsheet the economies which are expected to result from the use of the equipment, it should then be submitted either to consulting engineers who make a specialty of handling layouts, or to the conveyor engineers who are in the employ of the conveyor-manufacturing companies. Supply these engineers also with such plans as are necessary to give them a clear idea of the physical conditions which will surround the handling equipment. Request them from this information to lay out an installation and to indicate on their layout the number of men and the amount of power necessary to handle the required volume of products with their system.

By comparison of the layouts submitted under this scheme with the predicted economies as shown on the flowsheets drawn for the industry and the actual economies obtained and shown on the flowsheet for similar industries, the plant which desires to install a mechanical handling system for its finished product is enabled to judge with a sufficient degree of accuracy just what benefit it will derive from installing any recommended handling system.

Dolomite for Refractories

If the lime in dolomite can be combined so as to render it non-slaking and at the same time hold up the refractoriness of the material, the abundant deposits of dolomite in the country would be rendered available for extensive use as a basic refractory, according to the United States Bureau of Mines. Briquets containing 90 per cent dolomite and varying percentages of iron oxide and clay have been burned by the Bureau of Mines at the ceramic experiment station, Columbus, Ohio. Slaking time tests were run and the results plotted on a triaxial diagram. The slowest slaking mixture was selected for making into bricks which were burned to a high enough temperature to render the lime inactive. Bricks with a high fusion temperature and high specific gravity, great mechanical strength and low porosity were the result. The work is being continued, using varying percentages of dolomite to determine the non-slaking areas over the entire field.

Refining of Salt Crude Glycerine

The Open and Closed Distillation Systems for Dynamite Glycerine —Manufacture of Chemically Pure and Yellow Distilled Grades— Operating Control and Procedure—Bleaching—Foots Treatment

By Walter E. Sanger
Wurster & Sanger, Chemical Engineers

THE refining of glycerine consists of the distillation of crude glycerine, together with subsequent bleaching to obtain a desired color. Dynamite grade of glycerine is usually obtained in one distillation whereas chemically pure (c.p.) glycerine requires a second distillation and, in exceptional cases, a treatment of the once-distilled stock before this second distillation.

Salt crude glycerine or glycerine obtained from spent soap lyes consists of glycerol, salt, water, fatty acids, esters and other impurities, and is sold on the basis of 80 per cent glycerol content[1]. Before distillation, the crude is tested for alkalinity and sufficient caustic soda is added, if necessary, to combine with the fatty acids present in the crude in order to prevent frothing as well as excessive fatty acids in the distilled glycerine. The amount of caustic required is determined for each charge of crude—there being added an excess of caustic soda sufficient to have from 0.1 to 0.3 per cent of free caustic on a boiling test.

The Two Systems of Distillation

At the present time there are in general use two systems of distillation for dynamite glycerine, which may conveniently be called the open system and the closed system. The open system is one in which the glycerine and sweet water are removed from the distillation unit in order to concentrate to the desired glycerine content. The dilute glycerine (75-90 per cent) is concentrated separately to the dynamite grade, and the sweet water is concentrated separately to make a sweet water crude glycerine which may again be distilled for dynamite glycerine or may be concentrated, bleached and sold as "yellow distilled" glycerine. In the closed system, the dilute glycerine is concentrated directly in a concentrator which is an integral part of the distillation unit; the sweet water is concentrated in the sweet water evaporator (which also is an integral part of the distillation unit) to sweet water crude, or it may be concentrated in a separate evaporator.

In the necessary distillation for c.p. glycerine both systems are the same in that it is necessary to handle the sweet water separately. In the open system the dilute c.p. glycerine is concentrated in a separate concentrator, while in the closed system it is concentrated in the concentrator, which is an integral part of the distillation unit.

It is important that the pressure on the coils of the system be in excess of 140 lb. As the pressure decreases below 140 lb. the rate of distillation falls very rapidly. A high vacuum on the system tends to produce a markedly higher rate of distillation and also an improved product. There are now on the market vacuum pumps suitable for glycerine distillation work which will pull a vacuum on closed suction to within ¼ in. of the barometer.

The Open System

The open system is shown in outline in Fig. 1. This cut shows the use of a preheater for the steam to be injected into the crude glycerine, although this steam is quite frequently introduced directly into the charge in the still. Where the latter procedure is followed, steam for injection is taken directly from the high-pressure line.

The preheater and still shells are of similar construction—namely, a steel vessel. Inside of the shells is a closed coil extending from the bottom to the top of the straight side, this coil also covering the bottom. These coils are of extra heavy pipe construction to withstand a pressure in excess of 150 lb. These coils are usually connected to steam traps so that full pressure is automatically carried on the coils. The still is further equipped with a steam injection pipe which is in the form of a perforated coil or cross on the bottom of the still. The preheater is equipped with a steam inlet pipe and also a steam outlet pipe which connects with the injection pipe in the still.

The Distilling Operation

In starting operations in the plant vacuum is first pulled on the whole unit. The still is charged with crude glycerine drawn in by vacuum or by gravity to a level of about 10 in. on the straight side of the still or about 4 in. in the gage glass. When the vacuum reaches 25 in., steam is turned on the closed coil slowly until the valve is wide open. It should require about 10 minutes to open the valve completely. The closed steam is turned on for the purpose of driving off the water in the crude as well as any water remaining in the still from a previous washing.

After the valve on the closed steam line is wide open, a small amount of open steam is turned into the preheater, where it is superheated by means of the closed coil. From the preheater this open steam is drawn by vacuum into the still through the perforated pipe, which is below the level of the crude in the still. The amount of open steam to be injected will depend on the grade of crude glycerine to be distilled; this amount will usually vary from 1 to 3 lb. of steam per pound of glycerine distilled.

As distillation proceeds, more crude is fed to the still continuously in order to maintain an approximately constant level in the still. This operation is continued until the full charge for the run has been fed. The amount of crude glycerine to be fed before running down to foots will depend on the capacity of the equipment and its design. A still run may vary from 8 to 24 or more hours.

[1]Lack of space precludes the publication here of technical specifications, methods of analysis, etc., for either dynamite or c.o. glycerine. For the former the reader is referred to British Standard Specifications for Dynamite Glycerine; the latter is described in the Pharmacopœa of the United States of America, Ninth Decennial Revision (Official from Sept. 1, 1916). For a description of salt crude glycerine see "Recovery of Glycerine From Spent Soap Lyes," by Walter E. Sanger, *Chem. & Met. Eng.*, vol. 26, No. 26, pp. 1211-16, June 28, 1922.

After the full charge of crude has been fed to the still, the feed is shut off and the operation (excepting feeding crude) is continued until the foots have the desired consistency. It usually requires from 2 to 4 hours to run the foots down to "dryness" after the last of the crude glycerine has been fed.

The vapors from the still pass to a catch-all or separator, where entrained crude is separated from the vapors and is returned to the still. The catch-all has one vapor inlet and two vapor outlets, one going to each set of air-cooled condensers.

Air-Cooled Condensers

Two sets of air-cooled condensers are usually employed. These are equipped with suitable baffle plates to cause the vapors to come in contact with the outer shells. The condensers are made of light steel plate. They are usually so connected that the condensate in each pair of condensers may be tested separately and if the glycerine is of inferior quality it may be kept separate from the satisfactory distillate and so not contaminate it. There are usually four sets of air-cooled condensers to a still, or eight condensers in all. The glycerine condensed here may be run by gravity to a closed receiving tank, whence it is transferred to a storage tank previous to being concentrated to the dynamite grade in a separate concentrator.

The glycerine condensed in the first pair of air-cooled condensers is usually tested for NaCl. If it shows none of this salt, the glycerine condensed in all of the air-cooled condensers is run by gravity into the closed glycerine receiver, which is under vacuum. If the sample shows the presence of NaCl, the air-cooled condensers remain shut off from the closed receiver and all glycerine is held in the condensers. At the end of the run these condensers are sampled by pairs and all glycerine giving a test for NaCl is run to the open glycerine receiver, whence it is usually returned for redistillation. If the NaCl content is sufficiently low, this once-distilled stock may be used for making the chemically pure grade.

The amount of distilled glycerine which is condensed in these air-cooled condensers varies considerably with the temperature of the glycerine room and is not regularly controlled by artificial refrigeration or other means. An average figure of the glycerine condensed here would be about 75 per cent of the glycerol in the original crude.

Sweet Water Condensers

The vapors which pass the air-cooled condensers go to the sweet water condensers, which are of a water-cooled surface type. Here the last of the distillate vapors are condensed to form sweet water, which is run by gravity to a closed sweet water receiver. From this receiver it is pumped to sweet water storage tanks. The amount of glycerine in the sweet water will vary considerably, but allowing 5 per cent for glycerol in the foots, this amount will be about 20 per cent of the glycerine in the original crude glycerine.

The sweet water is drawn from the storage tanks into evaporators, where it is concentrated to sweet water crude glycerine, which is again distilled to make the dynamite grade, the residue being foots, or it may be concentrated and bleached to be sold as "yellow distilled glycerine."

The handling of yellow distilled (Y.D.) glycerine and the bleaching of the dynamite grade will be discussed later under these heads.

Handling Foots and Washes

The vapor line between the still and the catch-all is equipped with a gate valve. This valve serves the double purpose of preventing any foots from splashing beyond the catch-all when washing out the still and also permits vacuum to be pulled on the rest of the unit while washing out.

At the end of a run this valve is closed and vacuum is broken on the unit. The sweet water and dilute glycerine are transferred from the unit in accordance with the use to which they are to be put. The valve on the bottom of the still is opened so that any liquid foots may be dropped into the foots tank. The foots tank has in it about 3 or 4 in. of water or washings from a previous run, which serves to prevent the foots as dropped from the still sticking to the tank bottom.

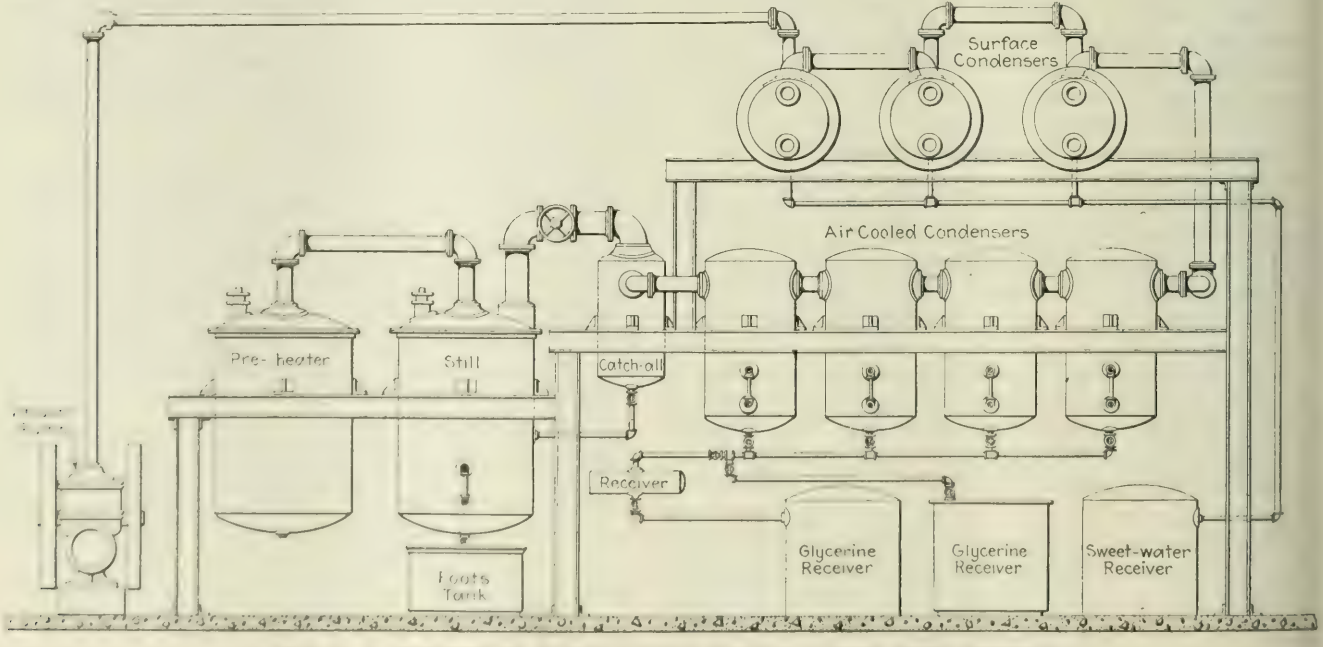
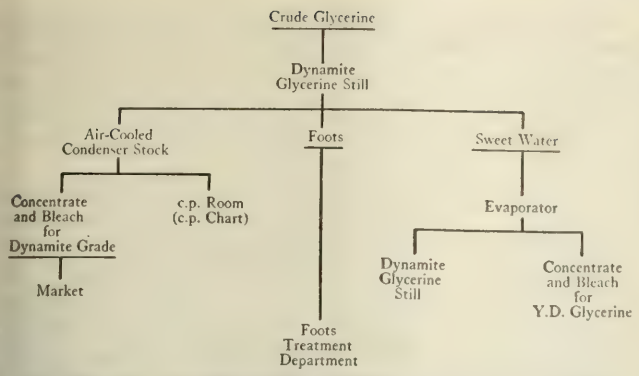


FIG. 1—A GLYCERINE DISTILLATION UNIT FOR THE OPEN SYSTEM



FLOW CHART FOR THE DISTILLATION OF CRUDE GLYCERINE TO DYNAMITE AND YELLOW DISTILLED GRADES BY THE OPEN SYSTEM

After all liquid foots has been dropped, the valve on the bottom of the still is closed.

The still is equipped with a nipple and valve which may be used as a vacuum breaker or as a vent line for the steam generated when washing out the still. This line is opened and water is slowly run into the still. The still coil has a temperature in the neighborhood of 350 deg. F., so that the first of the wash water is quickly converted into steam. If water is run in too rapidly, this steam may have enough pressure to strain the joints of the still, thus causing leaks.

Water is fed to the still to a level about 4 in. in the gage glass. This water is boiled for a few minutes and dropped into the foots tank. The still is usually given a second wash and, if necessary, further washes. It is usually determined by analysis how much of the wash water should be saved if the foots is to be treated for glycerine recovery. It will be understood that washes may be so low in glycerine content that it would not pay to handle them for glycerine. The washes which are to be saved are run to the foots treatment department; the other washes are run to the sewer.

The treatment of glycerine foots for glycerine recovery will be discussed in more detail under that head.

Chemically Pure Glycerine (Open System)

Where large quantities of chemically pure glycerine are manufactured, there are used separate distillation plants for the production of the dynamite and c.p. grades. Where only a small amount is produced, it is customary to use the same distillation unit for the production of both grades. In the latter case it is customary to accumulate a considerable quantity of the dynamite grade, which is later distilled to c.p. The reason for this is that the first of the c.p. glycerine distilled in a still used for dynamite has to be rejected due to the contamination of dynamite grade which deposits on the walls of the condensers.

The glycerine obtained in the air-cooled condensers from the distillation of soap lye crude will analyze about 75 to 90 per cent of glycerol. Depending on the quality of this distillate, it may be distilled for c.p. without further treatment, it may require bleaching or it may require acid and alkali treatment before the second distillation. When it is in proper condition for the second distillation, it is transferred to the still feed tank, where sufficient caustic soda is added to make it test slightly alkaline before being fed to the c.p. still.

The procedure in the distillation for c.p. glycerine is the same as that outlined for the dynamite grade. The products obtained are c.p. glycerine foots, which are returned to the salt crude still to be distilled for the dynamite grade; c.p. sweet water, which is concentrated in an evaporator to c.p. sweet water crude, which is again distilled for c.p. glycerine (the residue remaining in the still becoming c.p. foots, to be returned to the dynamite glycerine plant), and air-cooled condenser stock. This stock is concentrated in a separate concentrator and run to the first bleaching tanks, where it is diluted with distilled water to give a 95 per cent glycerine.

The Closed System

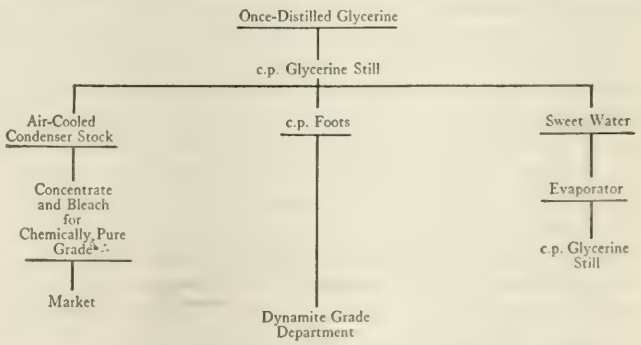
A glycerine distillation unit of the closed system type is shown in Fig. 2.

When starting the plant in operation, vacuum is first pulled on the whole unit. The still is charged with crude glycerine drawn in by vacuum to a level of about 10 in. on the straight side of the still or about 4 in. in the gage glass. When the vacuum reaches about 25 in., steam is turned on an extra heavy closed steam coil. This coil covers the bottom of the still and extends up the side close to the top of the still to prevent the condensation of vapors in the still. The valve on this steam line should be opened slowly to prevent any of the charge in the still from priming over. It should require about 10 minutes to open this valve full so that there is a pressure of 140 lb. or more on this coil. The condensation drain of the coil is connected to a trap so that full pressure may be maintained without loss of steam.

The sweet water evaporator is filled with water to a height of about 24 in. on the straight side. This evaporator is supplied with a heating coil for generating the steam to be injected into the still. A separate steam line may be run to the coil inlet, or else the drain from the still coil may be bypassed to connect to the evaporator coil inlet. The drain from the evaporator coil may be run to a trap.

After the vacuum on the still reaches about 25 in., steam is slowly turned onto the evaporator coil. The sweet water evaporator and the still are under practically the same vacuum when starting. As steam is generated in the evaporator, the vacuum on the evaporator drops; this steam is then drawn by the higher vacuum on the still into the still. The steam vapors pass from the evaporator through the preheater (which is designed as a surface condenser) and through a perforated pipe in the bottom of the still below the level of the crude glycerine.

The crude glycerine in the still has been heated to a temperature of about 350 deg. F. At this temperature the mixture of water vapors and glycerine is distilled



FLOW CHART FOR THE DISTILLATION OF ONCE-DISTILLED GLYCERINE TO CHEMICALLY PURE GRADE BY THE OPEN SYSTEM

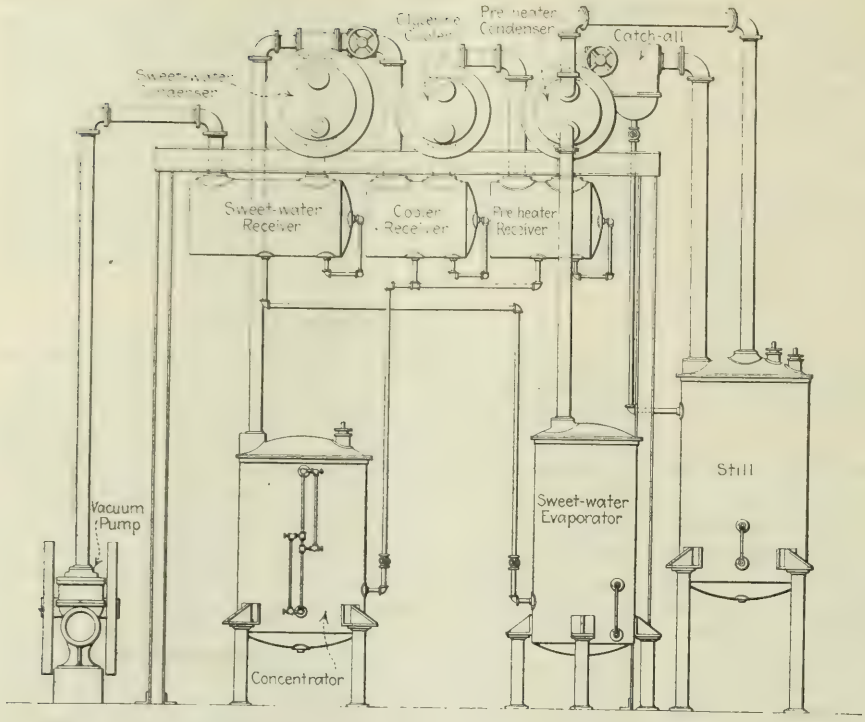


FIG. 2—A GLYCERINE DISTILLATION UNIT FOR THE CLOSED SYSTEM

off. The vapors pass from the still through a suitable catch-all, where entrained particles of crude glycerine are separated from the vapors and are returned to the still.

Condensing the Vapors

From the catch-all the vapors pass through the preheater, where they pass around the tubes, while the vapors from the sweet water evaporator pass through the tubes. The water vapors generated in the evaporator are in the form of steam under vacuum and so have a temperature of less than 212 deg. F. The mixture of water and glycerine vapors as they pass from the still have a temperature of about 325 deg. F. The vapors from the evaporator are thus preheated by the vapors from the still and are thus superheated before entering the still. The vapors from the still give up some of their heat in superheating the vapors from the evaporator and are thus condensed.

The glycerine vapors and the condensed glycerine pass from the preheater to the preheater receiver, where the vapors and glycerine are separated. The glycerine drops to the bottom of the receiver and runs by gravity to the glycerine concentrator, which is under vacuum. The vapors pass from the preheater receiver to the glycerine cooler.

The glycerine cooler is designed as a surface condenser, vapors passing around the tubes and water passing through the tubes for condensing purposes. The amount and temperature of water supplied to this cooler determines the amount of glycerine which will be condensed at this point. It is possible to condense all of the glycerine in the cooler, but if this were done, the glycerine probably would not concentrate to a sufficiently high gravity for the dynamite grade due to the presence of fatty acids, esters and glycols which are present in the distillate. For this reason, the water from the cooler is run at such a temperature that most of these impurities will pass beyond the cooler and be condensed with the sweet water.

The condensed glycerine, together with the remaining glycerine vapors, passes to the cooler receiver, where the glycerine drops to the bottom of this receiver and runs by gravity to the concentrator. The vapors pass on to the sweet water condenser.

One of the chief advantages of the closed system of glycerine distillation is the fact that the amount of glycerine to be condensed ready for concentration is easily controlled. In regular practice from 90 to 95 per cent of the glycerine in the original crude glycerine can be recovered in the form of dynamite grade.

The sweet water condenser is a surface condenser wherein the vapors pass around the tubes and water passes through the tubes. All of the condensible vapors are here condensed to sweet water. The sweet water and non-condensible vapors pass into the sweet water receiver, where the sweet water drops to the bottom and runs by gravity to the sweet water evaporator, while the non-condensible gases pass off into the vacuum pump.

As distillation proceeds, more crude glycerine is fed to the still in order to maintain a practically constant level. The cycle of operation is continued until a sufficient amount of crude for a run has been fed to the still.

The amount of sweet water obtained during a run is the sum of the water used in starting operations, the water present in the original crude and the glycerine, fatty acids, esters and glycols which are condensed in the sweet water condenser. The amount of glycerine present in sweet water usually varies from 1 to 2 per cent of the glycerine fed to the still in the form of crude glycerine.

The concentrator is equipped with an extra heavy pipe coil which covers the bottom and passes part way up the straight side of this vessel. After the glycerine shows in the gage glass on the concentrator, high-pressure steam is turned on the coil slowly so that the dilute glycerine will concentrate to the dynamite grade while the process of distillation proceeds.

After a run has been completed, the concentrator, sweet water condenser and receiver are cut off from the remainder of the distillation unit by means of a valve and the vacuum pump pulls vacuum on this part of the unit only. The vapors from the concentrator pass to the sweet water condenser. The condensible vapors are collected in the sweet water receiver, while the non-condensible vapors pass to the vacuum pump. When the charge in the concentrator reaches a temperature in excess of 350 deg. F. under a vacuum within 1 in. of the barometer, it should be of dynamite grade. It is then transferred to the bleaching department, where a sample is taken and tested. If it is of dynamite grade, it is then bleached and drummed ready for the market. An average sample of each shipment of glycerine is analyzed before shipment.

When the charge in the concentrator is finished, the vacuum is broken and the charge transferred as above described. The concentrator is not regularly washed with water.

If the stock used for making the crude glycerine was of a low quality, if the lyes had been stored for a considerable time in unclean storage tanks or if for any other reason there is present any appreciable amount of glycols, it is impossible to obtain a glycerine of the gravity required for the dynamite grade. If glycols are present, it is necessary to handle the concentrator stock for their removal, as described later.

If it is desired to concentrate the sweet water to sweet water crude glycerine or to yellow distilled glycerine in the sweet water evaporator, this is done while running down to foots. The return line from the sweet water receiver to the evaporator is closed so that sweet water will accumulate in the sweet water receiver. After the sweet water in the evaporator has been concentrated, it may be redistilled for the dynamite grade or transferred to a suitable tank, where it is bleached and handled as described under "yellow distilled glycerine."

At the end of a run the vacuum breaker on the sweet water evaporator is opened so that vacuum on the still is broken through the perforated pipe on the bottom of the still. If the vacuum on the still is broken first, the foots may be drawn through the preheater into the sweet water evaporator. Any foots in the preheater would then be washed down by the glycerine condensed here during the following run and so contaminate it that a second distillation would be required to produce the dynamite grade.

The valve on the vapor line beyond the catch-all is closed so that no foots will splash into the preheater. The vacuum breaker on the still is next opened; the foots is dropped and the still washed as described under the preceding discussion of the open system.

Bleaching of Dynamite Glycerine

The dynamite glycerine as it comes from the concentrator has a color depending on the quality of the crude from which it was distilled as well as on the design of the distillation unit.

A bleaching medium such as bone black is usually employed. This is used for the double purpose of removing coloring matter and also to give a press cake so that fine particles of solid impurities will not pass through the press cloths.

The glycerine from the concentrator is transferred to a bleaching tank, which is equipped with an extra heavy closed steam coil for heating purposes and an open air coil for agitation. For each 1,000 lb. of dynamite glycerine there is usually added 1 lb. of bleaching material, after which the charge is agitated for a few minutes with air. Where c.p. glycerine is manufactured, it is customary to use the spent bleach from the c.p. department for bleaching.

After the bleach has been added and agitated for a few minutes, the circulating pump is started. This pump takes the glycerine with bleach from the bleaching tank and delivers it to the filter press, from where it is drained back into the bleaching tank. The air is then shut off and, when necessary, steam is turned on the closed coil to maintain a temperature slightly less than 170 deg. F. If the glycerine is permitted to become cool, it is difficult to filter, and if the temperature is permitted to exceed 170 deg. F., there is danger of precipitating coloring matter. The time required for bleaching may vary from 1 hour to a number of hours. If it does not bleach readily, more bleach is added from time to time.

The procedure of circulating the glycerine through the press is continued until the glycerine is satisfactory as to color and has a "shine," which is due to the removal of all solid impurities, including the bleach. When the charge is in satisfactory condition, it is drained from the press into the drumming tank, from where it is drawn off into suitable receptacles for shipment.

Bleaching of Chemically Pure Glycerine

The glycerine from the c.p. concentrator should be very light in color. The bleaching medium may be the same as that used for the dynamite grade, although a lower quality may be used for dynamite due to the less stringent specifications regarding the percentage of ash in an incinerated sample.

The glycerine from the c.p. concentrator is transferred to a bleaching tank which is equipped with an extra heavy closed steam coil for heating purposes and an open coil for air agitation. For each 1,000 lb. of glycerine in the tank there is added 1 lb. of bleach; it is well agitated for a few minutes and then filtered through a c.p. glycerine press. The filtrate is returned to the bleaching tank and the glycerine thus circulated through the press.

Samples are taken at frequent intervals, and if the bleaching is not proceeding satisfactorily, more bleach is added from time to time. If the temperature of the stock falls below 160 deg. F., steam is turned on the closed coil to maintain a temperature slightly less than 170 deg. F.

The glycerine as it comes from the concentrator has a glycerol content in excess of 95 per cent. Distilled water to reduce the content to this figure is usually added during bleaching so as to insure thorough mixture of the glycerine and water.

The operation of circulating the charge through the press is continued until the charge meets the specifications for c.p. glycerine. It is then run to drumming tanks, from where it is drawn off into suitable receptacles for shipment.

At times it happens that even under correct temperature and vacuum conditions it is impossible to concentrate to the gravity specified for the dynamite grade of glycerine. This is almost invariably due to the presence of glycols or, more especially, to the presence of trimethylene glycol, which is a fermentation product. There are two chief sources of glycol, one being low-grade stock and the other being the fermentation of spent soap lyes.

If glycol is present in the concentrated glycerine to an objectionable extent, it may be removed by distilling off a small fraction of the glycerine in the concentrator with high-pressure steam under highest vacuum. The glycol will distill more readily than glycerine, but carries glycerine off with it. By continued fractionation it is possible to produce a distillate which is high in glycol and low in glycerine.

Yellow Distilled Glycerine

Yellow distilled glycerine is a distilled glycerine which is of lower specific gravity than the dynamite grade. It is usually made by concentrating the sweet water obtained in the distillation of crude glycerine for the production of the dynamite grade, but may be made by dilution of dynamite grade to a grade of a lower specific gravity.

There are no standard specifications for Y.D. glyc-

erine such as are recognized for the dynamite and chemically pure grades, but it is sold on sample. It usually has about the same qualities as the dynamite grade except for the gravity, which is usually about 29 deg. Bé.

If made from sweet water, it is concentrated in an evaporator to the desired specific gravity and then bleached and clarified as described under bleaching of the dynamite grade.

Treatment of Glycerine Foots From Salt Crude Glycerine

The residue left in the still at the end of a run is known as glycerine foots. This term is applied both to the residue as such and also to the mixture of residue and water which is obtained when washing out the still. The amount and quality of glycerine foots or foots obtained from any run will depend largely on the quality of the stock from which the salt crude glycerine was obtained, as well as on the efficiency of the lye treatment.

Foots consists of salt, glycerine, fatty acids, esters, polyglycerols and water. The amount of glycerine present will depend relatively on how far down the foots has been distilled. It is the practice in some factories to distill to dryness and then run the washings to the sewer; other factories drop foots in a semi-liquid state and then treat it for glycerine recovery.

The chief ingredients to be removed from the foots are the salt and fatty acids. Salt is easily removed by evaporating the solution to foots crude glycerine. However, if the fatty acids are not largely removed, this crude will distill very slowly and not much of the glycerine can be recovered. The main problem in foots treatment consists in the elimination of fatty acids.

The fatty acids present are those of the acetic series. A mineral acid will displace a fatty acid upon concentration; a mineral salt will combine with a fatty acid to form an insoluble mineral soap, qualitatively speaking. These conditions are usually made use of in the treatment of foots regardless of what varieties of treatment are given.

Outline of a Complete Method of Treatment

The following is an outline of a complete method of foots treatment which may be varied to meet special conditions in any given plant:

The foots as washed from the still is treated with a small amount of soda ash and then filtered through a press. This treatment precipitates some of the fatty acids as sodium soap, but is primarily used to clarify the foots by removing flocculent material which is present.

The solution is run from the filter press into lead lined tanks, where 60 deg. sulphuric acid is added. The amount of acid to be added is determined in the laboratory, where three samples of foots are treated with varying amounts of 60 deg. sulphuric acid in graduated glass vessels. Upon standing for a number of hours, there is a separation of tarry matter on the top and light material on the bottom. It is observed which of the three samples shows the best separation, and this is taken as the quantity to be added to the foots in the tank. The specified amount of 60 deg. acid is added to the tank and the charge is warmed by open steam and thoroughly agitated with air. After about 24 hours the tarry matter, which contains considerable fatty acids, is skimmed off and discarded.

After the tarry matter has been removed the strongly acid foots is transferred to a wood vat, where it is treated to a strong alkalinity with milk of lime, which precipitates some of the remaining fatty acids. This mixture is filtered to remove the lime and lime soap, the filtrate being run to a tank, where soda ash is added to remove the excess of lime. This lime precipitate is removed in a press and the filtrate transferred to the spent soap lyes, to be again concentrated to salt crude gylcerine. Where high grades of stock are used, such as in toilet soap factories, the foots may be thus returned for several years.

A simple and frequently employed method of treating foots is to transfer the foots from the still to a tank where sufficient sulphate of alumina is added to precipitate all fatty acids which can thus be removed. This solution is filtered into a second tub where sufficient acid is added to neutralize the ash alkalinity of the foots. This strong acid solution is then evaporated to foots crude glycerine.

Chicago, Ill.

The German Zinc Market

A pronounced shortage of zinc exists in Germany at present, says *Commerce Reports* of Oct. 9. Visible stocks are estimated at 8,000 metric tons, as compared with 14,000 metric tons a year ago.

The numerous factories using zinc in the Rhineland, Westphalia and other industrial centers of Germany are averse to consuming their small reserves and are endeavoring to cover their current needs by purchases in the open market. This is becoming increasingly difficult, due both to the scarcity of the metal and to the phenomenal upward movement of prices.

Numerous factors are responsible for the shortage of zinc in Germany. One of the most important was the loss of 80 per cent of the former Silesian zinc production to Poland. It was thought that this loss, which occurred in June, would not be felt immediately, since a free exchange of raw materials was provided for in the agreement covering the surrender of this territory, but transportation difficulties have prevented the arrival of expected shipments of zinc from Silesia. Constantly increasing acuteness of the coal situation and mounting prices of coal also hamper production.

Limited stocks in other countries make it seem unlikely that relief will come in the near future from abroad, even if German exchange should materially improve.

Carbide and Cyanamide Industry Slack in Norway

Norway has eight modern well-equipped calcium carbide plants, three of them built during the war, with a total annual output capacity of about 265,000 tons. These plants have installed about 170,000 hp. and in full operation employ about 3,000 men. Several of them are now completely closed down, and the others are operating with small or minimum force.

Commenting on this situation in a recent address, Ove Collet, a leading Norwegian electrochemical engineer, said that before the war the total world's production of calcium carbide was about 350,000 tons per year; that today Norway has factories with a capacity of nearly 80 per cent of the pre-war world production, and that war-time optimism as to the future of carbide has proved without sound basis, especially so far as the production of cyanamides is concerned.

The single cyanamide factory in Norway, that at Odda in the Bergen district, with its annual capacity of 75,000 tons, has been closed down for more than a year, and it is extremely doubtful whether it, or the carbide factory at the same place, which counted upon delivering a large part of its product for the manufacture of cyanamides, will ever again be in operation —certainly not unless new uses for both carbide and cyanamides can be found.

Overstrain, Internal Stresses and Creep

Effects Similar to Those Caused by Working Iron at Blue Heat Have Been Observed in Nickel and Certain Alloys—These Phenomena and the Results of Overstrain Are All Due to Rapid Acquisition of Increased Strength on Slip Planes

By Zay Jeffries and R. S. Archer

When hot-rolled iron or mild steel is tested in tension, it is found that the first part of the stress-strain diagram is a straight line, representing elastic deformation up to roughly one-half the tensile strength. If a bar of such material is loaded to a stress well beyond its yield point, it will be found on removal of the load to have lost its elasticity. On a second application of the load, the stress-strain diagram curves away from the straight line representing proportional deformation; the proportional (or elastic) limit has been reduced practically to zero. If after the first loading beyond the yield point (overstraining) the bar is permitted to rest for a few weeks before the second tensile test, it will then be found to have recovered its elasticity, and may have a new proportional limit higher than the original proportional limit of the hot-rolled material.

This recovery of elasticity takes place slowly at ordinary temperatures, but more rapidly as the temperature is raised. Muir found that the recovery of elasticity at 100 deg. C. is as complete after a few minutes as in 2 weeks at room temperature. At 250 deg. C. the time required is measured in seconds or fractions.

While the proportional limit in tension can be greatly increased (approximately doubled) by overstrain in tension followed by aging or heating at low temperatures, the limit in compression is not similarly increased. In fact, it has been stated that the gain in tensile proportional limit is almost exactly compensated by loss in compressive proportional limit, so that the total elastic range is not greatly changed. Van den Broeck[1] has reported, however, that by stretching and reheating, the proportional limit of mild steel in tension can be about doubled, while still retaining approximately the original proportional limit in compression. In Fig. 1 the effects of aging and tempering are shown. Curve No. 118 shows the elastic properties of a hot-rolled low-carbon steel. Curves 114 and 171 show how the elastic limit in tension is reduced practically to zero by cold deformation either in tension or compression. The other curves illustrate the recovery of elasticity by aging and by heating to 100 deg. C. The elastic limit in tension of the steel which was compressed and heated to 100 deg. C. has not quite been restored to its original value, but it is possible it would upon further heating.

[1]"The Effects of Cold-Working on the Elastic Properties of Steel," J. A. Van den Broek. *Carnegie Scholarship Memoirs*, Iron & Steel Institute, vol. 9, also *Engineering*, July, 1918.

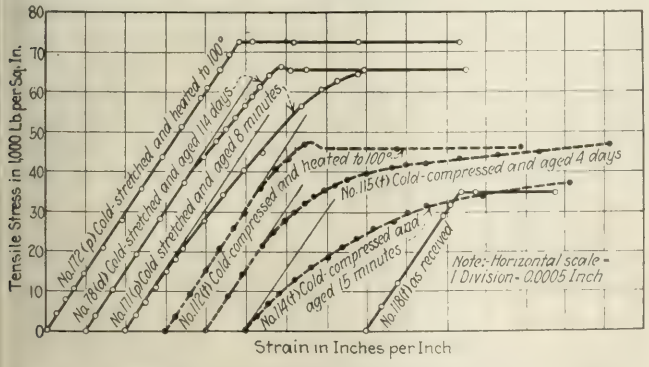

Tensile Stress in 1,000 Lb. per Sq. In.
Strain in Inches per Inch
No.172(p) Cold-stretched and heated to 100°
No.118(d) Cold-stretched and aged 114 days
No.171(p) Cold-stretched and aged 18 minutes
No.117(t) Cold-compressed and heated to 100°
No.115(t) Cold-compressed and aged 4 days
No.114(t) Cold-compressed and aged 15 minutes
No.118(t) as received
Note:- Horizontal scale - 1 Division - .00005 Inch

FIG. 1—EFFECT OF AGING AND TEMPERING ON THE ELASTIC PROPERTIES OF COLD-WORKED MILD STEEL. (VAN DEN BROEK)

Recovery of elasticity on aging at ordinary temperatures or on heating at temperatures up to about 300 deg. C. is accompanied by increase in hardness and tensile strength and by loss of plasticity. Elongation is usually reduced to a marked extent, although the reduction of area is less affected. The change that takes place is therefore a general hardening and stiffening.

Blue Heat Phenomena in Iron

It has long been known that iron is peculiarly brittle at temperatures from 200 to 400 deg. C., and that deformation, such as bending, effected at these temperatures causes the metal to be much more brittle after cooling to room temperature than would a similar amount of deformation at room temperature. Because of the blue scale or temper color formed on iron and steel, this temperature range is commonly called a "blue heat," and the brittleness is called "blue brittleness."

Tensile tests at elevated temperatures show that iron actually has a higher tensile strength but lower elongation and reduction of area in the blue heat range than at room temperature. The curves in Fig. 2 show the results of tests at the U. S. Bureau of Standards[2] on a mild steel whose properties are essentially those of iron. Results of a similar nature have been reported by one of the authors,[3] and are reproduced in Fig. 3. Robin has shown that the Brinell hardness is also greater at a blue heat than at room temperature.

The fact that a given amount of deformation effected at a blue heat hardens iron to a greater extent than does the same amount of deformation effected at room temperature is illustrated nicely by some experiments on the drawing of Armco iron wires. For example, wires reduced cold from 0.042 in. to 0.025 in. (64 per cent) at room temperature and at 275 deg. C., had the following tensile properties (measured at room temperature):

Temperature of Drawing	Tensile Strength Lb. Per Sq.In.	Elongation Per Cent	Reduction of Area Per Cent
Room temperature.	85,720	2.60	70.0
275 deg. C.....	111,000	1.58	67.0

The wire drawn at blue heat is stronger and less plastic than that drawn at room temperature.

About 30 years ago Le Chatelier[4] observed that the tensile properties of iron in the blue heat range are greatly affected by the rate of application of load. One specimen, for example, had a tensile strength of 66,850 lb. per sq.in. and an elongation of 10 per cent when broken in 20 minutes at a temperature of 170 deg. C.

[2]"Strength and Elasticity of Boiler Plate at Elevated Temperatures," H. J. French, *Chem. & Met. Eng.*, vol. 26, p. 1207.

[3]"Effect of Temperature, Deformation and Grain Size on the Mechanical Properties of Metals," Zay Jeffries, *Trans.*, A.I.M.E., vol. 60, p. 474.

[4]Abstracted in "The Blue Brittleness and Aging of Iron," Fettweis, *Stahl und Eisen*, Jan. 2 and Jan. 9, 1919.

On increasing the rate of pulling until fracture occurred in 2 seconds, the tensile strength fell to 38,400 lb. per sq.in., while the elongation rose to 28 per cent. The general result of his researches follows:

With various rates of applying load, the curves which give the tensile properties of iron as functions of temperature are approximately the same shape, but when testing at higher speeds, the curves are shifted toward higher temperatures. In other words, the maximum in strength and hardness does not occur at a fixed temperature, but at a temperature which depends on the rate of loading and is higher as that rate increases.

To explain these phenomena, Le Chatelier postulated that at temperatures above about 80 deg. C. any permanent deformation of iron gives rise to an irreversible transformation which tends to raise the tensile strength and decrease the ductility. This transformation requires a certain amount of time for its complete development, but takes place more quickly the higher the temperature. Above 300 deg. C., however, the transformation is less effective in producing strength and hardness, because of incipient annealing.

In a paper published in January, 1919, by Fettweis,[4] this transformation of Le Chatelier is, apparently for the first time, identified with the transformation responsible for elastic recovery after overstrain. Fettweis did not propose any hypothesis as to the mechanism of this transformation.

In February, 1920, one of the present authors[5] independently stated the theory that the blue heat phenomena and elastic recovery are due to the same cause: A spontaneous increase in resistance to motion on the slip planes formed during deformation.

[5]Discussion by R. S. Archer, on paper "Physical Changes in Iron and Steel Below the Thermal Critical Range," Zay Jeffries, February, 1920, meeting A.I.M.E.

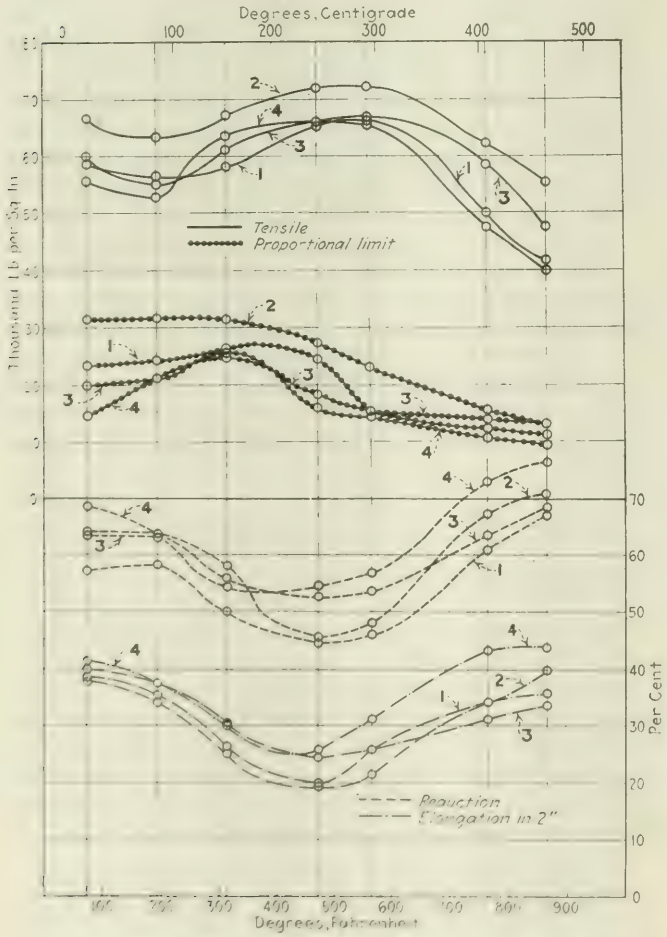


FIG. 2—EFFECT OF TEMPERATURE ON TENSILE PROPERTIES OF MILD STEEL. (FRENCH)

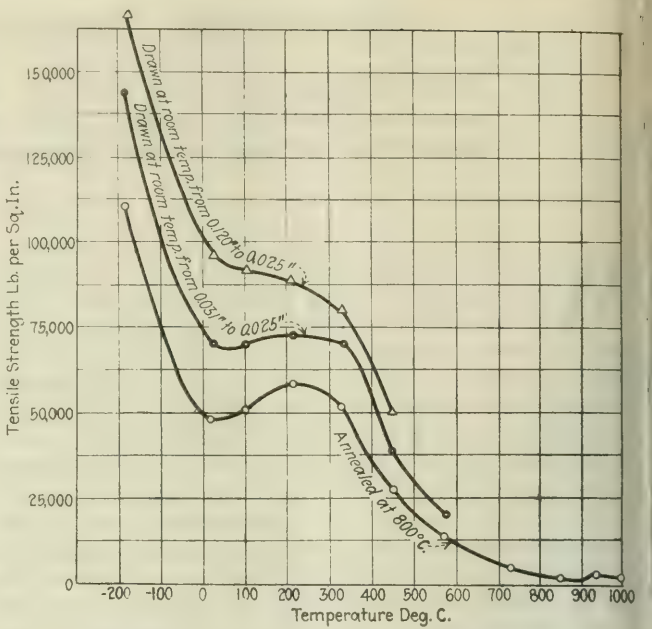


FIG. 3—TENSILE STRENGTH OF ANNEALED AND COLD-DRAWN ARMCO IRON WIRES AT VARIOUS TEMPERATURES. (JEFFRIES)

It is supposed that immediately after motion begins on a slip plane the resistance is less than the shearing strength of the unbroken crystals. Deformation tends to progress by continued motion on this plane, until brought to a halt by end resistance—that is, by the interference of adjacent grains. If the deforming load is removed immediately after slip has started and time is allowed for elastic recovery, then the resistance to motion on the plane of slip spontaneously increases to a value equal to or greater than the resistance to the formation of a new slip plane. Further deformation must then take place on new planes. The time required for this increase in resistance is less as the temperature rises, so that at about 250 to 300 deg. C. the change is practically instantaneous and occurs during the progress of any ordinary deformation such as a tensile test. The result is that at a blue heat a given *external* deformation produces more internal deformation, or cold-working, and hence more *hardening*, than the same amount of external deformation effected at room temperature.

This statement applies to deformations effected within a short period of time, such as during an ordinary tensile test. If the deformation which takes place during the tensile test at room temperature could be effected very slowly so that there was time for elastic recovery during the test, we should expect the tensile strength to be increased to an extent comparable with the increase obtained at a blue heat. The following experiments made by J. T. Bottomley[6] in Lord Kelvin's laboratory confirm this expectation:

Eight pieces of soft iron wire were tested in tension by gradually increasing stress applied in 10 minutes of time in each case. They broke at loads of 43.5 to 46 lb. (average 45.2 lb.) with 17 to 22 per cent elongation. Another specimen left with 43 lb. hanging on it for 24 hours and then broken by gradual increase of stress during 25 minutes broke at a load of 49.25 lb. with 15 per cent elongation.

[6]"The Testing of Materials of Construction," Unwin, 3rd ed., p. 113.

Another left for 3 days with 43 lb. hanging on it and then broken by increasing stress bore 51.5 lb. and elongated 14.4 per cent. A wire loaded first with 40 lb. and broken with gradual addition of load in 2 months broke at 57.25 lb. The slower loading had therefore increased the strength by about 27 per cent, which is an increase of the same order of magnitude as that obtained by testing in the blue heat range with ordinary rates of applying load.

According to the theory here described, the blue heat properties of iron are due to certain peculiarities of the process of deformation, and are not specific properties of crystalline iron. The yield point, tensile strength, Brinell hardness, elongation and reduction of area are all properties whose measurement necessarily involves plastic deformation. The true elastic limit, on the other hand, being the stress at which plastic deformation begins, cannot be affected by the mechanism described, nor can the modulus of elasticity. Unless there is an allotropic change (change in atomic arrangement), it is to be expected that both elastic limit and elastic modulus will decrease continuously as the temperature rises.

There is a lack of sustaining evidence of any allotropic change in these temperature regions, and recently E. C. Bain has found by X-ray analysis that iron at 300 deg. C. has the same body-centered cubic lattice as at room temperature.

TABLE I—STRENGTHENING OF NICKEL WIRE AT 250 TO 275 DEG. C.

Treatment of Specimens	Tensile Strength, Lb. Per Sq. In.	Per Cent Increase
Kept in liquid air until tested, 15 min. after drawing	125,000	.....
Kept in liquid air until tested, 15 min. after drawing	126,000	.....
Kept in liquid air until tested, 15 min. after drawing	126,000	.....
Kept in liquid air until tested, 15 min. after drawing	126,000	.....
Average	125,750	
Heated at 275 deg. C. 2 min	130,500	3.1
Heated at 275 deg. C. 5 min	132,000	4.6
Heated at 275 deg. C. 10 min	130,000	.....
Heated at 275 deg. C. 30 min	131,000	.....
Kept in liquid air until tested, 45 min. after drawing	126,000	.....
Heated at 250 deg. C. 1 min	128,000	1.6
Heated at 250 deg. C. 2 min	128.000	1.6
Heated at 250 deg. C. 5 min	128,000	1.6
Heated at 250 deg. C 20 min	130,000	3.2
Kept in liquid air until tested, 2 hr. after drawing	125,000	.....
Heated at 250 deg. C. 5 min	128,000	2.45
Heated at 250 deg. C. 15 min	130,500	4.00
Heated at 250 deg. C. 3 hr	127,000	.....

Actual determinations of elastic limit by various investigators are not in good agreement. Howard[7] in 1890 reported that the elastic limit decreases with rise in temperature. Huntington[8] also gave a curve which does not pass through any maximum in the blue heat range. Martens,[9] however, reported that the elastic limit passes through a maximum at about 200 deg. C., and recently H. J. French[2] found a maximum value at 200 deg. C. about 14 per cent greater than at room temperature. Accurate determination of proportional or elastic limit at the higher temperatures is a matter of some experimental difficulty, and in fact the values found in any determination depend on the sensitivity of the instruments. From the sufficiency of the deformation theory in explaining the other blue heat properties and the evidence against an allotropic change, it is very probable that the "elastic limit" which increases in the blue heat range involves some plastic deformation and that more sensitive measurements would show a continuous decrease in elastic limit and elastic modulus. The rise in tensile strength at a blue heat is most pronounced for iron in the annealed condition. Such strengthening becomes less in cold-worked irons tested at a blue heat, and finally in iron severely cold-worked and aged for some time, the tensile strength at room temperature is greater than at any higher temperature. This simply means that, because of the great hardening already obtained by cold-working and aging, the hardening effect of the relatively small deformation occurring during the tensile test is not sufficient to compensate for the natural loss of cohesion due to the rise in temperature. Furthermore, heating to temperatures as low as 100 deg. C. produces a slight softening in iron which has been severely cold-worked and aged.

[7]"Physical Properties of Iron and Steel at Higher Temperatures," J. E. Howard, *Iron Age* (1890), vol. 45, p. 585.

[8]"Effect of Temperature on Tensile Tests of Copper and Its Alloys," A. K. Huntington, *J. Inst. Metals* (1912), vol. 8, p. 126.

[9]"Influence of Heat on the Strength of Iron," Martens, *Proc.*, Inst. Civil Engrs. (1890-91), vol. 104, p. 209.

Overstrain in Non-Ferrous Metals

Iron appears to be unique in the magnitude of the overstrain and blue heat phenomena, but similar properties have been observed in some other metals.

It has been found that the tensile strength vs. temperature curve for nickel exhibits a horizontal portion between 200 and 300 deg. C., although the tensile strength does not actually rise in this region. There is a corresponding drop in elongation and reduction of area. This has been attributed to the allotropic change in nickel supposed to correspond to the magnetic change at 320 deg., but recently the space lattice of nickel at 500 deg. has been determined by E. C. Bain and found to be the same as at room temperature. The magnetic change is therefore not due to allotropy (in the sense of atomic rearrangement). In view of the properties of iron, it seemed probable that the break in the tensile strength-temperature curve of nickel was due to the same sort of spontaneous hardening.

W. P. Sykes has recently made some tests which show that freshly cold-drawn nickel wires are hardened by heating at 250 and 275 deg. C. His results are given in Table I. The nickel wire was drawn cold from 0.090 in. to 0.025 in. diameter. This wire was immersed in liquid air immediately after coming through the finishing die and kept in liquid air until tested or put in an electric muffle furnace for heat-treatment as designated in the table. Immersion in liquid air was for the purpose of preventing the hardening process from taking place, as it is known that in iron the change is extremely slow at low temperatures.

Price and Davidson[10] have also reported a hardening effect on heating cold-rolled nickel at temperatures up to 450 deg. C. Brinell hardness of bars cold rolled from 0.5 in. to 0.134 in. was as follows:

As rolled	235
Heated to 250 deg. C.	262
Heated to 350 deg. C.	255
Heated to 450 deg. C.	248
Heated to 550 deg. C.	228

The heating time was ½ hour to reach temperature plus 25 minutes at heat in all cases. A maximum strengthening effect was found in longitudinal specimens after heating at 250 deg. C., the strength increasing from about 123,000 lb. per sq.in. to 134,000.

It has been reported that the first effect of annealing cold-worked copper and aluminum at low temperatures is to increase the strength or hardness, but these observations are not well established.

It is well known that the first effect of annealing cold-worked brass is a slight hardening. Bengough and Hudson, working with a 70:30 brass, found that the tensile strength increased in all cases with rise in

[10]Discussion on "Physical Properties of Nickel," by Browne and Thompson, *Trans.*, A.I.M.E., vol. 64, p. 414.

annealing temperature up to about 300 deg. C. The yield point remained practically constant up to 100 deg. or higher, after which it dropped off. The effect of rest and low-temperature annealing on the elastic limit was investigated in one case, and it was found that the elastic limit was not affected by aging for 12 days at ordinary temperatures or by heating for 1 hour at 90 deg. C. The yield point was raised by both of these treatments. Annealing 1 hour at 210 deg. C. considerably decreased both elastic limit and yield point.

Bassett and Davis,[11] in their careful work on the relation of grain size to Brinell hardness in cartridge brass, found that annealing at low temperatures increased the Brinell hardness of the cold-worked metal, the increase being more marked the greater the reduction by rolling. This is shown in Fig. 4.

The increase of tensile strength reported by Bengough and Hudson has been confirmed by Mathewson and Phillips.[12] Their material was a very pure 70:30 brass which had been reduced cold 40 per cent. In this condition the average properties (five tests) were:

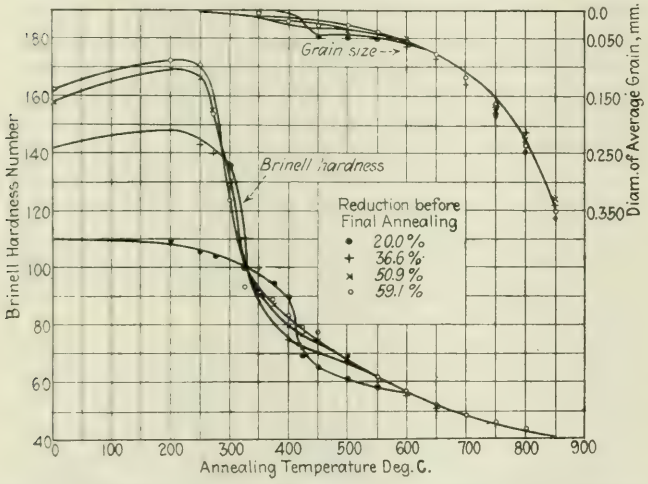


FIG. 4—EFFECT OF ANNEALING ON BRINELL HARDNESS OF COLD-WORKED BRASS. (BASSETT AND DAVIS)

tensile strength 76,763 lb. per sq.in., elongation 11.1 per cent and scleroscope hardness 33.2. After heating for ½ hour at 200 deg. C. the tensile strength (average of five tests) was 78,512, elongation 10.0 and hardness 34.2. Annealing at 300 deg. C. caused appreciable softening and visible recrystallization.

In connection with their investigation of season-cracking in brass, Moore and Beckinsale[13] have determined the effect of heating for 1 hour at temperatures from 250 to 325 deg. C. on the elastic limit. Their curves are reproduced in Fig. 5. It will be observed that the treatment at 250 deg. C. practically doubled the proportional limit. Treatments at higher temperatures have in all cases left the metal in an elastic condition, although the proportional limit decreases as the temperature of treatment is raised.

Hardening effects have been observed in nickel silver. F. C. Thompson found that the Brinell hardness was increased from 130 to 143 by annealing ½ hour at 300 deg. C. Price and Davidson[14] have also reported an

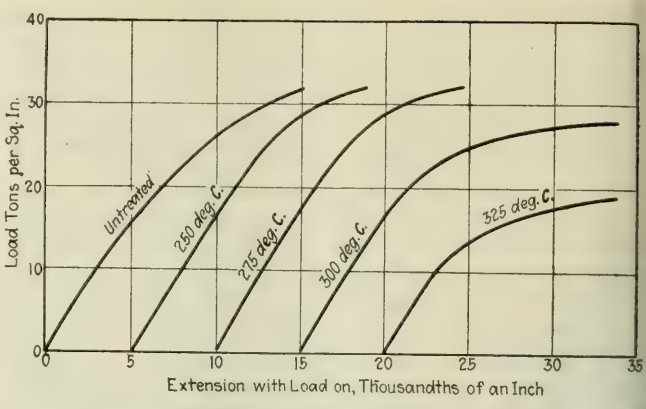


FIG. 5—EFFECT OF HEATING AT LOW TEMPERATURES ON ELASTIC PROPERTIES OF COLD-WORKED BRASS. (MOORE AND BECKINSALE)

increase in both yield point and tensile strength on annealing cold-worked nickel silver at 350 deg. C.

On the basis of the theory given above for the blue heat properties of iron it might be expected that brass and nickel silver would show discontinuities in hardness and strength when tested slightly above room temperature. Unfortunately, most of the work on the properties of these alloys at higher temperatures has not included tests between 20 and 200 deg. C.

The evidence on the occurrence of overstrain and blue heat phenomena in metals other than iron is thus rather limited. There is a strong indication that the phenomena are of general occurrence, although they are certainly most prominent in iron. It may or may not be of some significance that both iron and nickel are magnetic and that the extent to which spontaneous hardening is manifested is greater in the more magnetic element.

Internal Stresses and Creep

When a bar of iron is unloaded after being strained beyond its yield point, it does not return immediately, but approaches a stable position with increasing slowness. A more familiar example of the same phenomenon is found in the behavior of iron or steel when it is attempted to bend a piece to some desired shape, as in "straightening" a forging. It is at once apparent that in order to make the piece assume a final desired position it is necessary to bend it *past* this position, as there is an immediate elastic spring toward the original shape. Having caused the piece to assume the desired shape, it may be found some days later that it has returned still further toward its original shape. This slow return is often called "creep."

Creep is due to the action of internal stresses, produced by the deformation, slowly moving the crystalline fragments back along the slip planes toward their original positions. As has been remarked before, the elastic limit of a piece of metal is not passed until stresses are set up in some of the grains exceeding their shearing strength along the planes of easy slip. By the time the yield point is reached, practically all of the crystalline metal is highly stressed. When the load is removed, these elastic stresses are to a large extent relieved, but some remain to be gradually lessened by the slow movement of the grain fragments along the slip planes. Freshly formed slip planes have a relatively low resistance to motion. After elastic recovery is complete, little or no creep is to be expected. As a practical example, steel forgings are often

[11] "A Comparison of Grain-Size Measurements," Bassett and Davis, *Trans.*, A.I.M.E., 1919, p. 428.

[12] "Recrystallization of Cold-Worked Alpha Brass on Annealing," Mathewson and Phillips, *Trans.*, A.I.M.E., vol. 54 (1916), p. 611.

[13] "The Prevention of Season-Cracking in Brass by the Removal of Internal Stress," H. Moore and S. Beckinsale, *Trans.*, Faraday Soc., vol. 17, 1921, p. 162.

[14] "Physical Tests on Sheet Nickel Silver," Price and Davidson, *Trans.*, A.I.M.E., vol. 64, pp. 510-523.

traightened at or above a blue heat, so as to "stay put." 'he internal stresses set up by overstraining are ever completely relieved unless the metal is in a semi-lastic condition in which its elastic limit is substan-ally zero. That is, internal stresses are relieved only y flow, and their relief is opposed by elasticity. Metals nd alloys which are elastic at ordinary temperatures re left in a state of internal stress (also spoken of as internal strain") by all commercial cold-working rocesses. High internal stresses can also be produced y uneven temperature changes. Rapid cooling, uneven ections and mass contribute to such stresses.

The algebraic sum of the internal stresses in a piece f metal must always be zero; that is to say, tensile resses in one portion are balanced by compressive resses in other portions. An analogy may be drawn the various members of a steel bridge, which may ch be stressed in a different way, in tension, in com-ression, under bending, or under combinations of such resses, although the entire structure is in a state of uilibrium as regards external forces. Now if a bridge ember in tension is cut in two, its ends spring apart, d the sound members rearrange their loadings as best ey can; on the other hand, if a compression member cut, the ends come together. Internal stresses in a ece of metal can be detected and measured by means f the same principle.

If a light cut is machined from the surface of a piece f cold-drawn rod whose length has been carefully easured, a second measurement will show that the ngth of the remaining bar has increased. This means at initially the external layers of the rod were in a ate of tension while the core was in compression. On moving some of the exterior metal, which was hold-g the core in compression, the compressive stress in e core is partly released and it automatically in-eases in length a corresponding amount. The average ress intensity in the layer of metal which has been moved can be calculated from the observed change in ngth of the remainder of the rod: the relative change length times the modulus of elasticity gives the ress which has been released; this stress multiplied by e area of the section gives the total force released, hich is exactly equal to the tensile force in the metal achined off. This force divided by the cross-section ea of the metal machined off gives the average stress tensity in that metal.

The dimensional changes which result from cutting way part of an internally stressed piece of metal are ten a source of considerable trouble. A surface orig-ally machined "true" may be thrown out of true on moving stressed metal from some other portion of e piece.

If the external load to which a metal is subjected in rvice happens to be added to internal stresses already esent in the piece, the total stress may exceed the ength of the material and failure may result at an ternal load far below that which would normally cause ilure. Under some exceptional circumstances, it is ssible to utilize internal stresses to oppose external ds and thus extend the useful strength of the metal. dinarily, however, internal stresses are considered to a source of weakness.

Metals sometimes fail spontaneously from internal esses. The most common examples are hardened el and cold-worked brass. Severe stresses are set up steel by the hardening operation, both by uneven nperature changes in themselves and by the volume changes incident to hardening. Such induced stresses are often sufficient to burst the steel, either during the hardening or some time thereafter.

Removal of Internal Stress in Brass

Cold-worked articles of brass, such as cold-drawn bars, cartridge cases or spun jars or cups, often split open spontaneously. The failure may occur months or years after fabrication, and is known as "season cracking." It is due to internal stresses induced by cold-working, assisted usually by corrosive action. Season-cracking can be prevented by so controlling the deforming operations as to avoid setting up excessive internal stresses or by reducing the internal stresses to a safe value by annealing. It was shown by Merica[15] that the internal stresses in brass can be reduced below the danger point by annealing at temperatures too low to produce visible recrystallization or appreciable softening. More recently a very interesting quantitative study of the removal of stresses in brass by low-temperature annealing has been reported by Moore and Beckinsale.[13] Their results are summarized as follows:

"1. The rate of reduction of stress is fairly rapid at 200 deg. C. at first, but becomes very slow when the stress has been reduced to one-half to one-third its initial value and important stresses remain even after treatment for 24 hours or longer.

"2. As the temperature is raised the rate of reduction of stress increases, but shows the same characteristic of slowing down as the stress falls. At 300 deg. C. a very much shorter time is required to reduce the stress to a given figure than at 200 deg. C. and the remaining stress is much lower after a given time at the higher temperature, in brass of the same hardness.

"3. The higher the initial stress the higher is the remaining stress after a given treatment, in brass of the same hardness, although the amount of stress removed is greater the higher the initial stress.

"4. The higher the hardness of the brass the lower is the remaining stress after a given treatment and for a given initial stress. In other words, the harder the brass the more rapidly is a given initial stress reduced at a given temperature.

"5. A large reduction in the amount of stress is brought about by annealing conditions (temperature and time) which raise the hardness of cold-worked 70:30 brass, but treatments which result in some reduction of hardness are necessary to bring about complete removal of stress.

"6. At temperatures in the range 200 to 300 deg. C. slight plastic flow occurs in cold-worked brass at low stresses. The amount of flow is greater as the temperature is higher, the stress greater and the time longer for which the stress is maintained.

"7. The reduction of internal stress by low-temperature annealing is dependent on the plastic flow mentioned in (6).

"8. This plastic flow involves a lowering of the elastic limit at the temperature at which it occurs. This reduction of elastic limit is, however, not permanent provided the treatment is applied for a time not exceeding 1 hour at 275 deg. C. or certain limiting times which are much longer at lower temperatures. The limit of proportionality and elastic limit are raised considerably by treatments which do not exceed these limits of temperature and time."

These results are true specifically only for a 70:30 brass, but some general conclusions are warranted regarding the removal of internal stresses from other metals induced by cold-work or temperature changes. The temperatures at which stresses are removed from brass are near the lowest temperature of recrystallization. Complete removal of stress required an annealing which produced some softening and hence some recrystallization. It is probable that any metal must be heated to a temperature near its recrystallization temperature to remove stresses; heating to higher temperatures will result in more complete removal.

[15] "The Failure of Structural Brasses," P. D. Merica and R. W. Woodward, *Trans.*, Am. Inst. Metals, vol. 9 (1915), p. 298.

Manufacture of Carbon Bisulphide*

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In the past 20 years there have appeared from time to time in various technical journals articles describing in some detail the manufacture of carbon bisulphide in the electric furnace. Most of the articles in recent years have referred specifically to the so-called Taylor process. By using production data and power-consumption figures given by Mr. Taylor, others have calculated the approximate thermal efficiency of the operation. Such estimates are based upon the thermal constants to be found in the literature, and indicate a thermal efficiency ranging from 35 to 55 per cent, according to the assumptions made.

It has been thought of sufficient interest to go into the study somewhat further, with a hope of striking a thermal balance in order to approximate at least the distribution of heat losses in the manufacture of carbon bisulphide.

Inasmuch as the writer has had no personal experience with the Taylor method of making carbon bisulphide, it will be necessary to make such calculations from data obtained from a manufacturing process which differs in some essentials from the better-known Taylor process. In order to avoid a misunderstanding, it will be advisable (1) to review the general principles involved in the production of bisulphide of carbon, (2) to describe briefly, but specifically, the process under consideration, and (3) to give some data and calculations covering the process.

General Principles of Manufacture

Large-scale production of carbon bisulphide is based upon a direct union of two elementary substances, carbon and sulphur, such a union taking place from 600 to 1,000 deg. C. At these reaction temperatures the sulphur is obviously present as a vapor and the unreacted carbon exists as an incandescent solid. Care must be used in selecting the type of carbon for successful operation. In the writer's experience, gas coke, anthracite coal and other forms of dense carbon have proved of little use. Best results are possible with a reasonably good grade of willow or birch charcoal, which has a low ash content.

It is important that both sulphur and carbon employed be as dry as practicable. Water brought into the furnace as moisture in the sulphur reacts with the sulphur in the high-temperature zone, forming hydrogen sulphide and other volatile sulphur compounds. These side reactions evidently convert sulphur into useless products at the expense of some heat.

Water present in the charcoal delivered to the furnace is usually distilled from the furnace at a temperature lower than that needed for reaction with sulphur. This is due to the fact that charcoal is usually introduced into the furnace at the upper low-temperature zone in order to conserve heat by employment of countercurrent principles. This calcination of charcoal results in a certain small loss of heat, as will be discussed later. It is also of importance to specify a well-burned charcoal. A poorly burned product contains substantial amounts of hydrocarbons which cause loss of both heat and sulphur, due to the formation of useless sulphuretted compounds, which distill off with the carbon bisulphide. In practice it has been found profitable at times actually to dry and reburn some of the charcoal purchased before putting such charcoal into the furnace.

Description of Process

Fig. 1 shows diagrammatically the general layout of the installation under discussion. The furnace consists of a cast-iron shell lined with a suitable grade of refractory. Provision is made for water-cooled electrodes, through which power is furnished from a two-phase 440-volt a.c. line. Transformers and switchboard allow voltage changes in 10-volt steps, such changes being made either to control production or to adjust total power input as the internal electrical resistance of the heating bed varies from time to time.

A resistance bed of broken arc-light carbon is distributed over the entire cylindrical space between the electrodes. The heat generated is conveyed from the incandescent bed of resistor carbon to the charcoal above.

Sulphur is fed into the furnace from a melting kettle. It is fed through a liquid seal and delivered near the center of the hot zone, where it is vaporized instantly and reacts with the hot charcoal present.

Charcoal is introduced periodically as needed by means of a suitable hopper through the top of the furnace shell. Carbon bisulphide, hydrogen sulphide and other sulphur compounds leave the furnace and enter a condenser, where the bisulphide is recovered, and the impurities are washed out continually by means of overflow water.

Attempts have been made to control the temperature of the furnace by means of pyrometers. Peep holes, however, have proved fully as satisfactory, and represent considerably less maintenance costs. The usual maximum temperature is about 1,000 deg. C.

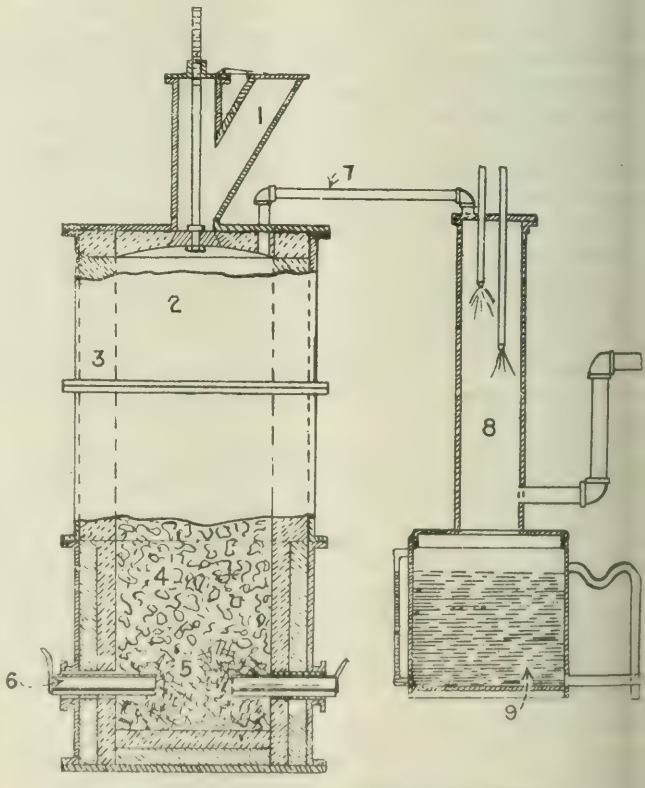

FIG. 1—CARBON BISULPHIDE PROCESS

1. Charcoal hopper; 2. Furnace; 3. Refractory lining; 4. Charcoal; 5. Resistance carbon; 6. Electrode; 7. Delivery pipe; 8. Condenser; 9. Product.

*Paper presented at the forty-second general meeting of the American Electrochemical Society in Montreal, Sept. 21, 22 and 23, 1922.

The unit diagrammed above will produce 1 ton of carbon bisulphide in 24 hours with a power consumption of 0.5 to 0.7 kw.-hr. per pound of washed material recovered. The principal losses of electrical heat and chemicals may be listed as follows:

1. Radiation of heat from a surface of furnace, including electrode losses.
2. Loss of sensible heat in exit vapors.
3. Loss of heat due to melting and vaporization of sulphur which leaves the furnace as unreacted sulphur and worthless sulphur compounds.
4. Loss of chemical accompanying heat loss listed under 3.
5. Loss of carbon bisulphide due to leaks and solution in wash water.

Calculating Distribution of Heat Losses

In calculating distribution of heat losses, it is important to have available values for the chemical losses which represent heat consumption without the equivalent yield of product. It is fair to estimate a sulphur loss represented by items 4 and 5 as totaling 20 per cent of the original sulphur fed to the furnace. This is equivalent to an 80 per cent yield of washed carbon bisulphide, based on original sulphur used, and must be accompanied by an additional 20 per cent power consumption over that theoretically required for the production of carbon bisulphide actually recovered.

Knowing the radiating surface, average shell temperature and the recovery of carbon bisulphide per 24 hours, it is possible by making a reasonable assumption for the heat conductivity coefficient to estimate the heat loss due to radiation. Operating conditions at the plant considered warrant accepting as reasonable the value $K = 2$.

In order to calculate thermal efficiency, it is necessary to know the theoretical number of heat units needed for the formation of a unit weight of carbon bisulphide. It is also essential that we know the heat requirements for each of the steps of the reaction in question. This involves tabulation of data on latent heats, specific heats and heat of formation. Unfortunately, there are some discrepancies in physical constants reported, and it has been deemed advisable to record the values found in standard compilations. Such values are given in detail in the appendix. As far as the writer was able to ascertain, no direct measurements of specific heat of sulphur vapor has ever been made. There appears to be an agreement in values given for heat of formation of carbon bisulphide, starting with solid sulphur and carbon and finishing with gaseous carbon bisulphide. Koref has calculated from equilibria data the heat of formation of carbon bisulphide, starting with sulphur vapor, and has shown that such a reaction is exothermic rather than endothermic, as is the case when solid sulphur is used. The vaporization of the sulphur prior to its reaction with carbon demands enough heat to cause a change from an exothermic to an endothermic process.

Heat of Formation

Mellor gives the following conception of the equilibria involved in raising sulphur to 1,000 deg. C. This summarizes in qualitative manner the results of the investigations of Smith and others during the past 30 years.

$$\underset{\text{Solid forms.}}{\overset{94.5^\circ}{S\alpha \leftrightarrows S\beta}} \overset{120^\circ}{\leftrightarrows} \underset{\text{Liquid forms.}}{\overset{160^\circ}{S\lambda \leftrightarrows S\mu}} \overset{444.5^\circ}{\leftrightarrows} \underset{\text{Gaseous forms.}}{\overset{1.000^\circ}{S_8 \leftrightarrows 4S_2}}$$

It is evident from this that the the thermal data required include (1) the heats of conversion of $S\alpha$ (rhombic) to $S\beta$ (monoclinic), (2) the heat of fusion of sulphur, (3) the heat of conversion of $S\lambda$ to $S\mu$, (4) the heat of vaporization of sulphur, (5) the heat of dissociation of S_8 to S_2, and (6) specific heat data for sulphur over the range 20 to 1,000 deg. C.

It is impossible to calculate exact thermal requirements for each of these steps since we have no data for specific heat of gaseous sulphur, much less for the heat of dissociation of S_8 to S_2. Bearing in mind, however, that our distribution of heat losses must necessarily be only approximate, we may simplify the above course of events and, by making certain allowable assumptions, arrive at a value which will be well within the precision limits of the entire problem. The steps simplified may be taken as:

$$\underset{20^\circ\text{ C.}}{\text{S (solid)}} \rightarrow \underset{120^\circ\text{ C.}}{\text{S (liquid)}} \rightarrow \underset{440^\circ\text{ C.}}{\text{S (gaseous)}} \rightarrow \underset{1{,}000^\circ\text{ C.}}{\text{S (at 1,000° C.)}}$$

Based on constants listed in the appendix, these three steps from solid, to liquid, to gas, to high-temperature vapor show an investment of heat units for 64 grams of sulphur amounting to

$$1{,}750 + 29{,}390 + 10{,}700 \text{ cal.}^1 = 41{,}840 \text{ cal.}^2$$

The heat required to raise the equivalent 12 grams of carbon from 20 to 1,000 deg. C. is calculated as 3,530 cal.[3] It is evident that the sum of calories represented by these two preparatory steps does not indicate the heat units expended in forming the equivalent amount of carbon bisulphide, inasmuch as there is a return of heat due to the exothermic vapor reaction as well as a return of heat to the entire system due to a cooling down of reaction products to about 200 deg. C.

Thomsen's value of —26,000 cal. for the heat of formation of gaseous carbon bisulphide and Koref's calculated value of +12,500 (from sulphur vapor) are quite consistent with the above heat values.

Loss by Sublimed S and Radiation

For purpose of heat-loss distribution, we must estimate the heat lost due to sulphur which has been vaporized but not converted to carbon bisulphide. Such byproduct sulphur leaves the furnace at comparatively low temperatures and would not represent a loss of 41,840 cal. per 64 grams. It is safe to omit the superheating effect of the vapor, thus reducing the loss to 31,150 cal. per 64 grams of sulphur lost. A second subtraction of 1,750 cal. must be made in calculating electric heat loss, inasmuch as the solid sulphur is warmed up and melted by steam outside of the furnace. With a 20 per cent loss of original sulphur fed to the furnace, this electric heat loss amounts to 97,000 cal.[4] per kilogram of product.

Loss of heat due to vaporization of water from charcoal containing 5 per cent moisture is a small item, amounting to only 5,000 cal. per kilogram of product.[5]

Radiation of heat from the furnace shell is quite the largest single heat loss realized. The units under consideration have about 320 sq.ft. (29.7 sq.m.) radiating surface. The average shell temperature approximates 100 deg. C. With a room temperature of 20 deg. C. and a conductivity factor[6] of $K = 2$, the radiation loss totals 610,000 cal. per kilogram of product.[7]

[1] Assuming 0.3 for sp. ht. of gaseous S.
[2] See appendix "B."
[3] See appendix "C."
[4] See appendix "D."
[5] See appendix "E."
[6] K = B.t.u. per sq.ft. per deg. F. per hr.
[7] See appendix "F."

The heat requirements for the production of 1 kg. of CS_2 in the furnace described above may be summarized as follows:

	Cal.
1. Heat of formation[8] of 1 kg. finished CS_2	320,000
2. Loss due to drying charcoal	5,000
3. Loss of heat due to subliming S, which leaves furnace in worthless form	97,000
4. Radiation loss	610,000
Total electric heat input	1,032,000

The tabulated heat balance indicates a thermal efficiency within the furnace amounting to about 31 per cent. Converting calories to kilowatt-hours it is possible to express our results as 1 kg. of carbon bisulphide produced per 1.20 kw.-hr., or 1 lb. per 0.73 hp.-hr. These values agree well with actual operating data.

It is quite evident that the largest loss of power is due directly to radiation losses from the furnace. Any increase in capacity of the furnace tends to lower the per cent radiation loss and increase the efficiency. The maximum capacity or output per unit time is limited by the maximum allowable sulphur sublimation loss. A point may be reached where added load may increase prohibitively the cost of operation due to loss of chemicals, as well as increased maintenance costs. With current prices of chemicals and hydro-electric power, it may actually prove more profitable to operate the furnace at a somewhat lower thermal efficiency, and to sacrifice efficiency for equivalent financial return.

Summary

1. A comparatively recent process for the manufacture of carbon bisulphide is described.

2. Actual plant data indicate that these units operate with a reasonably fair thermal efficiency.

3. An approximation of thermal losses is submitted.

In conclusion I wish to acknowledge the valued assistance rendered by Gordon Cave, who assembled and reviewed critically all references available pertaining to chemical and physical constants.

[8]See appendix "G."

APPENDIX B

Note:—All calculations were made with slide rule.

Calculations for bringing 64 grams of 2 gram atoms of sulphur from 20 deg. C. to 1,000 deg. C.

1. 20 deg. C. to 120 deg. C.
   (64 g.) (0.18) (100 deg.) = 1,150 cal.
2. Fusion.
   2 gram atoms × 300 cal. = 600 cal.
3. Heating liquid sulphur.
   (64 g.) (444 deg. — 120 deg.) (0.3) = 6,240 cal.
4. Vaporization of sulphur.
   2 × 11,580 = 23,160 cal.
5. Heating sulphur vapor to 1,000 deg. C.
   Assume sp. ht. of vapor = 0.3
   (64 g.) (1,000 deg. — 444 deg.) (0.3) = 10,700 cal.

Total = 41,840 cal. needed to bring 64 grams of sulphur to 1,000 deg. C.

Note:—In the furnace described, the melting is done outside the furnace by steam. This leaves about 40,090 cal. to be furnished by electric heat.

APPENDIX C

To heat 12 grams of carbon from 20 deg. to 1,000 deg. C.
(12) (1,000 — 20) (0.3) = 3,530 cal.
All this heat is supplied electrically.

APPENDIX D

Electric heat loss due to 20 per cent loss of sulphur in process.
Heat loss per 64 grams of sulphur so rendered worthless = 41,840 — 10,700 — 1,750 = 29,390 cal.
With 80 per cent yield of carbon bisulphide based on sulphur, heat loss in furnace =

$$\frac{64\ (1{,}000)\ (0.20)\ (29{,}390)}{76\qquad (0.80)\qquad (64)} = 97{,}000 \text{ cal. per 1,000 g. } CS_2 \text{ produced.}$$

APPENDIX E

Electric loss due to distilling of moisture from charcoal.

$$\frac{12\ (1{,}000)\ (0.05)\ (608)}{76\qquad (0.95)} = 5{,}000 \text{ cal. per 1,000 g. of } CS_2 \text{ produced.}$$

APPENDIX F

Radiation loss from furnace per kilo of CS_2 produced.
$K = 2$ B.t.u.
$K = 905$ cal. per sq.ft. per hour per deg. C.
Production of furnace = 2,000 lb. per 24 hr.
Production of furnace = 83.5 lb. per hour.
1 kg. production requires 0.0263 hour.
Furnace surface = 320 sq.ft.
Average temperature of furnace surface = 100 deg. C.
Room temperature = 20 deg. C.
Then: Heat loss =
(320) (80) (905) (0.0263) = 610,000 cal. per kg. of CS_2.

APPENDIX G

Heat of formation of 1,000 grams carbon bisulphide starting with liquid sulphur and ending with gaseous carbon bisulphide =

$$\frac{(1{,}000)\ [(-26{,}000) + (1{,}750)]}{(76)} = -320{,}000 \text{ cal.}$$

APPENDIX A—TABLE I

Carbon Bisulphide. Heat of Formation, Small Calories per Gram-Atom or Gram-Molecule

Substance	Condition	Constant	Authority	Compiler	Original Source	Method of Determination	Date
Carbon bisulphide	Vapor from amorphous carbon and rhombic sulphur	—26010	J. Thomsen	Dammer Landolt-Börnstein-Roth	*Jahresberichte*, 1883, p. 159; 1885, p. 183 Thomsen's Researches, vol. 2, p. 411. German edition	Constant pressure	1883-1885
Carbon bisulphide	Vapor from amorphous carbon and rhombic sulphur	—25430	J. Thomsen	Dammer	*Jahresberichte*, 1883, p. 159; 1885, p. 183 Thomsen's Researches, vol. 2, p. 411. German edition	Constant volume	1883-1885
Carbon bisulphide	Vapor from charcoal and S_2 vapor	+12500	Koref	*Chem. Abs.*, vol. 4, p. 1412	*Z. anorg. Chem.*, vol. 66, pp. 73-92	Calculation from equilibrium constants and equation of the reaction isochor	1910
Carbon bisulphide	Liquid from amorphous carbon and rhombic sulphur	—19610	J. Thomsen	Landolt-Börnstein-Roth	Thomsen's Researches, vol. 2, p. 411. German edition	Constant pressure	1883-1885
Monoclinic sulphur	From rhombic sulphur at 95.6°	81	Reicher	Landolt-Börnstein-Roth	Inaugural diss. Amsterdam 1883, p. 76; *Zeit. Kryst.*, vol. 8, p. 593	Calculated	1883
	From rhombic sulphur	86	Tammann	Landolt-Börnstein-Roth	*Z. anorg. Ch.*, vol. 63, p. 291	Calculated	1909
	From rhombic sulphur at 96°	105	Kruyt	Landolt-Börnstein-Roth	*Chem. Weekbl.*, 1911, p. 647	Calculated	1911
Sulphur λ	From sulphur λ	420	Lewis & Randall	Landolt-Börnstein-Roth	*J. Am. Chem. Soc.*, vol. 33, p. 487		1911

APPENDIX A—TABLE II

Carbon Bisulphide. Latent Heat in Small Calories per Gram-Atom or Gram-Molecule

Substance	Condition	Constant	Authority	Compiler	Original Source	Date
ılphur	Fusion (115°)	299.761 300.338	Person	Castell-Evans Landolt-Börnstein-Roth	*Ann. chim. phys.* (3), vol. 21, p. 333	1847
ılphur monoclinic	Fusion (119°)	330.	Wigand	Landolt-Börnstein-Roth	*Z. phys. chem.*, vol. 63, p.273	1908
ılphur S_x	Vaporization (316°)	11,605.72 11,580	Person	Castell-Evans Landolt-Börnstein-Roth	*Pogg. Ann.*, vol. 70, p. 310, 386, possibly from *Ann. chim. phys.*	1847
ırbon bisulphide	Vaporization (0°)	6850	Regnault	Landolt-Bornstein-Roth	*Mem. de Paris*, vol. 26, p. 761, 811, 819, 829, 835, 849, 857, 913	1862
ırbon bisulphide	Vaporization (0°)	6810	Winkelmann	Landolt-Börnstein-Roth	*Wied. Ann.*, vol. 9, p. 208, 358	1880
ırbon bisulphide	Vaporization (14.1°)	6610	Koref	Landolt-Börnstein-Roth	*Ann. Phys.* (4), vol. 36, p. 56	1911
ırbon bisulphide	Vaporization (46.1°)	6380	Wirtz	Landolt-Börnstein-Roth	*Wied. Ann.*, vol. 40, p. 446	1890
ırbon bisulphide	Vaporization (46.2°)	6600	Andrews	Landolt-Börnstein-Roth	*London Chem. Soc.*, vol. 1, p. 27	1849
ırbon bisulphide	Vaporization (46.6°)	8050	Person	Landolt-Börnstein-Roth	*Pogg. Ann.*, vol. 70, p. 310, 386, possibly from *Ann. chim. phys.*	1847

APPENDIX A—TABLE III

Carbon Bisulphide. Specific Heat in Calories per Gram per Deg. C.

Substance	Range	Constant	Authority	Compiler	Original Source	Date
ılphur 2 yr. after fusing	15–97°	0.1764	Regnault	Castell-Evans		
ılphur, rhombic	17–45°	0.163	Regnault	Castell-Evans		
ılphur, liquid	119–147°	0.2346	Person	Castell-Evans		
ılphur, liquid	160–201°	0.279	(Deysey) (Dussy)	Landolt-Börnstein-Roth	*Compt. rend.*, vol. 123, p. 305	1896
ılphur, liquid	160–233°	0.300	(Deysey) (Dussy)	Castell-Evans		
ılphur, liquid	160–264°	0.300	(Deysey) (Dussy)	Castell-Evans		
ılphur, liquid	201–233°	0.331	(Deysey) (Dussy)	Landolt-Börnstein-Roth	*Compt. rend.*, vol. 123, p. 305	1896
ılphur, liquid	233–264°	0.324	(Deysey) (Dussy)	Landolt-Börnstein-Roth	*Compt. rend.*, vol. 123, p. 305	1896
ılphur, rhombic	0–32°	0.1719	Wigand	Landolt-Börnstein-Roth	*Ann. Phys.* (4), vol. 22, p. 64	1907
ılphur, rhombic	0–95°	0.1751	Wigand	Landolt-Börnstein-Roth	*Ann. Phys.* (4), vol. 22, p. 64	1907
ılphur, rhombic	23–92°	0.1759±5%	Kurbatov	*Chem. Abs.*, vol. 5, p. 607	*J. Russ. Phys. Soc.*, vol. 41, p. 311-2	1909

APPENDIX A—TABLE IV

Carbon Bisulphide. Specific Heat in Calories per Gram per Deg. C.

Substance	Range °C.	Constant	Authority	Compiler	Original Source	Date
ırbon bisulphide	0	0.23523	Regnault	Castell-Evans Landolt-Börnstein-Roth	*Mem. de l'Acad.*, vol. 26, p. 262	1862
ırbon bisulphide	0	0.22958	Hirn	Castell-Evans	*Ann. chim. phys.* (4), vol. 10, p. 32	1867
ırbon bisulphide	18	0.242	Forch	Landolt-Börnstein-Roth	*Ann. Phys.* (4), vol. 12, p. 202	1903
ırbon bisulphide	30	0.24012	Regnault	Castell-Evans Landolt-Börnstein-Roth	*Mem. de l'Acad.*, vol. 26, p. 262	1862
ırbon bisulphide	30	0.23938	Hirn	Castell-Evans		
ırbon bisulphide	30	0.2388	Hirn	Landolt-Börnstein-Roth	*Mem. de l'Acad.*, vol. 26, p. 262	1862
ırbon bisulphide	60	0.24897	Hirn	Castell-Evans		
ırbon bisulphide	80	0.260	Sutherland	Castell-Evans Landolt-Börnstein-Roth	*Phil. Mag.* (5), vol. 26, p. 298	1888
ırbon bisulphide	100	0.26168	Hirn	Castell-Evans	*Mem. de l'Acad.*, vol. 26, p. 262	1862
ırbon bisulphide	120	0.276	Sutherland	Castell-Evans Landolt-Börnstein-Roth	*Phil. Mag.* (5), vol. 26, p. 298	1888
ırbon bisulphide	160	0.2882	Hirn	Landolt-Börnstein-Roth	*Mem. de l'Acad.*, vol. 26, p. 262	1862

Condition of the German Paper Industry

According to recent advices from the American Consul-General in Berlin and from the Consuls in Breslau and Frankfort on the Main to *Commerce Reports*, the paper trade in Germany is suffering at present from a serious shortage of materials, particularly newsprint. Owing to the low value of the German mark the importation of paper in large quantities is extremely difficult and the trade is compelled to confine itself largely to paper of domestic production. Paper prices are constantly rising, as are the prices on all commodities. Very little is being exported, and most of the mills are sold for months in advance.

This situation has made the position of newspaper publishers so embarrassing that many papers all over Germany have been forced to suspend publication entirely or have combined with other journals. Some that formerly had two or three issues daily now have only one.

The condition of the Silesian paper industry has recently become worse. Large deliveries of wood on separations have necessitated the importation of pulp wood from Czechoslovakia and Poland. Because of the uncertainty of rates of exchange, prices have continually increased. The leading manufacturers of wood pulp in the Breslau consular district state that they are not in a position to export and can scarcely produce enough for home demands.

The paper manufacturers are overrun with orders and cannot make deliveries because of the difficulty of obtaining raw materials. At present large orders for paper cannot be filled within the next 4 or 5 months. Toward the end of 1921 the buyers, anticipating a large increase in prices, placed heavy orders, and as a result the factories were completely sold out and had no stocks left on hand. In spite of the fact that production during the first 6 months of this year was on an average 60 per cent greater than during the same period of 1921, there is still a scarcity of paper.

German Prices for Cellulose and Paper

The price for cellulose has been set by the manufacturers at 170 per cent more than the August, 1922, price. The paper manufacturers demand three times as much for September deliveries as for August deliveries.

The following comparative prices, in marks, for 10,000 kilos (22,048 lb.) of print paper prevailed during the first 8 months of 1922: January, 70,000; February, 73,000; March, 82,000; April, 128,000; May, 159,000; June, 166,000; July 200,000; August, 280,000.

According to present information, 700,000 marks per 10,000 kilos will be demanded for print paper in September. This is 350 times the pre-war price.

Ordinary writing paper, which was quoted at 95 marks per kilo in July, 1922, advanced to 132 marks per kilo at the beginning of August, and increased still further to 192 marks per kilo by the end of August. During the same period ordinary business envelopes rose in price from 85 marks per 1,000 in July, 1922, to 145 marks per 1,000 at the beginning of August, and 450 marks per 1,000 by the end of August.

Modern Practice In Manufacture and Applications of Steamed Ground Wood

Part II of a Description of the Present Status and Practical Possibilities of This Process for Paper and Board Manufacture, in Which the Operation of a Modern American Plant Is Discussed

By A. O. Bragg

IN THE preceding installment of this article* the theory of steaming wood preparatory to grinding was discussed and the equipment used in a modern American plant was described from the wood room to the jordans. In the following pages, the operation of this equipment will be described, with special attention to the so-called operating kinks and practical considerations.

Wood Room

Wood room operations consist of cutting to the usual 2-ft. lengths and, where necessary, barking. Logs 2 ft. long are preferable for charging cookers, as mechanical complications and labor cost are increased by attempting to cook longer logs; hence this sawing should be done before the cookers are filled.

As previously indicated, barking may or may not be necessary, according to conditions. The determining factors are the type of cooker used and the product in which the pulp is to be used. For example, it would be needless and a waste of money to bark wood to be used in trunk board or as a filler in a board between two outside liners of other pulp, so far as appearance is concerned, and the strength of pulp from rough wood would not be appreciably less than from peeled wood. Ordinarily, when used for paper, it should be barked. For use in wrapping paper, for instance, where bark specks might cause holes in going through the calenders or detract from the appearance, the bark should be removed. No barkers will be needed with rotaries, as before stated, but barkers of some type are necessary with vertical cookers. Since the fine bark dust is not usually objectionable in the dark colored papers for which this pulp is suitable, the heavy wood loss from knife barking to obtain absolutely clean wood is not usually necessary. A fine grade of butchers' wrapping paper is being made of pulp from wood barked exclusively in the rotaries, where it is also steamed, the amount of slivers or brooming being very small and no bark being visible in the sheet.

Rotary Steamers

Below is given an operating schedule using rotary boilers 16 ft. in diameter, cooking for 12 hours, and providing for the maximum production from the equipment. It will be understood that the actual time in completing a cycle of operations is dependent on the time the wood is cooked. The equipment under consideration is that shown in Fig. 2.

Charging.—The chute is adjusted to discharge into the manhole of boiler to be filled by placing baffle board across the opposite side. The conveyor is started and boiler filled with 6 cords of rough or 7½ cords peeled wood from wood room. Then the conveyor machinery is stopped and a square-braided hemp gasket placed on the seat of the manhole cover, after which the manhole cover is lowered in place by Triplex block and the bolts tightened.

Cooking.—The reducing valve is set at pressure to be used for the cook and the steam turned on. The boiler is kept stationary until the charge is ready for barking. If boiler is tight, it requires about 1½ hours to get steam up to 20 lb. pressure. If boiler is not tight, leaks will prevent pressure building up at all. Condensed water is drained out every hour.

Barking.—About 1½ hours before the end of cooking time the boiler is started rotating and kept going until end of cooking period.

Dumping.—The cooker is stopped in such a position that the manhole cover can be reached by the Triplex block chain and lifted off. Then the boiler is started rotating again and this is continued until the cooker is empty. Rotation should be stopped in such a position that pulpwood will drop into manhole from chute for the next cook. It takes about 1 hour to dump a digester.

The barking is quite effective, only about 3 to 5 per cent of the logs having any bark still clinging to them and this bark is much disintegrated and loosened.

Dumping is rather a dangerous operation. At each revolution of the boiler more or less wood falls out together with finely divided bark. While the outlet is down and the digester is discharging, the workman must stand aside, out of reach of the falling logs. During the upper half of the revolution he "picks" logs onto the conveyor which takes the steamed wood to the grinders. When the pile accumulating on the high end of the slope gets too high, the wood falling from the boiler tends to push this pile down the slope toward the conveyors, and this danger must also be watched. Since the rate of dropping exceeds that at which one man can "pick" logs onto the conveyor, it is customary to stop the boiler until the accumulated pile has been disposed of, which time is included in the hour specified above. The number of logs dumped out at each revolution varies, as sometimes the manhole clogs up, owing to the arrangement of the logs inside. Much of the bark finds its way to the rack, being carried onto the conveyor while "picking" the logs. The excess bark is shoveled out through an opening in the wall of the pit kept closed by a door (Fig. 2) and thrown away. Its fuel value is low, because of the high moisture content.

Vertical Digesters

The operation of these cookers will be for the most part self-evident from the drawing. The wood bins are refilled while cooking is going on, dropping just enough wood over each cooker to fill it, which amount is measured in the wood room before putting on the conveyors. It should be mentioned that, when filling, some logs do not fall into the opening in the cookers, but fall on the floor. These must be put in by hand after the proper cordage has been dropped from the bin. As there is considerable danger from falling logs, no

*The first installment of Mr. Bragg's article was published in *Chem. & Met.*, vol. 27, No. 16, p. 793, Oct. 18, 1922.

workmen should be permitted on the third floor during the time logs are falling from the bin.

Dumping is practically instantaneous when the conical bottom has been lowered far enough to permit the logs to fall out. There is no occasion for anyone to be in the discharge pit, except to clean it out during shutdowns; hence there is no danger to the workmen from dumping. The hydraulic ram is provided with automatic stops. The pressure or temperature gages being on the first floor, the cooking requires very little time or attention, pressure or temperature readings every hour or so being all that is necessary.

As with the rotary, the steam should be passed through a locked pressure-reducing valve before admission to the boiler, to prevent possible explosion. At the end of a cook the steam remaining should preferably be blown off into boiler feed water by an insulated pipe going to the power plant and the whole steamer should be thoroughly insulated by suitable magnesia covering.

Bache-Wiig Process, Enge Process

The Bache-Wiig process[2] consists of boiling the blocks under pressure in a salt solution for 6 or 7 hours. This is said to exert a peculiar softening effect on the wood, the fibers disintegrating more readily with scarcely any loss in weight and a much stronger white pulp being obtained which takes color well. It is claimed that by the use of such pulp alone, a sheet fully as strong as one made of 80 per cent ordinary ground wood and 20 per cent sulphite may be obtained. The extra cost per ton, figuring on a 100 ton per day production, is estimated at $0.99 in 1916, necessitating for the processing alone a plant investment of $72,500. It is stated that the use of 5 per cent of sulphite is advisable with newsprint because of the better finish obtainable. The savings using 5 per cent sulphite and 95 per cent Bache-Wiig ground wood, as over 25 per cent sulphite and 75 per cent ordinary news ground wood, are estimated at $3.25 per ton.

The Enge process,[3] German patent 315,679, claims the production of a very tough ground-wood fiber with absolutely no discoloration—i.e., the color is that of the natural ground wood. The results obtained from tests on Enge pulp by the Laboratory for Testing Materials do not bear out these claims. In this method the wood is saturated with water at 80 deg. C. and kept boiling for 6 to 8 hours under a ½ atmosphere pressure. Grinding is done lengthwise, the axis of the log being kept at an angle of 10 deg. to the face of the stone, which increases the fiber length.

The pulp is darker in color than untreated pulp, but not so dark as steamed pulp. As would be expected, the process is rather slow. The breaking strength of newsprint made wholly of Enge pulp was found to be slightly more than for ordinary newsprint, but because of the brittleness of the pulp was much inferior to it in the number of foldings it would stand.

The advantages of the Enge process over ordinary wood steamings are not very evident, and it would seem that the relatively slight treatment which could be given to wood by it, necessary to keep the pulp from becoming too dark in color to be used for newsprint, would not effect benefits commensurate with the cost of treatment. The Bache-Wiig process is based on a scientifically correct foundation, the sodium chloride uniting with the brown coloring matters formed, to give water-soluble sodium salts of these dyes and thus preventing the discoloration of the pulp caused by Enge's process. However, with the recent advent of improved methods of dressing stones to obtain ground wood of sufficient strength for use in newsprint without sulphite, the investment and operating costs for the Bache-Wiig process would seem to be too heavy as compared with these more recent developments.

Proper Cooking Conditions

A generally inclusive and definite statement as to the proper cooking conditions to be used with different woods cannot be formulated, the number of variables being too large. The exact conditions are something which each mill must decide for itself. All the following factors have a bearing, directly or indirectly, on how long and with how much steam pressure a given wood should be cooked:

1. Moisture content of wood.
2. Pitch or rosin content of wood.
3. Seasoning the wood has had.
4. Time of year in which wood is felled.
5. Density of wood species used.
6. Soundness and freedom from decay and fungi.
7. Diameter of logs.
8. Color of pulp desired.
9. Strength of pulp desired.
10. Product in which pulp is to be used and its requirements as to color, strength and finish.
11. Paper machine equipment available and production desired from it, and if addition and alterations can be made to it to increase production.
12. Balance of cost—i.e., striking a balance between maximum strength or depth of color of pulp desired and permissible limit of cost for steaming operation (which involves yield per cord) and whether a slight increase in strength obtained by cooking beyond a certain period will not be offset by greatly increased cost and reduced yield.

The relative influence of these factors will perhaps be more evident after giving some present cooking practices used with different woods and for different products, describing the nature of the pulps obtained and the operation conditions for the machines.

Wrapping Paper

The first woods considered will be a mixture of scrub pine and white pine. These woods are now being used for pulp to make an excellent grade of butchers' wrapping paper. The cooking conditions are varied according to the condition of the logs, as determined by visual inspection and personal judgment. The limits are from 9 to 16 hours at 13- to 20-lb. gage. All dry, well-seasoned logs are treated for 9 to 12 hours at 13- to 16-lb. pressure; all green, freshly felled wood requires from 16 to 20 lb. applied for 12 to 16 hours. Mixtures of dry and green woods are treated in proportion to the amounts of the woods of different moisture contents present. Thus, a mixture of equal parts green and dry wood would be cooked at 16.5 lb. for 12.5 hours, the mean of the maximum and minimum limits. If all the wood was extremely green-steamed—for instance, the day after cutting in the spring when the sap is up—20 lb. for 16 hours or longer would be required to effect thorough saturation and freeing from pitch, while if all the wood has been stored in a dry place for 3 or 4 years, 9 or 10 hours at 13 lb. would be sufficient. Under these conditions 8- to 9-in. sticks are completely saturated, all rosin and pitch removed and suitable pulp obtained. Larger sticks are likely to be incompletely penetrated and to have some rosin still present. If many such logs are noticed in the wood room when sawing, they should be split before cooking.

[2] *Paper*, April 19, 1916.
[3] *Paper*, Sept. 6, 1916.

In grinding, any good medium grit stone is used. Like any ground wood, the quality of the pulp depends largely on the dressing given the stone and the production on the speed and pressure used. In this case, an 8 to 1-in. diamond burr is used, keeping the stone dull. The pressure is 60 to 70 lb. to avoid the crushing effect on the fibers by higher pressures especially noticeable in dull stones. At these pressures a stone will grind about 4½ cords per 24 hours with a three-pocket grinder. The yield is about 2,200 lb. of pulp per cord, which corresponds to a 24-hour production per grinder of 5 tons of pulp. The power consumption per grinder runs from 280 to 290 hp., or 56 to 59 hp. per ton per 24 hours.

For the wrapping paper mentioned above, 60 per cent sulphite and 40 per cent of the steamed pine ground wood are furnished. It is found that this paper takes and keeps a better finish and has a higher Mullen test if the pulp is cooked as above than if it is steamed at a higher pressure for shorter periods.

This ground wood, and any ground wood made from wood of similar fiber length similarly treated, can be classified as an exceptionally strong and high grade of ground wood, except, of course, as to color. It is much stronger and tougher than any untreated ground wood made from wood of the longest fibers, in spite of recent developments in stone dressing. It is still considerably weaker than sulphite. An attempt was made to produce butchers' wrapping paper from the steamed ground wood alone, but the sheet was found to be too low in tensile strength, and the above formula was adopted. Even using only 40 per cent steamed pulp, 40 per cent sulphite is replaced and its cost and freight saved. The heavier weights of this grade of paper can use a higher percentage of steamed ground wood than this, a 60-lb. sheet being perfectly satisfactory when containing 75 per cent steamed ground wood and 25 per cent sulphite. The stock dries well on the driers. As much as 46 tons of this paper, basis 24 by 36, 60 lb., can be made on a Fourdrinier trimming 105 in. with twenty-six 48-in. driers.

The pulp is a maple or tan color, verging on the orange. It is found from experience that when cooking these pines for longer than 20 hours the increased cost and darkening of the fibers offset the slightly improved Mullen and tensile strength obtained, so that this figure can be considered as an economical maximum for cooking time for similar woods. The fibers are long and the pulp is tough and tears with difficulty. It seems to be a trifle softer than untreated pulp when dry. For use in this kind of paper, careful jordaning is relied on to keep up the Mullen of the sheet, rather than the beaters, as previously mentioned. The Mullen test obtained from this pulp alone, with a Fourdrinier formation, is about 4 lb. per 0.001 in., which is rather more than would be obtained on the usual cylinder machine. The stock is kept very thin, 0.110-in. centrifugal screen plates being used.

Use in Board

Some cylinder machine applications of steamed pulp will now be considered. These include quite a variety of board products, such as wallboard, trunk and suitcase board, leather board, various container boards, etc., where the color is not objectionable and the pulp can replace more or less unbleached sulphite. It also serves to increase the strength over that obtainable from ground wood or waste papers. It is not sufficiently strong to replace any pulp stronger than sulphite.

Spruce, steamed at 50 to 55 lb. for 14 hours, and a mixture of birch (50 to 75 per cent) and maple (50 25 per cent), or either alone, similarly treated, yie pulps particularly adapted to make certain stror boards. This steamed spruce ground wood is now su cessfully used alone for solid jute boards in its natur color. Such boards are not brittle, are tough and a good benders. The color of the pulp, and hence of th boards, varies from a light to dark tan, sometimes wit a slightly reddish cast. Used as outside liners in fille jute board, the bending quality is improved, and th strength of the board increased over plain chip for th same caliper. All these boards take and retain a goo water finish and are good imitations of genuine jut Spruce and other coniferous woods are steamed unde the above conditions for the production of brown pul for suitcases, trunks, etc., and for use as a filler in th manufacture of leather board, mill board, etc.

Pulping Hardwoods

The pulp obtained from grinding hardwoods whic have been steamed as above is quite different in som respects from steamed spruce pulp. With both th hardwood and spruce a 6 to 1-in. diamond burr is usuall used, keeping the stones dull. The more seasoned an drier these woods are the less cooking they require Wood seasoned for 3 years, which is apt to be rathe punky, would be steamed for 14 hours at 30 lb., whic can be considered as the minimum limit for this clas of pulp.

Steamed hardwood pulp is of small tensile strength tender and very likely to cause trouble in lapping and o the paper machine owing to these characteristics. Whe dry it makes a very rigid but brittle sheet. While th fibers are short and lack the felting power of steame spruce, they are still not as slow as the steamed spruc ground wood, which is conceded to be one of the mos difficult stocks to handle on a cylinder machine. Th "footage" obtainable from the steamed hardwood i comparatively good in spite of the density and weigh of the pulp. The cooked hardwood logs are best groun with steamed spruce wood in the proportions of on pocket of steamed spruce and five pockets of steame hardwood. This permits lapping on the wet machine an easier running on the cylinder machine owing to th added tensile strength from the steamed spruce. In som cases the cooked spruce can be omitted from the grind ers and 20 to 30 per cent of natural ground wood an 5 to 10 per cent sulphite pulp used to give strengt and freeness to the stock and prevent machine trouble Though steamed hardwood pulp has a low tensil strength, the Mullen test of boards made from it run high on account of their great rigidity.

This pulp is much different in color and darker than steamed spruce, being a rich chocolate shade. For thin boards which must have both puncture resistance (rigidity) and tensile strength, a sheet made up of equa caliper plies of cooked spruce and cooked hardwood makes an excellent combination. Used as a filler and bottom liner, with a top liner of natural ground wood and sulphite in suitable proportions, very strong yet attractive looking boards are made. Where very thick heavy boards of extreme rigidity are desired, three o four plies of steamed hardwood boards, pasted together with sodium silicate on a sheet pasting machine, wil give a product with almost the rigidity and smoothness of solid wood, suitable for making the largest and strongest trunks and for other products which may be subjected to extremely severe usage.

Wallboard made entirely from steamed wood pulp would be too expensive, owing to the large weight per square foot giving small "footage" per ton of board; but one or two cylinder plies on the inside add much to the strength and rigidity so important in these products. The use of steamed ground wood in products of this character is patented.

Since all steamed ground-wood pulps are very slow, as compared with untreated wood similarly ground, some suggestions regarding proper construction and operating conditions for the paper machine might be of help. Owing to the difficulty in handling this stock on the machine, the machine crews must be of the very highest caliber and skill, preferably those who have previously handled slow stock on multicylinder machines.

In the first place, because of the slowness of the pulp, it is imperative that as little stock as possible be applied to any one cylinder mold in building up the sheet. This smaller amount permits the water to drain out more quickly from the greasy stock, thus reducing the likelihood of "blows." "Blows" in board are usually caused by an outside cylinder ply being more compact and thus slower than the filler stock. Consequently the press rolls cannot squeeze out the water from the liner fast enough, but instead the water in it acts something like a lever, forcing the liner from contact with the filler ply.

Referring again to the necessity of applying as little pulp as possible to each cylinder mold, in order that thick boards may be made, machines with unusually large numbers of cylinders are used. Trunk board, for instance, is made of steamed spruce and hardwood applied to from nine to twelve cylinder molds, rarely or never less than nine. As an approximate estimation of the caliper of dried pulp applied by each mold, this should run from 0.003 to 0.004 in., as contrasted with 0.005 to 0.006 in. for waste paper boards and 0.006 to 0.007 in. for coarse free ground-wood stock such as wallboard single-ply, for which six cylinders are used in place of nine or more.

Size of Vat Circle Important

Another important factor in construction is the size of the vat circle—the radial distance from the cylinder mold wire to the inside surface of the cylinder vat lining. If this clearance is small, say 3 to 4 in., especially with very wet stock, the fiber will be so compact that a dense, heavy, wet sheet is formed from which the water is very slowly removed; while a clearance of 6 to 8 in. makes a sheet which, while not giving quite the finish of the more compact stock, gives greater production and less trouble because of being freer and more open. The "footage" of board obtainable per ton of pulp will be greater, since it will run lighter in weight per unit of caliper.

To permit free and quick passage of the water pressed out, the felts used should be as open and coarse as consistent with the requirements of the sheet as regards smoothness and felt marks. All couch rolls, baby press rolls and main press rolls must be kept in perfect condition and alignment to prevent damp spots and streaks in the sheet.

The satisfactory operation of a board machine on this pulp involves more difficulties than a Fourdrinier. Using slow stock on a Fourdrinier, the suction is increased on the suction boxes and suction press roll. In a multicylinder steamed ground-wood board machine, the suction on each cylinder mold must be reduced and kept uniformly so, by lowering the head to 3 to 4 in. or less as compared to 13 to 14 in. on free stock. The driers must be regulated to dry the sheet slowly and gradually, to avoid blistering.

Where the quality and thickness warrant, refined ground-wood screenings are useful in reducing weight and freeing up the stock, and are cheap; refined sulphite screenings, though darker in color and more expensive, both free and increase the strength of the stock.

The following estimate of production possible from a cylinder machine operating on steamed pulp is probably conservative. If a machine making 90 tons of a pure uncooked spruce ground-wood board were put on 20 per cent refined ground-wood screenings and 80 per cent steamed ground wood, by working much harder the machine crew could maintain an output of about 75 tons.

General Considerations in Cooking Conditions

Table I summarizes the cooking practice for the various woods considered in this article and will be found suggestive in deciding on how best to cook a given wood for certain uses.

TABLE I—SUMMARY OF COOKING PRACTICE

Wood	Length of Cook, Hr.	Steam Pressure, Lb.	Natural Fiber Length, mm.	Color of Pulp	Tensile Strength	Other Characteristics
Maple, Birch:						
Dry	14	30	1.5	Dark	Low	Rigid. Brittle.
Green	14	50 to 55	1.5	Chocolate	Low	Compact. High Mullen. Tough.
Spruce:						
Dry	14	30	2.8	Light to	High	Elastic. Good bending.
Green	14	50 to 55	2.8	dark tan	High	Not so rigid as hardwood.
Scrub pine, White pine:						
Dry	9–12	13 to 16	2.8	Same as	High	Same as for spruce
Green	12–16	16 to 20	2.8	spruce	High	pulp.

Considering again the twelve factors determining cooking conditions, the fundamental one is No. 10—"Product in which pulp is to be used and its requirements as to color, strength and finish." This automatically specifies the color or strength the pulp must have and hence pressure and duration of cook that will give them.

In carrying out the trial steaming tests to determine the best conditions, no logs should exceed a certain maximum diameter, say 8 to 9 in., and their moisture content should be approximately constant for all test runs and either be extremely green or extremely dry, preferably the former, as the wood of high moisture content will require the most severe conditions. Practically, this means that all the wood used should have been felled at the same time of year and have been similarly dried afterward, if seasoned wood is used. In this way all the data obtained will be of unquestioned value for the purpose. Moreover, the wood should be of the same species or at any rate of species of practically equal densities. Steaming, grinding and machine runs under these known conditions having been carried out and all pertinent data recorded, if a satisfactory product has been obtained, factors 11 and 12 can be considered and the conditions modified so far as possible to conform with these two factors. As a final step in the standardization process, satisfactory cooking conditions should be found for woods containing the opposite extreme of moisture to the original content selected.

In connection with factors 11 and 12, dealing with the construction and financial conditions at the mill, the following may be of help. Practical economic considerations would dictate that the total cost for the steaming operation alone (not including wood preparation but including everything from power to elevate wood to cookers, to labor or power to take steamed wood to grinders) should not be more than three-quarters of the difference between the cost of natural ground wood and No. 2 unbleached sulphite pulp. Above this fraction of the difference in cost it would doubtless pay in the long run to use the unbleached sulphite rather than make steamed ground wood at all. Ground wood is now $32 a ton and No. 2 unbleached sulphite $48, a difference of $16. Three-quarters of the difference, or $12, is therefore the economical limit. There are practically no cost figures available on the steaming operation, and conditions vary greatly, so that such figures would not mean very much at best. The following data may help in approximating such cost:

1. Interest on investment would be comparatively small, a few cents per ton with rotaries; but would be much larger with the building, wood bin, conveyors, cookers and miscellaneous equipment necessary when the vertical type is used. The operating cost exclusive of interest charges would be less for the vertical type. Vertical cookers or steamers of the type and size indicated in the drawing can be obtained now for $5,050 each. Two would probably be necessary for most economical operation, as previously pointed out.

2. Steaming at 15 to 20 lb. for 15 hours, using unjacketed rotaries and not reclaiming residual steam by absorption in boiler feed water, the coal consumption is estimated to be ¼ ton coal per cord steamed. At an evaporation of 9 to 10 lb. water per pound of coal, this would figure out as 4,000 to 4,500 lb. steam per cord of wood. At a yield of 2,200 lb. AD pulp per cord, this would be 0.227 ton coal per ton AD pulp.

3. Where wood must be barked before cooking, two men per shift are required. Where unbarked wood can be used, one man per shift is sufficient. In both cases it is necessary that they devote their entire time to duties directly and indirectly connected with its operation.

Control of Operations

Satisfactory cooking conditions once having been worked out for a particular mill, care should be exercised to see that no woods varying widely in density from that considered in the standard conditions are used. Care should be taken that no wood with unusually large amounts of pitch are cooked under conditions suitable only for smaller amounts of pitch. Of course the moisture content of the logs will have to be watched and conditions varied as may be necessary. If the wood seems to be unusually wet or dry, occasional moisture determinations will aid in avoiding undercooked wood and machine trouble. The value of the product, as compared to higher grades of pulp, is not enough to warrant any great expenditures for elaborate control work for moisture, yields, etc.

Possible Future Applications of the Process

Steaming hardwoods and pitchy woods, neither of which give satisfactory ground wood in the untreated state, would seem to offer fields for wider use of the steaming process, to replace, in part, unbleached sulphite in locations where few of the local woods are adapted to the sulphite process.

Woodford, Me.

Groove Inspection of Thermit Welds

By J. H. Deppeler
Chief Engineer, Metal & Thermit Corporation

ONE fact that has been responsible more than any other for retarding the progress of welding is that when a weld is made it has been impossible to determine without destroying it what strength is definitely assured and safe to allow. An examination of the surface of welds does not reveal this. For example, in gas or arc welding, the operator can carelessly leave voids and laminations during the work, and yet finish the surface of his weld so smoothly that these cannot be detected. To show another example, there may be numerous burned spots and other oxide inclusions which are hidden and yet render an apparently strong weld

FIG. 1—GROOVES CUT IN COLLARS OF THERMIT WELD MADE IN 9x10-IN. BARS

absolutely useless. It is on this account that technical societies and associations interested in the possibilities of welding have greatly restricted the permissible applications to parts which are stressed relatively light, or in those whose failure will involve small risks.

It is highly important, therefore, to consider the fact that Thermit welding permits the drawing of proper conclusions as to the strength of welds. If the proper amount of Thermit has been used and the work has been done by a skilled operator, it is impossible to have such defects as lack of fusion. Oxide inclusions, such as those formed during the preheating and adding of weld metal, or those remaining on unclean surfaces (due, for example, to failure properly to clean scale from wrought-iron sections before welding) have always resulted in Thermit welding in only one type of defect—i.e., blow holes. Due to the natural tendency of the gases to rise in the molten mass, this defect, if present at all, will always be present in the Thermit steel collars. It is apparent that an examination internally of the collar or excess metal can be made without affecting the strength of the weld. Thus the unsound welds can be found and condemned.

In practice, this examination is made as shown in Fig. 1 by gouging deep grooves in the collars parallel with the axis of the piece, these grooves reaching almost to the original sections itself. It is unnecessary to cut as many as shown, since we have found that two such grooves on the four sides of a Thermit weld are sufficient. If these grooves are observed to be free and clean from blow hole defects, the inspector may be assured that the weld itself is sound.

New York City.

Synopsis of Recent Chemical & Metallurgical Literature

Deterioration of Stored Cement

Details of a study of the storage and transportation of portland cement, with a bibliography on the subject, are given in Serial 2,377, obtainable from the Bureau of Mines, Washington, D. C. Deterioration of cement stored in bulk is less than in bags, owing to the smaller area exposed, states the United States Bureau of Mines, as the result of an investigation to determine the cause of deterioration of portland cement during storage and transportation. Hydration takes place only at the exposed surface, and the bulk of the cement is unaffected. Cement transported in bulk must be shipped in a tight, closed car, and must be protected from moisture during loading, shipping and unloading. Preferably it should be used immediately after unloading at the point of destination. This practice is now followed by several manufacturers and where conditions are suitable it is becoming more common as its advantages are seen. Shipping in bulk effects a saving by eliminating the use of bags which is an important item in the cost of cement—and it should also permit a saving in freight rates.

Air Conditioning in a Munitions Factory

A criticism of the technical literature on the subject of air conditioning, on the ground that it is deficient in detailed and critical study of the actual performance of recognized ventilation systems under the normal conditions of everyday use, introduces a pamphlet which has just been issued by the United States Public Health Service and written by C. E. A. Winslow and Greenburg. It is said that the details of installation are recorded in technical literature very fully, to the neglect of the results obtained in actual everyday operation. The authors have carried out investigations in a munitions factory which included over one hundred separate buildings. The greater number of the workrooms involved no special air conditioning problems and furnished good examples of the ordinary factory workroom ventilated by windows only, but thirteen of the workrooms studied were equipped with systems of fan ventilation, many of them designed to combat heat hazards of considerable magnitude.

It was found that in most of the rooms requiring no special ventilation the general tendency was to maintain a temperature slightly above optimum working conditions. A temperature of 68 deg. F. should be maintained and it is said that the systematic observation of a thermometer placed in every workroom and the intelligent regulation of heating appliances are all that is necessary to provide this condition. In other words, to quote the words of the authors, "A thermometer and a little common sense will solve a great many ventilation problems."

A problem was encountered in the annealing shop, which contained a large number of rotary furnaces on each side of the room. The temperature in these furnaces was about 1,200 deg. F. A system involving two air washer fans, each having a capacity of 45,000 cu.ft. per minute, was arranged to deliver air to both sides of the room at the floor level, with another duct along the center of the ceiling. It was found that this system was amply sufficient to keep conditions good when the weather was cold, although the CO_2 content of the air rose to as high as 14 parts, due no doubt to the presence of furnace gases. Other detailed studies were made in the shell-washing shop, where the heat and humidity were controlled by fan ventilation. Curves are given which show very plainly the changes in atmospheric conditions in this wash shop caused by interrupting the fan ventilation. In general, it is concluded that while conditions in this workroom under normal operation were by no means ideal, the temperature being sometimes over 80 deg., they would be almost unbearable without the very efficient system of ventilation that has been installed.

In conclusion, the authors state that in the summer time while the hazard incident to processes involving the production of excessive heat can and should be mitigated to some extent by a system of ventilation which produces vigorous air movement, it cannot be fully controlled except by special systems of air cooling which involve considerable expense, but which must be accepted as an inevitable incident of certain industrial employments. Where this is the case, the effect of the high temperature should be minimized by short spells of work alternating with rest.

Tellurium and Its Uses

Detailed information regarding the properties, uses and metallurgy of tellurium is given in Serial 2,385, by H. A. Doerner, chemist, which may be obtained from the Bureau of Mines, Washington, D. C.

The finding of new uses for the mineral tellurium would render marketable a byproduct of which the copper refineries of the country can produce 125,000 lb. annually but for which there is little present demand. Although the mineral possesses various rather remarkable characteristics, present uses are so limited that the demand is supplied by a few hundred pounds per year.

Most gold and silver ores and particularly copper ores contain tellurium. In the course of smelting and refining these ores, tellurium is found in concentrated form in the flue dust of smelters, electrolytic slimes, and in the fumes and slags resulting from cupellation. The whole commercial supply of the element is obtained as a byproduct from copper ores. Pyrite and sulphur used in the manufacture of sulphuric acid also contain tellurium, as it is found in the flue dust and acid sludge of acid plants. Tellurium minerals are found in Transylvania, Hungary, Spain, Brazil, Bolivia, Chile, Mexico, Japan, Australia, California, Colorado and Virginia.

Efforts have been made by government agencies in co-operation with copper refiners to discover new uses for tellurium, but no important results have been reported. It has been used in a small way in high-resistance and other alloys, in organic dyes, for staining silver, in medicine and as a reagent in chemical laboratories. As a coloring agent in glass or porcelain, blue, brown and red colors may be produced by tellurium, some of the best ceramics being colored in this way. Tellurium dissolved in sodium sulphide solution is used in toning baths for photographic prints. Tellurium dioxide at red heat is a powerful oxidizing agent, decomposing completely even lumps of steel or metal alloys. Its chemical similarity to sulphur suggests many possible uses. It might be used, for instance, as telluride in coloring lithopone, and the extension of the use of tellurium might well be studied in connection with the iron and steel industry. The Bureau of Mines considers there is undoubted promise in experimentation with tellurium compounds in the field of organic medicinals, while their physiological action in derivatives similar to those of sulphur and selenium has not yet been developed. In compounds similar to selenium oxychloride, tellurium may provide valuable laboratory reagents.

The use of 0.2 per cent diethyl telluride in gasoline as an anti-knock compound has been reliably reported. It is said to eliminate carbon deposits and to produce greatly increased efficiency when used in motors designed to operate on very high compression. A special type of engine is said to be required to produce these results, hence its general use in motors will not be feasible unless the motor industry should conform to the required type. This step in turn would be dependent on a supply of tellurium adequate to treat all the motor fuel. For this purpose, 1,500 tons of tellurium per year would be required, and as the possible annual supply of tellurium from the present best known sources of copper refineries is said to be only about 125,-

000 lb., a much larger supply must be developed; the discovery of new uses not dependent on so large a supply would result in wider utilization of present resources.

Tellurium is usually offered in the impure state, and no market standards have been developed. No ores are known that are rich enough in tellurium to permit mining and treatment for tellurium alone, even if the demand increased to large proportions. It is probable that the future supply will be derived as a byproduct from metallurgical processes, as in the past.

Samples of tellurium for research purposes may be obtained from the Committee on the Uses of Selenium and Tellurium, National Research Council, Washington, D. C.

Comminuted Smokeless Powder for Blasting

Information regarding the physical properties of comminuted smokeless powder and instructions regarding the handling, packing and use of the explosive are given in Serial 2,386, by C. E. Monroe, chief explosives chemist, and Spener P. Howell, explosives engineer, recently issued by the Bureau of Mines.

Tests made by the bureau show that large supplies of smokeless powder left in the possession of the federal government at the close of the war can, in the form of comminuted smokeless powder, be used effectively for certain industrial blasting purposes. Field tests made by the bureau at the explosives experiment station at Bruceton, Pa., have demonstrated the practical value of this powder for stump-blasting, boulder-breaking and ditch-digging purposes. As the result of experiments previously made by the Bureau of Mines looking toward the industrial utilization of other types of military explosives, more than 34,000,000 lb. of surplus trinitrotoluene, 13,000,000 lb. of picric acid and about 1,000,000 lb. of grenade powder have been allotted by the War Department to other departments of the government. These allotments have been used in industrial blasting and also on a great variety of government projects, and gave entire satisfaction.

The problem for smokeless powder is unlike that for TNT and picric acid. Both the latter are detonating explosives used to break up the shell, or other devices containing them, into fragments which act as missiles; smokeless powder is designed to take the place of black gunpowder in driving the projectiles from guns. Hence smokeless powder is a propellant, and an essential of a propellant is that it functions by progressive burning, not by detonation, as detonation within a gun would probably burst the gun.

From the time of the entrance of the United States into the war until its conclusion there was produced in this country 632,504,000 lb. of smokeless powder; at the declaration of the armistice one factory alone of our many factories had a daily capacity for production greater than the entire annual capacity of the country prior to the war.

The adaptation of smokeless powder to use as an industrial blasting agent is due to the discovery by Major John Herbert Hunter, Ordnance Department, U. S. A., that when smokeless powder is ground to fineness the ground material can be detonated by No. 6 detonator, and therefore may, in this condition, be used as a blasting agent. Major Hunter has dedicated to public use in the United States the patent granted to him for this discovery. Therefore all are free to use the process without payment of royalty. In his specifications Major Hunter points out that the rate of detonation of this comminuted smokeless powder varies with its fineness as measured by sieves of 8 to 80 mesh; it is possible, then, by regulating the grinding and sieving, to prepare explosives having different but determined rates of detonation, thus suitable for various kinds of blasting. He provides that in use this comminuted smokeless powder shall be packed in cartridges, as is the practice with dynamite. The product is styled "comminuted" because this term is broad enough to include any and every method of subdividing the grains without destroying their chemical identity.

As the gaseous products of detonation include poisonous and flammable carbon monoxide, comminuted smokeless powder is unsuitable for use as an explosive in dusty and gaseous coal mines or in other places where flammable dust, gases or vapors may be encountered. Nor should it be used in mines, tunnels or other close places, unless the ventilation is very good and workmen are not in contact with the poisonous gases produced by it. Comminuted smokeless powder has a pale yellow color with an earthy luster. It is tasteless, odorless and insoluble in water. When touched by the tongue, it gives the sensation imparted by dry earth or chalk. Being insoluble and non-volatile, it is not poisonous, and so far as this characteristic is concerned, it may be handled with impunity. It does not melt when heated, but it is very flammable and easily ignited.

South Carolina White Clays

The methods of mining and preparing white clays for market in the vicinity of Langley, S. C., are described in Serial 2,382, by W. M. Weigel, mineral technologist, just issued by the United States Bureau of Mines. Langley is about 9 miles north of Augusta, Ga. The clays mined in this district are sedimentary kaolins with few impurities. The prevailing color is white; at times the color is smoky gray or pink, and occasionally strong pink to lavender. The lighter colors usually become white on exposure to the air and on drying. The lower parts of the beds are usually the whitest. These kaolins are fine grained in texture, and have good plasticity; their tensile strength is from 8 to 36 lb. They generally slake readily. Their specific gravity is from 2.50 to 2.25. The clay in the district are well adapted for us in paper stock, for which they ar mainly used, and in pottery and china ware, without washing. In the district as a whole considerable reserves of cla are yet untouched, hence the industr can be considered fairly stable.

Copies of Serial 2,382 may be ob tained from the Bureau of Mines Washington, D. C.

Tests on Miguet Process for Obtaining Alumina From Clay

As a good grade of clay contains fro 30 to 40 per cent of alumina, the pros pect of recovering it is alluring an proposed methods are appearing con stantly in the patent literature. Typi cal of these is U. S. Patent 1,376,56 granted to Paul Miguet. He propose to prepare an alkaline aluminate b fusing clay, lime and scrap iron with reducing agent in the electric furnace the reactions being supposedly as fol lows:

(1) $Al_2O_3.2SiO_2 2H_2O + Fe + 4C + CaO = CaO.Al_2O_3 + FeSi_2 + 4CO + 2H_2O$

(2) $CaO.Al_2O_3 + Na_2CO_3 = Na_2O.Al_2O_3 + CaCO_3$

The sodium aluminate thus obtained readily yields aluminum hydroxide while the ferrosilicon should be a profit able byproduct.

So many reactions similar to the above have been proposed and it is so popularly believed that alumina can be obtained from clay by fusion that the Northwest Experiment Station of the Bureau of Mines at Seattle, Wash. undertook to investigate the Miguet process. The results are recorded in *Reports of Investigations*, Serial 2,393 by Clyde E. Williams and Clarence E. Simms.

The tests were carried out in a car bon-lined pit furnace of the Girod type having a tap-hole to remove the fused material. Clay containing 38 per cent alumina, pure air-slaked lime, steel turnings and gas-retort carbon were used. Using these in the proportions indicated by the equations, only a trace of alumina was obtained. Increasing the carbon to three times and the iron to twice theoretical, and melting the charge with the furnace over-powered to such an extent that dense fumes arose, the product was found to contain carbides of calcium, aluminum and silicon, sillimanite and quantities of a glassy substance. Analysis showed that 40 per cent of the silicon had been reduced and alloyed with the iron. About 30 per cent of the alumina was recovered. However, the prospects of successful commercial application are extremely poor, as under the most favorable test the cost of material alone would be more than $300 per ton. Moreover, there is no proof that calcium aluminate was formed, because with so much carbide present it is just as likely that the sodium aluminate obtained was formed by the decomposition of aluminum carbide and its subsequent solution in the sodium carbonate.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Economics of Industry Discussed by Engineers

ociety of Industrial Engineers Holds Very Successful Convention in New York—Place of Engineer in Business Arouses Interest

OSEPH W. ROE was re-elected president of the Society of Industrial ngineers at the ninth annual conven- on held in New York, Oct. 18, 19 and). Professor Roe is a member of the xecutive board of the American Engi- eering Council and head of the de- artment of industrial engineering at ew York University. F. C. Schwedt- an, vice-president of the National City ank of New York, was re-elected easurer, and George C. Dent of Chi- go was continued as secretary and siness manager.

"Economics of Industry—the Funda- entals Necessary to Maintain Maxi- um Production with a Minimum Ef- rt, Waste and Cost" was the major bject of the convention, notable for e wide public interest attracted by the apers and addresses and for the co- eration of the United States Shipping oard, which made the event the occa- on for a declaration of policy as to e American Merchant Marine. The port of the American Engineering ouncil's committee on elimination of aste in industry shaped to a consider- le extent the proceedings of the con- ntion, at which the viewpoint of both orker and managing executive was esented.

On the opening day the delegates were ncheon guests of the Shipping Board oard the steamship President Hard- g at Hoboken. Commissioner E. C. lummer of the board made the journey om Washington to address the engi- ers. Mr. Plummer advocated the pas- ge of the bill providing aid for Ameri- n ships now before Congress as ecessary to economic development and e building up of American trade oad. "To delay is to play directly to the foreigners' hands," asserted r. Plummer.

President Roe, in his opening address, id that "the hard-boiled" factory man- er has been forced to accept the pure ientist from the laboratory and that e engineer, the chemist, the metallur- st, as the case may be, is now as cepted and necessary a part of large- ale industry as the accountant.

"We are at another joining of the ays," added Professor Roe. "Fifty ars ago it became apparent that in- strial waste and mechanical ineffi- ency were no longer negligible. To- y, with the increasing scale of pro- uction, it is becoming evident that cial wastes are no longer tolerable."

A major cause of overproduction, according to Professor Roe, is the ignoring of the law of diminishing returns by industrial leaders.

Engineers in Business

J. H. Pardee, president of the J. G. White Management Corporation, New York, discussing "The Part of Economics in the Formation of a Policy of Business Administration," said that the engineer has presented the broadest and most comprehensive points of view of business practices. Mr. Pardee said manufacturers should have a clearer understanding of the principal characteristics of their business.

Ernest Du Brul, general manager of the National Machine Tool Builders Association, Cincinnati, speaking on "The Economic Aspect of Production," said that the idea that mere fabrication creates value is a common error of industry, continuing:

"In this country we have had various destructive projects by big men in business, like the Ford and Edison and Durant schemes of currency and credit. We likewise have had some notable business smashups, to the tune of three-quarters of a billion of liabilities last year. Heaven only knows how much more was lost by those who did not smash but were able to survive the tidal wave of deflation. The biggest and most failures were among the manufacturers of various kinds, fabricators of goods. Do these failures not indicate that something is very wrong with the economics these men applied in management? Business gets into such a state because business managers start out on false premises due to incomplete knowledge of economic theory."

Welfare of Workers

Frank B. Gilbreth and L. M. Gilbreth of Montclair, N. J., presented a paper on "The Relation of Fatigue Elimination to Other Activities," which urged that the fatigue committee of the society work along two lines: First, increasing co-operation with others, engaged in other types of work; second, development of units, methods and devices that will be useful in the elimination of unnecessary fatigue.

A feature of the convention was a discussion by William Geiger of Newark, representing the workers, and John A. Faust of New York, representing the executives. Mr. Geiger answered the question of executives as to how production costs can be reduced by advising better use of the workers' time. Mr. Faust said that the remedy was to be found in the creation of a commission composed of high-grade specialists in financing, accounting and engineering. This commission, he said, would apply precautionary measures to business much as the Life Extension Institute applies them to the human body.

Robert B. Wolf, of New York, vice-president of the American Society of Mechanical Engineers and a member of the Hoover committee on waste in industry, in an address on "The Importance of the Elimination of Waste to the Economic Structure," said that in order to reduce industrial waste to a minimum industries must be so organized as to stimulate the workers' process of thinking.

Many Prominent Speakers

During the convention sessions were held by various groups, including managing executives, accountants and sales managers. Other speakers at the convention covered a wide range of activities. They included Dr. Lee Galloway, the Ronald Press; Prof. R. C. McCrea, Columbia University; Prof. Fred R. Fairchild, Yale; Prof. Edwin H. Schell, Massachusetts Institute of Technology; Prof. Edward J. Kunze, Pennsylvania State College; Miss Nellie Swartz, New York State Department of Labor; Dr. Louis I. Harris, New York City Department of Health; A. J. Lutterbach, Milwaukee; Charles Cheney, South Manchester, Conn.; O. L. Preble, New York; Dr. Davis R. Dewey, Massachusetts Institute of Technology; Francis H. Sisson, New York banker; Royal R. Keely, New York; Arthur J. Todd, Chicago; Earl B. Morgan, Philadelphia; Miss Louise B. Moore, Poughkeepsie, N. Y.

Activities of British Institute of Metals

A general program of the meetings of the British Institute of Metals and its local sections has been issued by the general secretary, listing a number of prospective papers of considerable importance. The Institute now has five local sections holding monthly meetings during the winter—namely, Sheffield, Scottish (meeting at Glasgow), Birmingham, London and North-East Coast (meeting at Newcastle-on-Tyne). The last has been organized during the summer. Walter Rosenhain, head of the metallurgy department of the National Physical Laboratory, has been chosen to deliver the annual May lecture.

Grasselli Medal Awarded to W. H. Fulweiler

American Section of Society of Chemical Industry Honors Gas Expert

The Grasselli medal, presented every year by the Grasselli Chemical Co. to the author of the best paper presented before the society during the previous year, was presented to W. H. Fulweiler, chemical engineer of the United Gas Improvement Co. of Philadelphia, at the regular meeting of the section at the Chemists' Club, New York, on Oct. 20. The presentation address was made by H. S. Miner, chief chemist of the Welsbach Co. of Gloucester, N. J.

Dr. Miner sketched the professional career of the medalist and described his numerous accomplishments in the field of applied research in the chemistry of the gas industry. Mr. Fulweiler is a graduate of the University of Pennsylvania and has devoted his entire professional career to the problems of the gas industry, having first served as superintendent of the Kansas City Gas Co., later in the department of tests of the United Gas Improvement Co., becoming chief chemist for that company and finally chemical engineer, the position which he now occupies. He was the first to apply the waste heat boiler in water-gas manufacture. The development of the well known road binder "Ugite" is the result of his research work, as is the "cut-back" method of tar production. During the war Mr. Fulweiler co-operated with the Ordnance Department in developing new processes for the manufacture of toluene. He is also responsible for the development of a new motor fuel for airplanes, which was a byproduct from the manufacture of toluene.

The medalist is well known as the author of many articles and papers on problems and developments of the gas industry.

In accepting the award, Mr. Fulweiler spoke briefly of the growth of the gas industry in this country, pointing out that in spite of the growing popularity of electricity for lighting, the production of gas has increased tremendously in the past 20 years. He expressed the belief that the adoption of the thermal standard starts a new era for the gas industry. He pointed out that the gas industry utilizes some of the most complicated physical and chemical reactions, although very little is known of the fundamental theory back of them. Consequently there is still a big field for research in the gas industry.

The enthusiastic reception which Mr. Fulweiler received was evidence that the choice of this year's medalist was a popular one.

Papers on Ozone

The subject for discussion before the meeting was ozone. Two papers were presented; the first, by F. E. Hartman of the United States Ozone Co., described ozone generators and their industrial application, while the second, by E. W. Felkel, of Mellon Institute, discussed the effect of ozone on organic compounds.

Mr. Hartman described the early attempts to manufacture on a commercial scale and traced the development of the modern ozone generator. He described the application of ozone to the drying of oils, giving the results of tests comparing the drying of varnish in air and in ozone. It has been established that the physical properties of the varnish are superior when the varnish is dried in ozone; the hardening period is reduced from weeks to hours and some special waterproof varnishes which cannot be satisfactorily dried in the ordinary way can be satisfactorily dried in an atmosphere of ozone. The speaker discussed the effect of ozone on varnish constituents. The action is, in general, both bleaching and oxidizing. Linseed oil is bleached by treatment with ozone. On the other hand, there are some oils that do not bleach on treatment, but after standing for a period of a week following the ozone treatment, they are decolorized. The explanation offered for this phenomenon was that the ozone forms ozonized air which later breaks down and gradually bleaches the oil. No oil has yet been found which cannot be bleached, either by simple treatment with ozone or by such treatment followed by a period during which this secondary action takes place.

Effect of Ozone on Organic Compounds

Mr. Felkel's paper described the general behavior of organic compounds when treated with ozone and particularly described the formation and properties of the ozonides. Ozone reacts on organic compounds in two ways: Ordinarily it is an active oxidizer, but with the unsaturated hydrocarbons, it forms addition products.

The formation and properties of the ozonides have been utilized in determining the structure of various organic compounds. For example, the constitution of oleic acid was discovered by first forming the ozonide and then breaking it up.

Industrial Applications

An interesting discussion of the industrial application of ozone was started by the inquiry of J. C. Olsen, who has worked with ozone in the treatment of contaminated water. Numerous applications were discussed, among which were the use of ozone in the air used for ventilating cold storage warehouses; for the purification of down and feathers and in smoke houses, to prevent the formation of mold on the meat.

Mr. Hartman stated that there are about 1,500 commercial installations of ozone water purification systems in this country. The most widespread application of the apparatus is in the treatment of water used for carbonated beverages. It has also been successfully used for purifying the water in swimming pools.

Technical Meetings to Feature Power Show

Engineering Societies Schedule Meetings to Coincide with Exposition in New York

The National Exposition of Power and Mechanical Engineering, to be held at the Grand Central Palace in New York from Thursday, Dec. 7 to Dec. 12 closing, however, on the intervening Sunday, is being planned in co-operation with the national societies interested in the economy of fuel and in the production and use of power generated therefrom.

The opening of the exposition in the Grand Central Palace will take place on the closing day of the annual meeting of the American Society of Mechanical Engineers, and time has been set aside in the A.S.M.E. program so that members may attend the opening exercises. Furthermore, the programs of the twenty sessions to be held at the A.S.M.E. meetings have been so arranged that all members attending the meetings may take in both the technical discussions and the exposition in the least possible time.

In addition, the A.S.M.E. professional divisions on aëronautics, ordnance and forest products will hold sessions of general interest to the engineering profession.

The American Society of Refrigerating Engineers is to hold its meeting at the Hotel Astor for three days commencing Dec. 5, and its members, as well as the members of the A.S.M.E., will be admitted to the exposition upon the presentation of their membership cards.

The opportunity this exposition offers for the power house operating man will also be grasped. The National Association of Stationary Engineers is perfecting plans for the various chapters to visit the exposition in a body. In addition, the New York Building Superintendents' Association, 600 strong, will attend in a body and they will be received by the officers of the N.A.S.E.

The great diversity of exhibits insures the particular appeal that this exposition will have to all engineers, as it will permit them to learn quickly and thoroughly of the progress in mechanical engineering. All industries using heat or power in any form will be interested in the displays of steam turbines, steam engines, steam boilers, feedwater heaters, superheaters, economizers, metering devices, stokers, coal handling apparatus, valves and pipe fittings. Each of the exhibitors is planning to emphasize the features of his product which denote progress.

Vitrefrax Company Plant Destroyed by Fire

The plant of the Vitrefrax Company at Los Angeles, Calif., was completely destroyed by fire on Sunday, Oct. 15. Reconstruction was begun at once along lines that will bring the capacity of the plant to a figure considerably higher than ever before.

Federal Coal Commission Begins Study

John Hays Hammond Appointed Chairman of President's Committee to Analyze Problems of Coal Industry

THE FIRST ACT of the United States Coal Commission at its initial meeting on Oct. 18 was to designate John Hays Hammond as its chairman. The commission immediately plunged into a discussion of a program for its exhaustive study of the problems of the coal industry. No formal announcement has been made as to how the work will proceed, but certain of its policies already are apparent. It is the intention of the commission to keep the public informed as to each step of its progress. It recognizes that in this way the public will be able to absorb more knowledge of the problems of the coal industry. The commission recognizes that the only chance that it has to accomplish anything is to obtain public support for its recommendations. It is believed that if the public mind goes through the same processes that the minds of the commissioners will go through, they will be prepared to pass intelligent judgment on the conclusions. Frequently when conclusions constitute the first knowledge that the public has, much time must elapse before their real purport is understood. Thinking takes time. Recognizing that fact, the commission hopes to be able to carry the public along with it as the study progresses.

Distinguished Personnel

The commission was appointed by the President on Oct. 10. Its personnel includes John Hays Hammond, well-known mining engineer; Thomas R. Marshall, Vice-President during the Wilson Administration; Samuel Alschuler, Judge of Seventh U. S. Circuit Court; Clark Howell, editor of the Atlanta *Constitution;* George Otis Smith, director of the U. S. Geological Survey; Edward T. Devini, teacher, writer and lecturer on social and economic questions and Charles P. Neill, expert on labor problems and conditions.

It is expected that the commission will appoint a fairly large staff of specialists who know how to collect coal information and put it together. It is believed the commission will hold as few formal hearings as possible and try to glean its information through more intimate contact with those who are acquainted with the industry. The hope is very generally expressed that the work will be divided among the individual members of the commission and among the commission's staff so as to amass data in that way rather than go through the time-consuming and generally unprofitable process of a public hearing.

The problem is so intricate that the commission expects to call to its aid each subdivision of the coal industry. One of its first acts was to invite into informal conference John L. Lewis, president of the United Mine Workers of America; Alfred M. Ogle, president of the National Coal Association, and S. D. Warriner, a leading anthracite operator, and to ask each to appoint a consulting committee, which is to maintain close contact with the commission and assist it by presenting such facts as may be called for from time to time.

Immediate Action Expected

Since E. E. Hunt is the secretary of the commission, it is reasonable to suppose that he will resort to much the same form of organization that functioned so successfully during the President's Unemployment Conference—the plan also used at the Conference on Limitation of Armament. At those conferences, advisory committees, composed of representatives of the varied interests concerned, were used with great success. For instance, an advisory committee on storage would be composed of representatives of coal operators and of large consumers—those most likely to benefit or be interested in storage. This plan, if acceptable to the present commission, would be carried out in a way so that an advisory committee would be formed for each of the important problems within the industry. In this way the commission would be saved a large amount of work and would be furnished with much predigested material.

Since the commission must make its preliminary report on Jan. 15, advantage must be taken of all means to expedite the study. It is probable that the commission will call upon those most concerned to loan it some of their specialists. Only in this way can the commission secure the requisite skill necessary to its work.

Daugherty Makes Capital of Chemical Foundation Suit

In a campaign speech at Canton, Ohio, on Oct. 21 Harry M. Daugherty, the Attorney-General, among other things said:

"We would have heard little criticism of the Department of Justice had it not been discovered that a case like the Chemical Foundation, for instance—in which valuable patents were assigned by public officials to companies which they themselves had organized—was under investigation, and the part played by those involved also was being scrutinized by government agents.

"And let me here, without giving any intimation as to who the men were, let me suggest that I have had the unique experience of sitting in the Department of Justice and listening to the story of a man formerly connected with the government and hearing patiently his pleas for certain fairly legitimate concessions, when, at the same time, in the city of New York, another former official, one of his associates, was busily engaged in getting contributions and making connections in order that the attacks upon the Department of Justice and the government might be increased, reinforced and successfully continued.

"I can give the names of these parties if ever they lift their voices to dispute this statement, but, unless I am authorized by them so to do, I should like to go through this entire investigation without prematurely mentioning names except in the orderly process of court proceedings. Their names, however, will be found in connection with certain litigation wherein some of the most important questions and some of the most questionable transactions and some of the most valuable properties in the world are in dispute, and the right and wrong of the transactions connected with the transfer of certain property must be determined in a court of justice."

Gas Analysis Basis for Automatic Control

Washington Chemical Society Has Demonstration of Novel Principle for Process Control

A most convincing demonstration of the manifold possibilities of automatic gas analysis for industrial process control was given by P. E. Palmer of the Bureau of Standards on Oct. 12 before the Chemical Society of Washington. Mr. Palmer illustrated a number of the automatic methods of analysis of gas mixture met commonly in industrial work and showed how the analytical apparatus could be made to control automatically the composition of these gases within narrow limits.

One of the most striking examples demonstrated was in the case of a mixture of sulphur dioxide, carbon dioxide, hydrogen and air. Three gas analysis cells were used in this apparatus, the first indicating or controlling the sulphur dioxide concentration, the second the carbon dioxide concentration, and the third the hydrogen concentration in the mixture. An automatic continuous record can be made of the percentages found.

The operation of the apparatus depends upon the difference in heat conductivity of the gas mixture and the same gas after removal of the constituent to be determined. Thus, in the case of sulphur dioxide the heat conductivity of a mixture containing it is compared with the heat conductivity of the same gas after passage through an iodine solution to remove the sulphur dioxide. In cases where it is not feasible to remove the constituent by any simple chemical method, the unknown gas may be compared with a known standard gas, and if pains be taken to maintain operating conditions properly, equally reliable results are obtained by this method.

The apparatus has been given successful test in a number of plants for long periods. Many interesting possibilities for further application have been suggested.

Dirigible Accident Hastens Helium Development

Destruction of C-2 Emphasizes Need for Improved Recovery Processes and Federal Action

As a result of the destruction of the dirigible C-2, the possibility is admitted at the War Department that no further use of hydrogen will be made in the inflation of ships of the dirigible type. There is enough helium available at present to inflate three ships of the C-2 type. The Fort Worth helium plant is again in operation, thus promising material additions to the present reserve. While the recovery of helium in that plant is costly, an effort is being made to increase the present reserve from 2,500,000 to 10,000,000 cu.ft. The gas from the Petrolia Field, which is comparatively rich in helium, is being burned, with the prospect that this unusually favorable source of supply soon will be gone.

Because of the great expense attached to the recovery of helium at present, it may be that practice with dirigibles will be discontinued until greater reserves are built up and cheaper methods of recovery devised. While the use of helium greatly reduces the fire hazard, it cannot be eliminated, since a gasoline load must be carried to operate the engines. Disaster can come in other forms to such craft, so it is doubtful if either the army or navy would be willing to risk any great amount of practice flying when an accident would mean the loss of one-third of the helium available.

Hope to Improve Process

Experiments conducted by the Bureau of Mines in its cryogenic laboratory have been so successful that a plant of semi-commercial size is to be built to demonstrate whether or not the laboratory method will work out on a larger scale. That plant will be in operation during the present fiscal year. Those who have followed these experiments are hopeful that a great reduction in the cost of recovery will be found possible.

Before any extensive use of dirigibles inflated with helium is attempted, it is probable that the ships will be redesigned. This can be done so as to result in considerable efficiencies. It will be possible to place the engines very close to the envelope, thereby greatly increasing their efficiency and making possible greater ease in the manipulation of the craft. There is every reason to believe that the fire hazard can be reduced until it is no greater than in the case of airplanes.

Accident Will Hasten Action

The accident to the C-2 is certain to stimulate the consideration of the helium bill now before Congress. Hearings on this measure are to begin in November or December. This bill has received the approval of the President and of several members of the Cabinet. It proposes to centralize in the Bureau of Mines all matters pertaining to the conservation and production of helium. The army and navy is to be given first call on any supplies developed. The bill provides a revolving fund of $5,000,000, of which a part can be used for the construction of a plant, the purchase of leases and in the conservation of existing supplies. The remainder is to be used as an operating fund. The helium produced is to be turned over to the army and the navy, which are to reimburse the revolving fund. Any surplus not needed for military purposes can be sold or leased for commercial use. The bill also prohibits the export of any helium.

The President is on record as favoring this legislation. Before the bill was sent to Congress, the Secretary of the Interior took the matter up with the President. In that connection the President wrote Secretary Fall:

> I have received a copy of the proposed bill authorizing the conservation, production and exploitation of helium gas, which you recently sent me.
>
> I note that the Secretary of War and the Secretary of the Navy, as well as yourself, strongly approve this bill. I agree with you that the matter in question is of great importance and that Congress should make provision for obtaining a proper supply of helium for the future needs of the army and navy. Conditions for extracting the gas at a reasonable cost should also be made as favorable as possible. Since this country has practically a monopoly of helium resources at the present time, it would appear to be advisable to hold this monopoly and exercise control over exportation of the gas. I believe that the bill in question covers these points and I therefore suggest that you transmit it to the Military Committee of the House and of the Senate with a recommendation for its early consideration.

Helium occurs in the gas of a number of American fields. It is estimated that enough of it is going to waste each day to fill a dirigible the size of the ZR-2. An indication that the recovery of helium at a cost which is not prohibitive is not regarded as improbable is the fact that rights to construct zeppelins in this country have been obtained and construction is now in progress. These interests are considering the production and use of helium.

Committee to Investigate Direct Oxidation Method of Sewage Disposal

Following the reading of a paper before the American Public Health Association in Cleveland, Oct. 19, by G. W. Fuller on "Sewage Disposal at Lima, Ohio," discussion centered on the so-called "direct oxidation process." This is the method formerly known as the Landreth electrolytic lime method which had previously received attention of engineers and sanitarians following investigations and experiments at Elmhurst, N. Y.; Decatur, Ill.; Phillipsburg, N. J., and Allentown, Pa.

The Sanitary Engineering Section of the A.P.H.A. decided to appoint a committee to investigate the efficacy of this process and to make its report at the next annual meeting of the association. In addition to members of the Sanitary Engineering Section, this committee is to include a representative of the American Electrochemical Society.

German Reparation Dyestuff Deliveries

Bulk of Them Made Right After the Armistice—Italy Has Received the Most

Contrary to the popular conception that Germany reparation deliveries of dyestuffs have been made in large proportion since the London schedule of payments, a study of the records by the Western European Division of the Department of Commerce shows that the major deliveries were made during the months following the armistice, in the first efforts of Germany to meet the requirements of the Versailles treaty. The London schedule of payments became effective on May 1, 1921.

Distribution of the deliveries made previous to May 1, 1921, was as follows:

	Gold Marks
France	9,251,000
Italy	9,124,000
British Empire	8,499,000
Belgium	2,949,000
Japan	2,630,000
Serb-Croate-Slovene State	23,000
	32,476,000

On May 1, 1921, Germany began deliveries on account of the annuities described in the schedule of payments and dyestuff deliveries are now credited to annunity payments only. From that date to June 30, 1922, they totaled 10,708,000 gold marks distributed as follows:

	Gold Marks
Italy	5,589,000
Belgium	3,221,000
France	2,006,000
British Empire	1,696,000
Greece	196,000
	10,708,000

Thus during the 31 months previous to the London schedule the deliveries were 75.2 per cent of her total deliveries, leaving 24.8 per cent during the 14 months since that schedule became effective.

An interesting fact which appears in the records of deliveries is that the largest deliveries have been to Italy, rather than to France and Belgium, as popularly believed. Deliveries to France were one million gold marks less than to Italy, while those to Belgium were less than half as great as to Italy. The total distribution to June 30, 1922, was as follows:

	Gold Marks	Percentage
Italy	12,213,000	29.4
France	11,257,000	26.0
British Empire	10,195,000	23.6
Belgium	6,170,000	14.3
Japan	2,630,000	6.1
Greece	196,000	.5
Serb-Croate-Slovene State	23,000	.1
	43.184.000	100.0

The above tables include only the deliveries distributed among the powers. In addition to these, from the beginning of German deliveries to June 30, 1922, dyestuffs to the value of 4,000,000 gold marks were sold through the Reparation Commission to the Textile Alliance of the United States and others to the value of 3,000,000 gold marks were resold to German buyers. These sums were credited as cash received rather than as deliveries in kind.

Engineers Discuss Scientific Management

Many Joint Meetings of Three Societies Feature "Management Week" in Various Cities

Management Week meetings, bringing forcibly to public attention the increasing importance of the engineer in industry, were held in thirty cities, Oct. 16 to 21, under the auspices of the American Society of Mechanical Engineers, the Society of Industrial Engineers and the Taylor Society. With these societies, other engineering organizations and civic and economic bodies co-operated.

President Dexter S. Kimball and Vice-President L. P. Alford were among the principal speakers. Dean Kimball addressed the Central Pennsylvania local section on Oct. 16, the Cincinnati section on Oct. 19, and the Columbus section on Oct. 20. Mr. Alford spoke at Meriden, Conn., on Oct. 6; at New York on Oct. 17, and at Plainfield, N. J., on Oct. 18. A meeting at St. Louis on Oct. 11 was addressed by John Lyle Harrington of Kansas City, president-elect of the A.S.M.E.

Mr. Alford's paper, entitled "Ten Years Progress in Management," was read at meetings in several cities, including Birmingham, Ala., Davenport, Ia., and Chicago. Mr. Alford elaborately reviewed the history of the advance of scientific management. "Industry and business as developed in modern civilization must continue, else infinite misery will overtake the human race," said Mr. Alford. "Management is the agency by which community, state and nation shall endure."

Engineers in Management

Messages presenting the American, the English and the German points of view were read at meetings throughout the country. Dean Kimball, speaking for the American engineer on the question of management, said:

"The engineer has been drawn into the field of management partly because of his proximity to the problems of industry, partly because of the exigencies caused by the rapid growth of scientific methods, but more particularly because of his scientific method of attacking problems of all kinds. It has been found that his methods of attacking the problems of design and construction are powerful tools in handling the problems of administration. There can be little doubt that the engineering executive is to remain a dominant figure in industrial management. I do not contend that he alone can solve these human problems, but I do believe that if he will give his best effort to this work he can make a contribution that will go a long way toward the attainment of industrial peace."

Messages From Abroad

James F. Whiteford, discussing "Development of Management in the United Kingdom," said: "In general, it may be stated that management practices in the United Kingdom are following very closely the same sequence of developments as have been instituted in American industries. The application over there is a few years late, but the best portion of the practices in American industries is being fairly generally accepted over there."

G. Schlesinger of Charlottenburg, Germany, told of "The Development of Scientific Industrial Organization in Germany," saying: "It gives me pleasure to be able to place before the American industrial world some proofs of successful results in scientific and practical industrial organization in Germany. I am convinced that after a long period of 'lagging behind' we have at least caught up with the Americans in scientific management; but the deeper foundation that we possess and the greater economy in the manipulation of our system (we can carry out the work of accounting in factories according to our method with half the personnel that is required with the usual American system) will perhaps prompt American industry to take note of our organization science and practice, as the German industry once gladly and gratefully accepted advice and information from American sources."

New York Meetings

Conspicuous among the Management Week meetings were those held in New York, Chicago, Indianapolis and Cambridge, Mass. Fred J. Miller presided at the New York meeting, speaking generally on the results attained by scientific management and on its potentialities. Other New York speakers were Myron H. Clark, of the United States Rubber Co., John H. Williams of Philadelphia and Frank B. Gilbreth of Montclair, N. J.

Meetings in Various Cities

Three meetings were held in Chicago at the Auditorium Hotel, the keynote being "true wealth and prosperity come only from careful, unwasteful management of productive enterprises, coupled with industry and thrift." The Boston Engineering Societies participated in the Cambridge meeting held at Harvard University. Other co-operating organizations were Boston Chamber of Commerce, Associated Industries of Massachusetts, Taylor Society, Society of Industrial Engineers, Boston Association of Stock Exchange Firms, Massachusetts Bankers Association and Harvard Graduate School of Business Administration.

Management mechanisms and their efficiency is one vital subject which the industrial engineer studies. Stores control, standardization of operation, cost accounting, educating the employee, scheduling and planning are all management mechanisms. Human engineering is an elaborate title for the vital work being done on employee-employer relations and throughout all their work must be the leaven of service and an emphasis on the service motive—a real industrial co-operation which is the only basis for ultimate industrial health.

Potash Producers Must Work Own Salvation

"Desperate but Not Hopeless," Says Association Secretary

The domestic potash industry has been dealt a severe blow by failure to protect it from foreign competition in the new tariff act, but by careful management and reductions in costs it will survive and eventually develop health, in the opinion of Frederick W. Brown, secretary of the United States Potash Producers Association.

Reports show that the Nebraska field is completely out of production. The Nebraska output, while low in salt content, formerly supplied approximately half of the United States tonnage. The only activity in Nebraska at present is by one company which is sinking a well in hope of striking either oil or gas which would give cheap fuel and permit operation.

There are only three companies in general commercial operation for potash now, in contrast to the high record of 77, exclusive of wood-ash producers, in 1918, this figure declining to 18 in 1921. These three are the American Trona Corporation of Searles Lake, Calif., with potash deposits, and two byproduct plants, that of the Santa Cruz Portland Cement Co. of San Francisco, which produces from cement mill dust, and the United States Industrial Chemical Co. of Baltimore, producing from alcohol distillery waste. There are two, possible three, other cement plants which are selling dust locally, to farmers who bring their wagons to the plants.

While production is far below the war records, the potash now being produced is of very much higher grade on the average than the war-time average. Despite conditions in the domestic industry, potash men are pushing ahead to develop their business in hopes of eventually being able to meet the German and French competition, probably by a combination of an increase in the price of the foreign product and a lowering of their own costs.

The core drill being sunk in west Texas to determine the stratum of the potash deposits known to exist over a wide section of that country is reported to be down about 900 ft. This potash is known to be comparable to the best German potash.

Mr. Brown expects a combination of the French and German potash interests and a considerable increase in their prices this year. The condition of the domestic industry is summed up by Mr. Brown in the phrase, "desperate, but not hopeless."

Feldspar Producers Contemplate Organization

Feldspar producers throughout the country have been invited to gather in Washington on October 25, to determine whether or not to form a national association. The meeting will be held in the director's office of the Bureau of Mines, at 11 o'clock a.m.

Personal

CHARLES T. BRAGG, formerly with the Michigan Smelting & Refining Co., is now president and general manager of the Michigan Valve & Foundry Co.

Dr. FRANK K. CAMERON, general manager of the Salt Lake Insecticide Co., Salt Lake City, Utah, gave an interesting address at a recent meeting of the mining committee of the local Commercial Club, dealing with the conversion of the scorodite ores of the Western Utah Copper Co. into calcium arsenate.

FRED W. COHEN, assistant general manager of the Metal & Thermit Corporation, has gone to Europe for an extended business trip.

J. V. N. DORR returned a few weeks ago from a 6 months' trip to England, France and Germany, where he inspected numerous installations of his machinery in the metallurgical and chemical plants of those countries.

FRANK HODSON, president of the Electric Furnace Construction Co., has just returned from a trip to Europe, having been gone several weeks.

E. J. JANITZKY has been awarded the gold medal for the best paper presented before the annual meeting of the American Society for Steel Treating, held a year ago at Indianapolis. His paper "Influence of Mass in Heat Treatment" was reprinted in *Chemical & Metallurgical Engineering*, vol. 25, page 783. The second prize was awarded to Messrs. Gill and Bowman for a paper on the "Constitution of High-Speed Tool Steel."

H. A. LINCH, director of the Westport Mill, has begun an inspection of the beet sugar industry both in this country and abroad.

W. E. MCCORMICK has been appointed development engineer at the tire and tube departments of the Youngstown, Ohio, plant of the Republic Rubber Corporation. E. A. Armstrong has been made general superintendent at the plant.

WALTER S. MCKEE has resigned as vice-president and director of the American Manganese Steel Co. and will develop the business of the Inland Engineering Co. of Chicago, of which he is president.

Dr. GEORGE OTIS SMITH has been appointed a member of the President's Coal Commission, which will make it necessary for him to reduce his duties as director of the U. S. Geological Survey. P. S. SMITH will act as director during the time that the Coal Commission will require the major portion of Dr. Smith's time.

F. B. TOUGH, United States supervisor of oil and gas operations on leased public lands, has been appointed chief petroleum technologist of the Bureau of Mines, to succeed A. W. Ambrose.

The president of the American Electrochemical Society has appointed an advisory committee to co-operate with the Bureau of Mines in its electrometallurgical work. The committee is constituted as follows: Carl G. Schluederberg, Westinghouse Electric & Manufacturing Co.; Acheson Smith, Acheson Graphite Co.; Frank W. Brooke, Electric Furnace Construction Co.; Daniel L. Crosby, Detroit Electric Furnace Co.; C. B. Gibson, Westinghouse Electric & Manufacturing Co.; John A. Seede, General Electric Co.; Robert Turnbull, U. S. Ferro Alloys Co.; F. A. J. FitzGerald, consulting metallurgist, Niagara Falls.

The American Mining Congress elected the following officers at the twenty-fifth annual convention of the organization recently held in Cleveland: President: Sidney J. Jennings, vice-president, U. S. Smelting & Refining Co., New York City. Directors: Daniel B. Wentz (re-elected), Philadelphia, Wentz Coal Corporation; William Lindsay, Napier Iron Works, Nashville, Tenn.; W. C. Doering, Southern Wheel Co., St. Louis; Albert Nason, Nason Coal Co., Chicago, Illinois. Vice-presidents: Daniel B. Wentz; H. W. Seaman, Chicago; E. L. Doheny, Mexican Petroleum Co., New York.

Obituary

FRANK SHERMAN WASHBURN, chairman of the board of directors of the American Cyanamid Co., whose death on Oct. 9 was briefly noted in these columns last week, was a pioneer in the development of the process of extracting nitrogen from the air. He was born in Centralia, Ill., Dec. 8, 1860, the son of Elmer Washburn, a former president of the National Livestock Bank of Chicago. He was graduated as a civil engineer from Cornell in 1883 and became associated with railroad engineering in the Middle West. He reorganized the belt line of the Union Stock Yard & Transit Co. and then was sent abroad by the Chicago & Northwestern, Illinois Central and several other railroad companies to study railway economics in Europe.

FRANK SHERMAN WASHBURN

Upon his return from Europe in 1889, Mr. Washburn played an important part in the development of Purdy's dam and reservoir and other sources of New York City's water supply. Later he went to Chile as consulting engineer in connection with the production and shipment of Chile's nitrate of soda. His next important work was as consulting engineer in connection with the building of an interoceanic canal in Central America, a project which was abandoned when the United States Government undertook the building of the Panama Canal.

After some years spent in developing coal and iron mining and water-power projects in the South, Mr. Washburn saw the possibilities of application of hydro-electric power to the fixation of air nitrogen for the manufacture of fertilizers. The result was the organization of the American Cyanamid Co. Factories were erected at Niagara Falls on the Canadian side, which since have developed an annual production of cyanamid for fertilizer and chemical use valued at more than $10,000,000.

Before the war, Mr. Washburn foresaw that if the Chilean supply of nitrate of soda upon which the United States depended for making military explosives were cut off, this country would be seriously menaced. As early as 1910 he gave his thought to a means of making America independent of South American deposits so that in the event of an enemy blockade the country could produce its own nitric acid. The German Government had already started on a large scale, for military purposes, the same fixation of air nitrogen which Mr. Washburn and his associates had applied to agriculture.

So with the entrance of America into the World War, Mr. Washburn and the American Cyanamid Co. were requested by the Ordnance Department to organize the Air Nitrates Corporation to construct and operate for the government the huge $50,000,000 air nitrates plant at Muscle Shoals, Ala. Mr. Washburn was the president of the corporation. Although the armistice came before the Muscle Shoals plant and two others near Cincinnati and Toledo were completed, this great war project is one of the few that could be turned to peace time use.

Mr. Washburn was president of the Goodman Manufacturing Co. of Chicago. He was married in 1890 to Miss Irene Russell of Augusta, Ga., a member of an old and prominent Southern family. He was a trustee of Cornell University for two terms and also of Vanderbilt University. He was a member of the American Society of Civil Engineers, American Institute of Mining Engineers, Society of Western Engineers, American Institute of Electrical Engineers, American Electrochemical Society, Alpha Delta Phi and Sigma Xi, the honorary scientific society. Among his clubs were the University, the Apawamis and the Century.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

A Persistent Shortage of Unskilled Labor

A Great Decrease in Immigration Is Partly Responsible for This Shortage—How Extensive Will It Become? Will It Effect a Change in the Manufacturer's Attitude Toward Labor?

UNSKILLED LABOR is an essential to chemical industries. In fact, the proportion of skilled labor, in the ordinary sense of the word, to unskilled labor in chemical plants is exceedingly small. Unlike the mechanical industries, the proportion which labor cost represents of the total cost of a product is small. All generalizations on this subject are somewhat unsafe, but 15 per cent might be said to represent as close an estimate as possible. Labor problems in chemical industries, since they represent only 15 per cent of the total cost, and since this labor is largely unskilled, have never held a predominant position in the minds of chemical executives. Nevertheless the labor shortage during war time brought home to chemical companies the necessity of having a supply of such labor as is needed and brought it home hard. There followed the period of prosperity in 1920 during which time the returning soldiers and workers in war-time industries eliminated the labor problem. In 1921 manufacturers began to forget that there ever was a labor problem, for there was always a large supply of workmen waiting at the factory gates for an opportunity to work. And then when they had completely forgotten the problem it loomed up again, especially in industries analogous to the chemical industries wherein unskilled labor is in demand. The first important notice which was taken of this shortage was when the U. S. Steel Corporation advanced common labor wage 20 per cent, and now it is a common cry that unskilled labor is not to be had.

A search into the reasons for this shortage is worth while in order to determine the probable extent of the shortage and whether any remedies suggest themselves. Service letter No. 123 of the National Industrial Conference Board of July 3, 1922, discussed the labor shortage at some length, mentioning the many localities which had already felt the shortage and the time when the shortage began to appear; then it went on to point out that under the present immigration act only one-tenth the net increase in population due to immigration was recorded in 1921 as against the pre-war rate. In the year ended June 30, 1922, 309,556 men, women and children were admitted to this country, whereas 198,712 left the country. This is a net gain of 110,000 persons, yet when we come to study the classifications of these people we find only 32,724 laborers among the immigrants and over 100,000 emigrating. This amounts to a net loss of 67,334 laborers, and it is on this class of labor that chemical industries must depend, a significant loss that demands immediate executive attention.

So we are faced with a shortage which is likely to increase rather than decrease unless a radical change in the national policy toward immigration takes place. The immediate effect of this situation will be a scurry by manufacturers to enlist the aid of nostrums and formulas designed to "solve" all labor troubles. For example, many firms will take out life insurance for the benefit of its employees and profit-sharings schemes will come into being by the gross. All of this will be a frantic gesture on the part of managements to retain their common labor. It will largely be unsuccessful, for the laborer can sense with uncanny accuracy the spirit which moves management and will recognize such gestures as the above in their true light—a primarily selfish motive. The answer will have to be a complete change of attitude. From neglect of labor problems and temporary palliative, management will have to adopt constructive measures, an attitude which begins with a sound philosophy of labor's share in manufacturing enterprises and which is synthesized with a true sense of justice toward labor. There are enough successes as a result of this attitude to warrant adherence to it. "A word to the wise is sufficient!"

When an Irresistible Force Meets an Immovable Body

The irresistible force in this specific instance of the proverb is American productive capacity and energy. The immovable body is economic law. For a long time we have been a debtor nation and our trade balance, the ratio of exports to imports, has been favorable—that is, greater than 1. Now we are a creditor nation, and economic law states that our balance of trade must become unfavorable—that is, that imports must be greater than exports. Does this mean that our productive capacity, if it does not actually fall off, will at least not keep pace with its expected increase and with the increase which would normally be expected from the survey of the past half century? This increase up to the present time has been the most amazing industrial development ever recorded and it actually takes on the proportions of an irresistible force.

Before we enter cyclone cellars to await the crash, we might consider the words which Secretary Hoover advanced in his Toledo speech on this subject. Certain unique factors enter into any settlement of international balances between Europe and America, such as the annual expenditure of American tourists abroad, the remittances of immigrants in the United States to their relatives abroad, the growing volume of investments made by Americans in foreign countries, interest upon investments in the United States of private citizens of debtor countries and such other items as are usually called invisible exchange. This invisible exchange was estimated to be one and a half million dollars in the last fiscal year, a year of depression. It is likely to increase, so it is perhaps possible that American productive capacity may still maintain a favorable balance of trade, even though we are a creditor nation. There is at least food for thought. There usually is in anything Herbert Hoover has to say.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	157.71
Last week	153.77
October, 1921	151
October, 1920	263
April, 1918 (high)	286
April, 1921 (low)	140

Only one of the commodities declined in price during the last week, ammonium sulphate, and that very slightly. The relatively large increase in the index number is due to increases in the prices of commercial solvents, particularly methanol, and also of linseed oil, both of which are important factors in the index calculation.

Price Fluctuations and the "Reasons" for Them

Every now and then it is desirable to dip behind the scenes and evaluate the reasons given for the rise and decline of the market price of commodities. A commodity is advanced in price. Consumers as well as economists and students of markets ask: Why? Frequently the answer is "increased cost of production," and occasionally this answer may be correct. On the other hand, it must be remembered that unless the market is strong and the demand vigorous, an increased cost of production would not, could not, affect the selling price. Let us take, for example, the increased price quoted on commercial solvents during the past week. It so happens that the shortage of common labor, already referred to, has very definitely increased the cost of manufacturing these products. Lumbering was one of the first industries affected by the labor shortage. On the other hand, this effect has been felt in the industry for some months and yet from February until the end of September there was no change in quoted prices and some contracts most advantageous to the consumer were made at prices well under market quotations. In September the demand began to stiffen, perhaps because excess stocks had been used up, and within a month the price increase has been 25 cents per gallon. In other words, the increase in selling price lagged behind the increase in manufacturing cost probably by months.

Chemical Market Is Speculative

Thus to give as a reason for the increase in selling price the increased cost of production is not a fair statement of the case. In other words, the formal reasons given for price increase must be discounted. The real reasons or the immediate reasons for most price changes can be traced to the speculative nature of the market. This situation is inevitable when a commodity market is handled through brokers, dealers and selling agents. Their big profits (and big losses too) are derived from fluctuating markets, and the tendency is therefore to develop a speculative market. The effect of this upon manufacturers depends upon the proportion of their business which is handled in this way. Large fluctuations in price are apt to be very dangerous to producers, although it must not be supposed that some of them do not welcome a fluctuating market.

The Middleman's Wings and Halo

This must not be construed to be an indictment of the middleman. It happens to be the Mr. Hyde side of him and it is on the whole an unbalancing and therefore detrimental influence to the industry. There are plenty of reasons why the middleman is a Dr. Jekyll to this industry as well as all industries. He needs no defense. If he were nothing more than a sensitive barameter, he would fill a valuable function.

The St. Louis Market

St. Louis, Oct. 19, 1922.

The market for industrial chemicals has now settled down considerably after a very exciting period brought about by the new tariff. However, inquiries are still very heavy and actual buying is being continued in large volume. Nearly all orders received are for immediate shipment, as buyers are encountering more difficulties each day with transportation facilities, and furthermore, many large consumers wish to cover their winter requirements of certain commodities at this time of the year. There have been no important price changes since our last report, and apparently domestic producers have about adjusted their prices to meet the foreign competition. In view of the transportation difficulties and the shortage of stocks created by the sudden demand of several weeks ago, buyers should anticipate their requirements very liberally until the freight movement becomes easier and production again normal.

Alkalis

Only routine business is being transacted in the alkali market at present and prices remain as they have been for the past 60 days. Not much of a change either way is expected, for some time to come. *Caustic soda solid* is being quoted in 5-drum lots at $3.85 per 100 lb. delivered buyer's door, with a 55c. differential for the flake. Plenty of stock on consignment in this market. *Soda ash*, 58 per cent light, is quoted at $2.20 in bags and $2.40 in barrels for 5 to 10 barrels or bags. *Bicarbonate of soda* is being passed along at $2.40 per 100 lb. generally, although in a few cases this has been shaded to $2.25. *Sal soda* can be had generally at the buyer's price, barrels having gone as low as $1.65 per 100 lb., with kegs at $1.90.

General and Special Chemicals

The heavy mineral acids are moving in large volume and the demand is increasing. Prices are quite firm and stocks very limited. *Acid carbolic crystals* is moving very freely and in large volume at the present prices. While the demand for *citric acid* is only routine, the tight situation which has existed for some time is still in evidence and spot stocks are extremely light. Domestic producers are still unable to bring up their production to meet the demand from the regular trade. Prices are very firm. There is no heavy demand for *tartaric acid* at this moment, but sales of large volume are being made through regular channels. The demand for *phosphoric acid sirupy* is nil. *Aqua ammonia, 26 deg.*, has firmed up a bit, but the demand is only routine. The *white arsenic* market has advanced very sharply since our last report and is now being quoted at 9½@10c. New York, with practically no stocks available. Some domestic producers are sold up entirely and their output is insufficient to take care of their regular trade. *Carbon bisulphide* has slowed up a bit and spot goods are easily obtainable. The *copperas* situation is still unchanged, the demand greatly exceeding the supply. Prices are quoted at $20@$21 per ton in bulk f.o.b. producers' works. *Glycerine* is holding firm at 18½c. in drums and a further rise in price might make its appearance in the near future. *Sulphur* is still being quoted at the very low figure of $1.90 per 100 lb. for the commercial flowers, and we judge that the fight between the producers is still on, since this is abnormally low for sulphur. *Zinc dust* has advanced sharply and is now being quoted at 10c. in carload lots f.o.b. New York. In our last report we intimated that an advance in *zinc sulphate* should be expected at any time, and today carload lots are being quoted at 3½c. f.o.b. St. Louis; less than carload lots at 3¾c. f.o.b. St. Louis, showing an increase of ¼c. A still further advance may be expected at any time. Stocks in the hands of producers are only fair.

Vegetable Oils and Naval Stores

Turpentine is climbing steadily upward and it seems that the end is not yet. Today's market quotes turps in 5-bbl. lots at $1.60 and single barrels at $1.66 per gal., which is a jump of 10c. per gal. over yesterday. *Castor oil* is firm at 14c. in drums, with no indication of a price decline. Sales are better than normal. *Linseed oil* is moving in good volume and quite a bit of contract business, in some cases coming to May 1, is being done. Spot prices in 5-bbl. lots are 90c. for raw; 92c. for boiled, while single barrels are held at $1 for raw; $1.02 for boiled.

The New York Market

New York, Oct. 23, 1922.

Domestic inquiry has shown material improvement during the past week, especially for the more important basic commodities. Importers, however, were eager to dispose of some surplus stocks of lesser items and slight shading of quotations resulted. The demand for bleaching powder, caustic soda and soda ash was maintained and considerable business was transacted for home consumption. The most noteworthy feature of the week's activities was the acute advance in all solvents. Manufacturers announced advances in acetone, acetate of lime, formaldehyde and methanol, due to increased costs of production. Formaldehyde showed the most strength, with spot supplies very limited and demand strong. Commercial white arsenic retained its past strength and distributors were again inclined to raise prices. Prussiate of soda, barium carbonate and chloride, permanganate of potash and sal ammoniac showed slight reductions, due to a desire on the part of several smaller importers to dispose of surplus stocks. Citric and tartaric acids were in good demand and a fair volume of business was transacted. Acetic and sulphuric acids were quite firm, with the former quoted at slightly higher

levels, due to the advance on all acetate products.

General and Special Chemicals

Alums—Important producers and dealers are quoting 3½c, per lb. for the ammonia lump in quantity lots. Sales of the potash alum are recorded at 3½c. per lb.

Acetate of Lime—Producers have announced another advance and the present market is being held around $3 per 100 lb. in bags. The new price is said to be due primarily to increased costs of production. Demand is quite active.

Acetone—A new advance due to increased costs of production is reported and a more pronounced demand is evident. The new figure ranges around 12½c. per lb.

Arsenic—Manufacturers are now quoting as high as 10½c. per lb. for prime white powdered material on spot. Supplies are very limited for immediate delivery and demand continues quite active. Futures are quoted at 10@10½c. per lb.

Barium Carbonate—Spot material is obtainable at $75 per ton. Several large tonnage sales were reported at this figure. The general range is around $75@$80 per ton.

Bleaching Powder—Leading producers quote 2c. per lb., f.o.b. works for carload quantities and report an active demand. Shipments over the remainder of the year are held at the same price.

Caustic Soda—The export demand is moderate at $3.45@$3.50 per 100 lb., f.a.s., standard brands. Dealers report a very good movement for domestic consumption at $3.75@$4 for 100 lb., ex-store New York. A heavy demand is reported on contract, with producers quoting $2.50 per 100 lb., basis 60 per cent f.o.b. works.

Formaldehyde—Makers announced an advance to 13½c. per lb., f.o.b. works in carload lots. On account of the advance in methanol, producing costs have increased and this is maintaining a strong market for the product.

Sal Ammoniac—Imported white granular is somewhat easier on spot at 6½c. per lb. The gray variety is very scarce and some sellers are asking up to 8½c. per lb. The general tone is fair.

Methanol—Producers have sharply advanced prices and the market was exceedingly active, with production in most instances well sold ahead. Quotations for the 95 per cent were heard around 90@92c. per gal. The 97 per cent was quoted at 92@94c. per gal. Denatured and ethyl alcohol remained unchanged.

Coal-Tar Products

The general condition of the market maintained a steady tone in most of the crude products and intermediates. Business continued moderately active, with no depressing tendencies noted. Inquiries from consumers are reaching the market in fair amount and indications point to a gradual increase in the volume of business. Phenol still continued to be the feature of the market, with supplies exceedingly scarce. H acid was advanced by several leading sellers. Orthonitrotoluene was also quoted higher, with the demand quite active.

Aniline Oil—An active demand for this material is holding the market steady at 16c. per lb. Several interests recorded some fair-sized tonnage transactions at this level. Smaller lots were quoted at 17c. per pound.

Alpha-naphthylamine—Producers are placing a fair business at 29c. per lb. and report a very steady market. The general range is around 29@30c. per pound.

H Acid—Producers quote much higher prices for this product and while resale lots can be had at slight concessions, the general tone is much firmer at 85@90c. per pound.

Phenol—A very strong demand continues to feature this market. Offerings are very limited and available material is being held at high levels. Several transactions were recorded at 26c. per pound.

The Iron and Steel Market

PITTSBURGH, Oct. 20, 1922.

Fundamental conditions in the steel market have continued to soften. Buying of steel products has dropped to small proportions, the turnover in the past week having easily been the lightest in any week thus far this year. There have been no distinct declines in steel prices, but there is, generally speaking, an easier tone. This is seen definitely in the decreases that have occurred in the premiums that have to be paid to get early deliveries of sheets and plates. In bars the delivery premium is perhaps a shade less. In tin plates and wire products there have been no delivery premiums.

Steel Production

The prospect is that the mills with the leaner order books will soon have occasion to curtail production and that they will do this in preference to cutting prices in an effort to develop business. They will have some business, booked at prices recently prevailing, to protect. The Steel Corporation is well filled with business and will probably continue to run well. Two years ago a somewhat similar condition obtained. The corporation actually increased its operations slightly, fuel and labor becoming more plentiful, while the independents as a whole reached a low operating rate. In each case the corporation's better filled order book is to be ascribed to the following of a conservative policy in prices.

Car supplies at steel mills have not improved materially and little progress has been made in moving the steel recently piled. Shipping conditions have not grown worse, and there is less complaint among buyers.

Steel Prices

In general, steel products are steady at basis prices, 2c. being the basis for bars, shapes and plates, while plain wire is 2.45c. and wire nails $2.70. Prompt plates now rarely command more than 2.15c., while a fortnight ago 2.25c. was not uncommon and a month ago small lots were bringing as high as 2.50c. Prompt bars rarely bring 2.25c. now, but 2.15c. is not uncommon. In sheets the 3.35c. basis of the Steel Corporation is nominal in that the corporation is sold out until it opens its order books for first quarter. Among independents there have been prices of 3.50c., 3.60c. and 3.75c., according to the delivery the particular mill could make, but 3.75c. practically disappeared recently, and 3.60c. is now less common than 3.50c. as a settling price.

A curious incident is furnished by the National Tube Co. advancing its prices on welded tubular goods about $4 a ton under date of Oct. 19. No change in prices had been expected, particularly when prices of other steel commodities are not in stiffening mood. Pipe advances, however, had been very conservative, and order books are better filled than is the case with some other steel products. The new basing discount is 66 per cent on merchant steel pipe. On last year's readjustment a minimum of 71 per cent was reached. The net advance from the low point, five points, figures out a trifle less than $9 a net ton.

Coke

Connellsville furnace coke, which had ruled stiff at $12 for several weeks, began softening about 10 days ago and then proceeded to break, offers of standard grade having been made yesterday and today at $8 without finding takers. Production has continued to increase and when prices began to soften consumers became disposed to postpone purchases, so that from the demand and offerings standpoint the market has been under double pressure. With coal at $3 the coke equivalent would be about $5.75, so that there is room for more decline. Coke has sometimes sold at less than its coal equivalent.

Pig Iron

Pig iron, which was in very poor request throughout the period of exceptionally high prices when nearly all the merchant furnaces were idle, has been softening with the increasing production. The combination of consumers now receiving deliveries on old purchases and of prices declining naturally does not stimulate demand. Asking prices are down to $33 for bessemer, $30 for basic and $32 for foundry, f.o.b. valley furnaces, and there may be little buying of real tonnages until prices have developed their new level, in keeping with coke at a reasonable price in relation to its cost of production. Wages at the union coal mines are the same as before the strike, while in the Connellsville region wages are up fully 40 per cent. In January and February coke sold at about $3 and pig iron at $18 to $19, both coke and pig iron producers asserting these prices were below actual cost of production.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.		$0 38 $0 40
Acetone	lb.	$0 22½ $0 22¾	23 – 23½
Acid, acetic, 28 per cent	100 lb.	2 80 – 2 90	2 95 – 3 50
Acetic, 56 per cent	100 lb.	5 60 5 75	5 80 – 6 25
Acetic, glacial, 99½ per cent, carboys	100 lb.	11 00 11 25	11 50 – 12 00
Boric, crystals	lb.	11 – 11½	11¾ 12
Boric, powder	lb.	11 – 11½	11½ 12½
Citric	lb.		52 – 52½
Hydrochloric	100 lb.	1 10 – 1 20	1 25 – 1 70
Hydrofluoric, 52 per cent	lb.	11 – 11½	11½ – 12
Lactic, 44 per cent tech	lb.	09½ – 10	10½ – 12
Lactic, 22 per cent tech	lb.	04½ – 04¾	05 – 05½
Molybdic, c.p.	lb.	3 00 – 3 25	3 30 – 3 75
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg.	lb.	06 – 06¼	06¾ – 07
Nitric, 42 deg.	lb.	06½ – 06¾	07 – 07½
Oxalic, crystals	lb.	14 – 14¾	15 – 15½
Phosphoric, 50 per cent solution	lb.	07½ – 08	08¼ – 09
Picric	lb.	20 – 22	23 – 27
Pyrogallic, resublimed	lb.		1 65 – 1 75
Sulphuric, 60 deg., tank cars	ton	9 50 – 10 00	
Sulphuric, 60 deg., drums	ton	12 00 – 14 00	
Sulphuric, 66 deg., tank cars	ton	15 00 16 00	
Sulphuric, 66 deg., drums	ton	19 00 20 00	20 50 – 21 00
Sulphuric, 66 deg., carboys	ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19 00 – 20 00	
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22 00 – 22 50	23 00 – 24 00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31 00 – 32 00	33 00 – 34 00
Tannic, U. S. P.	lb.		60 – 75
Tannic (tech.)	lb.	40 – 45	46 – 50
Tartaric, imported crystals	lb.		31 – 31¼
Tartaric acid, imported, powdered	lb.		31½ – 32
Tartaric acid, domestic	lb.		32
Tungstic, per lb. of WO	lb.		1 00 – 110c
Alcohol, ethyl (Cologne spirit)	gal.		4 75 – 4 95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.		36 – 38
Alcohol, denatured, 188 proof No. 5	gal.		36 – 38
Alum, ammonia, lump	lb.	03½ – 03¾	04 – 04¼
Alum, potash, lump	lb.	03½ – 03¾	04 – 04½
Alum, chrome lump	lb.	05 – 05¼	05½ – 06
Aluminum sulphate, commercial	100 lb.	1 50 – 1 65	1 70 – 2 25
Aluminum sulphate, iron free	lb.	02½ – 02¾	03 – 03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	06¾ – 07¼	07½ – 08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	30 – 30½	30½ – 31
Ammonium carbonate, powder	lb.	08½ – 08¾	09 – 09½
Ammonium nitrate	lb.	06 – 06½	06¾ – 07½
Amylacetate tech.	gal.		2 35 – 2 50
Arsenic, white, powdered	lb.	10½ – 10¾	11 – 11¼
Arsenic, red, powdered	lb.	12½ – 12¾	13 – 13½
Barium carbonate	ton	75 00 – 77 00	78 00 – 80 00
Barium chloride	ton	100 00 –102 00	103 00 –105 00
Barium dioxide (peroxide)	lb.	20 – 21	21½ – 22
Barium nitrate		09 – 09½	09½ – 10
Barium sulphate (precip.) (blanc fixe)	lb.	04 – 04¼	04½ – 04¾
Blanc fixe, dry	lb.	04 – 04½	
Blanc fixe, pulp	ton	45 00 – 55 00	
Bleaching powder	100 lb.	2 00 – 2 10	2 15 – 3 25
Blue vitriol (see copper sulphate)			
Borax	lb.	05½ – 05¾	06 – 06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	27 – 38	28½ – 35
Calcium acetate	100 lb.	3 00 – 3 15	3 20 – 3 50
Calcium carbide	lb.	04½ – 04¾	05 – 05½
Calcium chloride, fused, lump	ton	22 00 – 23 00	23 50 – 27 00
Calcium chloride, granulated	lb.	01½ – 01¾	02 – 02¼
Calcium peroxide	lb.		1 40 – 1 50
Calcium phosphate, tribasic	lb.		15 – 16
Camphor	lb.		86 – 87
Carbon bisulphide	lb.	06¾ – 07	07½ – 07½
Carbon tetrachloride, drums	lb.	10 – 10¼	10½ – 12
Carbonyl chloride, (phosgene)	lb.		60 – 75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	04½ – 04½	
Chalk, precip.—domestic, heavy	lb.	03½ – 03¾	
Chalk, precip.—imported, light	lb.	04½ – 05	
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	05 – 05½	05¾ – 06
Chloroform	lb.		25 – 32
Cobalt oxide	lb.		2 00 – 2 10
Copperas	ton	20 00 – 22 00	23 00 30 00
Copper carbonate, green precipitate	lb.	20 – 20½	20¾ 21
Copper cyanide	lb		58 – 600
Copper sulphate, crystals	100 lb.	5 75 – 6 00	6 10 – 6 504
Cream of tartar	lb.		26 27
Epsom salt (see magnesium sulphate)			
Ethyl acetate com. 85%	gal.		60 65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal		90 95
Formaldehyde, 40 per cent	lb.	13½ 13¾	14 14¼
Fullers earth, f.o.b. mines	net ton	16 00 17 00	
Fullers earth—imported powdered	net ton	30 00 – 32 00	
Fuse oil, ref.	gal.		2 75 2 90
Fuse oil, crude	gal.		1 65 1 85
Glauber's salt (see sodium sulphate)			
Glycerine, c.p. drums extra	lb		18½ – 18¾
Iodine, resublimed	lb.		4 40 – 4 50
Iron oxide, red	lb		12 – 18
Lead acetate, white crystals	lb		11½ – 12½
Lead arsenate, powd	lb	13 13½	13½ 14½
Lead nitrate	lb		15 – 20
Litharge	lb.	07¾ – 08	08½ 09
Magnesium carbonate, technical	lb	06 – 06½	06½ – 07½
Magnesium sulphate, U. S. P.	100 lb	2 00 2 25	2 30 – 2 50
Magnesium sulphate, technical	100 lb		1 00 – 1 80
Methanol, 95%	gal		90 92
Methanol, 97%	gal		92 94
Nickel salt, double	lb		11 11½
Nickel salt, single	lb.		12 – 12½
Phogene (see carbonyl chloride)			
Phosphorus, red	lb.		40 – 45
Phosphorus, yellow	lb.		30 – 35½
Potassium bichromate	lb.	10 – 10½	10½ – 11
Potassium bromide, granular	lb.		17 – 23
Potassium carbonate, U. S. P.	lb	12 – 12½	13 – 16
Potassium carbonate, 80–85%	lb.	06 – 06½	06½ – 06¾
Potassium chlorate, powdered and crystals	lb.	07½ – 07¾	08 – 08½
Potassium cyanide	lb		55 – 57
Potassium hydroxide (caustic potash)	100 lb.	6 25 – 6 50	6 60 – 7 00
Potassium iodide	lb.		3 45 – 3 55
Potassium nitrate	lb.	06½ – 06¾	07 – 08
Potassium permanganate	lb.	16 – 16½	16¾ – 17
Potassium prussiate, red	lb.		95 – 1 00
Potassium prussiate, yellow	lb.	37½ – 38	38¼ – 38½
Rochelle salts (see sodium potas. tartrate)			
Salammoniac, white, granular	lb.	06½ – 06¾	07 – 07½
Salammoniac, gray, granular	lb.	08¼ – 08½	08¾ – 09
Salsoda	100 lb.	1 20 – 1 40	1 45 – 1 60
Salt cake (bulk)	ton	25 00 –27 00	
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1 60 – 1 67	2 00 – 2 25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1 75 – 1 80	1 85 – 2 35
Soda ash, dense, in bags, resale	100 lb.	1 85 – 1 90	1 95 – 2 40
Sodium acetate	lb.	08 – 08¼	08½ – 09
Sodium bicarbonate	100 lb.	1 75 – 1 85	1 90 – 2 30
Sodium bichromate	lb.	07½ – 07¾	08 – 08½
Sodium bisulphate (nitre cake)	ton	4 50 – 4 60	4 65 – 5 50
Sodium bisulphite powdered, U.S.P.	lb.	04¼ – 04½	04¾ – 05½
Sodium chlorate	lb.	06½ – 06¾	07 – 07½
Sodium chloride	long ton	12 00 –13 00	
Sodium cyanide	lb.	19½ – 21	21½ – 25
Sodium fluoride	lb.	09 – 09½	09¾ – 10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3 35 – 3 40	3 75 – 4 00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3 45 – 3 50	3 55 – 4 00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3 80 – 3 90	4 25 – 4 40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4 00 – 4 15	4 40 – 4 60
Sodium hyposulphite	lb.	02½ – 02¾	03 – 03¼
Sodium nitrite	lb.	09¼ – 09½	09¾ – 10
Sodium peroxide, powdered	lb.	28 – 30	31 – 35
Sodium phosphate, dibasic	lb.	03½ – 04	04¼ – 04½
Sodium potassium tartrate (Rochelle salts)	lb.		18 – 21
Sodium prussiate, yellow	lb.	23 – 23½	23½ – 24
Sodium silicate, (40 deg. in drums)	100 lb.	80 – 1 00	1 05 – 1 25
Sodium silicate, (60 deg. in drums)	100 lb.	2 25 – 2 40	2 45 – 2 75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	85 – 95	1 00 – 1 40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	04 – 04¼	04½ – 05
Sodium sulphite, crystals	lb.	03¼ – 03⅝	03⅝ – 04½
Strontium nitrate, powdered	lb.	09½ – 10	10½ – 12
Sulphur chloride, yellow	lb.	04½ – 05	05½ – 06
Sulphur, crude	ton	18 00 –20 00	
Sulphur dioxide, liquid, cylinders extra	lb.	08 – 08½	09 – 10
Sulphur (sublimed), flour	100 lb.	2 25 – 3 10	
Sulphur, roll (brimstone)	100 lb.	2 00 – 2 15	2 20 – 2 70
Talc—imported	ton	30 00 –40 00	
Talc—domestic powdered	ton	18 00 –25 00	
Tin bichloride	lb.	10 – 10½	10½ – 10¾
Tin oxide	lb.		39 – 40
Zinc carbonate	lb.	14 – 14½	14¾ – 15½
Zinc chloride, gran	lb.	06 – 06¼	06¾ – 07
Zinc cyanide	lb.	42 – 44	45 – 47
Zinc oxide, XX	lb.	07½ – 08	08¼ – 08½
Zinc sulphate	100 lb.	2 75 – 3 00	3 05 – 3 30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0 95 — $1 00
Alpha-naphthol, refined	lb.	1 10 — 1 15
Alpha-naphthylamine	lb.	29 — 31
Aniline oil, drums extra	lb.	16 — 17
Aniline salts	lb.	22 — 24
Anthracene, 80% in drums (100 lb.)	lb.	75 — 1 00
Benzaldehyde U.S.P.	lb.	1 25 — 1 35
Benzene, pure, water-white, in drums (100 gal.)	gal.	30 — 35
Benzene, 90%, in drums (100 gal.)	gal.	28 — 32
Benzidine, base	lb.	85 — 95
Benzidine sulphate	lb	80 — 85
Benzoic acid, U.S.P.	lb.	72 — 75
Benzoate of soda, U.S.P.	lb.	57 — 65
Benzyl chloride, 95-97%, refined	lb.	25 — 27
Benzyl chloride, tech.	lb.	20 — 23
Beta-naphthol benzoate	lb.	3 75 — 4 00
Beta-naphthol, sublimed	lb.	53 — 55
Beta-naphthol, tech	lb.	23 — 25
Beta-naphthyla mine, sublimed	lb.	1 50 — 1 60
Carbazol	lb.	75 — 90
Cresol, U. S. P., in drums (100 lb.)	lb.	14 — 20
Ortho-cresol, in drums (100 lb.)	lb.	18 — 22
Cresylic acid, 97–99%, straw color, in drums	gal.	60 — 65
Cresylic acid, 95-97%, dark, in drums	gal.	55 — 58
Dichlorbenzene	lb.	06 — 09
Diethylaniline	lb.	50 — 60
Dimethylaniline	lb.	32 — 34
Dinitrobenzene	lb.	20 — 22
Dinitroclorbenzene	lb.	21 — 22
Dinitronaphthalene	lb.	30 — 32
Dinitrophenol	lb.	32 — 34
Dinitrotoluene	lb.	22 — 24
Dip oil, 25%, car lots, in drums	gal.	85 — 90
Dipnenylamine	lb.	54 — 56
H-acid	lb.	72 — 75
Meta-phenylenediamine	lb.	90 — 1 00
Monochlorbenzene	lb.	10 — 11
Monoethylaniline	lb.	95 — 1 10
Naphthalene crushed, in bbls.	lb.	06 — 06½
Naphthalene, flake	lb.	06½ — 07
Naphthalene, balls	lb.	07½ — 08
Naphthionate of soda	lb.	58 — 65
Naphthionic acid, crude	lb.	65 — 70
Nitrobenzene	lb	10 — 12
Nitro-naphthalene	lb.	30 — 35

Nitro-toluene	lb.	$0.15	— $0.10
N-W acid	lb.	1.20	— 1.30
Ortho-amidophenol	lb.	2.10	— 2.15
Ortho-dichlor-benzene	lb.	.17	— .20
Ortho-nitro-phenol	lb.	.80	— .85
Ortho-nitro-toluene	lb.	.12	— .15
Ortho-toluidine	lb.	.12	— .14
Para-amidophenol, base	lb.	1.20	— 1.25
Para-amidophenol, HCl	lb.	1.25	— 1.30
Para-dichlorbenzene	lb.	.17	— .20
Paranitroaniline	lb.	.72	— .80
Para-nitrotoluene	lb.	.55	— .65
Para-phenylenediamine	lb.	1.55	— 1.60
Para-toluidine	lb.	.85	— .90
Phthalic anhydride	lb.	.35	— .38
Phenol, U. S. P., drums	lb.	.26	— .27
Pyridine	gal	1.60	— 1.75
Resorcinol, technical	lb.	1.50	— 1.55
Resorcinol, pure	lb.	2.00	— 2.10
R-salt	lb.	.55	— .60
Salicylic acid, tech., in bbls	lb.	.29	— .30
Salicylic acid, U. S. P	lb.	.32	— .34
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27	— .32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12	— .14
Sulphanilic acid, crude	lb.	.24	— .26
Toluidine	lb.	1.20	— 1.30
Toluidine, mixed	lb.	.30	— .35
Toluene, in tank cars	gal.	.25	— .28
Toluene, in drums	gal.	.30	— .35
Xylidines, drums, 100 gal	lb.	.40	— .45
Xylene, pure, in drums	gal.	.40	— .45
Xylene, pure, in tank cars	gal.	.45	— ....
Xylene, commercial, in drums, 100 gal	gal.	.33	— .35
Xylene, commercial, in tank cars	gal.	.30	— ....

Waxes

Prices remain quotably unchanged.

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50 gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.70	— ....
Rosin E-I	280 lb.	6.70	— ....
Rosin K-N	280 lb.	6.75	— $6.85
Rosin W. G.-W. W	280 lb.	7.75	— 8.25
Wood rosin, bbl	280 lb.	6.25	— ....
Spirits of turpentine	gal.	1.65	— 1.70
Wood turpentine, steam dist	gal.	1.15	— ....
Wood turpentine, dest. dist	gal.	1.12	— .70
Pine tar pitch, bbl	200 lb.	.....	— 6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	— 9.50
Retort tar, bbl	500 lb.		— 9.00
Rosin oil, first run	gal.	.38	— ....
Rosin oil, second run	gal.	.41	— ....
Rosin oil, third run	gal.	.48	— ....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr.1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.65	— 3.75
Blood, dried, f.o.b., N. Y	unit	4.60	— ....
Bone, 3 and 50, ground, raw	ton	42.00	— 44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10	— 3.20
Nitrate of soda	100 lb.	2.35	— 2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50	— 4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50	— 4.00
Tennessee, 78-80%	ton	7.00	— 8.00
Potassium muriate, 80%	ton	33.00	— 34.00
Potassium sulphate	unit	1.00	— ....

Crude Rubber

Quotations remain same as previous report.

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½	— $0.13
Castor oil, AA, in bbls	lb.	.13	— .13½
China wood oil, in bbls	lb.	.12½	— 12½
Coconut oil, Ceylon grade, in bbls	lb.	.08¼	— .08½
Coconut oil, Cochin grade, in bbls	lb.	.08¾	— .09
Corn oil, crude, in bbls	lb.	.08¼	— .09
Cottonseed oil, crude (f. o. b. mill)	lb.	.07¾	—
Cottonseed oil, summer yellow	lb.	.10½	— .10½
Cottonseed oil, winter yellow	lb.	.11½	— 11½
Linseed oil, raw, car lots (domestic)	gal.	.87	— .88
Linseed oil, raw, tank cars (domestic)	gal.	.84	— .85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90	— 91
Olive oil, denatured	gal.	1.15	— 1.17
Palm, Lagos	lb.	.07	— .07½
Palm, Niger	lb.	.06⅜	— .06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¼	— .09
Peanut oil, refined, in bbls	lb.	.12¼	— .12½
Rapeseed oil, refined in bbls	gal.	.77	— .78
Rapeseed oil, blown, in bbls	gal.	.85	— .86
Soya bean oil (Manchurian), in bbls. N. Y	lb.	.11½	— ..
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.08¼	— .09

FISH

Light pressed menhaden	gal.	$0.51	— ....
White bleached menhaden	gal.	.54	— .55
Blown menhaden	gal.	.61	— ....
Whale Oil, No. 1, crude, tanks, coast	gal.	.45	— .48

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$600.00	$800.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65.00	— 80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00	— 17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00	— 23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	— 21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	— 24.00
Barytes, crude f.o.b. mines	net ton	8.00	— 9.00
Casein	lb.	.10½	— .13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	— 8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	— 9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	— 20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00	— 20.00
China clay (kaolin), imported, lump	net ton	16.00	— 20.00
China clay (kaolin), imported, powdered	net ton	30.00	— 35.00
Feldspar, No. 1 pottery grade	long ton	7.00	— 7.50
Feldspar, No. 2 pottery grade	long ton	5.75	— 5.90
Feldspar, No. 1 soap grade	long ton	7.00	— 7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00	— 22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y	lb.	.05	— 05½
Graphite, Ceylon chip	lb.	.04	— .04½
Graphite, high grade amorphous crude	ton	35.00	— 50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	— ..
Kieselguhr, f.o.b. N. Y	per ton	50.00	— 55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00	— 15.00
Pumice stone, imported	lb.	.03	— .05½
Pumice stone, domestic, lump	lb.	.05	— .05
Pumice stone, domestic, ground	lb.	.06	— .07
Shellac, orange fine	lb.	.59	— .60
Shellac, orange superfine	lb.	.61	— .62
Shellac, A. C. garnet	lb.	.63	— .64
Shellac, T. N	lb.	.57	— .58
Silica, glass sand, f.o.b. Indiana	per ton	1.50	— 2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50	— 5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00	— 16.00
Silica, building sand, f.o.b. Pa	per ton	2.00	— 2.75
Soapstone	ton	12.00	— 15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00	— 12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50	— 12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00	— 17.00

Refractories

Prices remain quotably unchanged

Ferro-Alloys

Prices remain same as previous report

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00	— $9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00	— 23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19.00	— 20.00
Coke, foundry, f.o.b ovens	net ton	12.00	— 12.50
Coke, furnace, f.o.b. ovens	net ton	9.00	— 9.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00	— ....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50	— 19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½	— .01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45	— ..
Manganese ore, chemical (MnO_2)	net ton	70.00	— 75.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80	— .85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport.	unit	27.00	— ....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½	— .11
Pyrites, Spanish, furnace size. c.i.f. Atlantic seaport	unit	.12	— .13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12	— ....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00	— 8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	7.75	— 8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25	— 1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25	— 2.50
Vanadium pentoxide, 99%	lb.	12.00	— 14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00	— ....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½	— .13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

		Cents per Lb.
Copper, electrolytic		14.00
Aluminum, 98 to 99 per cent		20.00-21.00
Antimony, wholesale lots, Chinese and Japanese		6.85-7.00
Nickel, ordinary (ingot)		36.00
Nickel, electrolytic		39.00
Nickel, electrolytic, resale		32.00-33.00
Nickel, ingot and shot, resale		30.00-31.00
Monel metal, shot and blocks		32.00
Monel metal, ingots		35.00
Monel metal, sheet bars		38.00
Tin, 5-ton lots, Straits		33.75
Lead, New York, spot		6.50
Lead, E. St. Louis, spot		6.30
Zinc, spot, New York		6.95
Zinc, spot, E. St. Louis		6.625

OTHER METALS

Silver (commercial)	oz.	$0.67½	
Cadmium	lb.	1.15	
Bismuth (500 lb. lots)	lb.	2.35@2.40	
Cobalt	lb.	3.00@3.25	
Magnesium, ingots, 99 per cent	lb.	1.00@1.05	
Platinum	oz.	$108.00	
Iridium	oz.	275.00@300.00	
Palladium	oz.	55.00	
Mercury	75 lb.	73.00	

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

TARRANT CITY—The National Cast Iron Pipe Co. has preliminary plans in progress for the erection of a new foundry. A special system for cast-iron pipe production will be installed. It is expected to commence work early in the coming year.

MOBILE—The Patterson Oil Co., Conception and Virginia Aves., is reported to be planning for the immediate rebuilding of the portion of its plant recently destroyed by fire with loss estimated at about $60,000, including equipment.

TUSCALOOSA—Fire, Oct. 3, destroyed Foundry No. 3, at the local plant of the Central Foundry Co., with loss estimated at about $65,000. It is planned to rebuild at a later date. Headquarters of the company are at 41 East 42nd St., New York.

Arkansas

PINE BLUFF—The Jefferson County Cotton Oil Co. is installing new equipment at its plant for considerable increase in capacity. I. L. Hathaway is general manager.

FORT SMITH—The Athletic Mining & Smelting Co. has plans under way for enlargements in its plant, to include the installation of about 1,600 new retorts, arranged in two major blocks, and a new kiln at the zinc smelter. It is expected to commence work early in 1923.

FORT SMITH—The Zenor Bottle Co. has plans under consideration for the installation of new equipment at its plant. The company was recently incorporated with a capital of $50,000, to take over a local plant. C. P. Zenor is president, and James B. McDonough, vice-president.

CAMDEN—The Bradstreet Oil Co. is planning for enlargements in its storage and distributing plant. A number of new 55,000-bbl. storage tanks, with auxiliary equipment, will be installed.

Colorado

DENVER—The Producers' & Refiners' Corp., California Bldg., has plans in progress for the construction of a new oil-refining plant in the vicinity of Fort Steele, Wyo. It is also proposed to build a similar plant at Omaha, Neb. New pipe lines, pumping plants, etc., will be installed.

Florida

JACKSONVILLE—The Tidewater Glass Mfg. Co. has awarded a general contract to Frank Richardson, Jacksonville, for the erection of a new plant on local site to cost about $150,000, including machinery. Work will be placed under way at once.

California

LOS ANGELES—The Amalgamated Talc Co. has plans nearing completion for the construction of a new 1-story plant, 40x160 ft., on East 1st St. Milling machinery, cleaning apparatus and other equipment will be installed. A. Godfrey Bailey, Junior Orpheum Bldg., is architect.

OLEUM—Fire, Oct. 1, destroyed a portion of the oil storage and distributing plant of the Union Oil Co., Los Angeles, in the San Pablo Bay district, with loss estimated at about $250,000, including tanks, stock, etc. It is planned to rebuild.

LOS ANGELES—The W. P. Fuller Paint Co., Los Angeles, is taking bids through Hudson & Munsell, 444 Douglas Bldg., architects, for the erection of a new 1-story plant at Barranca St. and Ave. 22, estimated to cost approximately $40,000.

LOS ANGELES—The Shell Oil Co. of California, San Francisco, is planning for enlargements in its plant in the harbor section, to include a new refinery in the vicinity of Wilmington, for handling the output of the Signal Hill oil wells. The work is estimated to cost close to $1,000,000, including machinery.

LOS ANGELES—The Kay-Brunner Co. has awarded a contract to the Austin Co., Pacific Electric Bldg., for the erection of a 1-story foundry, 56x152 ft., on Frederick St., near Cypress Ave.

Georgia

AUGUSTA—The plant and property of the Planters' Cotton Oil Co. have been acquired by new interests, headed by John Aspewgren. The new owners will operate the mill and have tentative plans under consideration for extensions and improvements.

Illinois

OLMSTEAD—The Sinclair Refining Co., 111 West Washington St., Chicago, has completed plans and will commence work early in December, for a new 1-story mill, 70x115 ft., here, for the production of fullers earth.

Indiana

EVANSVILLE—The Evansville Enameling Co. has plans in progress for the erection of a new 1-story plant addition, 50x85 ft., sawtooth roof type.

Kentucky

RUSSELLVILLE—The Independence Nitro Co. has plans under way for the erection of a new local plant for the production of nitroglycerine and kindred products.

Louisiana

GRETNA—The Gulf Refining Co., New Orleans, has plans in progress for the installation of a new storage and distributing plant on local site.

Maryland

CUMBERLAND—The Better Brick Co., recently organized, has acquired a tract of property on the Allegheny Grove district, and plans for the construction of a new plant for the manufacture of hollow tile blocks, concrete brick and kindred products. The works will consist of a number of buildings. Theodore Smith is general manager.

BALTIMORE—The Argol Sulphide Co. has acquired a tract of land, totaling about 2 acres, on Curtis Ave., Curtis Bay, for a consideration of about $10,000, and is said to be planning to use the site for a new plant. It has been held heretofore by the Standard Wholesale Phosphate Co.

BALTIMORE—The American Oil Co., American Bldg., has purchased a portion of the Smith's shipyard property at Curtis Bay, consisting of about 10 acres, and has tentative plans under consideration for a new storage, handling and distributing plant, estimated to cost close to $500,000, including machinery.

BALTIMORE—The Crown Oil & Wax Co., 22 South Eighth St. is planning for the rebuilding of the portion of its plant destroyed by fire, Oct. 10. An official estimate of loss has not been announced.

BALTIMORE—The Bartlett-Hayward Co., Scott and McHenry Sts., will build a new 1-story foundry, 200x262 ft., at its iron and steel works. The erection contract has been let to the Whiting Turner Construction Co., 427 East Lombard St. Howard Bruce is president.

Massachusetts

CLINTON—The Clinton Gas Light Co., Pleasant St., has plans in progress for the construction of a new artificial gas plant. Walter W. Russell, 77 Franklin St., Boston, is engineer.

Michigan

DETROIT—The Detroit Foundry Co., Grand Boulevard and Orleans St., has leased the former foundry of the American Blower Co., in the vicinity of its plant, with building totaling about 50,000 sq.ft. of floor space, on 2-acre site, and will use the property for immediate extensions. The privilege of purchase at a later date has also been secured.

Missouri

CAPE GIRARDEAU—The McCracken Pip Co., Sioux City, Ia., has tentative plan under consideration for the erection of new plant on local site, for the manufactur of concrete sewer pipe and other concret pipe products. It is estimated to cost abou $30,000. J. W. McCracken is president.

MALDEN—The Roberts Cotton Oil Co. i considering the rebuilding of the portion o its plant, recently destroyed by fire, wit loss estimated at about $25,000.

Montana

NEIHART—The American Zinc & Lead Co has awarded a contract to the Stearn Rogers Mfg. Co., Denver, Colo., for the con struction of a new concentrating mill, esti mated to cost in excess of $500,000. Worl will be placed under way at an early date

Nebraska

OMAHA—The Standard Chemical Co. ha taken possession of its new plant at 42n St. and Leavenworth Ave. and removed it former works on Harney St. to this location Considerable increased capacity will be pro vided.

New Jersey

GLOUCESTER—The City Council will soor award a contract for the installation of a new filtration plant at the municipal waterworks.

NEWARK—The W. H. Hughes Co., Inc. 507 West 35th St., New York, manufacturer of enamels, paints, lacquers, etc., has leased the entire building at 164 Coit St., Irvington, heretofore held by the Pierce, Butler, Pierce Mfg. Co., New York, manufacturer of boilers, etc. The new owners will take immediate possession for a branch plant.

New York

NEW YORK—The American Smelting & Refining Co., 120 Broadway, has plans in progress for extensions and improvements in its plants in Colorado to cost in excess of $5,000,000, including buildings and machinery.

Ohio

PORT CLINTON—The American Gypsum Co. has plans in preparation for the erection of a 1- and 2-story addition to its local plant, 65x70 ft., to be used for the manufacture of wall plaster and kindred products.

CLEVELAND—The Otis Steel Co., Jennings Ave., is having revised plans prepared for the erection of its proposed new plant addition, estimated to cost close to $3,000,000. It is proposed to construct the mills with force employed directly by the company.

DAYTON—The Lowe Brothers Co., 452 East 3rd St., has construction under way on a new addition to its paint manufacturing plant. John M. Lowe is president.

Oklahoma

HOLDENVILLE—The C. R. Cordell Oil Co. has plans under way for the construction of a new compounding and blending plant for the production of lubricating oils.

CUSHING—The Shaffer Refining Co. will soon commence the erection of an addition to its local plant, comprising a new four-unit cracking mill, estimated to cost approximately $500,000. It is proposed to have the new plant ready for service in the spring of the coming year.

OKLAHOMA CITY—The Mineral Bank Mining Co., 507 Baltimore Bldg., has inquiries out for a new ball mill, to be used in connection with its gold concentrating and amalgamating plant.

Pennsylvania

PHILADELPHIA—The Independence Mfg. Co., Aramingo St. and Wheatsheaf Lane, manufacturer of greases, tallow, etc., has filed plans for the erection of a new 1-story building at Coral St. and Wheatsheaf Lane.

PHILADELPHIA—The Philadelphia Cut Glass Co., Redfield St., near Baltimore Ave., has awarded a contract to the Farrell Roth Construction Co., 122 Diamond St., for the erection of a new 1-story plant, 80x90 ft.

PUNXSUTAWNEY—The Elk Run Window Glass Co. is planning for the rebuilding of the portion of its plant destroyed by fire, Oct. 3, with loss of about $12,000.

PHILADELPHIA—The Precision Grinding Wheel Co., 8301 Torresdale Ave., manufacturer of abrasive materials, will commence the immediate erection of a new 1-story plant addition.

PHILADELPHIA—Fire, Oct. 5, destroyed a large portion of the plant of H. Swoboda & Son, Inc., Bodine St., manufacturer of leather products, with loss estimated in excess of $150,000, including equipment.

LOCK HAVEN—The American Aniline Products Co. has plans under way for the construction of a new 3-story factory, 45x90 ft., to replace a fire loss of a number of months ago. It will be equipped for grinding and other service. Another structure of approximately like size will also be built.

Tennessee

ROCKWOOD—The Roane Iron Co. has tentative plans under consideration for the rebuilding of the portion of its local plant, recently destroyed by fire with loss estimated in excess of $100,000, including equipment.

Texas

HOUSTON—The Houston Terminal Refining Co., recently organized with a capital of $500,000, has plans in progress for the enlargement of its local oil refinery, comprising the former plant of Hoffman & Turnblow, lately acquired. The purchase includes 28 acres of land on the Houston Ship Canal, a portion of which will be used for the proposed expansion.

DALLAS—The Southwestern Dehydration Co., 409 Andrews Bldg., recently organized with a capital of $125,000, has acquired a local 4-story building, 75x125 ft., and will commence the immediate installation of equipment for a new plant.

CORSICANA—Fire, Oct. 3, destroyed a portion of the plant of the Southland Cotton Oil Co., with loss estimated at about $80,000. Plans for rebuilding are under consideration. C. C. Roberts is local manager.

BRAZORIA—The Union Sulphur Co., Sulphur, La., has acquired a tract totaling about 210 acres of land at Brazoria, as a site for the erection of a new mining, refining and terminal plant, estimated to cost in excess of $4,000,000, including machinery.

Virginia

BIG STONE GAP—The W. W. Taylor & Son Co. is planning for the establishment of a local plant for the manufacture of bricks and kindred burned clay products. Inquiries are being made for various equipments for installation.

Washington

EVERETT—The Whitman County Iron Co. has negotiations under way with the local Chamber of Commerce for a new site for the erection of a steel mill, with blast furnace and other structures. The initial capacity of the plant will be about 50 tons daily. E. G. Hammer is vice-president in charge.

VANCOUVER—The local Chamber of Commerce has negotiations under way with a company, whose name will be announced at a later date, for a suitable site for the erection of a new mill for molybdenum steel production. John O. Bender, Los Angeles, Calif., is interested in the project.

West Virginia

PARKERSBURG—The General Porcelain Co. has commenced the erection of its proposed plant—1-story plant addition, 65x225 ft., estimated to cost about $25,000.

Industrial Developments

RUBBER—The Republic Rubber Co. has resumed operations in the tire-making department at its Youngstown, O., plant, following a shut-down for close to 2 years past. The inner tube and mechanical rubber goods departments at this factory are running full, with normal working force. The tire-manufacturing department at the Canton O., plant of the company is operating under a capacity schedule.

The Mason Tire & Rubber Co., Akron, O., has adopted a capacity operating schedule and expects to remain on this basis throughout the winter.

The Goodrich Tire & Rubber Co., Akron, O., is running on a production basis of about 20,000 tires a day, with full-time working force.

METALS—The Federal Steel Foundry Co., Chester, Pa., has resumed operations at its steel foundries, following an extended curtailment.

The Calumet & Hecla Co., Calumet, Mich., is running full at its local smelting plant, and has recently advanced the wage scale about 11 per cent, affecting practically all classes of labor at the mills.

The Jennings Brothers' Co., Bridgeport, Conn., producer of gold and bronze products, is increasing production at its plant, and a number of additions are being made in the working force. Business is about 50 per cent better than at this same time a year ago.

The Unifed States Cast Iron Pipe & Foundry Co., Burlington, N. J., is operating at full capacity at its local plant, with employment of regular working force.

The Utah Consolidated Mining Co., Tooele, Utah, is operating at capacity at its new milling plant, and is also running full at its copper smelter. A large working force is being employed.

The American Brass Co., Waterbury, Conn., is advancing production to a point in excess of pre-war production at its different plants. All of the mills in the Naugatuck Valley are running close to capacity, while western plants will soon be on a similar basis. Additional workers have been added.

The Davis-Daly Co., Butte, Mont., is running on one full-time shift at its local properties, with present output totaling about 500 tons of copper ore per day.

The Park-Utah Mining Co., Salt Lake City, Utah, is advancing production at its copper properties from 160 to 250 tons. An increased working force is being employed.

The Ray Consolidated Copper Co., Ray, Ariz., is increasing production at its mills. The wage scale has been advanced recently 10 per cent.

The American Smelting & Refining Co., New York, is advancing operations at its Mexico mills, and will make substantial additions in the working force.

IRON AND STEEL—The Delaware River Steel Co., Chester, Pa., is arranging for the early resumption of operations at its plant after a shut-down since December, 1920. The plant normally gives employment to about 350 men, and initial production will be increased gradually to this full working quota.

There are now 27 blast furnaces in operation in the Mahoning Valley district, Ohio, which equals the highest record of production for the year, established several months ago before the recent curtailment.

The Foley Steel Mills, Slatington, Pa., have resumed operations after a curtailment of a number of months.

The Carnegie Steel Co. has blown in blast furnace No. 1 at its Sharon, Pa., works, following a shut-down for about 8 weeks. Two out of three stacks are now in operation at this plant.

The Illinois Steel Co., Chicago, Ill., has 15 blast furnaces in service at its plant and has advanced steel production to about 70 per cent of mill capacity.

The Bethlehem Steel Co. has blown in another blast furnace at its Steelton, Pa., plant, making three units now in service here.

The Brier Hill Steel Co., Youngstown, O., has established a new high record for steel ingot production at its local 12-in. furnace, with output for September totaling 68,197 ingot tons, compared with previous high figures in October, 1920, of 67,640 tons. The new production total is said to be a world's record.

The American Steel & Wire Co. has resumed operations at its hot mills at Sharon, Pa.

The Altoona Iron Co., Altoona, Pa., has resumed production at its local plant with a 60 per cent operating force. This will be increased gradually to normal. The plant is said to have sufficient orders on hand to insure continuous operations for a number of months.

The Inland Steel Co., Chicago, Ill., has all three blast furnaces in service at its plant and has placed the steel mills on a basis of about 65 per cent of capacity.

The American Sheet & Tin Plate Co. has started up all remaining hot mills at its Farrell, Pa., works, totaling 30, bringing production in this department to capacity for the first time in more than 2 years. Extensive additions will be made in the working force.

CERAMIC—The Jackson Vitrified China Co., Falls Creek, Pa., has granted the demand of employees for a 7 per cent wage advance, affecting about 100 workers. The men have returned to work after a brief strike.

A total of seven general ware plants at Trenton, N. J., are now inactive, owing to the strike of pottery operatives for increased wages. These are the two plants of the Greenwood Pottery Co., International Pottery Co., Cook Pottery Co., Mercer Pottery, the Lamberton Works of the Maddock Pottery Co., and the Unger Pottery. It is estimated that 2,000 workers are idle.

The Mt. Clemens Pottery Co., Mt. Clemens, Mich., has granted the demand of employees for a 7 per cent wage increase, and operations have been resumed at the pottery.

The Southern Potteries Co., Erwin, Tenn., has met the demand of employees for a 7 per cent wage advance, and production has been resumed at full capacity.

MISCELLANEOUS—The Hollow Ware & Enameling Co., Lancaster, Pa., is running full at its local plant, giving employment to more than 200 workers. A wage advance of 5 per cent for molders and laborers has recently been placed into effect.

The Montana Refining Co., Billings, Mont., has completed enlargements at its local oil refinery, providing a capacity close to double the previous output. The entire mill will be placed in service at an early date.

The Southwestern Graphite Co. has resumed operations at its works at Burnett, Tex., following a considerable curtailment.

Following a shut-down since Aug. 9 for necessary curtailment and repairs, the Interstate Glass Co. has resumed operations at its plant at Kane, Pa., giving employment to about 300 men.

The International Products Co., New York, manufacturer of tanning materials, is operating its quebracho plant in Paraguay at full capacity, on a basis of 25,000 tons per annum. This is an increase from 17,000 tons, produced in 1921, and 8,527 tons in 1920.

New Companies

THE UNION CHEMICAL CO., Burlington, N. J., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are Joseph Harrison, Harry M. Barg and Warren R. Rahn, all of Burlington. The last noted represents the company.

THE (N-G-R) ENERGY CO., 730 North Franklin St., Chicago, Ill., has been incorporated with a capital of $5,000, to manufacture washing compounds and kindred specialties. The incorporators are A. E. and R. E. Anderson, and Frank T. Tolkuehn.

THE GILL LEATHER CO., Salem, Mass., has been incorporated with a capital of $50,000, to manufacture leather products. John Gill, Wisteria St., Salem, Mass., is president and treasurer, and represents the company.

THE S. JACK HAINES CORP., New York, N. Y., care of J. J. Ryan, 355 East 149th St., representative, has been incorporated with a capital of $10,000, to manufacture shellacs, varnishes, etc. The incorporators are S. Jack Haines and M. Spitzer.

THE BOWIE COTTON OIL CO., Bowie, Tex., has been incorporated with a capital of $150,000, to manufacture cotton oil products. The incorporators are H. O. Bannon and R. C. Feagin, both of Bowie.

THE CLINCHFIELD MICA CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture mica products.

THE NOVATONE CO., Brooklyn, N. Y., care of J. H. Garmesy, 51 Chambers St., New York, N. Y., representative, has been incorporated with a capital of $5,000, to manufacture paints, dyes and affiliated products. The incorporators are L. and M. Ornstein, and J. Randolph.

THE MID-CITY FOUNDRY CORP., 1901 Rockwell St., Chicago, Ill., has been incorporated with a capital of $15,000, to manufacture iron, steel and other metal castings. The incorporators are Frank Cedarwell, Innart Dahlberg and Carl J. Berg.

THE ARRENDALE OIL CO., El Dorado, Ark., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are Samuel Arrendale, and W. L. Breyfogle, both of El Dorado; and W. M. Hall, Kansas City, Mo.

THE HIGH-GRADE LEMON POLISHING CO., 144 Parker St., Newark, N. J., has filed notice of organization to manufacture polishing oils. The company is headed by Michael Monetti.

THE TARRANTINE MFG. CO., INC., Bangor, Me., has been incorporated with a capital of $96,000, to manufacture soap products. Hugo H. Hanson is president; Samuel F. Chalfin, treasurer; and Charles D. Bart-

bett, clerk, all of Bangor. The last noted represents the company.

THE RISHER FIRE BRICK CO., Room 842, 10 South La Salle St., Chicago, Ill., has been incorporated with a capital of $40,000, to manufacture firebrick, tile and other refractory products. The incorporators are Howard E. and E. B. Risher, and Herbert O. Engstrom.

THE PORTABLE REFINERY CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $500,000, to manufacture petroleum products.

THE ALBION MECHANICAL RUBBER MFG. CO., Richmond, S. I., N. Y., care of B. O. Eadie, St. George, S. I., representative, has been incorporated with a capital of $5,000, to manufacture mechanical rubber products. The incorporators are J. E., E. M. and K. V. Dubois.

THE BIRMINGHAM, LITTLE & PROSSER CO., Kansas City, Mo., has been incorporated with a capital of $60,000, to manufacture paper products. The incorporators are John Birmingham, E. H. Becker and Con J. Murphy, all of Kansas City.

THE SLENDAFORM CORP., New York, N. Y., care of Harry S. Hechheimer, 1540 Broadway, representative, has been incorporated with a capital of $20,000, to manufacture chemicals and affiliated products. The incorporators are W. N. Hechheimer and G. J. Lloyd.

THE LLOYD-BRECKENRIDGE GREASE CO., 608 South Dearborn St., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture lubricating oils, greases, etc. The incorporators are W. H. Breckenridge, C. B. Lloyd, and R. S. Robbins.

THE TWO STATES LIME CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,500,000, to manufacture lime products.

THE REED-MACLAURY RUBBER CO., St. Louis, Mo., has been incorporated with a capital of $10,000, to manufactue rubber specialties. The incorporators are A. A. and B. E. Reed, and J. D. Maclaury, all of St. Louis.

THE NEWTON OIL CO., Newton, Mass., has been incorporated with a capital of $200,000, to manufacture oil products. Daniel J. Sullivan, 37 Glenwood Ave., Newton Centre, Mass., is president and treasurer.

THE KO-KONDEL CO., Houston, Tex., has been incorporated with a capital of $14,000, to manufacture chemical specialties, insecticides, etc. The incorporators are T. E., J. W. and H. F. Harrington, all of Houston.

THE ALBANY STEEL & BRASS CORP., 716 West Madison St., Chicago, Ill., has been incorporated with a capital of 100 shares of stock, no par value, to manufacture steel, brass, bronze and other metal products. The incorporators are J. Kendall, Herbert Green and G. Mitchell.

THE UNITED STATES & MEXICAN OIL CO., Richmond, Va., has been incorporated with a capital of $15,000,000, to manufacture petroleum products. The incorporators are Cyrus W. Beale and Guy B. Hazlegrove, both of Richmond, who will act as president and secretary, respectively.

THE NIAGARA CHEMICAL CO., Middleport, N. Y., care of G. F. Thompson, Middleport, representative, has been incorporated with a capital of $500,000, to manufacture chemicals and chemical byproducts. The incorporators are E. Knapp and C. P. H. Schoellkopf.

THE LINCOLN STEEL CO., Woodhaven, L. I., N. Y., care of the United States Corporation Co., 65 Cedar St., New York, N. Y., representative, has been incorporated under Delaware laws with capital of $1,250,000, to manufacture steel products. The incorporators are Charles A. Follet, Woodhaven; George E. Follet, Richmond Hill, L. I.; and George W. Wheeler, East Orange, N. J.

THE UNITED STATES GLASS CORP., Pittsburgh, Pa., has been incorporated with a nominal capital of $5,000, to manufacture glass products. The incorporators are W. W. McAdams, B. D. Booker and Frank J. Holan, 747 Union Arcade, Pittsburgh. The last noted is treasurer and represents the company.

THE KEN-O-TEX OIL CO., Muskogee, Okla., has been incorporated with a capital of $25,000, to manufacture petroleum products. The incorporators are W. J. Chapman, L. R. Chambers and J. W. Patterson.

THE H TYREE CHEMICAL CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with a capital of $200,000, to manufacture chemicals and chemical byproducts.

New Publications

THE REHEATING OF COMPRESSED AIR. By C. R. Richards and J. N. Vedder. Bull. 130, published by the Engineering Experiment Station, University of Illinois, Urbana, Ill.

THE PRODUCTION OF NITRIC OXIDES AND OZONE BY HIGH-VOLTAGE ELECTRIC DISCHARGES. By Karl B. McEachron and R. H. George. Bull. 9, Engineering Experiment Station, Purdue University, Lafayette, Ind.

BOOKS

WOMEN IN CHEMISTRY: A STUDY OF PROFESSIONAL OPPORTUNITIES. Studies in Occupations, No. 4. The Bureau of Vocational Information, New York City. Here the student girl who is looking forward to chemistry as a life pursuit will find assembled an invaluable accumulation of information bearing on the problems in which she is most likely to be interested. This volume, as Dr. Herty quite truthfully points out in his letter of introduction, is "a comprehensive, conservative description of existing conditions, interspersed with sage advice as to the difficulties to be encountered, and with sound philosophy as to the benefits derived from devotion to a science whose goal is service to humanity." The text is divided into four parts. The first is a brief chapter on chemistry as a vocation, in which most stress is laid on the importance of chemistry in modern life and the need for adequately trained chemists. This is followed by a detailed analysis of positions in chemistry. In it are reviewed the opportunities offered by educational institutions, medical laboratories and hospitals, analytical and research laboratories of industry, of governmental and state institutions, and by several other related fields, such as library work and journalism. The third part of the book is devoted to training—both graduate and undergraduate. The text is concluded with a résumé of such important considerations as physical and mental requirements, salaries, means of securing positions, etc. An appendix contains much useful information on colleges and universities in which women may receive training in chemistry, prizes and grants available for research, fellowships and graduate scholarships open to women, scientific and technical publications and the national scientific societies for chemists.

BENN BROTHERS, London, published during September the third volume of H. H. Broughton's series on Electrical Handling of Materials, entitled "Electric Cranes." This volume, to which the two already published are introductory, deals in the most comprehensive manner with every kind of crane and crane mechanism. There are 300 illustrations and 65 tables. Another publication is "Recent Progress in Rubber Chemistry and Technology," by Dr. Philip Schidrowitz, also issued by Benn Brothers, which gives the results of research carried cut during the last few years. This company also announces a new series of full-length monographs, each of which will be devoted to some specialized parts of the broad field of gas and fuel, three of which will be ready this fall. Of these the first, "The Administration and Finance of Gas Undertakings, With Special Reference to the Gas Regulation Act, 1920," by George Evetts, consulting engineer, discusses the procedure necessary when applying for special acts of Parliament, the features of private bills, provisional orders, and so forth. A considerable amount of attention is given to financial features, the sliding scale, capital and revenue and the accounts of gas undertakings. The volume, in fact, is designed in such a way as to prove useful not only to technical gas officials but to directors, secretaries and accountants. In the second of these volumes, "Gasworks Recorders," the author, Dr. Leonard Levy, in addition to pointing out the innumerable uses to which recorders may profitably be put, so describes the construction and practical working of these instruments that all those who have to deal with them should have no difficulty in allocating and attending to defects on the spot. Almost every known form of recorder is dealt with, and there are 200 illustrations. Finally, "Modern Gasworks Chemistry," by Geoffrey Weyman, D.Sc., F.I.C., chief chemist to the Newcastle & Gateshead Gas Co., has primarily been written so as to form a companion volume to Meade's "Modern Gasworks Practice" and Hole's "Distribution of Gas." The two last-named volumes have now for some years provided for the requirements of the gasworks engineer and the distribution engineer respectively, but the equally important chemical phase of the science of gas making has been very inadequately provided for. Dr. Weyman has included in his volume every chemical test and process which is likely to be met with in even the largest gasworks.

Manufacturers' Catalogs

THE QUIGLEY FUEL SYSTEMS, INC., New York, calls attention to Bulletin A, just issued, giving a condensed description of the Quigley powdered coal system and appliances. The layout of a typical coal-milling plant is shown and the method of fuel distribution and control briefly described.

THE MERRIMAC CHEMICAL CO., Boston, Mass., has issued a pamphlet listing its products. This company is a manufacturer of chemicals for tanneries, paper mills, steel and wire works, textile mills, dye and chemical works, celluloid, smokeless powder and fertilizer manufacturers, artificial ice and refrigerating plants, foundries, brass finishers, engravers, etc.

THE L. R. CHRISTIE CO., Pittsburgh, Pa., has issued a catalog illustrating and describing its driers, calciners and coolers.

THE PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., in a new 16-page bulletin, No. 202, describes the company's line of double-suction single-stage centrifugal pumps, containing useful engineering data.

THE BUFFALO FOUNDRY & MACHINE CO., Buffalo, N. Y., has issued an attractive catalog on vacuum drying, evaporation and other processes and the principal types of apparatus employed in modern industry, together with a brief description of "Buflovak" and "Buflokast" apparatus.

THE METALS COATING CO. OF AMERICA, Philadelphia, Pa., has issued an illustrated pamphlet describing the adaptability of the Schoop metal-coating process to commercial requirements, in a form of interest to industrial users.

AUTOMATIC & ELECTRIC FURNACES, LTD., 281 Gray's Inn Road, London, W. C. 1, England, calls attention to its new catalog dealing with Wild-Barfield automatic electric hardening equipments. Particular attention is given to the problems of heat-treatment and their solution by the use of electricity.

THE NASH ENGINEERING CO., South Norwalk, Conn., has issued Bulletin 25, on "The Jennings Hytor Vacuum Heating Pump Size M, Electric Motor Driven."

HERMAN A. HOLZ of New York has issued a pamphlet on "The Dommer Gas Calorimeter," which is a self-contained apparatus for the accurate and convenient determination of the heating value of gases.

Coming Meetings and Events

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, 52 East 41st St., New York City Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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Fixing Wages and Standards Of Living by Statute

IT WILL NOT be difficult for reasonable men to follow the logical mental processes of the Railroad Labor Board in reaching the conclusion that "the living wage" theory is untenable. The reader will recall the demand made on the board by A. C. WHARTON, labor member, to establish a "living wage" for railroad workers regardless of wages paid for similar work in other industries. He wanted to disregard all economic laws and considerations and determine a wage that would enable a family of five to live on an arbitrary standard.

It is much to the credit of the Labor Board that it has declined to yield to the demand for any such artificial method of fixing wages. Statutory determination of a standard of living and arbitrary setting of wages for a group of men without regard to conditions under which similar groups are working are fallacious ideas that cannot find acceptance. Standards of living result largely from personal aspirations, and wages must be determined on a basis of service with due regard for relative values. Standards of living are improving in this country, but, as the Labor Board wisely remarks, the movement must be gradual and "cannot be consummated in the twinkling of an eye by artificial expedients."

Enlightened Labor Policy

WITHIN the last week two stories have reached us which tell a whole volume of stories. A young chemical engineer in charge of a manufacturing unit wrote: "We are having all kinds of trouble with labor. Every morning brings a long line of colored gentlemen with employment cards to be made out and an equally long line of men getting their time. It's got so that you ease up to a kindly ace of spades and ask him if he would mind rolling a few ounces. He will usually say, Yes, he would mind!"

With that experience fresh in our minds we asked another man, a plant manager, whether he had labor troubles. "Why, no!" he replied. "We haven't had any for years!" Then it developed that this company had realized that its location was disagreeable and that in order to hold its men it would have to make the work and the living conditions attractive. This the company has done in so far as possible and its labor turnover is less than 5 per cent!

How this has been accomplished is an interesting story which some day may be told. In any case the sooner industrial men realize that satisfied labor is an asset and move in that direction the better it will be for them.

The best example of what can be done is that of the Philadelphia Rapid Transit Co. A few years ago the company was bankrupt. Today it is healthy. The one difference is that the loyalty of the employees has been enlisted. Today they realize that their interests and those of the company are identical. A wise executive has seen to it that this fundamental principle has been adhered to. This principle must be steadfastly and sincerely followed, otherwise the distrust of the worker will persist. While other companies fight strikes, the employees of the Philadelphia Rapid Transit Co. voluntarily reduce their own wages.

Is an enlightened labor policy worth while?

Packing Industry Adopts Research Program

EDITORIAL reference was made in our issue of June 7 to the research and educational program for the packing industry outlined by THOMAS E. WILSON as the development plan for the Institute of American Meat Packers. At the seventeenth annual meeting of the Institute held recently in Chicago, the plan was adopted at the close of a most interesting session in which Dean RALPH G. HEILMAN of the Northwestern University School of Commerce demonstrated the value of research and education to an industry. The specific benefits to the packing industry were discussed by such competent critics as OSCAR G. MAYER, ARTHUR LOWENSTEIN, W. D. RICHARDSON, L. D. H. WELD, ARTHUR CUSHMAN, M. D. HARDING and J. C. DOLD.

As a working program, the report of the Institute plan commission was also adopted. This recommends raising by individual volunteer subscription the sum of $50,000 a year for three years to be spent on educational and research activities. For the first year, recommendations include: the appointment of a director of research to be responsible, with adequate assistance, for the entire scientific work of the Institute; to enable the committee on practical research to handle all matters dealing with practical packing house operation, the service of a competent secretary will be required; as a start in educational work, a series of lectures designed primarily to give men engaged in the packing business a general survey of the entire industry and of company organization and operation will be given by well-known authorities in the industry. The appointment of a man technically familiar with the problems of industrial education is also recommended so that he may survey the educational possibilities and requirements of the industry.

Thus an immediate start will be made in the field of scientific research, practical research and education. It has wisely been thought best to proceed along unpretentious lines at first so that the growth may be natural and not forced. The packing industry is to be commended for its determination to support the plans laid by its forward-looking leaders. The development will be watched with a great deal of interest by all branches of the chemical and allied industries.

Renewed Demand for An International Economic Conference

IN EXPRESSING his desire for an international conference on economic and business matters, Judge GARY is only voicing the feelings of the business and industrial leaders of the country. Sentiment in favor of such a conference was very strong last spring, immediately following the Disarmament Conference in Washington. At that time the U. S. Chamber of Commerce made a special effort to get the Administration in Washington to take the leadership in calling such a conference, feeling that the apparent success of the Disarmament Conference augured well for a similar international gathering to deal with economic and industrial matters. The Administration, however, felt it undesirable either to invite an economic conference at Washington or to participate in one in Europe. Nevertheless many will still agree with Judge GARY in his hope that there will soon be held in Washington another international conference "for the full and frank discussion of all unsettled financial, commercial and industrial questions in which our people are interested, directly or indirectly, to be participated in by able, open-minded, well-disposed representatives from the different nations." The results of such a conference will be more effective and far reaching than the present long-range parleys among political representatives. We are inclined to the opinion that certain political matters will be soonest settled if business and financial representatives determine certain economic and industrial problems that now disturb the international prosperity.

Rules, Regulations And Esprit de Corps

ONE of the most foolish notions in business is that somebody can draw up a set of rules and then expect things to run themselves. EINSTEIN has pretty well destroyed the Absolute in philosophy, but the notion has not yet percolated into the heads of a vast number of men of affairs. A great general once gave his definition of the perfect officer as "a man who knows when to disobey orders." This holds true in industry.

A competent works manager of our acquaintance once was asked, after something had gone wrong, why he didn't post rules about the plant. He replied that his policy was to have as few rules as possible, but to see that they were enforced. Too many rules crowd one another out.

We know it is a great convenience to demand that "all letters be addressed to the company"; otherwise the person addressed may be absent or he may be the wrong person. But often it is an expensive rule, and defeats its own purpose. We have referred hitherto to the cost to a corporation involved in forbidding its salesmen to write personally to the superintendent or for him to reply personally—although it is just as easy to keep records of such letters as of those addressed nominally to the company. Here is an example of how it may work the wrong way. A correspondent writes:

> On one occasion during war time I was placed in charge of some new chemical equipment which had just been installed. None of the operating men, including the superintendent, his assistants or the engineers of the plant, were familiar with the operation of this particular piece of apparatus, for I asked them first. I finally asked permission to write to the head of the company manufacturing the apparatus, knowing the party in question personally. Permission was refused, it being against the rules, but they would do it for me. Though I asked repeatedly for any word of a reply, none was ever forthcoming and I was left to work out my own salvation. I am reasonably certain that had permission been given, I could have obtained the information desired in a few days. On another occasion with another concern where I was doing some experimental work in connection with catalysts, it occurred to me that I might be able to get some material I wanted to try out from a metallurgical concern. I had worked elsewhere with this superintendent, and had addressed a letter to him personally stating what I was after and asking for information. About ten days later the assistant manager of the firm I was with came out to the laboratory with a reply from the concern in question. It had not been answered by my friend personally, but had been turned over to someone else. This party had addressed a letter not to me, but to the firm I was with, advising them that someone in their employ had written personally for information, as though this was a crime, and, to show my offense, they attached my letter to theirs. The tone of the letter implied a rebuke to my company for permitting anyone in their employ to do such a thing.

When concerns get so big that individual members of their staff are forbidden to think for themselves or to do their best to make things move, it is time to decentralize into units that can so organize their operating forces as to achieve a real *esprit de corps*.

Cutting Capital Costs In Gas and Coke Manufacture

ONE of the greatest difficulties which the gas and coke-oven industries have faced during recent years is the very high investment cost per unit of product. It has been the ambition of all designing engineers in these fields to increase the unit capacity of installations without sacrifice of operating efficiency. The recent development of a new type coke oven described in this issue by JOSEPH BECKER seems to be an unusually successful step forward in this direction.

The seriousness of the situation in the gas business perhaps affords a more striking example of the difficulty which has been met than any which can be taken from the coke business. Previous to the war it was not uncommon for public utility companies to get money at 5 per cent and they could build the best plants then available for about $4 investment per thousand cubic feet of gas made per year. Thus the capital charge in the form of interest was only 20 cents per thousand, and other charges on capital thus invested were not excessive. In fact, it was not uncommon to find the total capital expense under 30 cents per thousand and the net operating cost was often almost nothing, for the return on byproducts frequently equaled material and labor charges for the entire process.

With the advance of money costs and the great increase in construction expenses of all sorts, the industry during the war period and since found a very different situation confronting it. In some cases money cost 7 or 8 per cent and construction costs advanced so much that $8 to $10 investment was necessary in coal-gas plants per thousand of annual output. With an investment of $10 and 8 per cent for interest alone, which are not by any means the maximum figures that were reached, the interest charge per thousand feet of gas made was obviously 80 cents. This was an almost prohibitive figure, and it is not strange that resort was had to other types of gas-making equipment in order to avoid these tremendous investments that would have been a millstone about the neck of a company for many years.

In the coke-oven business corresponding conditions prevailed, though perhaps not to such extremes. It is with great satisfaction, therefore, that one can look forward to great increase in output per oven. One example of this increase in output which is forecast

for the new type oven is given from the estimates for one of the plants now under construction. In this plant it is expected that thirty-seven ovens which cost little if any more than the earlier types will produce as much coke as fifty of the best previous type of oven. Thus at one stride the industry advances by 25 per cent. Needless to say, it is an advance that will be of great importance to users as well as to producers of this most important manufactured fuel—coke.

The Junquera Process Of Nitrate Recovery

THE U. S. consul at Iquique, Chile, contributes to a recent issue of *Commerce Reports* an account of a new process for extracting nitrate from caliche, invented by Señor BUENAVENTURA JUNQUERA. Official tests, we learn, "were witnessed by many men prominent in the nitrate industry," the result being that "there is a disposition to recognize that a new invention has been made which, when improved, may revolutionize the industry." The tacit admission that the new process is incomplete—that it needs improving—is no logical preliminary to the extravagant claims made, which include, *inter alia*, assurance that the adoption of the process will result in:

"1. An increase of ten to twenty fold in the nitrate riches of the republic, as caliches with nitrate content as low as 10 per cent can be worked profitably.

"2. Assurance to the government for many years of the collection of export taxes at the present rate without hurting the industry.

"3. Cheapening the cost of Chilean nitrate so much that the competition of artificial products will be postponed for many years."

The Chilean nitrate industry is noted for the number of its "experts." Let us examine the details of the test that convinced a group of these worthies that a new era of expansion and prosperity was at hand in consequence of Señor JUNQUERA'S invention. According to Consul BRETT, "the material is ground to pass through a ¼-in. mesh, and is then highly heated. It is placed in a battery of eight gyratory drums, each 6 ft. in diameter, and having its edge made of filter cloth. Water is forced into the center of the first drum and is driven through the material and out of the drum's edge, where it is caught and passed in rotation through all the drums. Leaving the eighth and last, it is saturated with nitrate and is allowed to cool and deposits its nitrate contents in settling tanks . . . Working with material of 12 per cent content of nitrate, the extraction was said to be total and the consumption of oil fuel was only 9½ kilos per ton, but it should be noted that this test was made with fresh water and that the various weak solutions were not worked out as they would have to be in actual practice."

The final paragraph indicates the absurdity of adopting an optimistic attitude in consequence of the "success" of an experiment such as this, for there is no reason, if dependable data were desired, why the inventor should not have used solutions of a nitrate content customary in practice. However, had he done so, the extraction would not have been "total"—by any means. It is easy to saturate water with nitrate, but it is a difficult matter to obtain saturation at a high temperature by the abstraction of nitrate from caliche and to leave a residue that contains less of value than it does after treatment in a Shanks maquina. The publication of figures indicating oil consumption during a test such as the one described is an indication of the absurdity of the claims made and given publicity by the American consul at Iquique, who obviously is unacquainted with the technique of nitrate recovery. Accounts such as this make a burlesque of the industry; they tend to discourage the entry of American inventive genius and equipment into a field that offers unusual opportunities for advancement and profit.

The Junquera system appears to lack all the essential features of a cheap and efficient process. That it can be "improved" in such a manner that the industry may be "revolutionized" will be doubted by those who are familiar with the operation and scope of centrifugals, with the handling of high-grade nitrate liquors and the economic removal, by selective solution, of a soluble salt from earthy material.

Electric Furnace In the Steel Industry

ELSEWHERE we print a brief address made before the American Iron and Steel Institute by Dr. JOHN A. MATHEWS on "The Present Status of the Electric Furnace in Refining Iron and Steel." Metallurgical engineers particularly will be interested in what he has to say, because he is one of their number who has achieved conspicuous success in an executive capacity, or, as he more aptly puts it, a siderologist turned considerologist. Furthermore, he knows whereof he speaks, for he was one of the officiating doctors at the birth of electric steel in America.

In the intervening 16 years he has had ample opportunity to study the relative merits of open-hearth, crucible and electric steel. If memory serves right, he has always been a very enthusiastic advocate of the electric furnace, but has never been willing to admit that the crucible process would be supplanted in the production of superfine steel for small tools. Even recognizing the fact that the crucible pours out only what was put in, an electric furnace will pour out nothing but mediocre stuff unless great care and keen intelligence are put into it, along with so many kilowatts. So the relative quality of the two processes is truly relative—bad steel has been produced from both; most excellent steel has been produced in quantity from both—each heat must be judged on its own merits. By and large, Dr. MATHEWS still appears to favor the crucible, quoting his own words, written several years ago:

"It is seldom that a process is discovered that cannot be improved upon. Crucible steel is an exception to this rule. This earliest process makes the best steel and has never been surpassed."

Much more interesting is the fact that he is one of the few executives in the American steel industry who have a lively appreciation of what quality in steel means, and of the responsibility of the industry in providing metal considerably better than "just good enough to get by." Consequently his words have a great deal of significance as an appraisal of the trend in the steel-consuming industries (rather than the steel-producing), and as a prediction on the future of fine steels in America:

"When users acquire a full appreciation of what clean sound steel means in terms of national efficiency, safety and economy, we shall see more rapid growth [in the use of electric furnaces] than has as yet been seen. Its usefulness to engineering and industry has just begun."

Readers' Views and Comments

Growing Appreciation of the Value of Chemical Warfare

To the Editor of Chemical & Metallurgical Engineering

SIR:—Can it be possible that the country is beginning to regret its hasty action in so readily entering into an agreement to abolish chemical warfare? Only within the last week a Chicago newspaper twice raised the question of chemical warfare. Nor was it mentioned—as newspapers were wont to mention it—as a weapon of war to be abhorred; brutal and inhumane. Chemical warfare was urged, editorially, as a bulwark against the perils of an Asiatic invasion. A lengthy interview with ex-General von Ludendorf concludes with the forecast that the next war will be fought with the power of science rather than with multitudes of men.

With such slight encouragement shown and emanating as it does from the press, it seems all the more desirable to keep up the good work of educating the people to see the value of chemistry in warfare. Our Chemical Warfare Service is doing a wise piece of work in devoting part of its energies to the study of fumigation. The results from this work should be pushed to broad publicity.

Irrespective of what may be said against popularizing science, it must be conceded that our Chemical Warfare Service must be popularized—to use a timeworn expression, it must be "sold" to the public in general and to the personnel at Washington in particular—if we are to maintain that branch of the army in even a state of defensive preparedness. FLOYD K. THAYER.

The Abbott Laboratories,
Chicago, Ill.

Who Financed the German Economic War?

To the Editor of Chemical & Metallurgical Engineering

SIR:—The first article on "European Conditions as I Saw Them" printed in the Oct. 18 issue of *Chem. & Met.* has raised the question: Who financed the German economic war? This very logical question can be answered by elucidating somewhat the statement that those who engineered this war, being good German psychologists, foresaw to a certainty that ample finances lay dormant first in the productive power of the German masses and second in the get-rich-quick mentality of the foreign dupes so well defined by the American expression "suckers."

That the productive capacity of the German masses has yielded vast amounts of munitions will become evident after reading the other articles (nine in all) which complete my series. They will prove that the German employees got as wages and salaries only a small fraction of what they ought to have received, were they paid the due reward for the intrinsic value of their work. This was an easy task, considering that the German masses could readily be brought to the point of believing that they were acting as soldiers and that they kept on fighting under the continuous propaganda of hatred against the makers of the Versailles treaty. They and their families were not left to suffer physical hunger, because the German Government acted as a fatherly quartermaster by facilitating their getting the strictly needed food with their minimum-for-existence pay. Similarly with their transportation and rent costs. As for the remainder of their needs and wants—well, good soldiers must not play at living *schieberisch* (like profiteers) while in active service.

The foreign dupes have contributed vast amounts of real money in exchange for German-printed banknotes. This was an indirect levy on all the world and was easily accepted because it was cloaked in the form of a get-rich-quick inducement for speculation in German paper marks. Few are the foreign bankers who did not accommodate eager clients with this made-to-order so-called German money. It is not for me to produce statistics as to what extent America, England, Holland, Switzerland, Spain and all the other countries with par money have answered the call for this indirect levy, but it is already public knowledge that America alone has thus contributed nearly one billion dollars—i.e., about twice as much as the total amount in money which Germany has thus far paid to the Allies. I may mention here that very reliable persons have told me that along the boundary between Germany and Holland Germans sell in the public markets basketfuls of German paper marks for foreign currency.

What was still needed to complete the total of the required finances was provided from the assets which the German Government still had at the close of the war. This was the first source of supply to be exhausted and was rapidly followed by sharp drops in the two other sources of supply, with the result, as pointed out in the above-mentioned article, that Germany has lost her economic war.

The productive capacity of the German working masses, which has been only sparingly paid for, the vast amounts of good foreign money obtained in exchange for their printed paper marks and the amounts contributed by the German Government to enable the working masses to subsist on their minimum-for-existence wages provided the sum total of the finances used in carrying on their disastrous economic war. J. S. NEGRU.

New York City.

Electric Welding by Alternating Current

To the Editor of Chemical & Metallurgical Engineering

SIR:—We notice on page 712 of your issue of Oct. 4 that you give space to note on "Electric Welding by Alternating Current," as being a new thing. It is new, but you don't have to go to Stockholm to find such a system.

This company holds exclusive license under patents for such an alternating current transformer welding system, the patents being granted June 3, 1919, applied for in 1917, and the development made from 1912 to 1916.

A technical description of it was given before the American Institute of Electrical Engineers, White Sulphur Springs meeting, June 29, 1920.

ELECTRIC ARC CUTTING & WELDING CO.,
Newark, N. J. BY C. J. HOLSLAG.

American Iron and Steel Institute

Judge Gary Heads Notable List of Speakers at Semi-Annual Meeting—Technical Sessions Hear Papers on Fuels, Furnace Design, Fluorspar, Steel-Making Equipment and Fine Steel

EDITORIAL STAFF REPORT

ABOUT 900 steel makers and men interested in steel making assembled last Friday at the American Iron and Steel Institute's semi-annual meeting, to hear what Judge Gary, chairman of the U. S. Steel Corporation, had to say about the business outlook, and to swap views on coal, recent shows, the Kaiser's autobiography, and the way Tom Brown plays the nineteenth hole at Gadzooks. Perhaps some mention was also made of the price of pig. A hopeful sign is that the Judge made one of his few references to technology, when he remarked that we are now making steel of better quality than ever before. It appeared, also, that the listeners to the prepared papers were rather more numerous than formerly—as is fitting. No report of the committee studying the 12-hour day was presented, since it has not yet been able to collect the necessary data on its prevalence.

JUDGE GARY'S ADDRESS

The president's address was, as usual, confined to carefully chosen generalities on the business situation, both in its international aspect and as this is reflected in the iron trade. Judge Gary can see no quick relief from present high prices, since he believes that the price of commodities is made up of 85 per cent labor cost and there is no apparent possibility of reducing wage rates, except in isolated cases. The only way he sees to get away from the vicious cycle of rising prices is to suppress all conspiracies to control production, trade or labor; to refrain scrupulously from interfering with the natural law of supply and demand; and to insist upon unprejudiced and adequate publicity about business conditions and practices. Failure to observe these conditions is responsible for the only obstacles to unbounded success for the American steel industry, since we have an extraordinary amount of raw materials, transportation facilities, skillful personnel and diversified demand. Mr. Gary is opposed to cancellation of the foreign debt, likening such to "forced charity." He thinks that an international conference on economic conditions, if held in Washington and attended by such high-minded representatives as was the Arms Conference, would be of great value toward re-establishing commercial peace.

FUEL AND FUEL ECONOMY THE THEME OF TECHNICAL SESSIONS

Nine excellent technical papers were read. With two or three exceptions they referred to production, storage and economical consumption of various types of fuel. Some of those papers are without the province of *Chemical & Metallurgical Engineering*.

Some remarks made by H. Foster Bain, director of the Bureau of Mines, may help the casual reader to realize the difficulties of stabilizing the coal industry. In introducing his paper on "Modern Methods of Mining Coal," he said that business and humanitarian impulses in the coal industry were apparently quite divergent. Thus the best results may be had if a coal-mining area is equipped to work intensively, continuously and at such a rate that the coal will be exhausted in 25 years. Each such development requires the building of a town to house the workers; yet in 25 years a community has barely time to take root.

"Storage of Bituminous Coal" was another paper (by Messrs. Stoek and Freeman) which has incidental interest. Coal storage costs not less than 25 cents a ton; on the other hand, excess mining expense in slack times amounts to twice that much. Deterioration in the coal occurs at the surface only, and is therefore quite negligible in large piles. Spontaneous combustion occurs almost exclusively in fine coals, those with high FeS_2 content or those stored over timber or rubbish. Fires can be extinguished only by digging out the burning coal.

POWER PLANT ECONOMIES

It is seldom realized that the total power used in a steel mill may easily cost 5 per cent of the sales value of the finished steel, even with good utilization of by-products. This figure may be reduced by electrification —elimination of steam engines and boilers and installation of electrical generators driven by gas engines, and motor drives at all points, as pointed out by E. F. Entwisle of the Bethlehem Steel Co., in a paper entitled "Economic Importance of the Power Plant." Few plants could not reduce their total power costs and show a good return on the necessary expenditures—failure to proceed along these lines can be excused only where the same amount of money invested in other departments would show a greater return.

EFFICIENCY OF HEATING FURNACES

W. P. Chandler, Jr., of the Carnegie Steel Co., presented a paper on "Heating Furnaces for Blooms, Slabs and Billets" in which he gave heat balances for two large furnaces on such work, one continuous and the other non-continuous. The latter was built like an open-hearth furnace, fired through ports at either end, with air and producer gas preheated by underground regenerator checkerwork. Its hearth was 18x35 ft., with a burned-in silica bottom. Cold blooms varying from 5 to 10 in. square were charged through six doors, and heated to rolling temperature, 2,100 deg. F. As the furnace was unloaded, it was progressively refilled with cold material. Two furnaces are necessary to feed one rolling train. Thermal efficiencies—heat absorbed by steel divided by total heat in gas supplied—varied from 36.5 to 41 per cent, the latter occurring when heating steel at the slowest rate—viz., 32,900 lb. per hour.

Continuous recuperative furnaces showed better efficiencies. The one studied had a sloping hearth 25 ft. long and 32 ft. wide. Billets were charged and discharged endwise through small side doors, and rest on cast iron skids, not water cooled, or on a magnesite-brick bottom at the firing end. The roof is a series of flat arches. It is cooled from above by air for combustion on its way to the recuperator, after passing which it goes through passages under the hearth and then to a series of fifteen gas burners, thus acquiring a total

superheat of 325 deg. F. The recuperator consists of a series of vertical cast-iron pipes through which hot waste gases (at 1,300 deg. F.) pass on the way to the stack. Air for combustion bathes the outside of the pipes. Thermal efficiencies varied from 47 to 57 per cent, being greatest when heating 2½ in. square billets at the highest rate—66,000 lb. per hour.

A similar furnace, wherein the recuperator was built of brick tiling, gave efficiencies of 58 to 63 per cent. The increase was principally due to lower stack losses—i.e., the air for combustion was preheated 25 deg. higher, and less of it was required for correct combustion.

Various recommendations can be made, looking toward an even more economical furnace of the continuous type. Roofs should be flat, without water cooling, and placed rather low over the steel. A roof recuperator should be installed only when the roof would melt if adequately insulated. The hearth should be sloped downward toward the discharge end, and have solid cast-iron skids built in. Numerous burners will give more uniform heat distribution; each should have independent adjustments and control. Gas and air pressures at the burners should be automatically registered, and each furnace should have an accurate gas meter. Slots and swinging doors for charging or discharging the steel should be avoided on account of large leakages of cold air which always takes place. Have small doors on the sides. Metal recuperators are doubtless best; they have higher heat conductivity than firebrick, and may be made tighter. If the recuperator is properly designed, it will make it unnecessary to install a waste-heat boiler. Insulate wherever the brick will stand it. Avoid water-cooled devices.

W. P. Chapman, in the discussion, showed some photographs of special recuperative furnaces for glass making, which gave a much higher superheat and required much less air for combustion. This was done by using recuperators made of special thin-walled tiles, having small straight passages for air travel. Leakage was minimized by special joint construction and so arranging the fans that pressures on the waste gas and air side of recuperator passages are substantially equal.

Professor Trinks, of Carnegie Institute of Technology, also pointed out that the efficiency of continuous furnaces was a maximum when heating about 30 lb. of steel per sq.ft. of surface per hour. Very great heat losses are due to leakage, not only in the recuperator but by cold outside air leaking into the passageways. Unquestionably a continuous furnace should be used wherever permitted by the uniformity of shape and size of material to be heated and steady operation throughout the rest of the mill.

Liquid Fuel

A treatise on the "Use of Liquid Fuel in Metallurgical Furnaces" was prepared by R. C. Helm, of the American Steel & Wire Co. Fuel oil from 30 to 12 deg. Bé. has been used for this purpose. Flash point should be over 150 deg. F. to reduce fire hazard. Sulphur is limited to 0.75 for open-hearth melting, although after the bath is covered with slag high-sulphur oils can be used to complete the work. This involves a duplicate installation, which is not relished. High-sulphur oils will also discolor sheet brass during annealing. Solids, which clog the pipes and nozzles, are carefully removed by strainers, placed in the pipe lines in duplicate.

Oil nozzles atomize the fuel by a spray of dry steam or air at high pressure; a number of such designs were illustrated. Mechanical atomization so common in boiler practice is almost unknown, possibly because the latter throws a flaring conical flame rather than the long torch effect desired in most furnaces.

Coke-oven tar is used wherever it may be had cheaply. It is heated to about 160 deg. F., when it can be pumped about easily. Three-inch mains, steam jacketed, deliver the oil to the furnaces; sometimes a 50 per cent excess must be circulated. Special nozzles (steam atomizers) are also required. While the equipment necessary to handle tars and oils of low gravity seems quite complicated, the very low price of the fuel furnishes an attractive return on the investment.

Open-Hearth Design

One of the most notable papers of the session was on "The Thermal Efficiency and Heat Balance of an Open-Hearth Furnace," by Messrs. Kinney and McDermott, of the Illinois Steel Co., notable because it shows how thermal investigations have pointed the way in designing more efficient furnaces. We hope to give adequate space to present the details of this study in a later issue.

Various speakers urged that the Iron and Steel Institute appoint a committee to recommend standard methods for thermal studies. Apparently a great amount of this sort of work is being done, but it is not readily comparable between plants, because of variations in experimental procedure and methods of calculation. Much work ought also be done on specific heat and conductivity of refractories, metal, and gases at high temperatures.

Electric Furnaces

Dr. Mathews' important paper on "Present Status of the Electric Furnace in Refining Iron and Steel" is reprinted in full on page 872 of this issue.

Automobile Steels

A paper entitled "The Steel Requirements of the Automotive Industry" was presented by Henry Chandler, of C. H. Wills & Co. He emphasized the fact that automobile steels are bought on physical properties; even though chemical analysis is often specified, it is done only because the purchaser knows that a well-made steel of that composition will satisfy his other requirements. Tensile test is chiefly relied upon. While it by no means duplicates the service conditions (the ultimate test), when correlated with other tests and with experience it furnishes a sound basis for estimating quality. Mr. Chandler places considerable faith in the "merit number" derived from a tensile test.[1] Brinell or scleroscope tests are next in importance, giving information on machinability and the efficacy of the heat-treatment. The impact test is often used, and its chief usefulness it to check the merit number derived from the tensile test. Sometimes the microscopic constitution of the steel is so different from the expected that the above-mentioned tests give quite misleading indications—they must therefore all be interpreted in the light of full and complete information.

[1] "Quality in metal is equal to $\frac{work\ done}{metal\ affected}$ which is proportional to $\frac{mean\ breaking\ strength \times elongation}{constant - reduction\ in\ area}$, where the constant varies as the type of fracture.

Ninth National Convention of Society of Industrial Engineers

The Society Devoted Its Attention to the Significant and Timely Topic of the Relation of Economics and Business—An Abstract of the Most Significant Speeches Reflects the Progress Being Made Along These Lines

EDITORIAL STAFF REPORT

PLEASE consider this a kind of official introduction to the Society of Industrial Engineers. The organization of this society was significant, and its work continues to be significant. It is indicative of the increasing attention which is being devoted to the problems of scientific management in all of its phases. Chemical industries have suffered and still do suffer from a lack of contact with the principles of scientific management. This statement does not mean, of course, that many chemical companies are not well managed. That would be absurd, but if they are well managed, it is probably due to a rather empirical development than to a careful study of management principles as such. It is therefore high time that the attention of these industries should be turned to a group which is devoting its energy to the study of these principles and to the development of new ones.

PRESENT STATUS OF ECONOMICS IN BUSINESS

The meeting in New York last week took for its text the economics of industry and intended to develop such fundamental economic principles as were necessary to maintain maximum production with a minimum effort, waste and cost. President Joseph W. Roe, head of the department of industrial engineering at New York University, gave the keynote speech. There is, he remarked, a close analogy between the attitude of the manager of an industrial plant of today toward economics and the attitude of the plant manager of 50 years ago toward the study of science. The attitude runs its course from an amused tolerance to a distinct distrust, with enough significant exceptions who take a serious interest in the subject and who make it worth while to study the exceptions. Fifty years ago these exceptions, the men who pinned their faith on the scientifically trained engineer, soon made it apparent that industrial waste and mechanical inefficiency which were then so universal could not be tolerated. It is now a paramount question to eliminate social waste in industry. Nearly all waste in industry is now due either to bad management or social causes. It is of course legitimate to point out that good business men are often ignorant of economics, but so too were the good practical engineers without scientific training a generation and a half ago. With the present complexity of industry, the economist becomes essential. He sees forces in perspective which the individual manager can but vaguely feel.

Let us take as an example a single economic law, the law of diminishing returns, and study industry to see in what ways this law may operate. The first example has been multiplied so many times in the last 2 years that it is almost a redundancy to mention it. Overproduction is inevitably and invariably a result of a disregard of this economic law. Another variation of this law is the possibility of an economic limit to the size of a business. One conspicuous example will develop the idea which lies behind this. Holmes of the Waterbury Valley is a name to conjure by in the brass industry. During the middle of the last century he started five successful enterprises which are still in existence. He believed that a thousand employees was the right size of any individual unit in the brass industry, and when he reached a thousand employees he started over again. Therefore the continued success of these five enterprises is noteworthy and makes very pertinent the question, Can we overdo size?

We must bring industry and economics together, concluded President Roe. First, let the labor leaders and industrial men read economic history and study its cycles. Let there be more readable economic books and sound economics taught, not only in colleges but in schools. Business men should be taught to use the present statistical sources and through their trade associations to study economic problems, including such things as the sources, quantities and prices of prime raw materials, not only in their own industry but in other industries.

ECONOMICS PART IN FORMING BUSINESS POLICY

Another keynote speech was made by J. H. Pardee, president of the J. G. White Management Corporation. From his wide experience he picked out the functions of economics in forming a policy of business administration. Business men today are gamblers, most of them, he said, largely because they do not study the fundamentals of economics and their application to their own business. There was in his opinion one great need in economics at the present time, and that was standards throughout the science. Mr. Pardee pointed out that chemistry, physics and astronomy made little advance until standards of measurement were adopted, and finally developed the very significant analogy that very little progress was made by the Interstate Commerce Commission on railroad problems until it had thoroughly standardized procedure, nomenclature and measurements. It was notable, he pointed out, that such problems as tariff, taxation, etc., find astute business men on opposite sides. This, he felt, was due largely to the fact that the definitions in this field did not define and that there is a distinct lack of adequate standards. With proper standards the many problems which now confound the business man would undoubtedly be ironed out. He would be able better to understand the law of supply and demand in relation to his own business. He would see that selling price and cost of production were interrelated. He would understand the fallacy of a fixed overhead and more than 10 per cent of the manufacturing establishments (the present ratio) would see the vital necessity of adopting cost accounting systems.

The Employer-Employee Relation

Two questions which primarily involve the employer-employee relations were discussed ably and at some length at one of the sessions. The discussion took the

form of answers to two questions. First, how can we reduce production costs, and, second, what keeps the workers contented? Each of these questions was discussed, first through a paper designed to represent the employer's point of view, and then with a paper presenting that of the employee. James A. Faust, of New York City, pointed out the significant fact that chief executives are usually somewhat unbalanced. This is not at all strange, for, of course, a chief executive develops through one of the individual departments, either sales or cost or production, and it is therefore quite understandable that his department of the work would be more emphasized because he was more familiar with it when he became chief executive. Mr. Faust claimed that the chief executive was the chief factor in cost reduction. Charles M. Schwab once said that he had no high-priced executives in his company, but he had the best paid executives in the country. The way he attained this peculiar situation was by paying them a bonus; for any man, he said, can produce pig iron for, let us say, $1 a ton, and that was what he was paid his salary for, but if he produced pig iron at 95 cents a ton, then he would receive 5 per cent of the net saving that he had made, and so on. If the chief executive cannot pass on an enthusiasm and a faith in the organization down to the lowest workman in the plant, that organization will fall short of its highest efficiency by just so much.

The Big Problem of Co-operation

From the worker's standpoint Mr. Geiger of the Keratol Co. pointed out that costs could be reduced by using the workman's time to better advantage. The worker has three things to give a company—time, skill and co-operation. Of these time has up to the present received by far the greatest attention. Time charts, man charts, etc., are becoming better and better known, but it must be remembered also that unused skill is as expensive as unused time, and if for reasons of poor co-operation a workman is not stimulated to use his best skill and thought for the company, then that company is not using that workman to either its or his best advantage. Co-operation is that easiest and hardest thing to obtain, and it is extremely necessary to the efficient use of the worker's energy. A suspicious worker is not a good co-operator, and a worker will become suspicious if he feels that for some reason or other he is not getting his just due. Wages alone, be they high as the sky, and fancy cafeterias do not make a good place in which to work.

The second question, how to keep the worker contented, was answered from the standpoint of management by Charles Cheney of the Cheney Brothers Silk Manufacturing Co., South Manchester, Conn. He pointed out that it was necessary to go back to fundamentals before this problem could properly be studied. What is contentment? Above all, it should not be sedative, and it should not stifle the creative impulse which exists in every man, be he workman or executive. The welfare worker is looked on with suspicion, because welfare work has been undertaken so often in a narrow spirit, demanding a plastic submission. Does it pay to do welfare work? He hoped so, but he felt the proof was lacking. Another question, the answer to which was also more or less indefinite but which he also hoped was true, was, Does it pay to be honest? The sore, aggrieved worker is a menace, and he must be eliminated, not by being kicked out, but by being taken into the confidence of the organization management, by being made an associate. Then, treated as an associate, he must receive his due.

What is his due? Again, we must get down to fundamentals. Compensation should vary with the results received, but should vary with the results obtained by the individual and not the results obtained by the business. The amount of compensation should first of all insure a margin of safety above decent living. Such extra compensation as is in order should be based on individual efforts, should be large enough to strive for, should be paid soon enough to make the worker realize just what effort is necessary to accomplish that result and should be paid on a system simple enough to be easily comprehended. It is not generally known that such a system of compensation has been applied as well to clerical help as to mere manual or machine labor. In addition to such a basis of compensation based on efficiency, Mr. Cheney recommended a credit rating plan, adding a bonus for good citizenship, for marriage, for service, as well as for efficiency. In other words, the value of a man to a firm will vary in respect to these things, and therefore it is reasonable to vary his compensation on that basis too.

Profit sharing, as it is practiced at the present time, is not logical. It is a present and nothing more. The statement that labor makes profit he believed to be inaccurate, for he felt that labor had almost no connection with the profits of a business. Labor could be faithful, could give his own best energy and yet the business might fail, due entirely to poor purchasing, poor sales policy, economic conditions, strenuous competition, poor advertising or any number of other items over which the individual worker has no control. The fact that he has common interest with the firm does not make him a partner in the firm. Furthermore, profit sharing has not worked out well in practice. The advantages gained at first are soon lost, and the profit-sharing bonus is expected as regularly and counted on as definitely as ordinary wages. Many firms have found it extremely difficult to discontinue profit sharing in bad years. Furthermore, Mr. Cheney felt that in general the investing of the employee's money in the business was not wise and somewhat dangerous.

The worker should be dealt with on a basis of justice, plus consideration, sympathy and human interest. It must be reciprocal, and the method of accomplishing this is by personal work rather than by any cut and dried system. Labor does not want to lead, but is willing to be led if kindly led. His thoughts must be expressed somewhat and should be expressed for the benefit of the firm, and his aspirations must be considered and made to coincide as closely as possible with the interests of the firm itself. When this identity exists, the state of that corporation will be healthy.

Partly in reply and partly in extension of the remarks of Mr. Cheney, O. A. Prebble, who has been an officer in the American Federation of Labor and has been connected with labor problems for a long time, presented what might be considered labor's views. With Mr. Cheney, he felt that labor wanted justice more than anything else. He did not want presents or patronage or even consideration—but justice.

Economics and Production

From the standpoint of the engineer the most immediately appealing subject on the program was that covered by Ernest F. Du Brul, general manager of the

National Machine Tool Builders' Association, "The Economic Aspect of Production." The problems of production and the vocabulary of production are familiar to the engineer and therefore hear what he has to say!

The Engineer's Contact With Economics

The engineer thinks of the fabrication of physical goods when production is mentioned, but there is danger in this point of view. The danger is that he will and does consider that when goods are fabricated, value is created. True, money has been expended in fabrication, but there is no value until a market has been obtained. In other words, production of utility, which is the thing of value, must not be dissociated from distribution and financing, else we begin to have the unbalanced view that: "The producer gets too little out of what the user finally pays," and "Labor produces all wealth." Accordingly they begin to think that simply by fabricating or growing something, they are entitled to demand other goods and services in return for theirs.

Another point in which the fabrication man's logic has slipped a distinct cog is in adhering to the fallacy, "The more the output of the plant the lower the cost and the greater the profit." This does not follow and many an engineer has urged greater production when it resulted ultimately in increased cost, and even when costs were lower a market was often not assured. Even so it has been in many industries. The rubber tire industry suffers today from a large overhead which it must carry. The market was estimated to be nearly double its actual extent.

Different businesses will require widely different policies. Standardization of their patterns would be fatal where standardization of a make of automobile is vital. An expert aviator may know nothing of the physics and thermodynamics of engines. Yet both the expert in construction and design and the aviator are essential to the progress of aviation. So with the economist and the business man. The one must discover and the other apply economic laws to the business machine. More, more and still more economics will be essential to proper and effective progress.

Other Convention Activities

In abstracts of these few keynote speeches we have reflected the outstanding spirit of the meeting. There were many other papers presented, prominent among which were "The Budget and the Financial Forecast," by A. J. Lutterbach, controller of the Palmolive Co., and "The Necessity of Waste Elimination to the Economic Structure," by Robert B. Wolf.

There were group meetings on a variety of topics: The Economic Background of the Executive; The Measurement of Management; The Reduction of Sales Costs; Is There a More Scientific Method of Selecting People for Jobs? The topics were interesting, but in general the discussion fell short of the high plane of the addresses. The discussion was not animated in those groups attended and the matter brought out was usually nothing more than casual. With that reservation, however, the meeting was thoughtful, timely and stimulating. Give the society your attention. We believe it will merit it.

Prof. J. W. Roe was re-elected president of the society and announced that the next convention would probably be held in Buffalo during April of next year. No subject has been chosen as yet for the meeting.

Status of Italian Artificial Silk Industry

The Italian artificial silk industry has attained a considerable development as regards capital invested, labor employed, raw materials and actual production, says *Commerce Reports*, Sept. 25, 1922. The industry is a comparatively new one, being unkown in the world's market for only 30 years and in Italy for about 15. All four known processes are used—nitrocellulose, cuprammonium, cellulose acetate and viscose.

Amount of Capital and Labor Involved

The present amount of capital involved is about 420,000,000 lire (approximately $21,000,000 at current rate), and by the end of 1923 it is estimated that the amount will be fully double that figure. Twelve thousand laborers are now employed, and by the close of 1923 it is estimated that the number will be about 20,000. Some of the raw materials used—i.e., soda, carbon bisulphide and sulphuric acid—are produced by native industries, and it is hoped that after a time the wood pulp may be also, though at present it is imported principally from Scandinavia. Considerable quantities of cloth, hosiery and knitted goods are being manufactured from the fiber.

At present there are five large factories in Italy—located at Pavia, Padua, Venaria Reale and Cesano Maderno, which produce in all 24,250 lb. of artificial silk per day. These figures are furnished by the Associazione Nazionale Seta Artificiale. It is estimated that, with the possible increase in the production of the old plants and with the two new large factories in the course of construction at Rome and Naples, the present production will be more than doubled.

Importation Despite Large Domestic Production

The rapid increase in the uses and consumption of artificial silk justifies the great increase in production, says the *Bollettino di Notizie Commerciali*. At present the factories do not meet the national demand, as they have a considerable export trade. Consequently there is quite an import trade also. The imports come at present from countries of high exchange conditions—which are also the greatest and best producers and exporters—as the German production is insufficient to meet the needs of its own market at home.

The export trade is constantly increasing. This is doubtless caused not only by the quality of the Italian product, but also by the exchange situation, as the trade is directed almost exclusively to countries where money has depreciated very little, if any. The latter element is, of course, of transitory character and a change in currency conditions or the revival of competition by a country with lower exchange than Italy (for example, Germany) might alter the situation greatly.

Study of Electric Furnace Refractories

As it is hoped to develop refractories for electric furnaces, it is desirable to have a method and apparatus for measuring their conductivity at advanced temperatures, states the Bureau of Mines. Moreover, data in regard to the conductivity of existing refractories at temperatures above 1,400 deg. C. are meager. It is proposed by the bureau to study the leakage factor through refractories. The method of attack has been worked out and the furnace designed, the material for which is arriving at the bureau's ceramic experiment station at Columbus, Ohio.

The Present Status of the Electric Furnace in Refining Iron and Steel*

Flexibility of Furnace and Quality of Output Have Established the Position of the Electric Furnace—As Consumers Realize the Economy of Using Clean, Sound Steel, They Demand an Increasing Tonnage of Electric Steel

By John A. Mathews
President, Crucible Steel Co. of America

IT SEEMS to have been generally overlooked by the steel trade that this year, 1922, marks the tercentenary of iron making in the Western Hemisphere. In 1622 the first iron was made at Falling Creek, Va., and in the same year the plant was destroyed and the workmen massacred by the Indians. It is a far cry from charcoal hearths and forges to the consideration of the electric furnace—the latest development in steel-making processes.

Optimistic Predictions of Inventors

The earliest literature of electric melting of iron and steel dates back but a score of years and was provided by the inventors of various furnace types. It is characterized by the enthusiastic optimism of the inventor, and on that account may not have been considered very seriously by conservative, practical steel men. Their confidence in electric furnaces may not have been greatly increased during the next few years by the writings (including my own) of those who made the earliest installations. They may have felt that there was something of the child-with-a-new-toy air about them, and that both inventors and early users were overstating the case and that time and further experience might change matters. The war needs stirred some of the doubting Thomases to action and furnaces were installed in great numbers, particularly in the years 1917 and 1918. So rapid was the introduction of electric furnaces at this time that I felt constrained to utter a word of caution in a previous paper to this Institute[1] when I said: "We will pass through a period of reaction and dissatisfaction with electric products while many of the new furnaces are in the experimental stage."

This opinion was based upon the fear that furnaces could be built faster than skilled operators could be trained. I now feel that my fears were justified by the experiences of the war period, for much electric furnace product was not what it should have been, and possibly not as good as much of the open-hearth product produced during the same period. I have always discouraged the idea that the electric furnace was a foolproof and automatic process for making superior steel by those unskilled in steel making.

Importance of the Method at Present

I believe now that the period of disaffection is past and that the 16 years of experience since the first electric furnace was installed in America, at the Halcomb Steel Co., have been sufficient to afford a sounder basis of judgment than may have been afforded by the earlier literature already mentioned. There are now nearly 1,000 electric furnaces in America and Europe, not quite half of them in the United States and Canada. Constant interest in these developments from the beginning leads me to feel that the pioneer writers were not overenthusiastic and that their claims and predictions have, in general, been fulfilled.

It will surprise many of you to know that Italy has about 180 electric furnaces for steel melting, and that 27 of them are from 15 to 25 tons capacity, and in 1921 her tonnage of electric steel was second only to that of the United States and reached a new high mark for that country. The annual productive capacity there is about 1,000,000 tons, and Dr. Giolitti recently told me that some of these furnaces were operating at unusually high speed and with great economy of electrode consumption, as low as 6½ lb. per ton for cold melting. For installed capacity, Italy ranks ahead of Germany, England and France, and second only to the United States.

The rapidity with which electric furnaces have been installed within the last decade all over the world calls for some analysis as to cause. After 10 or 12 years of invention and pioneering there were about 125 furnaces in the world in 1912. At this time Germany led with nearly one-third of the total number. Today, as nearly as may be estimated, there are 1,000 furnaces, 388 of them being in the United States according to the *Iron Age* figures for Jan. 1, 1922. Accurate statistics have been extremely difficult to secure during late years, but according to Dr. Richard Amberg[2] there are 65 furnaces in Germany engaged in the manufacture of ingots, with a yearly productive capacity of 430,000 tons, and an unknown number of furnaces making steel castings, with a capacity estimated at 300,000 tons per annum. I think we may estimate the total number of electric furnaces in Germany as about 100 to 110.

Flexibility of the Electric Furnace

The reasons for the world-wide expansion of electric steel making are three:

(1) Cheapening of wholesale power rates, due to hydro-electric and improved steam plant developments. Thus it is now commercial to use electricity for melting, whereas the original promoters of arc furnaces felt that their use would be of necessity confined to refining of metal premelted by the older processes.

(2) The extreme flexibility and adaptability of electric furnaces to a wide range of uses. It has been shown by experience that they may be successfully used for melting cold charges or refining liquid charges, for making ingots or castings, and for melting ferro-alloys. They may be used alone, or in conjunction with the bessemer or open-hearth, or both. They may be operated acid or basic. They may be used in conjunction with the blast furnace or cupola for making gray-iron, malleable and semi-steel castings. For foundry use particularly the small units are advantageous for making frequent small heats of steel or iron castings.

*Paper read before the American Iron and Steel Institute at New York, Oct. 27, 1922.

[1] "The Electric Furnace in Steel Manufacture," Yearbook American Iron and Steel Institute, 1916, p. 73 (May, 1916).

[2] "Electric Furnaces in the Iron and Steel Industry," *Helios*, vol. 28, p. 169, for April, 1922.

The most popular size of electric furnace in this country is of 6 gross tons capacity, but furnaces from ½ ton to 40 tons capacity have proved equally successful. In furnaces of 6 tons or a little larger hand charging is general, but in the larger sizes either mechanical charging of cold materials or the use of hot metal charges is usual. Duplexing of open-hearth steel is practiced in many of the larger units, while triplexing is done at the great installation at the Illinois Steel Co. as described at the Institute a few years ago by T. W. Robinson.[3]

All of the manifold methods of operation are possible with the use of arc furnaces, which are by far the most frequently used here and abroad. Of the different types of arc furnaces in the United States nearly one-half are of the Heroult type and considerably more than one-half of the productive capacity is represented by them.

The electric furnace has small possibilities in this country for the manufacture of pig iron from the ore, but during the war period several furnaces were used to make so-called synthetic pig iron from turnings and borings and other light scrap in the United States, Canada and France. In Sweden, Norway and Italy, where metallurgical fuel is very dear and electricity is cheap, electric smelting of ores is an established industry. The world's production for 1921 is placed at 377,000 tons, and most of you will recall that the year 1921 was not a good year for high records.

Quality of Product

(3) Quality of products. A new process to succeed must be cheaper in operation or produce a better quality. The cost of electric steel is rarely lower than open-hearth and never lower than bessemer, and therefore its success is presumably due to its producing a generally superior product. Of course there are especially favored localities or peculiar market conditions which warrant the installation of small electric furnaces where open-hearth and bessemer installations would be out of the question. In the same localities and markets electric furnaces do operate successfully alongside of large-tonnage plants, and under such conditions quality must be the principal reason for success rather than low cost.

It is quite obvious that this country has not installed 1,500,000 tons of productive capacity to compete with the present crucible capacity of one-tenth that volume. In an address several years ago I said: "It is seldom that a process is discovered that cannot be improved upon. Crucible steel is an exception to this rule. This earliest process makes the best steel and has never been surpassed." The superior lasting qualities of German guns was often ascribed to the use of molybdenum, zirconium, uranium or other strange alloys, but my own idea is that the use of clean, well-melted crucible or electric steel is a more probable explanation. Crucible steel was employed for many submarine crankshafts, and apparently the Germans recognize that when fabricating and machining costs are far in excess of material cost, and where dependability is a vital necessity, it is a poor policy to save at the spigot and let out at the bunghole. Quality depends upon the selection of raw materials, the process of melting and subsequent care in forging and heat-treating. The electric furnace provides a reducing atmosphere in which sulphur is readily removed and with it goes one of the generally recognized inclusions, manganese sulphide, and the same condition serves to eliminate oxides.

The electric furnace, therefore, is a potential source of clean steel which is more highly appreciated than formerly, and the electric product is opportune to meet the new and exacting requirements for ordnance, automobiles and airplanes, and other devices in which alternating stresses are very severe. The importance of clean steel has been observed in the course of extensive investigations of the fatigue of metals under the direction of Prof. H. F. Moore. It is not too much to expect that the higher the elastic or proportional limit resulting from heat-treatment the more serious would become defects such as non-metallic inclusions and seams in parts made from inferior steel. Dr. McCance confirms this in stating that fatigue failure under repeated stress is a progressive failure, starting in all cases in some defect or irregularity either of internal structure or external surface.

Freedom From Inclusions

By way of illustrating the freedom from inclusions in electric steel, I might mention the result of actual count of hairlines, due to inclusions, in the ground surface of steel to the same chemical specification—a chromium-nickel steel for airplane crankshafts. As the result of tests on several heats of this steel by the basic, and acid open-hearth and basic electric process, the average count ran in the ratio of 8 to 4 to 1, and the hairlines in the electric steel were much shorter than in the steel of open-hearth manufacture. Another illustration from my own experience may be convincing. In one of the races at the Indianapolis Speedway a few years ago, about one-half of the cars starting did not finish because of failure of vital parts. The following year nine or ten cars, which I knew contained our electric furnace product in their important parts, all finished the race without mishap, and included the winning car. A practical demonstration of this kind is more eloquent than columns of figures of laboratory tests. The recent paper by W. J. Priestley[4] outlines the splendid results of electric furnace ordnance steels made at Charleston, W. Va., in the largest furnaces in the United States. He shows that the results are due to clean steel and freedom from oxides, sulphur and phosphorus. These results show that large units, with proper handling, can produce very high-quality steel, and we see no reason, now that larger electrodes can be made of dependable quality, why a 60- or 80-ton furnace cannot be expected to give relatively as satisfactory results. The electric steel rail is still a desired possibility. The increased demands made upon materials of construction call for new methods for meeting those demands. As I stated here 6 years ago, the electric furnace was opportunely invented to meet a new demand rather than to replace an old process.

Recent Improvements

It would be mere repetition to restate here the various types of furnaces, such as arc, induction, radiation, etc. They have been described in books and technical magazines and we need only observe in passing that there have been no new principles of heating employed since the first few years—with the possible exception

[3] "The Triplex Process of Producing Electric Steel at South Chicago," Yearbook American Iron and Steel Institute, 1918, p. 115. Reprinted in *Chem. & Met.*, July 1, 1918, vol. 19, p. 15.

[4] "Effect of Sulphur and Oxides in Ordnance Steel," *Trans.*, A.I.M.E., vol. 67, p. 317 (1922). Abstracted in *Chem. & Met.*, vol. 21, p. 259.

of Dr. Northrup's high-frequency induction furnace[5] which has not thus far been successfully employed in units of commercial size in the steel industry. Of mechanical and electrical refinements there have been many, all in the nature of improvements in regulation and economy. Among these may be mentioned two of American origin, J. A. Seede's automatic electrode regulator and E. T. Moore's peak-load regulator. The principle of dual, or rather multiple, voltages was embodied in our original installation in 1906, but its metallurgical significance was not so apparent as it was later when we installed a process employing a 220-volt arc and with considerable difficulty succeeded in persuading the inventor that provision for a lower voltage for use during the refining period must be provided. The desirability of relatively high voltage for melting and low voltage for refining is now generally recognized. Many improvements have been made as the shortcomings of the earlier furnaces appeared, such as well-fitting doors, water-cooled arches, better electrodes and holders and economizers to cut down oxidation and waste of the electrode. I have seen electrode costs per ton of product as high as $8 gradually decline to 35 cents. This was in a furnace refining molten charges.

Possibilities of the Future

The electric furnace is also a recognized factor in melting non-ferrous alloys, such as brass and Monel metal, as well as special alloys such as "Nichrome," "Rezistal," "Stellite," stainless steel, manganese steel and high-speed steels, besides an endless variety of the simpler alloy and carbon steels from the mildest to the hardest tempers. As stated earlier in this paper, its astonishing flexibility—versatility, we might call it—has attracted the attention of the metallurgical world in almost every branch of smelting, melting, refining, heating and even baking metals. To those of us who have watched its growth from the start, it seemed very slow in achieving the recognition we felt must inevitably come to it, but at last our early confidence has been confirmed in every steel-making country, because its products have fulfilled almost every expectation in every field wherein it has been thoroughly tried. The present success is due not only to the original inventors of the basic processes but also to the active co-operation of the great manufacturers of electrical equipment, furnace designers and builders, makers of refractories and electrodes and a group of earnest metallurgists in many plants who have studied every detail of operation.

When users acquire a full appreciation of what clean sound steel means in terms of national efficiency, safety and economy we shall see more rapid growth than has as yet been seen. Its usefulness to engineering and industry has just begun.

New Basis for Chilean Nitrate Prices

At a reunion of the nitrate producers, held in Valparaiso, Chile, and reported by Vice-Consul B. C. Matthews, of Antofagasta, Chile, it was decided to eliminate the confusion resulting in quoting prices in Spanish quintals by making all future quotations on the basis of the metric quintal of 100 kilos. On this basis the following prices have been fixed for the year 1923: from Oct. 1, 1922, 20s.; from Oct. 16, 1922, 20s. 6d.; from Dec. 1, 1922, to April 20, 1923, 20s. 8d.; May, 1923, 19s. 9d.; and June, 1923, 18s. 6d.

[5]American Electrochemical Society, meeting held April 3, 1919. *Chem. & Met.*, vol. 21, p. 259.

Effect of Manganese in Steel

Some work has recently been done at the Bureau of Standards on an extensive series of low-manganese steels with carbons ranging up to 1.6 per cent and manganese up to 2.0 per cent, prepared of pure materials, in order to determine the change in physical properties caused by adding manganese to plain carbon steels.

The effect of manganese, as observed in annealed alloys, is to confer upon the pearlite a very fine grain or sorbitic structure, even after slow cooling. The relative amount of pearlite present is considerably greater in the alloys of high-manganese content than in corresponding ones low in this element. The addition of manganese causes a shift in the eutectoid ratio toward lower carbon content. One per cent manganese lowers it to approximately 0.78 per cent carbon.

A pronounced increase in Brinell hardness of the annealed alloys accompanies the change in structure produced by the addition of manganese.

In the normalized alloys, a pronounced decrease in grain size was found in those of high-manganese content in addition to the structural effects mentioned above. In the annealed specimens, no noticeable difference in grain size was detected for high- and low-manganese content in alloys of any given carbon content. The well-known effect of manganese in lowering the transformation temperatures of the materials will account in part for the observed structural changes.

It appears also that manganese renders steel more sluggish and less responsive to structural changes than many of the other elements which produce a similar lowering of the critical temperatures. While the results of the structural examination will not warrant any definite conclusions concerning the use of manganese as a strengthening element in steel, the results obtained strongly support previous recommendations which have been made by different metallurgists concerning the advantages to be gained from the use of higher manganese, particularly in low- and medium-carbon steels.

German Potash Situation

Commerce Reports for Sept. 25, 1922, summarizes the German output and domestic consumption of pure potash as follows for the years indicated below:

Years	Output, Tons	Consumption, Tons
1913	1,110,362	557,000
1921	921,146	720,000
1922 (estimated)	1,250,000	850,000

There has been an increased use of potash in fertilizers for German soil because of the shortage of phosphoric acid. Only 268,000 tons of phosphoric acid was applied in 1921, as compared with 630,000 tons used in 1913.

It is estimated that the former German potash mines in Alsace will yield 120,000 tons of potash in 1922 and that the Alsatian export capacity this year will be from 50,000 to 60,000 tons, while the German export capacity is estimated at 400,000 tons.

The reported accord between German and Alsatian potash groups to establish a monopoly and raise prices has been denied by officers of the German Potash Syndicate.

The German price of muriate of potash c.i.f. American Atlantic ports is now $32.95 net per ton, as compared with $35 in 1913; and kainite is quoted at $6.70 at present, compared with $7.50 in 1913.

Modern Byproduct Coking

By Joseph Becker
Consulting Engineer, the Koppers Co.

*With Special Reference to the New Koppers Combination Oven**

BEFORE entering into the subject of this paper, perhaps it would be well to mention briefly the remarkable development which has taken place in the byproduct coke industry in the United States in the past decade, particularly in its relation to the iron and steel industry, with which it is so closely identified.

Not quite 15 years have elapsed since the United States Steel Corporation installed its first byproduct coke plant of Koppers design at Joliet, Ill., and since blast-furnace operators were looking with doubt and suspicion on the byproduct coke oven as a source of blast-furnace fuel; but in this comparatively short time the byproduct coke oven has come to be an essential part of an economically operated iron and steel plant.

European Coking Practice

It is no idle boast to say that American byproduct coke-oven practice leads the world today, this despite the fact that the byproduct coke oven originated and was in general use on the continent before it was even thought of in the United States. The writer had an opportunity last year to visit Europe and to study European byproduct coke-oven operation very carefully. What he saw convinced him that European practice is 10 years behind ours. That very little, if any, progress has been made there in the past 10 or 15 years is brought out very clearly in an article in the Sept. 2 issue of *The Gas World* of London, describing an installation of 100 ovens for the purpose of carbonizing 540 tons of coal per day. This article goes on to say that the plant previously consisted of 100 horizontal-flued waste-heat ovens which have been in operation for 15 years. These ovens have a capacity of 7 tons and the 100 ovens carbonize 500 tons of dry slack coal per 24 hours. This would be equivalent to 31 hours' coking time. The additional 100 ovens recently completed are of the vertical-flued type, and have a capacity of 7½ tons each, with a carbonizing capacity of 540 tons of dry slack per day. This would be equivalent to a coking time of about 33 hours.

This very strikingly shows that at least in this plant no progress has been made with respect to increasing the coking capacity per oven. It is remarkable that after 15 years a new plant is built which has even less carbonizing capacity per oven per day than the old plant, in spite of the enormous progress that has been made in the United States during the same period in the way of increasing oven capacity. This is merely citing one instance of English coking practice, and the majority of English coke plants operate under very similar conditions.

The writer observed similar things during his last year's visit in Germany. There have been recently put into operation ovens of the Koppers type, which are heated with blast-furnace gas and which are supposed to operate on 18 hours' coking time. These have an average width of about 16 in. and a length of about 32 ft. between doors, making a carbonizing capacity of about 14½ tons per oven per day. This is very likely the largest capacity of any type oven of similar dimensions in Europe. However, even this capacity is low when compared with American coke-oven capacities. Modern American ovens carbonize more than double the quantity of coal per day that can be coked in ovens as built in Germany and England.

Difference Between European and American Practice

The question now arises, What is the reason for this great difference in coking speeds? Many have been advanced by our European contemporaries, the most prevalent of which is that they have to carbonize wet-wash coals and that this makes it impossible for them to attain the same coking speeds possible here. This does not sound quite reasonable, and furthermore, it is a fact that several plants in this country are using washed coals averaging 12 per cent moisture and more, and carbonizing them in from 15 to 17 hours in Koppers ovens averaging 17 in. in width.

Another reason given is that the character of their coals is quite different from those found here. The writer has made an examination of the analyses and coking qualities of the various coals found there, and in general they correspond very closely to the coals found in this country, so this argument does not seem to hold.

Most striking proof of the fallacy of both these arguments was given during our recent coal strike, where several companies operating byproduct coke plants imported large quantities of English coals to avoid curtailing operations. The Seaboard Byproduct Coke Co. at Jersey City, N. J., received over 100,000 tons of English coals such as Yorkshire and Durham coals, and coked them in 16 hours continuously with the same ease as other American coals of different varieties used there, producing coke of very good quality for metallurgical purposes (see Figs. 1, 2 and 3). About 100 tons of Yorkshire and Durham coals were sent to the Chicago Byproduct Coke Co.'s coke plant and separate coking tests were made in the new five-oven battery. These coals were perfectly coked at a coking time of 11 hours without the slightest difficulty and the coke produced was just as good for blast-furnace use as any coke made in the Pittsburgh district from Pittsburgh coals. (See Figs. 4 and 5.) The capacity of this oven on these coals is, therefore, 25 net tons per oven per day.

Unquestionably one reason for their not being able to attain our coking speed is the fact that they do not generally use silica construction. On the other hand, there are ovens of this material over there; but these have not attained anything approaching American practice.

Organization the Keynote of Operation

The organizations operating the coke ovens in America consist generally of technically trained men with good practical experience, the latter not being gen-

*Abstract of paper presented at the recent meeting of the Eastern States Blast Furnace and Coke Oven Association at Buffalo, N. Y.

Fig. 1—Coke from 100 per cent Yorkshire coal coked at Seaboard Byproduct Coke Co.

erally the case in Europe. American operators have more tenacity in solving problems and difficulties in organization and operation in order to attain greater capacities from their plants and do not offer excuses for inability to maintain a high output as is done abroad.

One of the most important features of organization to be found on American coke plants is the strikingly systematic operation of the ovens. Ovens are heated by intelligent heaters and most of the assistants and superintendents of American plants have passed through the entire school of byproduct coke-oven operation, beginning as heaters. Even in cases where this is not so the assistants and superintendents fully realize the importance of even heating and consider the oven operation the "heart" of the entire byproduct coke plant.

In European operation, on the other hand, insufficient talent and talent of a lower quality are employed to take care of the ovens. The result is that coke-oven batteries need frequent repairs and relining, often after only 3 to 5 years of operation. In making this statement I do not refer to plants using highly expanding coals or coals containing excessive amounts of sodium chloride and which are coked in clay ovens instead of in silica ovens. The usual class of heaters employed in Europe are men who are not acquainted with combustion problems and who operate the ovens by rule-of-thumb methods. In most plants it will be found that there is no pushing schedule at all. Ovens are picked out and pushed as they become ready, so it can be stated as a general rule that the ovens on the continent operate the heaters, while in America the heaters operate the ovens.

Another excuse usually offered is that with our fast operation we destroy byproducts. The writer had an opportunity to investigate this and finds that the byproduct yields here are fully equal to those obtained in Europe.

Tendency of Modern American Designs

The development in America has been a gradual increase in the size of the ovens. The use of high-grade silica throughout the structure has reduced the time required for coking considerably as compared with the use of clay bricks. But beyond the increase of capacity due to the use of silica in the building of long and high ovens there was necessary an improvement of the design of the ovens proper to make it possible that long and high ovens could be built with proper heat distribution over the considerably increased coking areas.

The problem of designing ovens which would assure a perfect distribution of heat over such large areas was a difficult one. A great number of coke plants were desirous of coking 100 per cent high-volatile coals. The blast-furnace practice showed that coke made from such coals should be pushed at relatively lower temperatures. When pushing coke made at low temperatures, any uneven heating conditions in the ovens becomes much more pronounced and visible than when pushing hot coke. Furthermore, it is a matter of course that the heating system of ovens of large capacities has to permit passage of larger volumes of gas such as waste products of combustion through their flues.

Testing for Coking Temperatures

Fig. 6 shows a typical progression of temperature into the coal charge at various places in such an oven. These readings were taken by inserting thermocouples through the pusher side door 4 ft. into the coal charge; one was located 2 ft. above the oven floor, one just below the horizontal flue and another one at about the center line of the horizontal flue.

The figures given herein are an average of a great number of readings and exhibit in general the conditions as they exist in practically all the Koppers coke ovens which are heated reasonably well and operated to capacity. This indicates that the space occupied by the horizontal flue is quite appreciable and the amount of coke in the upper region of the ovens being affected by

Fig. 2—Coke from 100 per cent Durham coal coke at Seaboard Byproduct Coke Co.

Fig. 4—Coke from Yorkshire English coal coked in five-oven battery at Chicago in 11 hours.

the location of the horizontal flue is an appreciable percentage of the total coke made. This condition is tolerable, particularly when the ovens are pushed without waiting until the upper part is thoroughly coked, and such coking operations with these ovens have given very good blast-furnace results. These ovens have an average capacity of about 18 to 19 net tons of coal per 24 hours.

It will be interesting to note the results of an investigation of the heat progression in the coking charge in an oven that was designed for 17 hours' operation, but operated between 23 and 24 hours. Such tests were made at the Seaboard Byproduct Coke Co.'s plant by inserting thermocouples in the coal charge in the same way as in the tests described before. The test disclosed that on that coking time the lower part of the oven coked decidedly faster than the part below the horizontal flue. When the lower part of the coke reached the temperature of 1,890 deg. F. the part below the horizontal flue had a temperature of only 1,450 deg. F. These temperature differences could, of course, be expected, because when operating on a longer coking time the quantity of gas per flue becomes correspondingly less and combustion is relatively quicker, thus causing a quicker progression of the coking in the lower part as compared with the upper part of the oven.

As far back as 1914 Dr. Koppers proposed, as a means of evening out temperatures within the heating system of coke ovens, the addition of waste gases to the air required in order to retard the combustion of gases in the heating flues because of the reduced content of oxygen in the waste gases and air mixture and thus lengthening the flame, resulting in an improved heat distribution and temperature progression within the coal charge. This process was tried out at Seaboard and Fig. 7 shows the result of the addition of waste gas till the mixture of waste gas and air contained 12 per cent oxygen. The waste gas was taken from the stack by means of a fan and blown into the air boxes on the regenerators, while the air was drawn in according to the regular practice.

This test was carried on for several weeks and it was shown that when the fan was taken off the temperature went back to the original ones as mentioned before. This test proves that the return of waste gases in ovens which have unequal heating conditions from bottom to top will greatly help the distribution of heat progression in the coking charge. It is a good cure for ovens which suffer from hot bottoms, as it causes a condition in the heating flues which is similar to that existing when using blast-furnace or producer gas. Blast-furnace and producer gas are most excellent fuels for heating the ovens, because such gases have a slower combustion speed and distribute the heats very uniformly.

How Capacity Effects Design

It is the belief of the majority of coke-oven and blast-furnace operators that, especially from high-volatile coals, better coke can be made in narrower ovens. In making the oven narrower, the coking capacity per 24 hours would necessarily be reduced unless a considerable multiplication of the operations would be resorted to. The first thought would naturally be to compensate for this by building higher and longer ovens and thus increasing the tonnage per oven per 24 hours. This would mean that the horizontal flue, with the type of oven as mentioned before, would have to be enlarged and thus occupy a larger space in the coking region, thereby retarding the coking of a proportionately larger amount of coal in that region. Furthermore, when equipping ovens so that they can be heated in the future with producer or blast-furnace gas, this flue must

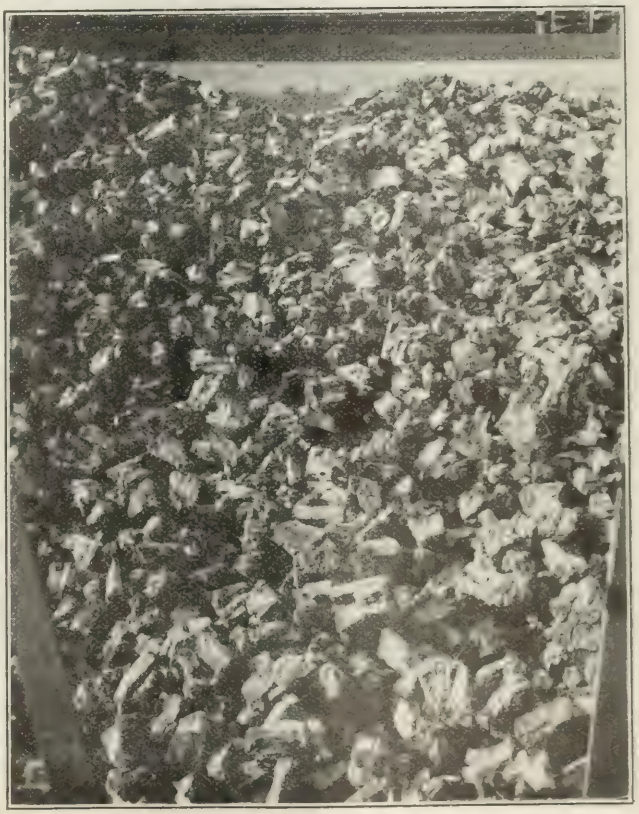


Fig. 5—Coke from Durham English coal coked in five-oven battery at Chicago in 11 hours.

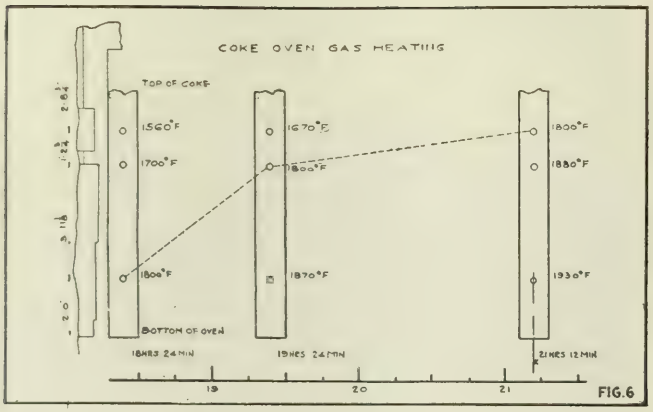
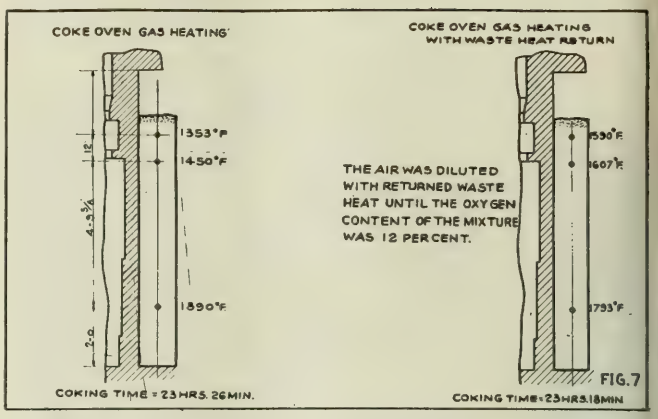


FIG.6


COKE OVEN GAS HEATING
1353°F
1450°F
1890°F
COKING TIME = 23 HRS. 26 MIN.
COKE OVEN GAS HEATING WITH WASTE HEAT RETURN
THE AIR WAS DILUTED WITH RETURNED WASTE HEAT UNTIL THE OXYGEN CONTENT OF THE MIXTURE WAS 12 PERCENT.
1590°F
1607°F
1793°F
COKING TIME = 23 HRS. 18 MIN
FIG.7

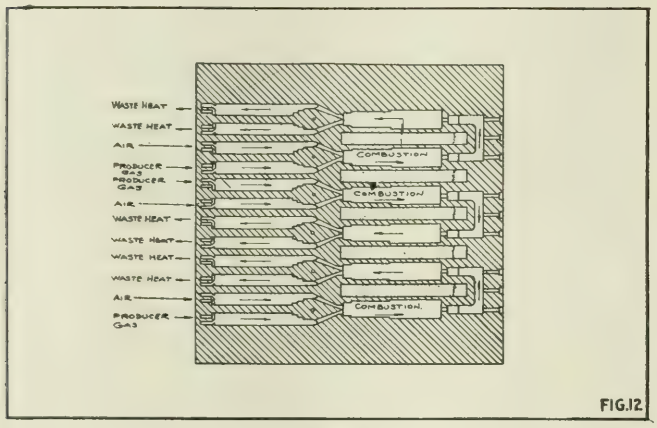


FIG.12

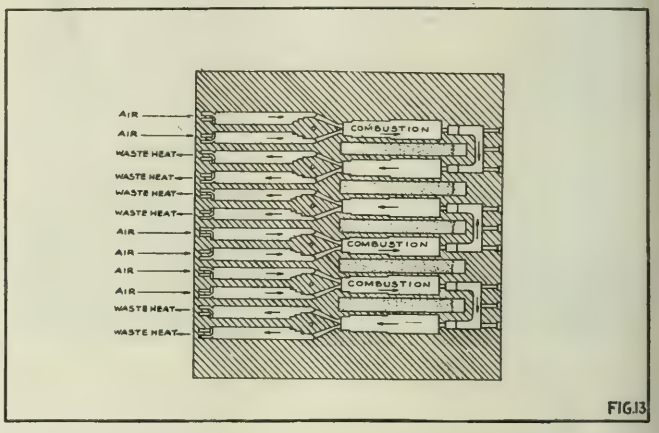


FIG.13

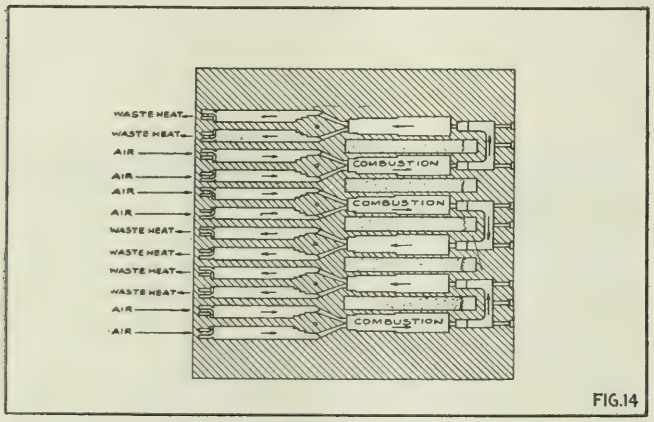


FIG.14

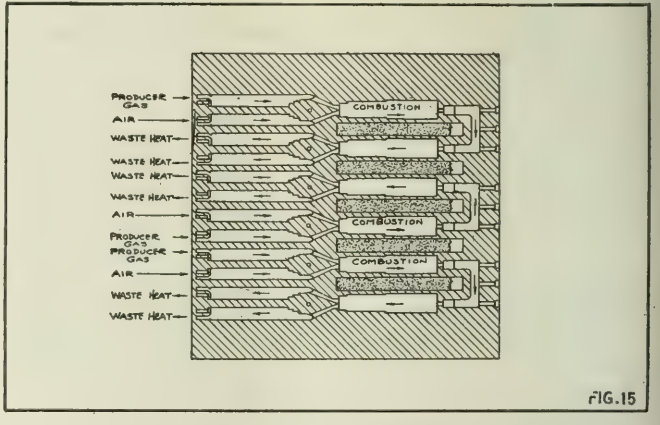


FIG.15

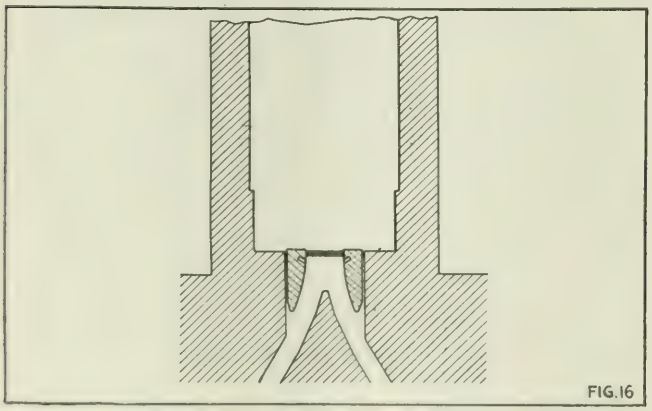


FIG.16

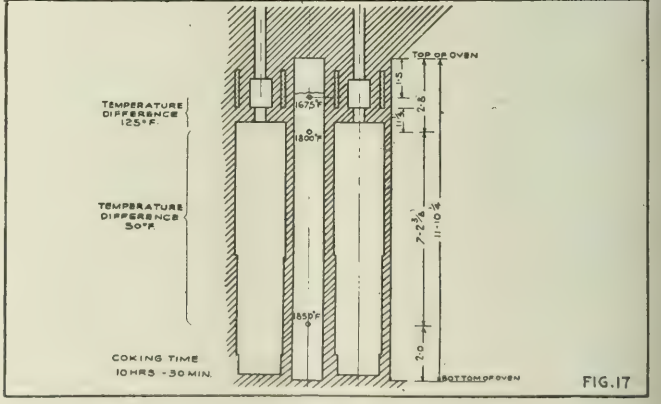


FIG.17

Fig. 6—Heat progression chart, old type Koppers oven.

Fig. 7—Heat progression chart, waste heat return.

Fig. 12—Producer-gas heating.

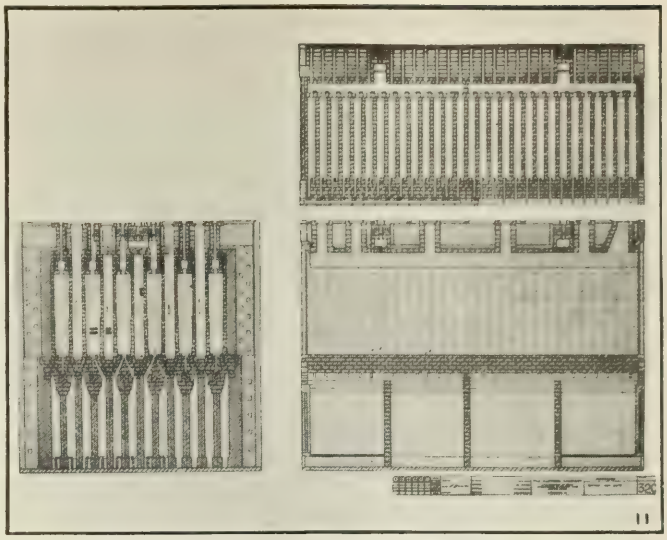
Fig. 13—Coke-oven gas heating, reversal.

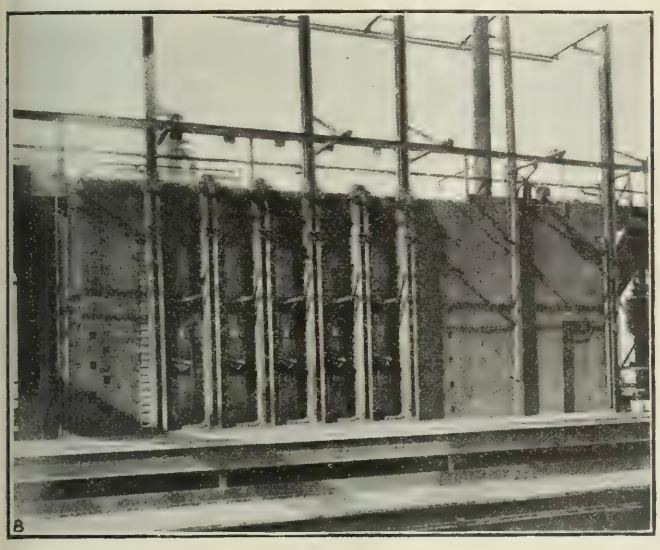
Fig. 14—Coke-oven gas heating.

Fig. 15—Producer-gas heating, reversal.

Fig. 16—Adjustable air port, new Koppers oven.

Fig. 17—Heat progression chart, new Koppers oven.





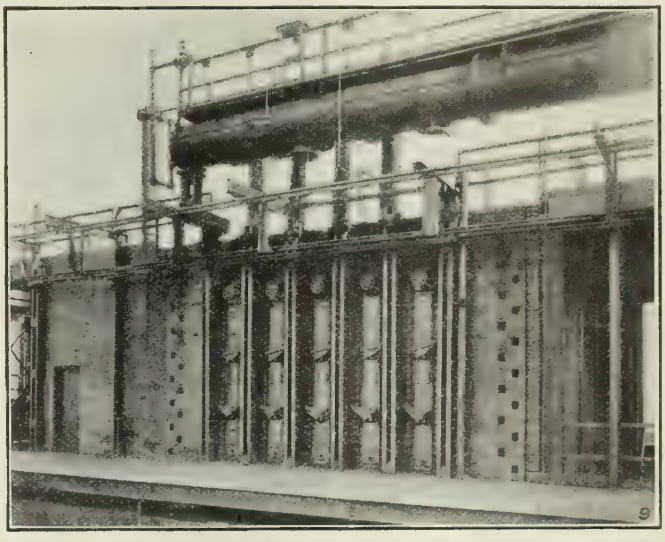


Fig. 10—Pusher side ovens at Chicago Byproduct Coke Co. New ovens in foreground.

Fig. 8—Coke side of new ovens at Chicago.

Fig. 3—Coke section 100 per cent Durham coal coked at Seaboard Byproduct Coke Co.

Fig. 11—General design of new oven.

Fig. 9—Pusher side of new ovens at Chicago.

Fig. 18—Coke from 100 per cent Black Briar Illinois coal.

be enlarged again in order to make it carry the additional amount of inerts present in such low B.t.u. gases.

It therefore was apparent that the oven as it stood should not be increased in capacity without making changes in the design eliminating the effect of the horizontal flue on the heating conditions and thus eliminating its effect on the quality of coke produced. Also with increased capacities a relatively smaller horizontal flue would require an exaggerated closing of the discharge openings of the vertical flues to such an extent that the drop of pressure through the reduced openings would become too high for the best draft conditions throughout the oven structure.

It might be thought best by some to design ovens without any horizontal flues. Such ovens without horizontal flues usually operate in such a manner that adjacent vertical flues serve alternately as up-burning flame flues and down-going waste gas flues and vice versa. It is evident, however, that an oven in which all adjacent heating flues or at least a large group of them serve at the same time in their entirety as up-burning flame flues or in their entirety as down-going waste heat flues is not subject to the danger of different draft conditions between adjoining flues.

Furthermore, the arrangement of the gas-supply flues in an oven in which the gas is burned up in one flue and down the next adjoining one is usually such that this gas-supply flue is paralleled by an up-going regenerator on the one side and a down-going regenerator on the other side. This arrangement greatly increases the difficulty of keeping the gas-supply flues tight. Also all ovens should be built so that producer gas or blast-furnace gas could be used advantageously in the future, and in up- and down-flow flue ovens there will always be a counter-current between waste gas and gas in regenerators, as well as between adjacent flues.

The New Koppers Combination Oven

These leading principles in oven construction have been tried out by the Koppers Co. in a battery of five ovens at the plant of the Chicago Byproduct Coke Co. at Chicago. The five ovens were put into operation on Feb. 1, 1922, and have since that time operated continuously on a great variety of coals at coking times between 10 and 12 hours. Fig. 8 shows the coke side of this battery. Fig. 9 shows the pusher side, and Fig. 10 shows the location of this battery in connection with the rest of the ovens. The new oven has a length of 37 ft. between doors, a height of chamber of 11 ft. 8 in. and an average width of 14 in., the taper between coke side and pusher side being 1½ in. Cast-iron jambs are used at the ends of the ovens. Fig. 11 shows the general design of the new type oven.

Heating in the New Oven

This shows that in this new design one side of the coke oven is heated in its entirety—that is, gas burns simultaneously on the coke side and on the pusher side —the products of combustion then join in the respective horizontal flues, pass through the crossover flues, one of which is located on the coke side and the other on the pusher side. Thence the products of combustion enter the respective horizontal flues of the adjacent heating wall and pass downward throughout the entire wall into the respective regenerators.

It is evident that the cross-sectional area of a horizontal flue when operating in such a way as described above can be considerably reduced as compared with the horizontal flue in ovens of the former design. This permits us to locate the horizontal flue higher than was previously possible and it furthermore permits the use of heavy walls between the horizontal flue and the coal chamber. This gives sufficient space to use insulating material if necessary in order to prevent any overheating of the gas space in the oven chamber.

One of the most important achievements claimed for this new design is the fact that the height of the flame flues has been considerably increased and these now extend as far up toward the top of the coal charge as is necessary for uniform heating of the entire charge. Thus the interference of the horizontal flue with the flame flue heating has been entirely eliminated. Of course the number of crossover flues could be increased beyond two preferably to five, the crossovers passing through the available spaces between charging holes. The size of the horizontal flue would thus of course be still more reduced, without causing an additional pressure drop.

It is clearly shown that with this new design the size of an oven has become independent of areas required for the former horizontal flue which interfered with the perfect operation of the ovens, especially when they were of great capacity, since it is important to retain the advantageous functions of horizontal flues.

Other Features of This Oven

It should be emphasized that on account of the fact that an entire side of a coke-oven chamber serves either for up-flow combustion or down-flow products of combustion, any leakage between individual flues becomes of little consequence, because all the gases flow either up or down and each flue is operating under the same pressure conditions. Since there is absolutely no counter-flow in any of the heating flues, it undoubtedly constitutes the safest construction for flame-heated coke ovens.

It will also be noticed that the regenerators reverse longitudinally with the battery instead of crosswise as used in the former design. The usual longitudinal taper of a coke oven requires that larger amounts of fuel gas are used on the coke side as compared with the pusher side. In the type of oven formerly built, products of combustion from the coke side of the oven chamber exchange their heat with the air or air and gas going up to the narrow pusher side. Since for the latter side gases are required in smaller volume, the efficiency of the heat exchange varies with reversals, as is shown by fluctuations in the stack flue temperature. In this new construction the in-going gases for each half of the oven are regenerated with the products of combustion from that half, and it is thus possible to maintain a lower uniform stack temperature which is the nearest practicable approach to the theoretical.

Flow of Gas in New Oven

The four drawings, Figs. 12, 13, 14 and 15, show the flow of gases when using coke-oven gas and blast-furnace or producer gas. Figs. 14 and 15 show the oven when operating on producer or blast-furnace gas. When producer gas or blast-furnace gas of low heating value is used for heating the ovens, it must be preheated in order to obtain the desired temperature and to operate economically. This preheating is accomplished by passing the gas through separate regenerating chambers on its way to the heating walls. In the new design of oven the arrangement of regenerators and flow of gases

is such that there does not exist at any time a counter-flow between incoming fuel gas and outgoing products of combustion in adjacent regenerator chambers. Fuel gas and outgoing products of combustion are always separated by a regenerator containing ingoing air. Should there be a slight leakage into the waste gas regenerator chambers, it would only result in loss of air, while it would be impossible to lose producer or blast-furnace gas.

Results Obtained From Test Battery

The battery of five ovens of this new design at Chicago was operated on 11 hours' coking time for several months with producer gas having a heating value purposely varied between from 85 to 125 B.t.u., and it was demonstrated that the oven when heated with this producer gas gave most satisfactory result as to heat distribution and fuel consumption. It was absolutely evident that there was no leakage of producer gas into waste gas on account of producer gas and air flowing in parallel and a counter-flow only existing between air and waste gas.

It has been demonstrated that on the five ovens at Chicago the arrangement of adjustable ports (Fig. 16) in that construction is correct for both conditions—that is, when using straight coke-oven gas or producer gas. The same small temperature difference between top and bottom when using coke-oven gas was observed as when using producer gas.

The tests for determining the progression of coking at different elevations in the oven chamber as made at the Providence plant were repeated with the same instruments and in the same manner on these five ovens at Chicago, and the results obtained were most gratifying. (See Fig. 17.) The absence of the interference of the horizontal flue, together with the unique design of adjustable air ports, gave a distribution of heat in such a way that the entire mass from top to bottom and from end to end was finished at the same time, the difference in temperature usually not exceeding 100 deg. F.

Coke Produced From New Ovens

The coke produced from these new type ovens was decidedly more uniform than that produced from the older ovens. The large pieces of coke originating near the horizontal flue region of the older oven were entirely absent in the coke from the new oven, and the coke from the bottom part of the new oven was just as large as the coke from any other part of the oven.

Shatter tests and combustion tests have been made from coke out of different elevations of the new ovens, and it has been found that the combustibility of the coke from the lower part of the ovens is the same as that taken from the upper part of the ovens. It was further shown that the shatter tests from the upper part of the oven are virtually the same as the shatter tests from the coke produced in the lower part of the oven.

In making coke of 11 hours in this new design of oven, the temperature of the flue walls did not exceed the maximum of 2,550 deg. F. and the fuel consumption in coking Pittsburgh coals was equivalent to 1,050 B.t.u. per pound of coal.

Advantages Claimed for New Oven

1. Greatest simplicity of design.
2. Perfect distribution of heat in such a way that the coking within the coal charge progresses uniformly at all places, thus preventing any over and under coking.
3. Increased capacity per oven unit.
4. Lowest fuel gas consumption.
5. Maximum strength of oven walls.
6. Lowest pressure differentials throughout the entire oven system.
7. Complete absence of counter-flow between flame flues and gas supply flues and gas regenerators.

All of the above-mentioned improvements will guarantee the long life of the oven structure and the continuous supply of most uniform coke at the lowest fuel consumption and operating expense. The low draft conditions existing in these ovens is of great importance, because it insures long life of the ovens.

Deductions From Operation of New Ovens

The foregoing shows that the coking of coal can be done in the most uniform manner, and the only matter to be decided upon in individual cases would be the width of oven that would be proper for certain coals to produce the best blast-furnace coke in respect to size of coke and its properties as to combustibility. Furthermore, at what temperatures or in length of time should coals be coked to produce the coke that gives the best blast-furnace results. From all observations made so far it seems to be correct for straight high-volatile coals to build the ovens as narrow as is practical, because this produces a coke of less fingery structure and cross-fracture than when made in wider ovens.

There is usually a variation in the coke starting with the wall side and ending at the center of the oven. This variation is greater in wider ovens than in the case of coke made in narrow ovens. In making tests of a piece of coke and taking samples from the inner end of the coke, the middle and the outer end of the coke, it has been observed that the specific gravity and porosity of the coke changes from center to end and that in wider ovens the cauliflower and dense end penetrates to a greater depth than in narrower ovens. It has been observed in the coke made in the five-oven battery at Chicago that a much more uniform porosity was practically maintained from one end to the other of a piece of coke.

Coals coked in narrow ovens give a higher yield of tar than when coked in wide ovens, indicating that the smaller yield of tar must have been accompanied by formation of additional gas and residue of carbon which is deposited on the cell walls of the coke. However, carbon coke made from tars is very refractory and combustion tests on carbon coke made from tar subjected to a temperature corresponding to that of coking operation—that is, about 1,800 deg. F.—showed that the combustibility of such material was decidedly less than the combustibility of ordinary coke. This would again indicate that a given coal when coked under conditions which yield the maximum in tar would produce a coke of greater combustibility than when coked under conditions where the tar yield is relatively low.

Author's Note—Figure 18 shows a photograph of coke on the coke wharf at the Chicago Byproduct Coke Co. made from Black Briar Illinois coal, such as is coked at a plant in the Mississippi Valley. Much has been said about a mysterious way of coking so-called non-coking Illinois coals at this plant. The coals which have been coked there and which have been called non-coking are in fact coking coals without any mystery whatsoever about them, and such coals have been coked in the oven described in this paper in 12 hours' coking time. Furthermore, thousands of tons of such coal have been coked at several other plants of Koppers ovens. (See Bureau of Mines Technologic Paper 137, by R. S. McBride and W. A. Selvig, Nov. 17, 1919.)

The Properties of Cold-Worked Metals

Properties of Cold-Worked Metals Explained by a Series of Postulates Regarding Conditions at Slip Planes—General Theory Checked by Experiments on Copper, Nickel, Iron, Molybdenum and Tungsten

By Zay Jeffries and R. S. Archer

MOST metals are hardened by working at ordinary temperatures. Tin and lead anneal rather quickly, so that a quick test is required to detect much hardening. Zinc also anneals at room temperature, but more slowly, so that considerable temporary hardening can be produced. The tensile strength of the ordinary metals like iron, copper and aluminum is increased from two to three times by commercial cold-working processes. The plasticity of a metal has probably never been exhausted by cold-working, since with sufficient care an almost unlimited amount of work may be carried out. Copper can be cold-rolled from a slab 1½ in. thick to sheet having a thickness of 0.002 in. Copper can also be easily cold-drawn until its length has been increased 5,000 times. Tungsten has been extended 200,000 times in length by drawing below its recrystallization temperature. By this it is not to be understood that extremely high reductions by cold-working are always practicable or desirable, but merely that they are possible.

Hardening by Cold-Work

While the general effects of cold-working are an increase in hardness and loss of plasticity, various specific properties are affected in somewhat different ways. As noted in a previous article,[1] when discussing overstrain, the elastic limit of iron is lowered sometimes to zero by cold-working, but is restored by aging or heating at low temperatures to a value which may be much higher than its original value. It has also been shown that the elastic limit of cold-worked brass may be raised from 22,400 lb. per sq.in. to 44,800 lb. per sq.in. by low-temperature heating. There is a lack of exact information regarding the effect of cold-working and aging on the elastic properties of other metals. Beilby[2] tested the elasticity of metals by making reed vibrators of them and observing the pitch and intensity of the notes produced. He found that cold-worked copper, silver and gold gave notes of greater intensity (i.e., had a greater amplitude of vibration) but lower pitch (lower frequency of vibration) than when annealed. This indicates that the cold-worked metals are less perfectly elastic than the annealed metals or have a slightly lower modulus of elasticity, but that they are elastic or nearly so up to much higher stresses.

The yield point is probably affected by cold-working more than any other property of the hardness group. While the tensile strength of iron (in wire) is raised from 48,000 lb. per sq.in. to 125,000, the yield point is raised from about 25,000 lb. per sq.in. up to a value practically identical with the tensile strength. Similar results are obtained with other metals, the ratio of yield point to tensile strength increasing markedly as cold-working progresses.

Figures are often given, particularly in handbooks, indicating that the elastic modulus is greater in the cold-worked than in the annealed condition. Such results are reported especially for the softer metals and alloys like copper and brass, whose true elastic limits are quite low when in the annealed condition. The lower moduli reported for the annealed metals were probably calculated from stresses which exceeded the true elastic limit. If there is any real difference in modulus, that of the annealed metal is probably the greater.

The hardening effect of cold-work is indicated to somewhat different degrees by the various tests for hardness. The scleroscope shows the greatest effect, followed by the Brinell test, while the sclerometer (indicating scratch hardness) shows little difference between cold-worked and annealed metal.

Resistance to repeated stresses is increased by cold-working. This is particularly noticeable in the softer metals, which can be used for springs when cold-worked, a service for which they are entirely unsuited when in the annealed condition.

The effects of cold-working are directional.[3] The increase in elastic limit and yield point are greatest in the direction of working, and there may even be a decrease in elastic limit under forces applied in the opposite direction. Cold-rolled or cold-drawn metals are generally used in such a way that the service stresses are in the same direction as the working stresses.

Elongation is reduced by cold-working. After very severe working the elongation before rupture is almost entirely elastic. The per cent reduction of area is also decreased by cold-working, but to a less marked extent than is the elongation. The reduction of area of a cold-worked metal may even be greater than that of annealed metal of large grain size. For example, a copper rod reduced by cold-swaging from ½-in. diameter to 0.10-in. diameter had a rather high reduction of area. After annealing at 700 deg. C., the reduction of area was somewhat less.

The hardening effect of a small or moderate deformation is greater the smaller the grain size of the metal subjected to such deformation. The strength obtainable by severe cold-working is about the same regardless of the initial grain size, so that a coarse-grained metal which originally has a lower strength than a fine-grained metal must be regarded as possessing greater capacity for hardening by cold-work.

In general the increase in hardness and loss in plasticity are continuous with increasing amounts of cold-work. The rate of change tends to decrease as the amount of work becomes large.

For instance, a discontinuity in the effect of cold-work on the properties of copper has been reported by Alkins.[4]

[1] "Overstrain, Internal Stresses and Creep," *Chem. & Met. Eng.*, vol. 27, No. 17, p. 833, Oct. 25, 1922.

[2] "The Hard and Soft States in Metals," G. T. Beilby, *J. Inst. Metals*, 1911, No. II, p. 5. For a complete account of Beilby's work, see his more recent book, "Aggregation and Flow in Solids," MacMillan, 1921.

[3] "The Effects of Cold-Working on the Elastic Properties of Steel," by J. A. Van den Broek, *Carnegie Scholarship Memoirs*, Iron and Steel Institute, vol. 9; also see *Engineering*, July, 1918.

[4] "The Effect of Progressive Cold-Work Upon the Tensile Properties of Pure Copper," W. E. Alkins, *J. Inst. Metals*, No. II, 1918, vol. 20, p. 33.

He found that when copper was reduced by wire drawing, a stage was reached at which a reduction of area of almost 10 per cent was accompanied by no change in tensile strength. This occurred when the diameter had been reduced from 0.553 in. to 0.373 in. in four successive passes. The tensile strength at this stage was about 52,000 lb. per sq.in. He also reported that wires which had been reduced less than this amount and which had a tensile strength less than 52,000 lb. per sq.in. were stable at ordinary temperatures, whereas wires which had been reduced a greater amount and which shortly after drawing possessed higher tensile strength were in an unstable condition and underwent a gradual reduction in strength at ordinary temperatures. The interruption in the hardening process on continued cold-drawing is probably attributable to spontaneous annealing.

After a metal has been severely cold-worked, further cold-working may cause a decrease in tensile strength. This is the result obtained when wires are "overdrawn." It is usually due to internal failures, such as splitting or drawing hollow. Strength normally increases as cold-working progresses as long as complete continuity of the metal is maintained. If the temperature of working is sufficiently close to the temperature of recrystallization, severe working may cause some annealing.

Commercial Terms for Hardened Metal

Commercially, metals are supplied in various degrees of hardness according to the purposes for which they are to be used. The various grades are designated by such terms as soft or annealed, medium or half-hard, and hard. A specially hard grade of brass is denoted by the term "spring temper." Aluminum sheet is supplied in various tempers designated by numbers which indicate the amount of reduction by cold-rolling subsequent to annealing. When it is desired to produce a finished article by some cold-working operation such as spinning or pressing and to have a certain degree of hardness in this finished article, sheet is selected of such temper that when subjected to the further deformation of the fabricating process it will have the desired final hardness.

The amount of cold-working which is necessary to produce material of any particular hardness is different for different metals. Copper wire is obtained in the half-hard condition by a reduction in section of about 60 per cent. A reduction in section of about 90 per cent is required to produce hard wire. These figures are typical of a pure metal of great plasticity. Less plastic metals and alloys such as brass harden more rapidly.

In general, the hardening effect of a given deformation is greater the lower the temperature at which deformation is effected. This is illustrated by some tests reported by Beilby.[2] Some gold wire was drawn at room temperature so that its length increased from 186 mm. to 352 mm. It was then drawn part way through a final die at room temperature, the remainder of the wire being drawn through the die at a temperature of approximately —80 deg. C. In this final pass the length of the wire was increased 32 mm., making the total length 384 mm.; therefore the total extension of the wire from the soft condition was then 106 per cent.

The tensile strength of the wire which had been drawn entirely at room temperature was 32,368 lb. per sq.in., whereas the tensile strength of the wire which was finished at —80 deg. C. was 35,213 lb. per sq.in. The wire drawn at the low temperature was thus 8.8 per cent stronger than the wire drawn completely at room temperature. Some copper wire treated in the same way showed a tensile strength of 60,928 lb. per sq.in. for the wire drawn entirely at room temperature and 64,960 for the part finished at —80 deg., an increase of 6.6 per cent.

The fact that iron is hardened much more by working in the blue heat range than at certain lower temperatures has been referred to in the former article[1] on "Overstrain, Internal Stresses and Creep," and it has been indicated that this behavior may be a general property of metals, although it is found to an exceptional extent in iron.

With the exception of tungsten and molybdenum, metals are usually worked either above their recrystallization temperatures or at room temperature—that is to say, intermediate temperatures are not intentionally selected for working and probably in no case is an artificially low temperature intentionally used. Work is often applied at temperatures between the recrystallization temperature and room temperature, however, in the natural sequence of operations. Thus ingots of copper or aluminum may be started through the rolls hot—that is, above the temperature of recrystallization —and rolling may be continued while the metal cools down gradually to room temperature. On the other hand, the heat produced by cold deformation itself may raise the temperature of a metal somewhat above the assumed working temperature. It has been estimated that in drawing copper wire presumably at a temperature of about 20 deg. C. the actual temperature may be about 75 deg. C.

Variations in the conditions of cold-working are unlimited in respect to such factors as the stages of reduction, the speed of drawing or rolling and the shape of dies or rolls. Variations in such factors produce slight variations in the properties of the metals, because of uneven distribution of the deformation, or of temperature and time effects. For practical purposes, however, the properties of a cold-worked metal are nearly independent of the manner of deformation.

Cold-Worked Metal at Elevated Temperatures

The properties of cold-worked metals vary with temperature in much the same way as do their properties in the annealed condition. Hardness decreases with rising temperature. Tensile strength decreases with rising temperature throughout the intermediate zone of temperature, but also decreases on cooling into the low temperature region of brittleness. Thus cold-drawn tungsten wire—like annealed tungsten wire—is weaker at liquid air temperature than at room temperature. No other metal so far tested is weaker at the temperature of liquid air (—185 deg. C.) than at room temperature, but most metals probably become weaker at some temperature lower still.

The elongation of cold-drawn wires likewise follows the same general trend as that of annealed wires. As the temperature rises from the cold brittle region, the elongation increases to a maximum value, and then, on further rise of temperature, decreases. The temperature of maximum elongation, however, is lower for cold-worked metal than for annealed metal, at least for those metals whose loss of ductility at low temperatures is due to grain boundary brittleness. It is in accordance with this law that cold-drawn tungsten wire is ductile at room temperature, whereas recrystallized tungsten wire is brittle. At temperatures above that of recrystallization, the effects of cold-working are lost, and the

properties become those of annealed metal, depending upon the grain size established by the conditions of deformation and heating.

When there is a discontinuity in the effect of temperature on the mechanical properties of a metal in the annealed condition, a corresponding discontinuity is found in the properties of the cold-worked metal. For example, the blue heat properties of annealed iron are also found in cold-worked iron, but are less evident as the amount of cold-working increases.

Cold-worked metals are nearly completely annealed or softened by heating under conditions of time and temperature that produce general visible recrystallization. Some softening may occur at much lower temperatures. It has already been mentioned[1] that iron which has been severely cold-worked and aged is softened somewhat by heating at 100 deg. C., although visible recrystallization occurs only above 450 deg. C., and that hard copper wire loses some of its strength slowly at room temperature. It has also come to the authors' attention that springs which depend for their elasticity on hardness produced by cold-work gradually deteriorate to some extent at ordinary temperatures so that they become unfit for certain uses.

Summary of Properties

The following general statements may be made regarding the properties of cold-worked metals:

1. Hardness and strength of a metal increase with the amount of reduction by cold-work until internal failure is produced.

2. Plasticity of a metal decreases as the amount of cold-work increases.

3. With change in temperature of test, the properties of a cold-worked metal follow those of annealed metal, any discontinuities in the properties of annealed metal being reflected in those of cold-worked metal.

4. The effect of a given deformation is greater the lower the temperature at which it is effected, except that in some metals abnormally large effects are produced in a certain region of temperature, corresponding to the blue heat in iron.

5. Elongation of a cold-worked metal increases with respect to the elongation of annealed metal, as the temperature of test decreases below the working temperature, reaching a maximum value, after which further decrease in temperature produces a rapid decrease in elongation.

6. Elongation of a cold-worked metal decreases with respect to the elongation of annealed metal as the temperature of test is raised above the working temperature until the recrystallization temperature is reached, when elongation is increased by annealing.

7. Temperatures of maximum elongation are different for various metals.

8. For any given metal, the temperature of maximum elongation is lower the greater the amount of cold-work, and is in general lower in cold-worked metal than in annealed metal.

9. In metals which become brittle on cooling because of intercrystalline weakness, the cold-worked metal may possess considerable elongation at temperatures at which the equi-axed metal is brittle.

10. The greater the amount of cold-work the less is the elongation at the temperature of working or at the temperature of maximum elongation on cooling.

11. The hardening effects of slight or moderate deformations are greater the smaller the initial grain size of the metal.

12. Reduction of area of a cold-worked metal is in general less than in the annealed state.

Conditions at Slip Planes

The properties of cold-worked metals and the phenomena of plastic deformation indicate that important changes may take place on the surfaces of slip during and after deformation. A number of propositions regarding the conditions at slip planes are herewith presented. For the purposes of this discussion, the term "slip plane strength" will be used to denote the resistance to motion along a slip plane after slip has started. "Crystal strength" means the shearing strength of the unbroken crystal on planes parallel to the slip plane under consideration; it is the resistance to motion on the slip plane, *before* slip starts.

(1) *Immediately after slip begins, the slip plane strength is less than the crystal strength.* In coarse grained metals, slips are readily observed which have extended for a distance of several thousand atom diameters. In single crystals tested in tension the extent of the motion on individual slip planes is still greater. After slip has once started, therefore, the resistance to further motion on the same plane must, for a while, be less than the resistance to the starting of slip on a parallel plane and hence less than the original shearing strength of the crystal. When iron has been recently

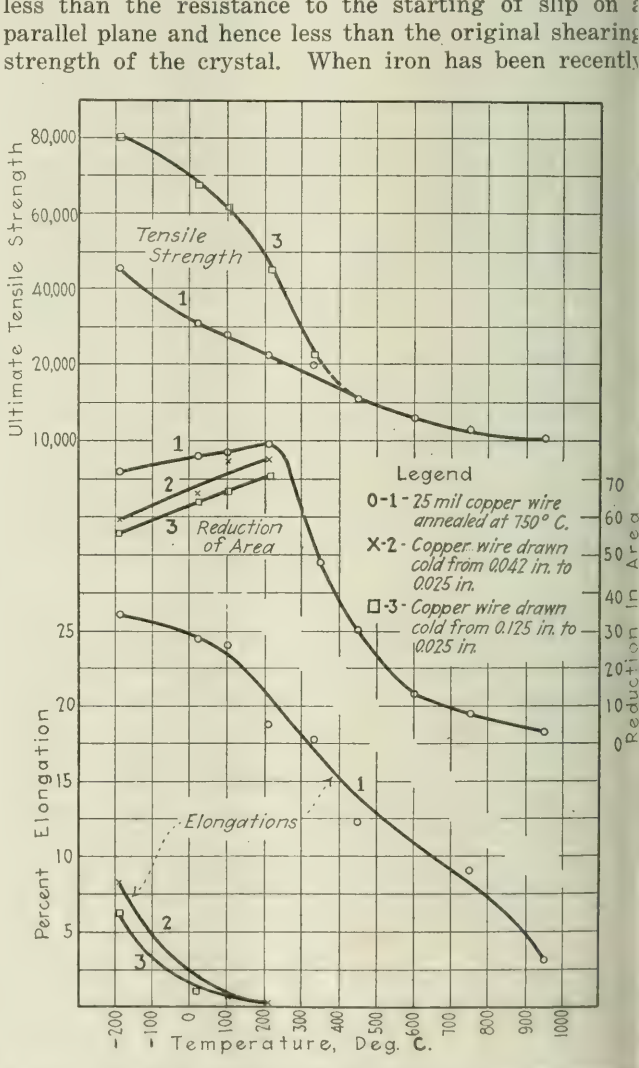
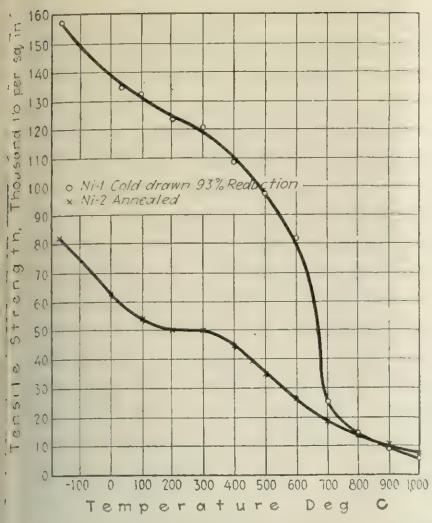
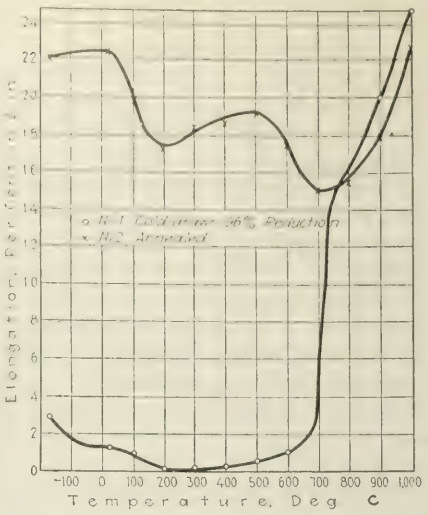
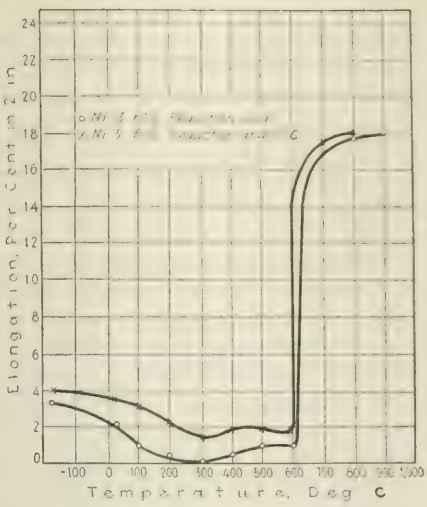


FIG. 1—TENSILE STRENGTH, ELONGATION AND REDUCTION OF AREA OF ANNEALED AND COLD-DRAWN COPPER WIRES AT VARIOUS TEMPERATURES. (JEFFRIES)







FIGS. 2, 3 AND 4—PROPERTIES OF NICKEL WIRE AT VARIOUS TEMPERATURES (SYKES)
Fig. 2—Tensile Strength Fig. 3—Elongation Fig. 4—Elongation, Cold- and Hot-Drawn

overstrained, the application of very small stresses results in permanent deformation which must take place by motion on the slip planes formed in the first overstraining process. Resistance to motion on these planes must, therefore, be quite low as compared with their original strength. The same is true of brass or other metals whose elastic limit is decreased by overstraining.

(2) *As slip continues, the slip plane strength increases to a value which may be greater than the crystal strength.* It is a striking fact that when single ductile crystals are tested in tension, failure does not occur on the first slip plane. Motion continues for a certain distance, after which further deformation takes place by slip on other planes. This means that the resistance to motion on the original slip plane must have increased to a value somewhat greater than the resistance to motion on parallel planes in the crystal. The process of slip may be termed "self-stopping."

(3) *In a metal composed of an aggregate of grains, slip is stopped partly by the interference of adjacent grains and partly by the resistance on the slip plane itself.* In a single crystal which is ductile it is necessary that motion continue on the first slip plane until the resistance to motion automatically becomes greater than that in the unbroken crystal. In an aggregate composed of many grains, however, motion on a slip plane in any one grain is opposed by adjacent grains through which there are no corresponding planes of weakness. Slip may there be brought to a halt by end resistance before sufficient motion has taken place to increase the resistance on the plane to the self-stopping point.

(4) *Slip planes in all stages of their history are present in cold-worked metals.* Since the slip plane strength increases with motion along the plane and since the extent of the motion on the various slip planes is different according to the various conditions of external support, it is evident that the resistance to motion on the various slip planes after deformation stops may be anything from the minimum to the maximum obtainable.

(5) *Slip causes rupture of the atomic bonds on the slip plane, and immediately after motion has stopped there is only partial re-establishment of cohesion.*

(6) *When the registry of the displaced crystal fragments permits, cohesion is re-established by the fragments joining into larger crystalline units.* The slip plane then disappears as such, being replaced by a *potential* slip plane whose strength is equal to the crystal strength.

(7) *As a rule, the crystal fragments do not register after deformation, and all degrees of disregistry occur.* It has been shown by X-ray analysis that new orientations are created by plastic deformation. Consequently there must be many, probably a large majority, of crystal fragments whose orientation does not permit them to unite except by the process of grain growth.

(8) *Re-establishment of cohesion between crystal fragments of different orientations must be attended with various degrees of disorganization as regards the arrangement of the atoms at the slip plane.*

(9) *This metal of partly disorganized structure simulates an amorphous material in its mechanical properties.* The characteristic properties of typical amorphous materials are first the great influence of time upon deformation, and second, the rapid change in properties with change in temperature. Cold-worked metals behave as though the resistance to motion on the slip planes varies in a similar manner with time and temperature. The slip plane strength increases on cooling and decreases on heating at a more rapid rate than does the crystal strength. For example, the tensile strength of cold-worked iron increases on cooling much more rapidly than the tensile strength of annealed iron.

(10) *Atomic rearrangement on slip planes takes place at temperatures much lower than are usually associated with recrystallization.* During the spontaneous aging of overstrained iron at ordinary temperature, or the rapid recovery of elasticity at a blue heat, the slip plane strength increases so that small stresses no longer produce permanent deformations. This increase in slip plane strength, or "healing" as we may call it, may consist in the growing together of fragments of sufficiently similar orientation, or in the establishment of cohesion at additional places on the planes between fragments that do not register. Rosenhain has observed that when a piece of iron is polished immediately after overstrain, lines are found which probably represent the intersection of the polished plane of the specimen with the surfaces of slip. These lines (called X-bands by Howe) are not found in the specimen if permitted to rest or recover before polishing. Lea has reported

that the recovery of iron or mild steel from overstrain is accompanied by an *increase* in density. All evidence is to the effect that the healing process involves an increase in the continuity of the metal. Although the electrical conductivity of metals is decreased by cold-working and is in general least when the metal is in its hardest condition, it is to be expected that the hardening of a cold-worked metal like iron by aging or heating at low temperatures would be accompanied by an *increase* in conductivity. Further heating would produce a continued increase in conductivity but eventually a decrease in hardness.

(11) *At certain temperatures slip planes may heal during deformation.* This is what happens at a blue heat in iron and at similar temperatures in nickel. When the slip plane strength exceeds the crystal strength, deformation is forced to take place on new slip planes. Spontaneous healing during deformation therefore results in a more intricate system of internal deformation.

(12) *On lowering the temperature, the slip plane strength may increase to a value greater than the crystal strength without any healing taking place.* For a given degree of disorganization at the slip plane and a given degree of re-establishment of cohesion, the ratio of slip plane strength to crystal strength is greater the lower the temperature. Slip may therefore reach a self-stopping state at low temperatures after less motion than at higher temperatures. This would lead to greater internal working by a given external deformation at low temperatures than at high temperatures. This excess of slip plane strength over crystal strength at low temperatures is the fundamental cause of the general increase in elongation with decrease in temperature of test, and in particular of the fact that wires drawn at certain temperatures until their ductility is nearly exhausted regain ductility on cooling to lower temperatures. Elongation takes place after the yield point is passed. Yield point is a function largely of *crystal* strength, being the stress required to deform the crystal. After the yield point is passed, permanent deformation of the metal continues as long as the strength is sufficient to sustain the deforming load. Rupture finally takes place at the slip planes. An increase in slip plane strength as compared with crystal strength therefore raises the tensile strength as compared with the yield point, and hence promotes elongation before rupture.

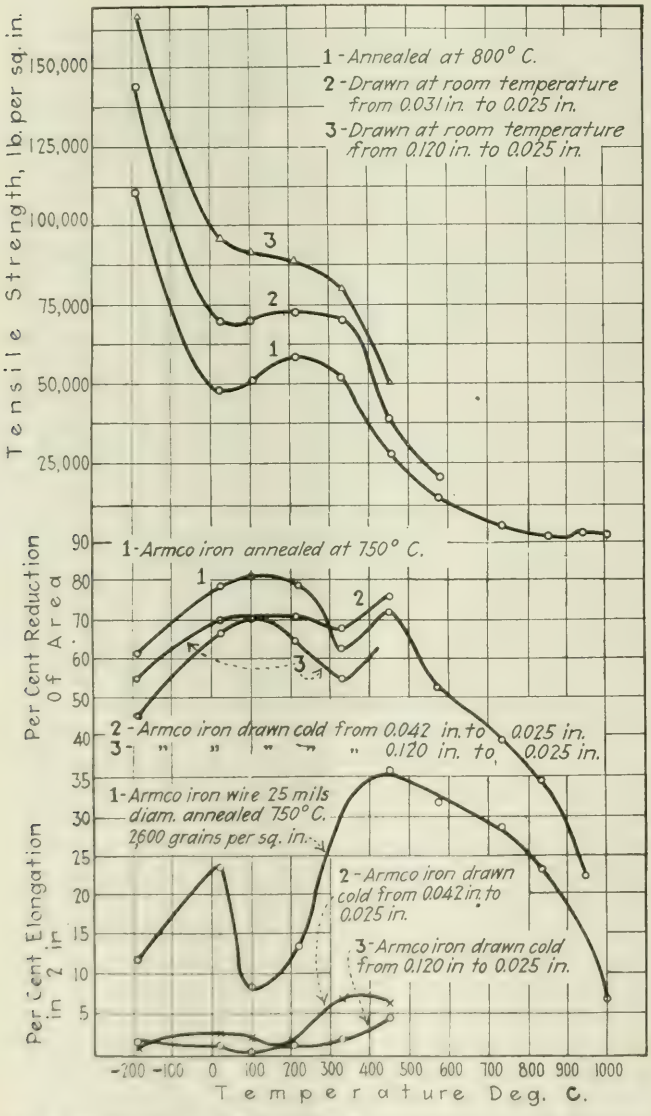

Tensile Strength, lb. per sq. in.
150,000
125,000
100,000
75,000
50,000
25,000
1 - Annealed at 800° C.
2 - Drawn at room temperature from 0.031 in. to 0.025 in.
3 - Drawn at room temperature from 0.120 in. to 0.025 in.
Per Cent Reduction of Area
1 - Armco iron annealed at 750° C.
2 - Armco iron drawn cold from 0.042 in. to 0.025 in.
3 - " " " " " 0.120 in. to 0.025 in.
Per Cent Elongation in 2 in.
1 - Armco iron wire 25 mils diam. annealed 750° C. 2600 grains per sq. in.
2 - Armco iron drawn cold from 0.042 in. to 0.025 in.
3 - Armco iron drawn cold from 0.120 in. to 0.025 in.
-200 -100 0 100 200 300 400 500 600 700 800 900 1000
Temperature Deg. C.

FIG. 5—TENSILE STRENGTH, ELONGATION AND REDUCTION OF AREA OF ANNEALED AND COLD-DRAWN ARMCO IRON WIRES AT VARIOUS TEMPERATURES (JEFFRIES)

(13) *The properties of the disorganized metal at the slip planes probably never become those of the hypothetical vitreous amorphous metal which would prevent any further motion on the same planes during further plastic deformation.* This has been discussed more fully in a previous article,[5] in which it was pointed out that slip planes must be used repeatedly to account for the large amounts of plastic deformation that are possible.

Cause of Strain Hardening

The motion of crystal fragments on a number of intersecting systems of slip planes destroys the continuity of the planes of weakness. Slip in any crystal fragment is opposed by adjacent fragments in somewhat the same way that slip is opposed at grain boundaries. During the first stages of deformation the orientations of the fragments produced from any one grain are only slightly changed and the effectiveness of the support by adjacent fragments is not so great as at the grain boundaries. As the deformation progresses, some of the crystal fragments are rotated, as is shown by the fact that new orientations are found. The slip interference is then comparable to that at grain boundaries and the structure is comparable to a very fine-grained structure.

Since the resistance to motion along a slip plane may be greater than in the unbroken crystal, these slip planes are sources of strength and hardness aside from the slip interference action. In this respect it may be said that the creation of disorganized structures whose properties simulate those of an amorphous material is a cause of hardness in cold-worked metals. However, the importance of such amorphous metal in hardening seems to have been greatly exaggerated.

The hardening effect of deformation increases with the number of slips taking place. Since strain-hardness is to be attributed chiefly to the slip interference created by the relative displacement of crystal fragments, this hardening will be greater, in general, the larger the number of planes on which slip takes place. A given external deformation will, therefore, produce greater hardness the greater the number of slip planes

[5] "The Amorphous Metal Hypothesis," by Zay Jeffries and R. S. Archer, *Chem. & Met. Eng.*, vol. 25, p. 697 (Oct. 12, 1921).

produced or the greater the internal working of the metal. In accordance with this principle, deformation produces hardness more rapidly as the temperature is lowered, as the initial grain size is smaller, and finally when spontaneous healing takes place during deformation (as in the blue heat range in iron). Fettweiss[6] states in his summary that cold-working of iron, followed by heating at a blue heat, produces the same results as working at a blue heat. The principle just stated shows, however, that a given deformation effected at a blue heat must produce more hardening than the same deformation effected at room temperature and followed by heating to a blue heat. A knowledge of the mechanism of the blue heat phenomenon thus assists in correlating its various manifestations.

Some Typical Examples

The examples to be given include metals crystallizing with face-centered and body-centered cubic lattices. No extensive investigations have been reported on metals crystallizing with hexagonal lattices, but such information as is available indicates a tendency toward less plasticity, a narrower range of temperature within which they are plastic and a tendency toward greater brittleness of the individual crystals than in cubic metals. The mechanical properties of the hexagonal metals are, however, in harmony with the general rules put forth in this article.

The data from which the accompanying curves were plotted are the results of tests made on wire of 0.025 in. diameter. In each case the elongation was measured on a length of 2 in. Testing conditions were similar for the various metals. For testing at low temperatures, a bath of liquid air was used; for tests at 100 deg. C., boiling water; and at slightly higher temperatures, a bath of oil. At still higher temperatures specimens were heated in an electric tube furnace, an atmosphere of argon being used to protect the specimens from oxidation when this was necessary. No determinations were made of elastic limit or yield point.

In Fig. 1 are two curves showing the variation in the tensile strength of annealed and cold-drawn copper with changing temperature. The curve for the cold-drawn wire is discontinued above 330 deg. C., because in this range of temperature the wire anneals rapidly and becomes practically identical with the material represented in the other curve. Below the recrystallization temperature the strength of the cold-worked wire increases more rapidly than the strength of the annealed wire.

Fig. 1 also shows the effect of temperature on the elongation of annealed copper wire and of two samples of cold-drawn wire reduced different amounts by drawing. Again the elongation of the cold-worked metal varies with temperature in the same manner as that of the annealed metal. At the lower temperatures the elongation of the cold-drawn wire increases more rapidly than that of the annealed wire, and the indications are that at some very low temperature the elongation of the cold-drawn wire might be the greater. Results are not plotted for temperatures above 200 deg. C. for the cold-drawn wires. Annealed and cold-drawn copper wires are also compared as to reduction of area in Fig. 1. The effect of temperature on this property is seen to be in the same general direction for cold-drawn and annealed wires. Again, results are not plotted above the recrystallization temperature.

Fig. 2 shows the effect of temperature on the tensile strength of annealed and cold-drawn nickel wire and records the same general tendency of decrease in strength with increase in temperature noted for copper. There is a marked break in the curve at 200 to 300 deg. C. for the annealed wire. This has been discussed above and is believed to be due to spontaneous healing of slip planes during deformation. The same discontinuity is reflected in the curve for the cold-drawn wire, but is less apparent. Annealing is seen to take place rapidly at 600 to 800 deg. C.

Elongation-temperature curves for the same nickel wires are shown in Fig. 3. Below the temperature of recrystallization annealed wire appears to have a general tendency toward increased elongation with decreasing temperature. This general trend is broken at 200 to 400 deg., the minimum in elongation at 200 deg. C. corresponding with the horizontal portion in the tensile strength curve. A slight drop in elongation on cooling from room temperature to the temperature of liquid air is probably due to the beginning of low-temperature brittleness. No tests were made between room temperature and liquid air temperature, and it is quite likely that at some intermediate temperature the elongation would be higher than at any point shown on the curve. Elongation of cold-drawn wire increases continuously as it is cooled from 200 deg. C. down to the temperature of liquid air. The fact that no drop in elongation at low temperatures is shown corresponds with the general observation that cold-drawn metals remain ductile at lower temperatures than annealed metals. The rise in elongation in the cold-drawn wire above 400 deg. C. is due to annealing.

Fig. 4 shows elongation-temperature curves for nickel wires reduced the same amount at room temperature and at 400 deg. C. respectively. It will be noted that

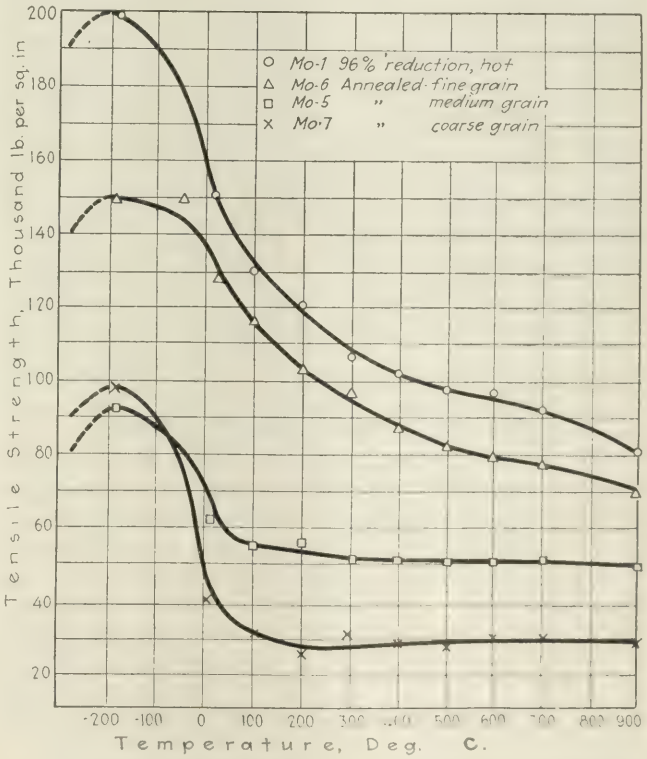


FIG. 6—TENSILE STRENGTH OF MOLYBDENUM WIRES AT VARIOUS TEMPERATURES (SYKES)

[6] "The Blue Brittleness and Aging of Iron," *Stahl und Eisen*, Jan. 2 and 9, 1919.

the elongation of the latter is higher, in accordance with the general rule that the effect of cold-work is greater the lower the temperature at which it is effected. These wires, which have been reduced less than the one represented in Fig. 3, show distinct minima in elongation at 300 deg. C., corresponding to the horizontal in the tensile strength curve for annealed nickel. In view of these curves it is probable that the minimum in elongation shown in Fig. 3 is also at least partly attributable to this blue heat phenomenon.

Fig. 5 shows the effect of temperature on the tensile strength of annealed and cold-drawn Armco iron wire. The strength increases with the amount of reduction by cold-drawing. There is a general decrease in tensile strength with increasing temperature, but annealed wire shows a very marked increase in strength on rising temperature, the strength reaching a maximum at about 200 deg. C. As pointed out above, the actual temperature of this maximum depends quite largely on the rate of testing. The same discontinuity is shown in the cold-drawn wires, but to a less marked extent. There is also a considerable increase in strength on raising the temperature of annealed wire between 850 and 930 deg. C., due to the allotropic change from alpha to gamma iron.

Elongation-temperature curves for annealed and cold-drawn iron wire are also shown in Fig. 5. Decrease in elongation of annealed wire at temperatures from 450 deg. C. upward is in accordance with the general law. A marked minimum in elongation at 100 deg. C. is due to the blue heat phenomenon. Below this temperature the elongation again rises in accordance with the general law to a maximum (which may be somewhat below room temperature), after which it decreases because of low-temperature brittleness. The cold-drawn wires also reflect the minimum in elongation in the blue heat range. Above about 450 deg. C. annealing takes place, after which the properties become similar to those of the annealed iron. There is no positive evidence here that the elongation of the cold-drawn wires would be greater than that of the annealed wire at very low temperatures, but such may be the case.

The same figure shows the effect of temperature on the reduction of area of annealed and cold-drawn iron wire. The general tendency is as usual—a rise in reduction of area with increasing temperature up to the recrystallization temperature, above which the reduction of area decreases. The minimum in reduction of area at about 330 deg. C. is again a manifestation of the blue heat phenomenon. It will be observed that the minima of elongation do not occur at the same temperatures nor at the same temperature as the maximum in the tensile strength, although the results are all from the same specimens. It is of interest that the cold-drawing has affected the reduction of area relatively less than the tensile strength and elongation.

Fig. 6 shows the effect of temperature on the tensile strength of annealed molybdenum wires of various grain sizes. (The wire described as reduced 96 per cent hot was produced by hot-swaging followed by drawing, part of the reduction at least being effected below the recrystallization temperature.) In all wires the tensile strength decreases with rising temperature throughout the range shown. In the annealed wires, particularly those of medium and coarse grain size, there is a marked horizontal extending from about 100 to 900 deg. C., which is approximately the recrystallization temperature of molybdenum. This may be a manifestation of the blue heat phenomenon. Although tests were not made below the temperature of liquid air, the strength is represented as decreasing at lower temperatures. This fall in tensile strength might be expected to occur at some temperature slightly lower than —185 deg. C., since the tensile strength of tungsten falls between 25 deg. C. and —185 deg. C. Curves have already been given and discussed showing the effect of temperature on the elongation of molybdenum, in Fig. 2 of an article entitled "Effect of Temperature, Pressure and Structure on the Mechanical Properties of Metal" (*Chem. & Met. Eng.*, vol. 27, No. 15 (Oct. 11, 1922).

Fig. 7 shows the effect of temperature on the tensile strength of two kinds of tungsten wire, of which No. 1 has a structure composed of unstrained but slightly elongated grains. Wire No. 2 was produced by swaging and drawing from 0.165 to 0.025 in. at temperatures gradually falling from 1,300 to 1,000 deg C. The temperatures covered by these curves are entirely below

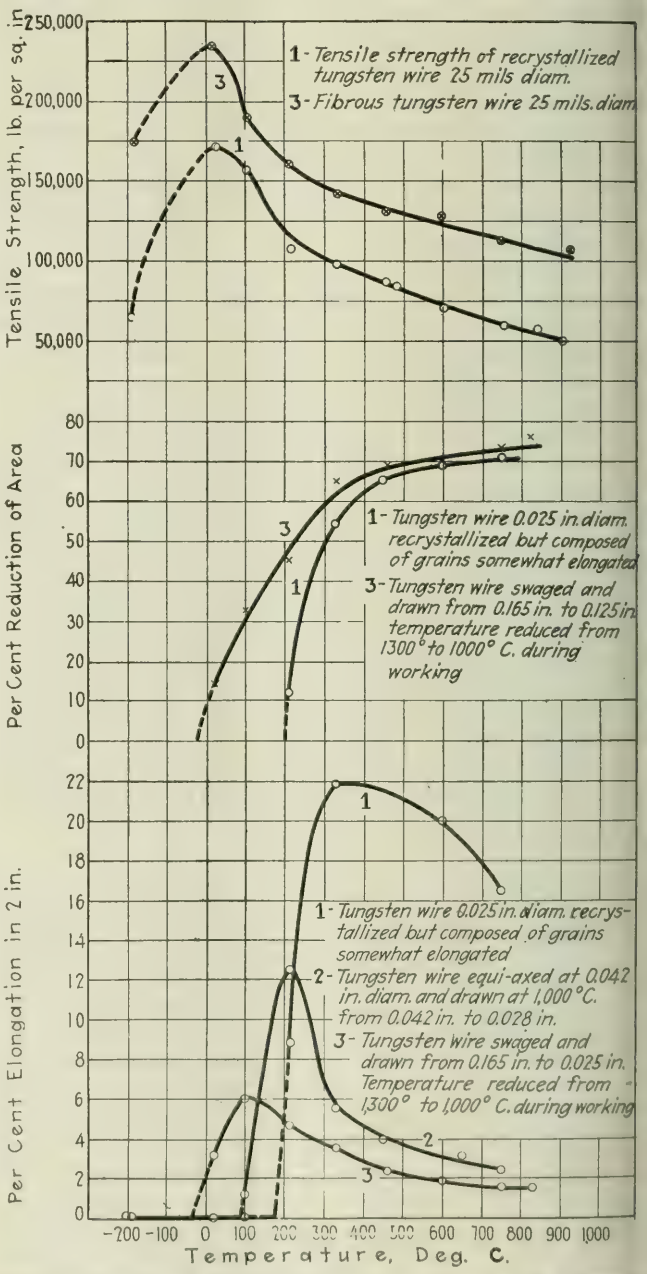

Tensile Strength, lb. per sq. in.
250,000
200,000
150,000
100,000
50,000
1- Tensile strength of recrystallized tungsten wire 25 mils diam.
3- Fibrous tungsten wire 25 mils. diam.
Per Cent Reduction of Area
80
70
60
50
40
30
20
10
0
1- Tungsten wire 0.025 in. diam. recrystallized but composed of grains somewhat elongated
3- Tungsten wire swaged and drawn from 0.165 in. to 0.125 in. temperature reduced from 1300° to 1000° C. during working
Per Cent Elongation in 2 in.
22
20
18
16
14
12
10
8
6
4
2
0
1- Tungsten wire 0.025 in. diam. recrystallized but composed of grains somewhat elongated
2- Tungsten wire equi-axed at 0.042 in. diam. and drawn at 1,000 °C. from 0.042 in. to 0.028 in.
3- Tungsten wire swaged and drawn from 0.165 in. to 0.025 in. Temperature reduced from 1,300° to 1,000° C. during working
-200 -100 0 100 200 300 400 500 600 700 800 900 1000
Temperature, Deg. C.

FIG. 7—TENSILE STRENGTH, ELONGATION AND REDUCTION IN AREA OF ANNEALED AND COLD-DRAWN TUNGSTEN WIRES AT VARIOUS TEMPERATURES. (JEFFRIES)

recrystallization. The tensile strength increases on falling temperature, but is lower at —185 deg. C. than at room temperature. Tungsten is the only metal in which this drop has been observed, but, as mentioned above, it probably occurs in most metals at some very low temperature. The actual hardness of the tungsten is probably greater in liquid air than at room temperature and the decrease in strength is probably due to brittleness.

Fig. 7 also shows the effect of temperature on the elongation of three kinds of tungsten wire as described in the figure. In all cases the the elongation increases on falling temperatures until the region of low-temperature brittleness is reached. These curves illustrate particularly well the law that the maximum elongation occurs at lower temperatures the greater the amount of cold-working, but that the actual elongation at this maximum decreases as the amount of working increases. Comparing the elongation and tensile strength curves, it will be noted that the development of brittleness is at first accompanied by a sharp rise in tensile strength. This appears to be a rule for all metals.

In both wires shown the reduction of area increases with rising temperature throughout the temperature range given. At all temperatures covered by these tests the reduction of area is greater in the cold-drawn wire than in the annealed wire.

Legal Notes

By Wellington Gustin

Notation in Receipt Regarding Disputed Shortage Not Sufficient Notice of Loss

An interesting point on shipping claims is had in an action by the Calumet & Hecla Mining Co. against the Delaware, Lackawanna & Western R.R. Co. and decided for the defendant by the Appellate Division of the New York Supreme Court. (190 N.Y.S., 410.)

The Calumet company claimed the right to recover from the railroad company the sum of $666.91, the value of 10 billets of copper, being a part of a shipment of 524 billets, shipped by it from its works at Lake Linden, Mich. The initial carrier was the Mineral Range R.R. Co. The freight was prepaid to New York City, consigned to plaintiff. The defendant, being the final and delivering carrier, duly gave notice of the arrival of the copper in New York. The plaintiff then directed the defendant to deliver the shipment, together with other copper, totaling 2,543 billets, to the steamship Orleans, of the Oriental Navigation Co., at the port of New York, for transportation to Bordeaux, France. Delivery was made 10 billets short.

Defendant gave to plaintiff the steamship receipts for the copper actually delivered, and received from the plaintiff in exchange therefor a receipt which plaintiff claimed constituted a notice of loss or damage which entitled plaintiff to recover. The receipt describes fully the copper actually delivered on board, and then contains the following statement respecting the 10 billets which had been lost:

"Ten (10) billets, mkd. C & H, more, in dispute. If on board to be delivered."

The sole question in the case to be determined was whether the above words contained in the receipt constitute a sufficient notice in writing within the meaning of the clause of the bill of lading following:

"Claims for loss, damage or delay must be made in writing to the carrier at the point of delivery, or at the point of origin, within 4 months after delivery of the property, or in case of failure to make delivery, then within 4 months after a reasonable time for delivery has elapsed. Unless claims are so made the carrier shall not be liable."

Claim Not Filed Within Specified Time

Within a few days of the receipt letters were written by both parties regarding the shortage, and 2 months thereafter the Calumet company was notified that the shipment checked 10 billets short on arrival at Bordeaux. Eleven months thereafter it filed its claim against defendant for the loss.

Notation Did Not Constitute Notice of Loss, Says the Court

The court says the receipt executed by plaintiff and the subsequent letters disclose that some dispute had arisen respecting the 10 billets of copper claimed to be missing from plaintiff's shipment. The defendant, evidently thinking there might have been a mistake in checking the copper, wished to take advantage of a rechecking when the ship reached Bordeaux. When the shipment was so rechecked at Bordeaux it became certain that the 10 billets of copper had not been found on board, and the plaintiff was so notified. However, it took no further step to notify the defendant until this belated notice of claim was filed, says the court. The receipt as mentioned above was not intended to operate as a notice under the bill of lading, the court said. The use of the words "in dispute" contained in the receipt, as above, showed clearly that neither of the parties regarded the notice as final, or that it had actually been determined that any loss or damage had been sustained. At most, it indicated only uncertainty as to whether the 10 billets of copper were included in the shipment. Such uncertainty was to be resolved when the goods came to be rechecked on arrival at Bordeaux.

The court says the defendant carrier had a right to expect further advices if, upon arrival there, it was found that the 10 billets were missing, and, if the plaintiff was to make claim for loss, that the defendant would receive timely written notice of such claim. Having failed to make such claim within 4 months after delivery of the property in question, reliance could not be had on the receipt, as it did not constitute even a substantial compliance with the requirements of the bill of lading.

Slide Rule for Furnace Calculations

A handy circular slide rule for calculating furnace additions has been designed by F. Wright and is being distributed by the Pittsburgh Electric Furnace Corporation. It contains six scales—viz., for the weight of the furnace charge, the points of alloy or carbon to be added, the percentage of that element in the ferro available, the per cent of absorption by the bath, the melting loss, and finally the pounds of ferro required. Normally the slide rule would be used to determine the pounds of addition required to bring the bath to a given analysis, although it may obviously serve to compute any unknown factor, given the other five.

Internal Mixers*

A Critical Study of the Limits of Application of the Internal Mixer to Rubber Compounding—The Chief Difficulties in Its Use Are Analyzed—Where Possible Corrections in Design Are Suggested and the Limits to Its Use Defined

By R. P. Dinsmore
Chief Compounder, Goodyear Tire & Rubber Co.

IT IS intended to discuss the action of internal mixers (chiefly in comparison with mill mixing) on the basis of practical production experience in connection with various types of rubber compounds, especially tire stocks. Although most of our work was done on one type of mixer, sufficient data were obtained from other types to make our conclusions more or less general. Under internal mixers we may class all those which utilize a closed chamber to hold the charge or batch and which for mixing depend upon the action of a mixing mechanism which works the material back and forth laterally, longitudinally or both.

The internal mixer naturally appeals to the practical rubber man who has been accustomed to working his rubber on a mill by means of his hands and a knife and to putting his compound onto the rolls with a shovel, during which process he must inhale considerable dust and fumes. The idea of eliminating much of this labor and greatly reducing cost and fumes is attractive. Probably the advent of carbon black into the field of rubber compounding has done more than any other one thing to popularize the idea of internal mixing. Certain factors combined to make it more practicable to use the early design of internal mixer for mechanical goods stocks—that is, molded goods other than tires—rather than for tire stocks. Later improved designs and, as previously stated, the dirt nuisance from carbon black caused tire men to investigate its possibilities more carefully.

Classification of Rubber Stocks

Before discussing the behavior of various types of stocks it may be well to make a general classification for reference purposes. The rubber manufacturer roughly classifies his stocks as high grade and low grade, not upon the basis of the degree of satisfaction with which they perform the required functions in the finished article, but chiefly according to rubber content. Under high-grade stocks, therefore, we may class most tire compound, balloon stocks, and a few mechanical goods and so-called master batches which are simply mixtures of individual compounding ingredients with rubber, designed to facilitate handling or increase the accuracy of weighing. Low-grade stocks include most mechanical goods compounds, a few tire stocks such as bead fillers and in this group we may also class accessories.

Low-Grade Stocks Can Be Handled in Internal Mixers

Early experience with internal mixers showed that most low-grade stocks could be mixed successfully and many of them more economically than on a rubber mill. The reasons are fairly obvious in that where there is a great deal of dry filler compared to the amount of rubber present, and especially where softeners are used in considerable quantities, it is easier to keep the fillers in contact with the rubber and effect a mixture when the entire mass is inclosed and subjected to a stirring action than when the compound must be shoveled onto the mixing rolls. It is a matter of long experience in the rubber industry that many batches of this type can be best mixed on a mill by the addition of a great deal of softener and the use of a scraper to take the rubber off the rolls. In internal mixing much the same thing is done in a more efficient manner. It is true that if batches were made too soft they sometimes stuck in an internal mixer and made it difficult to clean out, but in general it may be said that low-grade stocks mixed fairly well.

In the initial stages of internal mixer development work was also done with master batches, particularly those containing carbon black, but sufficient trouble was experienced to prevent the old type of mixer becoming a serious competitor of the mill for this purpose, and in the case of carbon black, the bearings were attacked due to inability to pack them tightly enough to keep the black out.

Before we leave the early history of this type of mixer it may be well to state that it was found essential to take the large chunks of rubber stock coming from the mixer and pass them through mill rolls in order to sheet them out in a form which would be convenient for handling and storage and which would admit of sufficiently rapid cooling to prevent injury to the compound. This condition has remained constant throughout all subsequent developments. It was found that even with this expedient high-grade stocks other than master batches were very tough when mixed in this way and had a strong tendency to start premature vulcanization, or as we express it, to "scorch."

Improved Design of Internal Mixers

In the last few years improved types of internal mixers have been put on the market with better mechanical design and better facilities for cooling. Bearings have been perfected, the machine in general strengthened, and the mixing mechanism as well as the chamber has been water-cooled and the method of emptying the mixer has been made much more simple and effective. It may be pointed out here that the internal mixer differs essentially from the mill in that much less batch surface, in proportion, is in contact with the cooling walls. This makes effective cooling difficult and hence cooling methods are highly important.

Experiments With High-Grade Stocks

In an endeavor to find out what this type of mixer could do, something over 1,000 experiments were made, chiefly on high-grade stocks which were grouped under two headings, one being master batches, which in no case contained sulphur; and the other group being tire stocks, which, of course, always contain sulphur and usually an organic accelerator.

In view of our past experience we expected our best results from high-grade stocks would be obtained in

*Revision of a paper presented at the Birmingham meeting of the American Chemical Society, April 5, 1922.

mixing carbon black into rubber, providing the bearings were properly designed. Work was therefore commenced on this basis.

For purposes of this study, a batch with the approximate composition of 35 volumes of carbon black and 100 of rubber was used. It was found impracticable to go to a higher concentration of black, and although lower concentrations were tried and equally good results obtained, no particular benefit was noticeable. Due to our experience in mill mixing, which showed that better results are obtained from mixing small-size batches, we began with a 60-kg. batch, which about half filled the mixer, and gave the rubber a separate mastication of from 2 to 5 minutes, adding the carbon black and mixing to a total time of from 8 to 20 minutes.

Initial temperatures averaged around 50 deg. C. and final temperatures about 95 deg. It was impossible to get a smooth mix, and the batch was dusty when dumped, showing an incomplete incorporation of the filler and the rubber. Batch weights were gradually increased to 75 and 100 kg. without any appreciable improvement. The temperature varied a great deal due to difficulty in regulating the water feed to the cooling chambers. This difficulty was finally overcome, but the tendency of the batch seemed to be to break up into lumps rather than to mix in a uniform mass. Longer working of the rubber before the black was added improved this condition to some extent; however, lumping continued to result, apparently from moisture taken from the rubber and condensed on the walls of the mixing chamber. It was finally found advisable to give the rubber a preliminary working or breaking down on the mill before putting it in the mixer. With this expedient better results were obtained, and after changing the batch weight we mixed as follows: Broken-down rubber was used and worked in the mixer for 5 minutes, then the compound was fed in very gradually until it was all assimilated, giving a total mixing time of 25 minutes. A 60-in. mill was required to batch off, the final temperature of the batch being 142 deg. C. This stock appeared to be uniformly mixed, no lumps were apparent, but it was noticeable that the glossy appearance characteristic of this batch when mixed on a mill was lacking.

Material mixed in this way gave a very satisfactory quality when tested in the various compounds employing

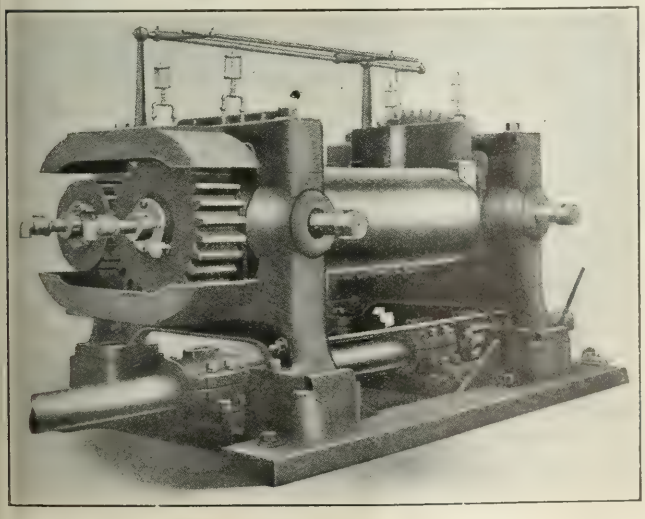


FIG. 1—STANDARD MIXING MILL

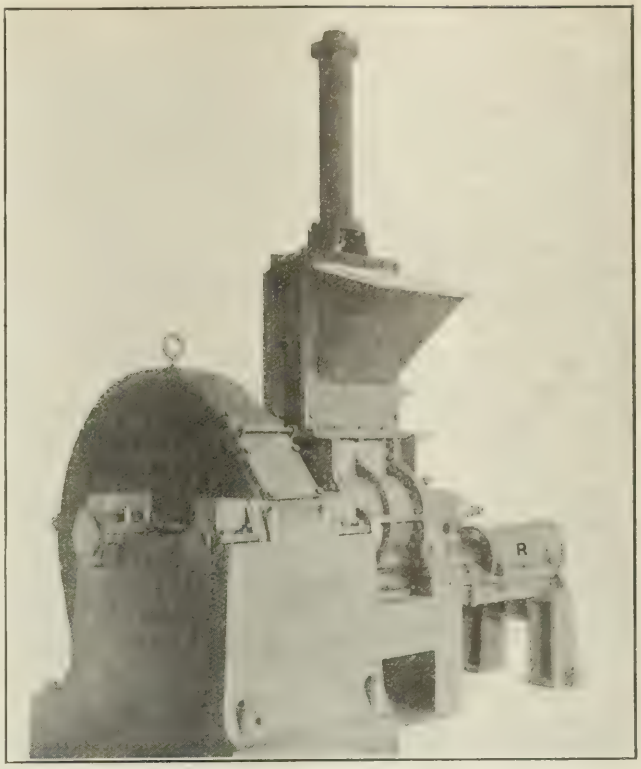


FIG. 2—BIRMINGHAM-BANBURY MIXER

carbon black, but continued production runs made with master batches processed in this manner established beyond question that these batches are tougher and do not work up as soft on a mill as the corresponding mill-mixed material.

Facts which were established by this series of experiments were that the chamber of the machine must be nearly full to mix properly, the rubber must be dry and in a fairly plastic state before the addition of compound, and the compound must be introduced slowly, at a fairly uniform rate, so that the mixing mass maintains its continuity and does not break up into lumps. The distribution of compound was evidently fairly uniform as shown by physical tests on vulcanized stock, but the mixed batch was tougher than corresponding mill-mixed material. I might add that the rotor speed was 23 r.p.m.

Tire Stocks Could Not Be Completely Compounded in Internal Mixer

Attention was now turned to work on tire stocks containing sulphur and accelerator. It was considered desirable to study the effect of variation in speed, and this was done between a range of 18 and 30 r.p.m. of the rotor. It was found that for high-grade stocks increase in speed is accompanied by increase in heat generated, power consumption and slipping between the rotor and the stock.

The range of 21 to 23 r.p.m. was fixed as the most satisfactory for these stocks. For lower-grade stocks where softeners are used and there is less rubber, the speed may be increased to give a shorter mixing time with a much lower proportional increase in heat and power consumption. It was found that for any batch weight or speed which was established it was impossible to mix accelerator and sulphur into the batch in the internal mixer. Most batches permitted the mixture of sulphur at the very end of the mix, although in some

it was found advisable to add only the accelerator. In any case either the sulphur or the accelerator had to be added to the batch on the batching-out mill. The temperature ranged from 90 to 120 deg. C. on the outcoming stock, the speed was held around 20 r.p.m., the average horsepower was about 130, but the maximum horsepower varied from 175 to 275. The time of mixing ranged from 18 to 30 minutes. This included stocks with gravities from 1.0 to 1.62. It is interesting to note that although all these batches could be mixed without scorching by the addition of accelerator or sulphur, after the batch came out of the mixer the resulting compound was found without exception to be tougher than that regularly mixed on mills. This toughness is not of the nature of set-cured stock, but stock in which the rubber has not been sufficiently broken down.

Several different types of mechanical goods stocks, ranging from a cheap bumper stock to a black heel, were tried out and good results were obtained, except that even in these stocks toughness was noticeable, which was not ordinarily found. The time of mixing was much less and the batch weight much greater as compared to tire compounds.

Summary

This study on internal mixers has brought to light three inherent defects:

1. The ratio of cooling surface to volume of stock being less than for a mill batch and the rate of working being greater, heat is generated sufficiently fast to increase the temperatures considerably above those which are ordinarily obtained in mill work. This renders it impossible to mix an entire batch in the mixer without scorching.

2. The resulting mix, although uniform, is tougher than that obtained from a mill. This apparently is due to the fact that the mechanical action is different from that obtained with mill rolls. We have suspected for some time that rubber which is made plastic by heat differs from rubber which is made plastic by mechanical action. It is true that the softening of rubber by mechanical action is always accompanied by a certain amount of heat. Nevertheless, with proper cooling, the effect of mechanical action may be made to predominate. We have observed that rubber softened by heat alone, provided the temperature is not excessive, although apparently much softer when hot, eventually reverts to more nearly its original state than rubber softened by working on the mill. This phenomenon agrees very closely with that observed in connection with the internal mixer. We have already observed that the temperatures obtained are much higher, and it therefore seems logical to assume that the softening action which renders the mixing of the rubber and compound possible in an internal mixer is chiefly due to the heat generated. This is probably chiefly a decrease in the viscosity of the rubber without any great amount of depolymerization and hence we get reversion or toughness after the batch has cooled off.

3. An internal mixer is not a complete unit, but requires the use of a mill to slab off the mixed stock. It is difficult to balance up batching-off mill capacity with mixer capacity, due to the fact that the volumes of different batches vary somewhat and the treatment on the batching-off mill varies depending on the sulphur or accelerator which must be added at that point. Also, it is necessary to batch out stock immediately after it

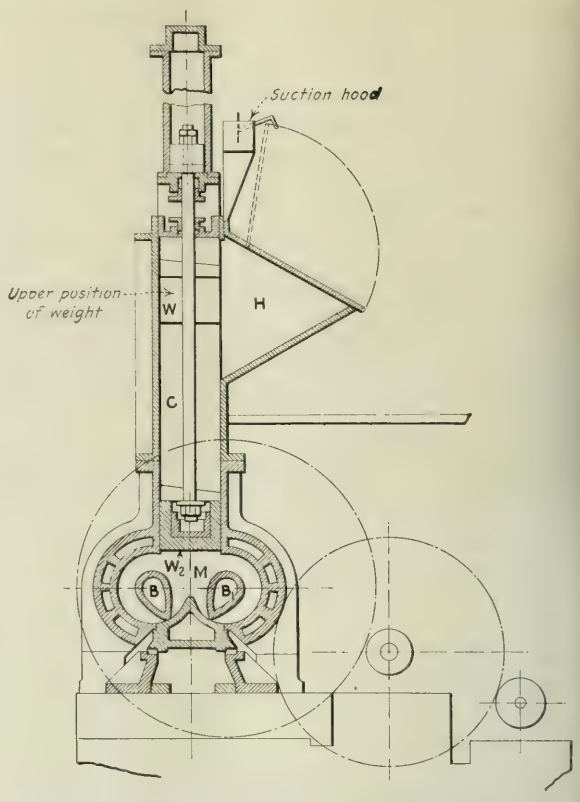


FIG. 3—DIAGRAMMATICAL CROSS-SECTION OF BIRMINGHAM-BANBURY MIXER

is taken from the mixer—particularly if the batch contains sulphur—because of the detrimental effect of the high temperature, which is maintained for a long period if the stock is left in large lumps. This means that the batch-out mills must be synchronized with the mixers. We have made a study of labor and power costs and believe it would be the most economical arrangement to erect a mixer on top of a suitable size mill with an integral drive. This arrangement would permit of dropping the charge directly into the mill rolls, would save trucking and insure rapid cooling of the charge after mixing.

In conclusion I will say that of the three defects mentioned, the first two appear to me to be inherent in the internal type of mixer, but of course the last can be readily remedied by design. I should like to point out that for certain type of stock, particularly mechanical goods, this type of mixer has great advantages over the regular mixing mill. Moreover, where a uniform plastic condition of a mixed stock is not highly essential or where fast curing organic accelerators are very little employed, it will undoubtedly be possible to handle high-grade stocks satisfactorily. In any event the reduction of the dust nuisance and the saving of labor will make it worth while for every manufacturer to study the mixer in connection with his own particular mixing problem.

Fig. 1 shows the standard mixing mill, which consists of two steel rolls driven in opposite directions in such a way as to draw the rubber between the rolls when inserted from above. The surface speeds of these rolls are slightly different, usually in a ratio of about 9 to 10. The rubber is sheeted around the slower roll and is cut back and forth with a knife until the right softness is attained. Then it is left running in such a way that a bank or roll of rubber is formed between the rolls, and fillers, sulphur, accelerators, etc., are added on top of

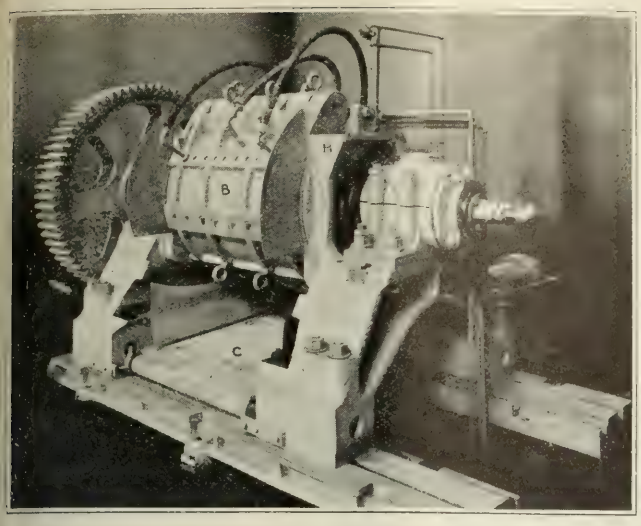


FIG. 4—FARREL MASTICATOR

the rubber, with a shovel. No cutting of the rubber is done during this stage of the mixing until all the filler is worked in.

Fig. 2 is a photograph of the Birmingham-Banbury mixer manufactured by the Birmingham Iron Foundry, Derby, Conn.

Fig. 3 shows a diagrammatical cross-section of the same machine. *H* is the hopper fitted with a cover and suction hood to take care of the dust. *W* is the weight which is raised by means of air piston to permit the introduction of the batch to be mixed through the hopper and cylinder *C* to the mixing chamber *M*. After the batch is introduced, the weight is lowered to the position W_2, thus forming an inclosed mixing box. The blades *B* revolve in such a way as to clean the walls of the chamber and work the batch back and forth. The blades and walls of the chamber are water-cooled. The batch is emptied by the operation of a hydraulic ram which displaces laterally the bottom plates of the mixing chamber, and permits the batch to fall down into a receptacle or onto a conveyor belt. The ram referred to is marked *R* in Fig. 2.

Fig. 4 is a masticator manufactured by the Farrel Foundry & Machine Co., Ansonia, Conn. The ingredients for the batch are introduced through the hopper *H*, which is duplicated by an exactly similar hopper at the other end of the machine. Material may thus be fed in from both ends. Inside the barrel of the machine *B* is a rotor, each half of which is in the form of a worm or screw. The direction of twist is such that the materials are forced toward the center from each end, causing a pile-up of material in the middle, which is relieved by the back-flow between the screw and the inside walls of of the chamber, thus giving an action which mixes and works the ingredients back and forth. The walls and screw of this machine are water-cooled. The batch is emptied by releasing a section of the mixing chamber, which permits the batch to fall on the conveyor belt *C*.

Aluminum Bronze for French Coins

Subsidiary coinage of aluminum bronze is to replace the paper notes now in circulation in France.[1] P. H. Gaston Durville, with M. Hanriot as chemist and principal assistant, have been working on the problem of new coinage alloys since 1909. They have succeeded in producing sound ingots of greenish-gold metal which conform to the several requirements of coinage metal: attractive; corrodes and tarnishes with difficulty and

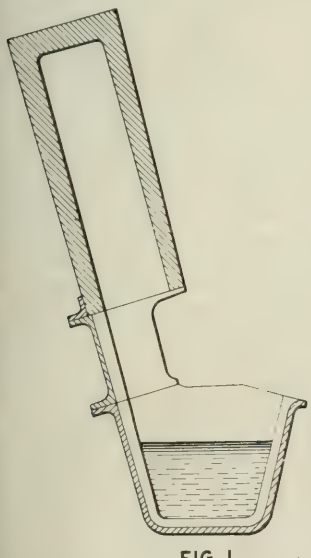


FIG. 1

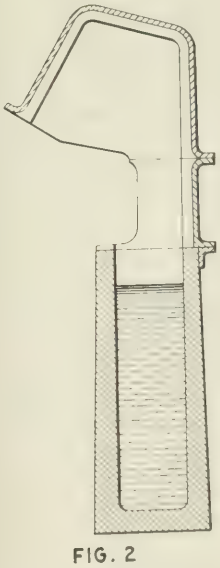


FIG. 2

especially retains its color in sea air; forgeable, yet with sufficient difficulty to discourage counterfeiters; fairly hard.

In manufacture, it was found very difficult to cast sound slabs, free of slag, gas bubbles or dirt. To overcome this, Durville has devised and patented a rotating, composite mold, diagrammed in Figs. 1 and 2. Crucible-melted alloy is skimmed and poured in the refractory-lined receiving basin as shown in Fig. 1. Immediately, and without the least jarring, the mold is rotated slowly into the position shown in Fig. 1. Four slabs, weighing 60 to 70 kg. each, are thus cast simultaneously; the pouring basin is removed and the slabs drawn as soon as they have solidified.

[1] *The Engineer*, July 21, 1922, p. 74.

Chilled-Iron Car Wheels

In view of the fact that the 5,000-lb. wheel loads of the freight car in use 50 years ago were carried on chilled-iron wheels weighing 525 lb., while today a similar wheel weighing 850 lb. is called upon to bear 25,000 lb., an investigation to determine the actual capacity of the wheel has been under way for several years, jointly under the auspices of the Association of Manufacturers of Chilled Car Wheels and the University of Illinois Engineering Experiment Station. Bulletin 129, by J. M. Snodgrass and F. H. Guldner, presents the first installment of their findings, on the strains in M.C.B. wheels due to pressing the wheel on the axle and due to static loads.

Tensile strength of specimens cut from wheel plates varied from 23,300 to 32,800 lb. per sq.in., and the modulus of elasticity from 14 to 28 million. These figures cannot be predicted by hardness tests.

Forcing the wheel on the axle stresses the wheel most highly in tension in a tangential direction at the bore. The outer face is stressed in compression in a radial direction. Brackets take no material load.

Static loads are transmitted from the hub to the rail mainly through the outer plate, and do not add greatly to the strains induced by mounting the wheel on the axle. It seems therefore that very great static loads may be safely carried by the present wheel.

Book Reviews

DICTIONNAIRE ANGLAIS-FRANÇAIS-ALLEMAND DE MOTS ET LOCUTIONS INTÉRESSANT LA PHYSIQUE ET LA CHIMIE. By *R. Cornubert*. xxxii + 297 pages. Paris: Dunod, Éditeur, 47, Quai des Grands-Augustins. Price, broché, 42 fr.; relié, 47 fr.

While a good technical dictionary is almost indispensable for any investigator who has to keep in touch with foreign literature, it is also true that the real usefulness of such a book is directly proportional to the ease with which it yields the desired information. Most three-language dictionaries are divided into three separate sections or even volumes, as English-French-German, French-German-English, German-English-French. By means of an ingenious arrangement, M. Cornubert has been able to combine these three into a single one with three parallel columns containing English, French and German words respectively. In each column the word whose translation is desired is set in black-face type while the equivalents appear on the same line in the other columns in ordinary type. With this procedure, a single alphabetical arrangement suffices for the three languages, as is evident from the following excerpt:

pilot burner	**veilleuse**	Sparflämmchen
vector	vecteur	**Vektor**
velocity	vitesse	Geschwindigkeit
loop	**ventre**	Bauch
to generalize	généraliser	**verallgemeinen**

An introductory section gives general data on German technical nomenclature, lists of English and German abbreviations and irregular verbs and of English units.

With its thorough treatment of technical terms in the fields of chemistry and physics and its rapid reference features, this dictionary should prove an invaluable aid to the busy technical man. ALAN G. WIKOFF.

ANALYSIS OF NON-FERROUS ALLOYS. By *Fred Ibbotson, D.Met., B.Sc., F.R.C., Sc.I., F.I.C.*, and *Leslie Aitchison, D.Met., B.Sc., A.I.C.* Second Edition. 246 pages. Longmans, Green and Co., London and New York, 1922. Price, $4 net.

As stated by the authors in preface to this second edition, they have added some new matter, consisting chiefly of methods for the analysis of light alloys of aluminum and of alloys of nickel. Otherwise the material presented has been reprinted without change from the first edition, issued in 1915. It includes chapters on apparatus for, and general description of, electrolytic analysis, on precipitation and comparative solubilities of the sulphides of the elements occurring in non-ferrous alloys and on methods of determination for these elements separately. The remaining chapters, occupying the smaller part of the volume, treat of methods specially applicable to commercial alloys. The general classes of non-ferrous alloys are covered by special methods for brass, bronze, phosphor tin, german silver, white metals, aluminum and nickel alloys and stellite. The added methods in this edition, besides those given for aluminum and nickel alloys, include methods for the separation of aluminum and zinc and for the determination of small amounts of elements which may be present in special brasses and bronzes. This new material comprises altogether about 22 pages.

The subject of analysis of non-ferrous alloys is probably covered more completely by this book, and by one other of American authorship, than by others published. However, in treating this subject it would be better if there could be given more detailed descriptions of methods of analysis for the various types of non-ferrous alloys and modifications required according to percentage composition. For instance, it would be well not only to give general methods for determination of white metal alloys but also to describe necessary details for applying the method to the separation and determination of tin in cable sheathing, where it is present to the extent of only 3 per cent, as well as in tin base-bearing metals, which may contain as much as 90 per cent and where it is necessary to separate tin from antimony and copper, as well as possibly from lead.

It should not be necessary to include in a treatise on this subject all of the important single methods of determination for each element, as this is the province of text-books on general quantitative analysis, but it would be desirable to include specific methods applicable to the separation and determination of elements present in particular alloys. The authors have described in the main part of the book most of the various methods for determination of separate elements, without in general stating which is preferable and without giving limits of accuracy. As an illustration of this, there is given under Antimony, as one of the gravimetric methods, a description of its determination as tetroxide, a method which is very seldom used. From the text one would not be able to learn where this method could be best applied or whether it might be more or less accurate than the other methods described. Under Volumetric Determination of Antimony four different methods are given without information as to probable accuracy or other means of judging which should be given preference. On the other hand, there is no mention made of certain methods which are very frequently used in analysis of alloys. For instance, under Lead, there is no description of its gravimetric determination as chromate, and under the analysis of White Metal Alloys no mention is made of a method which has been found generally useful and has been included in Standard Methods of the American Society for Testing Materials—namely, Thompson's method for alloys of lead, tin, antimony and copper, published in the *Journal* of the Society of Chemical Industry, 1896.

The style used by the authors in describing methods is a pleasing feature in that accurate descriptions of the operations to be followed are given without including explicit instructions as to capacity and shape of apparatus to be used, etc.—that is, directions are given so as to be perfectly intelligible to a chemist, without including detailed description of manipulation to be carried on by a laboratory assistant.

WILLIAM A. COWAN.

THE DETERMINATION OF SULPHUR IN IRON AND STEEL. By *H. B. Pulsifer*. Cloth, 9¼x6¼. 160 pages. The Chemical Publishing Co., Easton, Pa., 1922, Williams & Norgate, 14 Henrietta St., Covent Garden, W. C., London, England.

The author is to be congratulated upon his originality of publishing a book which covers but one element in iron and steel. He published his method for the determination of sulphur in iron and steel in the 1916 *Journal of Industrial and Engineering Chemistry*, vol. 8, p. 1115, in which a comprehensive list of the bibliography was published.

The present volume deals with the evolution method for determining sulphur in iron and steel, consisting essentially of using a strong solution of hydrochloric acid in a 500-c.c. flask containing a glass stopper which is water-cooled with a glass worm extending about one-third of the distance into the flask. The bibliography is very complete and covers references on the sulphur determination in iron and steel from 1797 to 1921. Illustrations are also given showing micrographs and sulphur prints of sulphide areas. The book is well written and contains descriptions of sulphur methods which have been published, including comparative results obtained by various methods.

The author recommends the use of hydrochloric acid, specific gravity 1.19, for determining sulphur by evolution, and on page 52 a table is given covering the use of six different sulphur methods and the results obtained on five different samples. The nitric acid method has a tendency to yield low results. This is also true of the dilute hydrochloric acid method. The least variation is shown in the concentrated hydrochloric acid evolution method. From the low results obtained when using dilute hydrochloric acid, it would appear that the use of concentrated hydrochloric acid is desirable. The importance of dispensing with rubber connections from which sulphur may be derived is dwelt upon. It is necessary to use a condenser when using concentrated hydrochloric acid, otherwise the acid will distill over and quickly neutralize the alkaline cadmium chloride solution.

On page 46 reference is made to the analytical results obtained with standard methods, and in each instance the

tudents found some sulphur in the ron. (An anomalous statement is nade that the results may be a 100 per ent too high or 100 per cent too low. As there can be no more than 100 per ent, it is difficult to see how the results ould be a 100 per cent too low, if the tudents obtained any sulphur whatever!)

Taken as a whole, the book is well dited, it covers the subject very fully nd is recommended to those interested n the various methods for determining ulphur in iron and steel.

J. A. Aupperle.

The Electrometallurgy of Steel. By *C. C. Gow*. 351 pages. New York: D. Van Nostrand Co. Price $7.50.

This recently published book gives he historical development of the electric furnace and considerable information on the electrical characteristics of he various types of furnace, a portion of the book being given up to highly heoretical electrical features of various furnaces. This possibly represents the author's chief interest. The matter relating to the metallurgical side of the problem is a summary of what has been covered in previous literature. The whole book presents no very striking advance in presenting known facts, but if one wishes an elementary survey of the general field it will be found in this volume, presented in very readable style.

Frank Hodson.

Synopsis of Recent Chemical & Metallurgical Literature

Lead Baths

In a paper read before the Detroit meeting of the American Society for Steel Treating, R. B. Schenck, of the Buick Motor Co., described an extensive use of lead baths for hardening and tempering axle shafts, transmission gears and other parts. It is a heating medium which is easy to control, heats the work uniformly, and without chemical action of any sort. Great uniformity of results is therefore easily possible.

Lead baths can be operated at any temperature from 650 to 1,700 deg. F. Lead will never stick to the work if the surface of the bath is kept free from a floating scum of oxide. This is best accomplished by maintaining a thin protective coating of granular carbon—some material like charcoal, having a low kindling temperature, is best. If annealing or tempering baths tend to leave an adherent metal film on the work, the articles may be plunged, immediately upon withdrawal, into molten caustic soda at a slightly lower temperature, and then into cold water. A molten salt cover works all right on lead for a few days, but thereafter the whole mass tends to get mushy.

Cast iron pots can be used for baths operating below 1,300 deg. F.; cast steel gives better results for hotter work. If direct flames are not permitted to strike the pot, it will last for months—the principal corrosion being at the surface of the melt. Rectangular pots, hung from a lip at the top, are very satisfactory, especially if heated from below by a single flame traveling from one end to the other and then deflected back again by proper baffle walls and partition. Deep round pots should be rested on a brick pier, and heated by tangential, swirling flames.

One hundred and thirty-five pounds of work can be heated to 1,500 deg. F. per gallon of oil burned, or if the waste gases be used for warming a preheating pot, the figure can be doubled. Double handling of the work may cost more, however, than the oil saved. If kept well covered, lead consumption should not run over ½ lb. per 100 lb. steel treated. About 1¼ lb. of charcoal cover is burned per sq.ft. of surface per hour.

Refractories for Zinc Smelting

Requirements for refractories used in the zinc industry are considered by G. C. Stone, of the New Jersey Zinc Co., in the September *Journal* of the American Ceramic Society, p. 597.

In roasting furnaces of the Hegeler type, which are most extensively used, refractory trouble is caused by the furnace design. These furnaces are very large, about 80 ft. long, 17 ft. wide and 30 ft. high. Everything is in two parallel sections. Starting from the bottom each section has regenerative chambers, and above, three gas chambers, seven roasting hearths and frequently special air passages. The arches are both set on the center wall. The life of the furnaces is long, as there is but little corrosion or wear and the temperatures are not excessive, but the load acting on the center wall, which is maintained at a relatively high temperature, causes it to settle badly. This settling is very serious, as it is not uncommon to find the inner side of the hearths 5 in. lower than the outer, which interferes materially with the operation of the furnace. It should be possible to burn brick so that even long-continued heating to a temperature of about 850 deg. C. and never exceeding 900 deg. C. would not cause a shrinkage of from 1 to 3 per cent.

In zinc oxide furnaces the temperature is only about 1,000 deg. C., but the sudden changes caused by air cooling, when the furnaces are cleaned out and charged every 6 or 8 hours, and the rather severe handling in breaking up and removing the charge often damage the brick. Dense hard-burned brick are best.

Spelter furnace linings have to stand a high temperature for long periods with a regular daily variation between 800 and 1,400 deg. C. Practically the whole lining is made of special shapes, which are often made by the smelters themselves.

Retorts are also made by the smelters as they are placed in the furnaces red hot from the kilns in which they are burned. They should be capable of standing a temperature of 1,600 deg. C. without deflecting materially when supported only at the ends, with a clear span of about 4 ft. They must be dense, so as to be impervious to gases and zinc vapor, which tends to form zinc spinel.

Condensers are not subjected to temperatures above 600 deg. C., but they get rather rough handling as they are taken down and scraped each morning. They are also always made by the smelters.

Brick are often blamed for defects when the short life is due to poor brick-laying. From observation the author concludes that less than 5 per cent of the brick used are laid in a manner calculated to give the best results and fully half are badly laid.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Separating Gaseous Hydrocarbon Mixtures—The process is described with particular reference to the recovery of acetylene from mixtures with other hydrocarbons of relatively lesser solubility, but it is pointed out that other gases such as ethylene, propylene and the like can be similarly separated by a process of differential solubility. Practically complete separation is accomplished by solution at low temperature and high pressure with subsequent progressive increase in temperature and gradual elimination of the dissolved gases. By this means the gases first evolved from solution are returned to the solution chamber and the relatively soluble component which comes out of the solution last is separated from the balance almost pure.

Further development of this idea is presented in a second patent which discusses several variations of the basic idea. A still further development in a third patent relates more particularly to the separation of ethylene from mixtures with other hydrocarbons. (1,422,-182-183-184. George O. Curme, Jr., assignor to Union Carbide Co. July 11, 1922.)

Manufacture of Acetylene Products—The patent contemplates a process of producing products from acetylene by passing it, together with another reacting gas, over hydrated metal compound, oxide, bog-iron ore, or other iron compound with hydrated alumina or with an oxygen-yielding compound at temperatures ranging from 250 to 500 deg. C. The production of catalysts is also covered by the patent. These are the various oxides or hydrated metal compounds, either as first formed or in a partly reduced state, prepared by passing hydrogen or other moist reducing gas over the hydrated oxide at

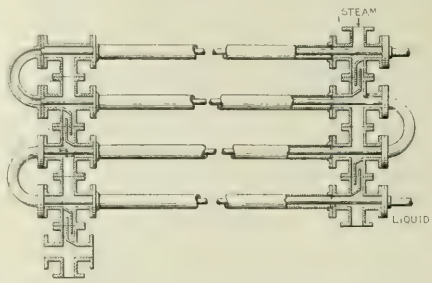
about 400 deg. C. The third group of claims covers the process for making compounds between acetylene and hydrogen sulphide by passing over appropriate catalysts at the temperatures named.

Five examples are given of typical applications of the patent. In the first, acetylene with four times its quantity of steam is passed over bog-iron ore at 400 to 420 deg. C., forming acetaldehyde as the chief product. It is claimed that 15 to 16 per cent of the acetylene is converted in a single pass. The second example relates to acetylene and a small amount of steam over partly reduced bog-iron ore for the production of the higher aldehydes, acetone, alcohol, acetic acid, furfurane derivatives, phenols, etc. The third example relates to acetylene and ammonia passed over bauxite at 350 to 380 deg. for production of nitriles and other nitrogen-containing bases to the extent of 50 per cent of the acetylene used. The fourth and fifth examples given relate to acetylene and hydrogen sulphide combinations used in contact with nickel hydroxide or bauxite for the production of thiophene, mercaptan, etc. (1,421,743. Bernhard Conrad Stuer and Walter Grob, assignors to the Chemical Foundation, Inc. July 4, 1922.)

Carbonaceous Product — This patent covers a product obtained by treating "rotted coal" with alkaline solution and the method of making the product. It is claimed that disintegrated coal treated with alkali produces a solution which would be useful as a fertilizer or as a raw material in the making of certain dyestuffs, etc. It is also suggested that a suspension of this rotted coal be used as a means for collection of ammonia from coal or coke-oven gas, the product being used as a fertilizer instead of ammonium sulphate. (1,420,754. Hugh Rodman, assignor to Rodman Chemical Co. June 27, 1922.)

Evaporator—This invention relates to evaporators; and it comprises an evaporator having tubular heating elements arranged in a vertical series with a substantially continuous evaporating tube passing through the several elements, the elements in each tier having a trapped liquid drain to the element below whereby to bypass condensed steam out of the path of heating vapors going through the series; and it more particularly comprises an evaporator of such a type wherein the trapped liquid drain is formed by co-operating and complementing unions, each said union having a flanged passage provided with a cuplike element having a portion extending beyond the flange plane and the elements being so shaped that on assemblage of two unions they together form a liquid-sealed trap.

In the well-known Kestner type of evaporator, evaporation is performed on what is termed a "climbing film"; liquid goes upward through a steam- or vapor-heated vertical tube, first as a sort of foam and finally as an annular ascending film with a central current of vapor traveling at a rather high velocity. For reasons of space it is sometimes desirable to use the same type of apparatus and operation in horizontal tubes rather than vertical; the evaporator tube being constituted of superimposed horizontal end-connected tube sections. In so doing, the surrounding heating element or jacket is likewise made as a series of superimposed sections connected together. In practice it is desirable that these jacket sections be rather narrow, giving a narrow annular pathway for the heating vapor or steam along the evaporator tube sections. The heating vapor flows through the system countercurrent to the liquid to be evaporated.



The difficulty with this construction is that condensed steam is apt to clog the long narrow pathway of the heating vapor at one point or another. Evaporators of this type have a high evaporative capacity with a concomitant absorption of heat, and the amount of condensate is considerable. It is necessary that the supply of steam or heating vapor be ample and that it flow through the heating elements with as little friction or interruption as may be from bodies of condensate. It is the object of the present invention to provide means whereby condensate in the heating elements may be bypassed downward from tier to tier out of the path of vapor in the narrow horizontal heating elements; the bypass connections being so arranged as to give a liquid seal to prevent flow of vapor. (1,424,254. Ralph Mellor, assignor to Kestner Evaporator Co., of Philadelphia, Pa. Aug. 1, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Titanium—Titanium dioxide is obtained from titaniferous bauxite by heating the finely powdered ore, preferably under a pressure of 3 to 4 atmospheres, with five parts of ammonium sulphate at a temperature of 350 to 400 deg. C. The iron and alumina present are converted into soluble double sulphates, with evolution of ammonia, the silica and titanium dioxide remaining unchanged. The product is treated with water, when the iron and aluminum salts pass into solution and the titanium dioxide forms a fine suspension. Silica and undecomposed ore are permitted to settle, and the suspension of titanium dioxide decanted off and filtered. Specification 15,590/06 is referred to. (Br. Pat. 181,775. E. E. Dutt and P. C. Dutt, London. Aug. 16, 1922.)

Artificial Filaments—A solution of starch or starchy matter in a large quantity of strong sulphuric acid and consisting of products intermediate between starch and glucose is used in the setting bath in the place of glucose in the manufacture of filaments, films, etc., from viscose as described in specification 21,405/07. Preferably, the moisture content of the starch, etc., is reduced to 5 per cent or less, and the dried starch is added rapidly and with continuous stirring to the acid which has been previously cooled to below 0 deg. C., for example to —5 deg. C.; after a homogeneous mixture has been obtained, the liquid is permitted to warm up spontaneously in order to complete the solution of the starch; before use, the mixture is diluted with water, and to the solution may be added sulphuric acid, sodium, ammonium or magnesium sulphate, or a zinc salt. (Br. Pat. 181,900. Courtaulds, Ltd., and M. T. Callimachi, London. Aug. 16, 1922.)

Phosphoric Esters—Mixed esters of phosphoric acid are prepared in known manner from parent materials which are either artificial mixtures of phenols containing at least 25 to 30 per cent of ortho- or meta-cresol, or the acid oils, either as a whole or single fractions therefrom, containing mixed monovalent phenols with at least 25 to 30 per cent of ortho- or meta-substituted homologs of phenol, which are produced in working up various tars, such as coke-oven tar or gas-works tar, low-temperature tar, mineral coal tar or brown coal generator tar. The method employed may be treatment with chlorine or oxygen compounds of phosphorus, such as phosphorus oxychloride or phosphoric anhydride; or the phosphoric di- and mono-chlorides from a single phenol or mixtures of phenols may first be prepared and then converted into the neutral esters. The products are slightly fluorescent viscous oils, useful as softening agents. (Br. Pat. 181,835. Chemische-Fabrik Griesheim-Elektron, Frankfurt-on-Main. Aug. 16, 1922.)

Phenol Condensation Products—The initial oily condensation product obtained by heating phenol with formaldehyde in the presence of sodium sulphite is mixed with a compound containing the CH_2OH or CH.OH group and the mixture heated; the liquid product obtained may be converted into a hard infusible product by heating without pressure, or may be mixed with mineral fillers (clay, talc, mica, etc.), molded and heated to give products suitable for electric insulation or building purposes, or the liquid product dissolved in an organic solvent may be used for coating or impregnating paper or paper board, which is then hot-pressed and heated. Suitable hydroxy compounds are oxy-fatty acids such as glycollic, lactic, malic, tartaric or citric acid; alcohols, such as glycerol, butyl, amyl, ceryl, cetyl or myricyl alcohol, or cholesterol, or glucose, levulose, mannose, maltose, mannite, cane sugar, etc. (Br. Pat. 182,886. S. Satow, Tokyo. Sept. 6, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Chemical Foundation Files Formal Answer

Statement of William D. Guthrie, Counsel for the Chemical Foundation

THE CHEMICAL FOUNDATION has filed its answer to the suit of the government in Wilmington, Del. The answer is a comprehensive and emphatic denial of the government's charges. It denies that the Chemical Foundation participated in any conspiracy or monopoly or suppressed any information from the President or his representative, Assistant Secretary of State Frank L. Polk, or paid an inadequate consideration for the patents, or did any act in bad faith or unlawfully. The answer, on the contrary, points out that before any patents were sold to the Chemical Foundation every material fact bearing upon the creation of the Chemical Foundation, its objects, its work and its doings was discussed in the official report made to the President by A. Mitchell Palmer as Alien Property Custodian on Feb. 22, 1919, and transmitted by the President to Congress. An extract from this report is annexed to the answer as an exhibit. From this report it appears that the whole plan concerning the Chemical Foundation and its taking over of the German patents was disclosed in detail.

It is claimed in the answer, in addition, that not only were the President and Polk and Congress and the country generally advised of the plans which gave rise to the Chemical Foundation and the taking over by it of the German patents, but that Palmer as Alien Property Custodian also explained the situation personally to the President and to his representative, Frank L. Polk, and that after such report and such explanation, they made the orders authorizing and approving the sales which the present administration now challenges and seeks to nullify.

Seizure of Patents Defended

The answer points out that the taking over of the German patents was necessary to the proper prosecution of the war against Germany, for the common defense in case of renewal of hostilities or future war, and for the emancipation of the American chemical industry from German control and domination.

It narrates in detail how Germany had succeeded, by means of patents and otherwise, in obtaining complete control over the organic chemical industry of the United States. That meant that before the recent war Germany not only controlled the supply of dyes in the United States, but also that the materials out of which poison gas, high explosives and important medicines, like salvarsan, were entirely in the hands of the Germans. The answer insists that in such a situation the ability of the United States to manufacture high explosives and to defend itself according to the means and methods of modern warfare were at the mercy of Germany; that the ability of the United States to supply its citizens with important medicines was likewise at the mercy of Germany, and that many of its most important businesses were equally at the mercy of Germany. The report to the Alien Property Custodian, which was given to the President and which is annexed to the answer, shows how it was necessary to break this control of Germany over the chemical industry of the United States, if the United States was to have the power adequately to defend itself and protect its citizens.

Not a Private Venture

The President approved the policy of Americanizing the basic industries of the United States in order to overcome the German domination of those industries the answer points out. To that end the Chemical Foundation was formed, after conference with the President and his representative, Frank L. Polk, and with their approval, and after similar conference and approval, the patents in suit were transferred to the Chemical Foundation in order that it might hold and administer them in the interests of America and secure to the United States the permanent freedom of the organic chemical industry from German or other hostile foreign domination.

It further appears from the answer that on the President's return to this country, the orders made by Polk were brought to his attention and that the matter was again considered by him and that he thereupon made an order duly ratifying in all respects what had been done by Polk and the Alien Property Custodian.

The answer shows that the Chemical Foundation is not a private venture; that it has made and can make no profits for private persons; and that, on the contrary, it has expended thousands of dollars of its own capital to accomplish the public and patriotic purposes of President Wilson and its founders. Thus the Chemical Foundation is not like the ordinary owner of a patent, shutting out some persons from the use of it while giving others the right to use it as it sees fit. Under its charter and under its agreement with the Alien Property Custodian, the Chemical Foundation is required to and has and does license all American citizens who are qualified without discrimination and at equal rates and upon like terms.

The Chemical Foundation is also the means which was adopted to enable the United States to avoid having to pay heavy damages for patent infringements to Germans who had taken out patents of the United States, not in order to help American science and industry, but to throttle it. That was accomplished by having the patents sold to the Foundation and a release and license given by the Foundation to the government.

The answer concludes by praying that the complaint be dismissed.

Helium Production for Aircraft Will Soon Be Commercial

For the encouragement of the friends of lighter-than-air craft, Dr. R. B. Moore, chief chemist of the Bureau of Mines, who is in charge of the research work on helium being done jointly by the War and Navy Departments and the Bureau of Mines, declares the present situation is another instance in which it is darkest just before dawn. In Dr. Moore's opinion, the future of lighter-than-air craft never has been brighter. Experimentation in the cryogenic laboratory of the Bureau of Mines leads Dr. Moore to believe that within the next decade 99.9 per cent helium will be produced at a cost as low as $20 per 1,000 cu.ft.

Thanks to the perseverence and unselfishness of the Linde Co. and certain scientists, the problems of helium production have been solved. All that remains to be done is to reduce the costs of production. Since American ingenuity has solved a hundred more difficult problems, Dr. Moore has every reason to believe that the production cost of helium will be reduced rapidly.

Once helium can be produced at a moderate cost, Dr. Moore expects to see the lighter-than-air ship take its place as one of the permanent agents of transportation.

University of Buffalo Inaugurates Capen

Dedication of New Chemical Laboratory Precedes Installation—Smith and Slosson Speakers

Samuel P. Capen of Washington, a member of the Society for Promotion of Engineering Education, has resigned as director of the American Council on Education to become chancelor of the University of Buffalo. He was installed Saturday, Oct. 28. The day preceding the inaugural, Foster Hall, the new $1,000,000 chemical laboratory of the University of Buffalo, was dedicated, the speakers being Edgar F. Smith of Philadelphia, president of the American Chemical Society, and Edwin E. Slosson of Science Service, Washington.

Special interest attaches to Dr. Capen's new position from the technical standpoint, because he is going to Buffalo for the avowed purpose of trying to carry into effect a system of "job analysis" for the professions that may pave the way toward elimination of useless frills in technical and academic education. Dr. Capen has been active in the educational relations of the National Research Council and during the war served on committees that aided the War Department in organizing the higher institutions of the country to make the most effective contribution to the war enterprise.

Dr. Capen was invited to become a member of the Society for Promotion of Engineering Education because of the excellence of the work he did while with the federal Bureau of Education, in evolving the technique by which the vital facts relating to the policies, financial administration and educational effectiveness of the institution being surveyed could be ascertained.

The New Laboratory

The new University of Buffalo laboratory is specially designed to meet the peculiar needs of the steel, dye, electrochemical and hydro-electric industries on the Niagara frontier and in western New York, which more and more are relying upon the university-trained man for important technical and administrative positions. The laboratory is not the largest, but it is believed to be the equal if not superior to any in the world. Many of the ideas of Prof. L. M. Dennis of Cornell, who for years has been studying the question of proper chemical laboratory construction, are embodied in the building.

One large room is so constructed that walls may be added or be torn out, according to the requirements of special work under way. The building includes a metallurgical, industrial, inorganic, organic, analytical, advanced analytical, miscroscopy and research laboratories, with private laboratories on a smaller scale for the professors.

The chemical laboratory is the gift of O. E. Foster, a Buffalo philanthropist, and is the first unit of the Greater University of Buffalo to be erected on the newly acquired 150-acre campus at the north end of the city, where an unusual educational experiment is to be carried on. Indicative of the backing the university has from the citizens of Buffalo is the fact that 2 years ago in an endowment fund campaign they contributed $5,000,000 in large and small amounts.

DR. SAMUEL P. CAPEN

Quebracho Forests in Danger of Extinction

The danger of the extinction of the quebracho forests of Argentina and Paraguay is imminent, according to H. M. Hoar, of the Research Division of the Department of Commerce. The total available tonnage of quebracho standing in 1922 has been liberally estimated at 71,300,000 metric tons for Argentina and 3,500,000 metric tons for Paraguay.

A minimum estimate of the potential production of quebracho extract by the companies now operating in Argentina and Paraguay is about 240,000 metric tons per annum, and as one ton of quebracho extract represents about 4¾ tons of logs, it would require an annual felling of 1,400,000 metric tons of quebracho wood for tannin purposes alone in these two countries.

Add to this the annual cut for construction work, paving blocks, fuel, telegraph and telephone poles, for which quebracho wood is extensively used, also an estimated annual requirement of 3,600,000 railway sleepers, 1,600,000 fence posts and an annual exportation of quebracho logs, varying from 108,945 metric tons in 1917 to 56,582 in 1920, and the duration of the present stands of quebracho wood can be readily grasped, together with the necessity for forest protection and the restoration of denuded tracts.

Describes Methods of Organic Chemist

Prof. W. Lee Lewis, Retiring Chairman Addresses Chicago Section, A.C.S.

To the layman the ways of all chemists are mysterious, but the organic chemist is frequently little understood even by fellow scientists whose work is confined to other branches of the subject. A decided step toward better mutual understanding was made Friday evening, Oct. 20, when Prof. W. Lee Lewis addressed the Chicago section of the American Chemical Society on "The Organic Chemist at Work." Taking as a typical problem the action of acetylene on arsenic trichloride in the presence of aluminum chloride, Dr. Lewis outlined step by step the methods of attack leading to the accumulation of sufficient data to enable large-scale production of a compound which because of its peculiar physiological properties was in demand at the time for military purposes.

Preliminary work on the reaction mixture having shown that the product consisted of a number of related compounds, one of which was more desirable than the others, studies were next conducted to determine the conditions which would give the greatest yield of this compound.

Following the main address were the group meetings which have become such a successful and helpful feature. The formality which is more or less inherent in a large gathering is not found in the smaller groups and this, together with the opportunity for more lively discussion, is very effective in increasing acquaintanceship among the members.

Laboratory Cost Accounting

Before the group on inorganic laboratory methods, A. W. Landstrom outlined a simple method of cost finding for a commercial laboratory. It was originally developed in order to determine whether the charges made for analyses were fair to both the customer and the laboratory, but was found so useful generally that it is kept up regularly. Time reports are made out for each analysis and from these the cost is determined as follows: The product of the number of hours and the analyst's rate per hour gives the direct cost. Fixed charges or overhead, and cost of materials and equipment for a year are divided by the number of man-hours per year to give the indirect cost on a man-hour basis. This is simpler than trying to figure the cost of materials, etc., for each type of analysis. The indirect cost is then the time multiplied by the man-hour factor, and this plus the direct cost gives the total. This system requires very little time and so costs practically nothing.

Topics at the other group meetings were: "Research Problems of the Baking Chemist," C. B. Monson; "1:4 Addition," C. D. Lowry; The Wassermann Reaction With Syphilis and Its Interpretation," J. J. Moore.

Tariff Commission Reorganized to Conform With New Rules of Procedure

Provision for Rate Changes Places New Responsibilities on Commission Which Will Be Met by Modified Organization

THE RULES of procedure under which the United States Tariff Commission will apply its enlarged powers were made public Oct. 26. On the same date William S. Culbertson, vice-chairman of the commission, in the course of an address before the American Manufacturers' Export Association, revealed the details of the reorganization of the commission to meet its new requirements. In that connection he said:

"The law provides that all investigations under Section 315 are to be made by the United States Tariff Commission and that the President shall issue no proclamation changing rates or classification until after the Tariff Commission shall have investigated. The commission has, as a result of these new responsibilities, completely reshaped its organization. Under the commission there are now four broad divisions: (*a*) The office of the chief investigator, (*b*) the office of the chief economist, (*c*) the legal division, (*d*) the secretary.

Detail of Organization

"The secretary handles the routine business of the commission. To the legal division are referred questions of customs laws and procedure and any other legal question that may arise in the commission's work. General investigations which the commission may conduct under its general investigational powers will be supervised by the chief economist, and special investigations made necessary by the new powers vested in the President will be under the direction of the chief investigator.

"The commission's organization under the direction of the chief economist and the chief investigator consists of a series of divisions each with a chief and other experts. These divisions are: chemicals, pottery and glass, metals, wood and paper, sugar, agriculture, textiles, leather, sundries, preferential tariffs and commercial treaties, and accounting. In addition, the commission has provided for the establishment of a New York office.

"The work of the commission's staff is co-ordinated in an advisory board which reports only to the commission and is under its immediate direction. The chief investigator is chairman of this board. Its other members are the chief economist, a representative of the legal division and the chief of the division of the commission concerned in the subject matter under consideration.

New Rules of Procedure

With regard to the new rules of procedure Mr. Culbertson said: "The first step in defining the commission's procedure was the issue on Oct. 7 of an executive order by the President directing that all applications for investigation under the new provisions "be filed with or referred to the United States Tariff Commission for consideration and for such investigation as shall be in accordance with law and the public interest, under rules and regulations to be prescribed by such commission."

"Today the commission gives publicity to its rules of procedure. They set forth how applications for investigations shall be made and under what conditions and in what manner the commission will conduct formal investigations upon which the President may change the tariff law. Anyone can apply for an investigation. The application need not be in any special form, but it must be in writing and signed by or on behalf of the applicant. It must also recite the relief sought and the reasons therefor. Obviously, the mere filing of an application does not obligate us to proceed formally. We shall not order an investigation unless the application or a preliminary investigation discloses to our satisfaction that there are good and sufficient reasons for doing so under the law.

"We can order a formal investigation upon our own initiative as well as upon application and we are not confined to the issues presented in an application; we may broaden, narrow or modify the issues to be determined.

Plan for Hearings

"When we finally decide to proceed formally with an investigation, we shall issue and publish a notice of its nature and scope. Any person who then can show to our satisfaction an interest in the subject matter of the investigation may enter his appearance in person or by a representative. He will be notified of public hearings and afforded opportunity to offer such testimony as we may deem necessary for a full presentation of the facts. Our hearings will usually be open to the public. Evidence submitted will be subject to verification from the books and records of the parties in interest. In conjunction with hearings we shall conduct field investigations both in the United States and in foreign countries.

"In the case of formal investigations our procedure will be judicial in character. Our rules provide for the attendance and examination of witnesses, the production of documentary evidence, the issuance of subpœnas and the taking of depositions. The commissioner or investigator in charge of any investigation will summarize the hearings and the information obtained by field investigation and will prepare a report. Parties of record will be permitted, before they file their briefs, to examine this report, as well as the record, except such portions as relate to trade secrets and processes.

"Final hearings will, of course, be before the commission. Parties of record may file briefs and in some cases present oral arguments. Our findings will be in writing, and will be transmitted with the record to the President for his action."

Muscle Shoals Report to Be Given Publicity

Senate Committee on Agriculture to Circulate Majority Findings

The printed record of the Muscle Shoals hearing conducted by the Senate Committee on Agriculture and Forestry during the last session of Congress is to be widely distributed. It is pointed out that it is important that those who mold public opinion which controls legislative action should know the facts concerning matters of this character. Accompanying the record will be the following letter signed by George W. Norris, of Nebraska, the chairman of the committee:

> So much misinformation has been published and propaganda spread over the country by real estate boosters and others personally interested, that many good citizens, farmers, farmers' organizations and commercial and civic bodies have urged Congress to accept without qualification the offer of Henry Ford to take over for 100 years the war-built nitrate plants and appurtenances at Muscle Shoals, in Alabama, which cost $90,000,000, and the uncompleted water-power dam on the Tennessee River in which the government has invested $17,000,000, in all about $107,000,000.
>
> Contrary to a general idea, Mr. Ford does not agree to reduce the price of fertilizer one-half, one-third or even at all, although he stipulates he must have 8 per cent profit on the cost, whatever that may be; he does not agree to reimburse the government the additional $50,000,000 to $60,000,000 required to carry out his proposed contract, nor does he in fact agree to pay 4 per cent interest thereon for a lease for 100 years of the power dams and electrical equipment. For $5,000,000 he acquires public property worth many times that amount, and exclusive use and control for 100 years of immense water power developed at government expense for about 2¾ per cent annual interest on the cost thereof, free of regulation, restriction or control by any public authority. He is exempt from the terms and provisions of the national water-power law passed 2 years ago to protect and conserve the interest of the public in the water-power resources of the nation, without obligation that any portion will be used by municipalities or industries in the South, but admittedly for the sole use of Mr. Ford in his own plants and his successors. He does not pledge his personal fortune or estate to the faithful performance of any obligation assumed by the corporation he will organize. He does not agree to repay the government all future outlays for repairs and maintenance, and whatever alleged public benefit proposed is not in any sense commensurate with the special and unusual privileges sought for one individual or corporation.
>
> Whether the Muscle Shoals project is controlled or operated by the government or by private or quasi-private concerns, the public interest in a great navigable river and the water power that follows the improvement of navigation, as well as the products of plants constructed with public funds, should be conserved, used and distributed for the common welfare.

It is pointed out that the public should be informed of the facts in this matter, for its own protection, and should understand that the majority report was submitted after weeks of thorough investigation and taking of a mass of expert testimony.

Formula Is Devised for American Valuation

Customs Division Calculation Sounds Like Recipe for Home Brew

The customs division of the Treasury Department has devised and issued to collectors a formula for determining United States value as defined in the tariff act of 1922 and which is to be the basis of assessing duties on non-competitive coal-tar products in contra-distinction to American valuation which is to be applied to duties on competitive coal-tar products.

Subdivision D of Section 402 of the new tariff act reads: "The United States value of imported merchandise shall be the price at which such or similar imported merchandise is freely offered for sale, packed ready for delivery, in the principal market of the United States to all purchasers, at the time of exportation of the imported merchandise, in the usual wholesale quantities and in the ordinary course of trade, with allowance made for duty, cost of transportation and insurance, and other necessary expenses from the place of shipment to the place of delivery, a commission not exceeding 6 per cent, if any has been paid or contracted to be paid on goods secured otherwise than by purchase, or profits not to exceed 8 per cent and a reasonable allowance for general expense, not to exceed 8 per cent on purchased goods."

Valuation of Coal-Tar Products

In interpreting this, the customs division has instructed collectors to ascertain the dutiable value by taking the selling price in the United States, dividing by 108, subtracting the quotient from the selling price, then dividing this remainder by 108 in the case of purchased goods or by 106 in the case of goods where that commission has been charged, subtracting this second quotient and from this remainder subtracting the transportation and insurance charges and the specific duty. The final remainder, divided by 100 plus the ad valorem duty, which in the case of finished coal-tar products is 60 per cent, gives the dutiable value, according to this formula.

Some importers have insisted that the proper way would be to divide immediately by 116, rather than have two operations. This would lower the duty somewhat.

Feldspar Producers Recognize Need of Trade Association

Inability on the part of a considerable number of the feldspar producers and grinders to be present at a meeting held at the Bureau of Mines Oct. 25 made it impossible to carry through at that meeting the plan to organize a national association within the industry. It was felt by those present that the action should not be taken until the industry could be more generally represented.

Another effort to obtain the attendance of a representative number of those interested in the industry will be made at the coming meeting of the United States Potters' Association. At that meeting it is hoped to perfect plans for the organization.

The discussion among those who attended the meeting in Washington indicated a determination to have a national organization. It was pointed out that the feldspar industry is unique in that no other industry with as much capital invested is denying itself the benefits of the constructive functions which trade associations perform.

New Laboratory at Yale to Be Dedicated

Ceremony Will Be Feature of Spring A.C.S. Meeting at New Haven

The dedication of the new Sterling Chemical Laboratory of Yale University on April 4, 1923, will be a feature of the spring meeting of the American Chemical Society at New Haven. This arrangement has just been completed by national officers of the society and officials of the Yale Corporation. The dedication ceremony, with probably 1,500 or 2,000 members of the American Chemical Society in attendance, as well as the Yale faculty and student body, probably will be one of the most impressive affairs of its kind ever held.

The new building is one of the finest in the world and is built on an entirely new architectural principle. The main building is constructed on three sides of a square, three stories high and is in harmony with other buildings on the campus. In this building are class and lecture rooms, private laboratories and offices. Inclosed in the square is a one-story, saw-tooth roof type of factory building, with movable partitions. This structure can be changed to suit the various needs of the teaching staff. It is constructed to give the maximum of light and air and equipped so that it can be converted into several small workshops or one large shop, equal in size to a small commercial chemical plant.

Committee Chairmen

The following are chairman of the several committees for the meeting: Program, T. B. Johnson; finance, J. S. Gravely; dedication, John Johnston; registration, Blair Saxton; arrangement, A. J. Hill; hotels and transportation, Ralph Langley; smoker, P. T. Walden; reception and entertainment, C. H. Matthewson; publicity, W. T. Read; ladies' entertainment, Mrs. John Johnston.

The Chi chapter of Alpha Chi Sigma is to have charge of the information service of the meeting. Headquarters are Room 157 Sterling Chemical Laboratory, New Haven, Conn.

The scientific meeting will be under the auspices of the New Haven and Connecticut Valley sections of the society. Prof. Treat B. Johnson of Yale is chairman of the executive committee in charge, chosen from members of the two sections.

Seventy Million Yearly for Research

Chamber of Commerce Report Points Out Value and Place of Trade Associations

American industry is spending about $70,000,000 annually on scientific research, according to the Fabricated Production Department of the Chamber of Commerce of the United States. About one-half of this sum is spent by American manufacturers in the conduct of laboratory research, while the remainder is expended in experimental and development work in plants. As a result of scientific research work approximately one-half billion dollars is being saved annually by industry in this country.

"The value of scientific research, both from an economic and industrial standpoint," the department says, "has never been so fully appreciated as at the present time. The problems of the recent war forced science and its research activities to the front in all civilized countries. It is now realized by leading manufacturers that scientific investigation is a necessary adjunct to efficient co-operation. A utilization of the scientific knowledge now available and a sympathetic co-operation in the free interchange of such information will lead to the adoption of improved manufacturing processes and do much to obviate the danger of ignorant, destructive competition. The realization of this fact is shown by the 500 or more firms now maintaining laboratories for industrial research.

Trade Associations Correlate Work

"If there were no correlation of effort on research work, much duplication might result. The logical solution, therefore, is to have the trade association make this correlation. This enables a pooling of resources to maintain a central laboratory to render service to a larger group than is possible with only individual laboratories. Another and very important factor, especially valuable in strengthening trade associations, is that such centralized research work makes it possible for the small manufacturer, financially unable to support an individual laboratory, to profit from the investigations.

"It is not surprising, therefore, that a continually increasing number of trade associations are realizing the value of research as one of their most constructive activities. Of the sixty-five to seventy associations now engaged in this work to whom a recent inquiry was sent by the Fabricated Production Department, thirty-three gave specific replies, indicating that eight were conducting their research independently, and twenty-five were acting in co-operation with some other agency. The general leaning is toward the scientific aspect of research work. Nineteen trade associations are engaged exclusively in that class, three in the general problem class, while eleven give attention to both types of problems."

To Compile Import Statistics on Dyes

Government Will Keep Manufacturers Informed on Prices

So that domestic chemical manufacturers may be advised promptly as to the exact character of imports, the Chemical Commodity Division of the Department of Commerce will compile each month detailed information as to the imports of synthetic organic chemicals. The report will be mimeographed and a limited distribution of it made in that form.

Now that the selective embargo has been removed, manufacturers have indicated great interest in the prevailing current prices on important and typical products of foreign chemical industries. The Department of Commerce is arranging with its representatives in chemical centers for a cable service which will quote the actual prices at which these chemical products are being sold (not the prices at which they are offered). It is the intention to publish price information in mimeographed form for distribution to the trade.

The articles on which the prices are most desired are: Dyes—acid black, auramine, bismarck brown, direct black, fast light yellow, indanthrene blue, indanthrene violet, indigo, methyl violet, patent blue, rhodamine B conc., sulphur black, sulphur blue, wool green; intermediates — aniline oil, benzaldehyde, benzidine, betanaphthol, H acid, acetanilid, aspirin, choral hydrate, gallic acid, metol.

Personal

O. Otis Bowman, 2nd, has resigned his connection with the Trenton Fire Clay & Porcelain Co., with which he has been associated for a number of years, to devote his entire time to the Bowman Coal Co., Trenton, N. J., of which he is secretary and treasurer.

Dr. T. R. Duggan will be the guest of honor at a dinner to be held at the Chemists' Club, New York, Friday, Nov. 3. Dr. Duggan, a former trustee of the club and chairman of the house committee, leaves for England shortly.

Alfred D. Flinn has been elected director of the Engineering Foundation which is fostering organized industrial research on a nationwide scale. Mr. Flinn is the first incumbent of the new post, created by the Foundation's governing board, composed of the four founder societies of civil, mining, mechanical and electrical engineers, to meet the expanding activities of the Foundation. Mr. Flinn will retire as chairman of the Engineering Division of the National Research Council, a position which he has held since October, 1921, but will continue as secretary of the United Engineering Society in order that the Foundation may continue intimate relations with the founder societies. Mr. Flinn has been secretary of this society and the Foundation since January, 1918, and is widely known by engineers throughout the country.

Louis J. Gurevich, formerly with the Hydraulic Steel Co., Cleveland, Ohio, is now metallurgist for the Owens Bottle Co., Toledo, Ohio.

Dr. H. J. Hamburger, professor of physiology, University of Groningen, Holland, addressed the Washington Academy of Sciences, Biological Society of Washington and the Chemical Society of Washington (D. C.) on Oct. 19. His address was on "The Increasing Significance of Chemistry in Medical Thought and Practice."

F. E. Hamer, editor of *Chemical Age*, London, who came here as a representative of Benn Bros, Ltd., to the meetings of the Associated Business Papers, Inc., and the National Conference of Business Paper Editors, sailed for home on the Baltic, Oct. 28.

Dr. Ellwood Hendrick spoke at the opening meeting of the Baltimore Section of the American Chemical Society at the Engineers' Club, Friday, Oct. 27, on "The Vision of Science."

E. E. Hunt, of Springfield, Ohio, has been selected as the secretary of the President's Coal Commission. Mr. Hunt has been in charge of the study of intermittency in the coal industry, which the Department of Commerce has been pursuing since last March. For the purposes of that study a contribution was made from the Cabot fund. The study was an outcome of the unemployment conference, of which Mr. Hunt was secretary. Mr. Hunt had been associated with Mr. Hoover throughout the preparation of the report on waste in industry.

Dorsey A. Lyon, chief metallurgist of the Bureau of Mines, is at the Minneapolis experiment station supervising test runs on the new blast furnace.

Prof. Emmanuel de Margerie of the University of Strassburg, French exchange professor in applied science and engineering, has arrived in America to take up work at seven leading engineering schools. The lectures begin at Columbia University.

Dr. C. E. K. Mees, director of the research laboratory, Eastman Kodak Co., Rochester, will give an illustrated lecture entitled "Chemistry and the Motion Picture" before the Society of Engineers at Troy, N. Y., Nov. 14, the Detroit Section of the American Chemical Society on Nov. 15, the Purdue Section of the American Chemical Society at Lafayette, Ind., Nov. 16, and the Chicago Section of the American Chemical Society on Nov. 17.

Frederick Stugard, formerly chief chemist and superintendent of the Kosmos Portland Cement Co., of Louisville, Ky., has accepted a position with the National Cement Co. of Birmingham, Ala., as chief chemist at its plant at Ragland, Ala. He was connected with the Kosmos Portland Cement Co. from the day it started production in 1905, and served in various capacities as assistant chemist, chief chemist, assistant superintendent and superintendent during the course of his employment at the plant at Kosmosdale, Ky.

Obituary

Dr. Ralph R. Potter, chemist recently engaged in the research department of The Barrett Co., Edgewater, N. J., from which he resigned on account of ill health, was drowned in Lake Nashotah, near Oconomowoc, Wis., on Oct. 13. He was undergoing treatment at a local sanitarium, to recover from a complete physical breakdown.

Colonel Jared Rice Smith of Augusta, Ga., died on Oct. 10. Colonel Smith was born in Berryville, Clark County, Virginia, July 27, 1847. According to the *American Fertilizer*, at the age of 16 he joined the Confederate Army and served throughout the remainder of the war. At its conclusion he returned to Clark County, Virginia, and shortly after became clerk of court of Clark County, which office he held for a number of years. He was subsequently engaged in mining in Virginia; and later, while still a young man, became associated with the George W. Graflin Co., of Baltimore, in the fertilizer-manufacturing business. He went to Atlanta for it and in 1880 removed to Augusta to take charge of its Southern business, making his home in that city. He became president of the Georgia Chemical Works, which office he held up to the time of his death. A part of the intervening time he lived at Richmond, where he was general sales manager of the Virginia-Carolina Chemical Co. In 1913 he returned to Augusta, and had since resided there.

In 1903 Mr. Smith was married to Mrs. Anna Platt Heard, of Augusta, who survives him as well as one son, Charles L. Smith, of New Mexico, and two daughters by an earlier marriage, Mrs. Hamlin P. Briggs, of Raleigh, N. C., and Mrs. Edwin Calhoun, of Chester, S. C.

Mr. Smith was a great sufferer for the last 3 years of his life, having developed angina pectoris 3 years ago. At that time it appeared as though he could live only a short time, as his suffering was intense during the attacks. However, he was afforded a measure of relief by his physician, and a method of treatment was adopted which if instantly available could check the attacks. He made a magnificent fight for 3 years.

In the early hours of Oct. 10, Mr. Smith was seized with a sudden attack, and died in a few minutes. He was buried in Summerville cemetery, the Hill, Augusta, Ga., on the afternoon of Oct. 12. The civic bodies of Augusta, and the Rotary Club, of which he was a life member, attended the funeral in a body from the Church of the Good Shepherd, of which Mr. Smith was a member.

Mr. Smith was indeed the dean of the fertilizer industry, to which he had given practically his whole active life. He was an honorary member of the National Fertilizer Association.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Economics—Is It a Basis for Sound Executive Action or Is It Bunk?

The Established Value of Economic Principles to Business Trends Brings Up the Question, Are They Useful to the Individual Business?

IT IS NOT inappropriate at this moment to consider the subject of economics and its relation to business. The report of the convention of the Society of Industrial Engineers which appears on another page of this issue summarizes the opinions of prominent men on this timely subject. But such conventions must and do speak generalities. What we are really interested in is the *argumentum ad hominem*. How does economics affect my business? True, the index number is going up, but my costs and selling prices are not affected. True, someone told me that Babson predicts better business for a while at least, but mine has not changed or is worse than in April. Is this economics stuff sound or is it bunk? How can it benefit me in my decisions?

A Characteristic Reaction Against Economics

Let us get down to a few brass tacks if possible and endeavor to locate the connection between the general and the particular. First let us look at Babson. I was talking to a textile manufacturer during the winter of 1920. He was wealthy and successful. He was not war wealthy, but wealthy because of 40 years of successful effort. "Economics is all right in its place," he remarked, "but you can't run a business from Babson's charts. The movements are too general to make specific application possible."

Just about that time Babson began to shout "Beware!" "Look out for the inevitable deflation period!" Executives with orders booked 6 months ahead for full capacity laughed, if they paused even long enough to do that. A few stopped and thought and then they stopped buying raw materials and cut down inventories. "Idiots!" exclaimed the rest of the world if they knew. And then—well, the story is history now. The deflation came with a dull thud and business failures reached unprecedented heights. Babson and those who studied economics were right. They expected and were prepared for deflation. Economics "worked" in business problems. All logic aside and all pet theories eliminated, America's most rigid test has been applied—the pragmatic test. Does it work? Is it successful? If it is, it's right. And economics has established beyond a doubt its utility in business, your business, my business, any business.

Babson's Use of Statistics and Their Economic Interpretation

To return to Babson for a minute and the so-called Babson chart. Those of you who subscribe to his service know what the chart is: It is a weighted index, a composite of twelve subjects. Each subject has intrinsic value as a sign of business health or the lack of it. At present these twelve subjects which are composited include check transactions, new building, failures, money rates (domestic and foreign), foreign trade, commodity prices, stock prices, railroad earnings, crops, Canadian conditions, immigration. Each of these is carefully weighted, seasonal variations are allowed for and a composite curve is constructed which might be called the curve of business value. This curve is studied in relation to another curve called the country's net gain or growth. During boom periods the business curve is above the net growth curve and during periods of depression it is below it. The area between the two curves during a boom period will equal the area below during the subsequent period of depression on the assumption that action and reaction will inevitably be equal. We are at present over half way through the reaction period which followed the war boom, with conditions on the mend.

Arbitrary and Therefore Unreliable, Howls the Critic

It will probably at once occur to many that the weighting on such a chart is of necessity arbitrary, that the curve representing the country's net growth is also arbitrary and that when you subtract one arbitrary unit from another the result can have but little significance. The answer to that is that it works. You can argue yourself blue in the face. You can invoke the old saying (and many do): There are lies, damn lies and statistics. You can say complacently that you'd rather have a man with business sense than all the economic statistics in the world (and many say that too). But you can't blast away the fact that this chart, with whatever empirical limitations there are, has been a reliable indicator of business health.

We are not trying to sell Babson. In fact we are not sure that we are not already liable to a copyright law-suit for the discussion so far. But the point that we wish to make is that economic statistics which are studied in the light of economic laws reveal business conditions accurately and no one can afford to neglect them.

The Individual Enterprise and Not Business in General

A Complementary Study by the Executive Necessary

Neither Babson nor anyone else would attempt or pretend to run a business solely on a basis of such a chart of general business conditions. Small variations which would break even large corporations must inevitably be lost in the vast composite sweeps of the curve. What you as the head of a business unit should do in addition is to construct and study such curves for your own business. Here, for example, is one set of curves which would be of inestimable value (and very few people construct such a set or any curves for that matter). The production curve and the sales and stock reserve curve on each commodity manufactured! Variations in the differences between these two curves could form a reliable basis for production.

An example will illustrate. A company was producing a commodity which had a distinctly seasonal demand. Each year a stock was built up to an arbitrary figure and the plant shut down. Each year inevitably the demand ran away with the stock and

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	157.71
Last week	156.10
November, 1921	146.82
November, 1920	240
April, 1918 (high)	286
April, 1921 (low)	140

Relatively little change in the weighted index over last week's figure. Three commodities dropped slightly, citric acid, nitric acid and linseed oil. The price of acetic acid advanced slightly but not sufficiently to counterbalance the drop of the three others. For practical purposes this change is negligible and taken in connection with information from the various correspondents the market may be considered steady and strong.

orders piled up in spite of night and day production. Each year the stock was increased and each year it was regularly wiped out. The stock became more and more valuable as its size was increased. Each year the argument was more and more heated: increase the plant capacity or the size of the stock before the plant is shut down. The executive was torn between desire to get all the business possible and the hesitancy to tie up capital either in plant or stock. A typical executive problem with nothing but empirical data and the much touted "business sense" to solve it with. The result, confusion!

It is the old story of the psychological dilemma: "I want to eat it, for it looks like a mushroom. But I am afraid to eat it, for it might be a toadstool." For heaven's sake, find out the difference between mushrooms and toadstools and stop worrying. That is just what a study of statistics in the light of economic laws will do to many executive problems. It will show them the difference between mushrooms and toadstools.

We can think of a dozen statistical charts which every business executive will ultimately be using just as assiduously and eagerly as he is using engineering skill now. Why not give the matter thought? If charts work for general business conditions, so they will for individual business conditions. And the man with only "business sense" will ultimately take a place analogous to that which the "practical" engineer holds now—valuable still for his hunches and ideas, but having to be carefully checked by scientific business methods and sound economics.

The Trend of the Chemical Market

The tariff bill went into effect before Oct. 1, but October prices showed the first effect of the new law. Materials which are imported but on which the protection is greater than previously tended to advance. Even some which lost protection showed some advance. Consumers have in general shown much more marked interest and so-called conservative buying methods have to a large extent disappeared. Pronounced optimism is fairly widespread and many large producers are sold up on important commodities.

Exports do not stir observers and dealers to much enthusiasm. Even caustic soda and soda ash buyers have not been inclined to purchase for foreign countries. A hope that this is a passing phase is expressed and activity in the Far East, coming as it does concurrently with Secretary Hoover's ruling, strengthens this hope.

Among the products which rose in price early in the month—all imported products—were barium chloride, barium carbonate, prussiate of soda and caustic potash.

The rise in the price of methanol was the most important single feature. From 72c. per gal. at the beginning to 92c. as the closing price for the month is rather spectacular. Naturally other wood products and derivatives showed a similar but not proportional rise. Formaldehyde went from 10½c. per lb. to 13½c., an exceptional gain, as the price has scarcely varied in the last 6 months. Acetone, all grades of acetic acid and ethyl acetate were affected by the same rise. A new schedule was also given out by manufacturers of lead acetate.

White Arsenic Still Going Up

Commercial white arsenic is still scarce. Opening at 8½c. per lb., it is now selling at 10½c. The demand has been persistent and it is likely to stay so, for although the season is over, producers will undoubtedly attempt to build up exceedingly large stocks during the winter in order to be ready to supply a demand which is likely to be unprecedented next year for the arsenic insecticides.

Phenol, with a rise from 21c. per lb. to 31c. per lb., has also demanded much attention. Spot material is scarce and the rather limited stocks in the hands of dealers are being held for the higher prices which appear inevitable. Producers are in general sold up for some time to come. It is believed that the advance in price is largely due to speculative interests.

Very few reductions were recorded. Oxalic acid and chlorate of soda were forced down to meet foreign competition. Toward the end of the month yellow prussiate of soda, sal ammoniac, barium chloride and permanganate of potash dropped. These declines were largely due to lack of interest and a desire on the part of some dealers to close out stocks.

The market is on the whole strong and large producers are well satisfied with the volume. The next month should show continued strength and volume.

Erratum

We believe that very few of our readers were misled by the obvious error on last week's market pages. In discussing the so-called invisible exchange from America to Europe an estimated value for 1921 of one and one-half million dollars was mentioned. This of course should have been one and one-half billion dollars. We tried to blame the composing room and the proofreader but they produced the manuscript in our own handwriting—it read "million."

Certainly one and one-half million dollars would not be much of a factor in allowing our trade balance to remain favorable and still permit the payment of interest and principal on foreign loans. We apologize and wish to call attention again to Secretary Hoover's ingenious analysis of the situation—an analysis which may have suffered in the eyes of some through our error.

September a Good Month

Steel and Coal Production Indicates Continued Business Activity

The Department of Commerce reports that business activity was maintained during September. Iron and steel production has recovered from its low point in August. Unfilled orders pile up and prices for both iron and steel have increased sharply.

Pig Iron and Steel

The September pig-iron production totaled 2,034,000 tons, or 218,000 tons more than in August, but still below the recent peak of 2,405,000 tons reached in July. Steel-ingot production, prorated to 100 per cent, rose from 2,532,000 tons in August to 2,714,000 tons in September, but is below the maximum reached in May of 3,099,000 tons. Ingot production, so far this year, is nearly 70 per cent ahead of the same months of 1921. Merchant pig-iron production increased in September, but shipments, unfilled orders and stocks all declined.

Unfilled orders of the U. S. Steel Corporation continued to increase in September, reaching a total of 6,692,000 tons, or 742,000 tons more than at the end of August. Structural steel sales declined slightly in September. The movement of iron ore through the Sault Ste. Marie canal showed a decline of nearly 2,300,000 tons, compared with August. The prices of all iron and steel products rose sharply during September.

The production of zinc showed a further increase in September, while stocks continued to decline. Stocks of tin also showed a marked decline, compared with August. The prices of zinc and lead rose during September while tin declined slightly and copper showed no significant change.

Coal Production High

The resumption of bituminous mining at the beginning of September caused the output for the month to rise to 40,964,000 tons, compared to 22,328,000 tons in August. The September production is the largest since October a year ago except for March, when stocks were being built up in anticipation of the strike. Bituminous production has been maintained at a steady level of just under 10,000,000 tons a week ever since the settlement of the strike. The present rate of production is limited only by the ability of the railroads to handle the product.

Anthracite production increased from 161,000 tons in August to 4,979,000 tons in September. Mining in the anthracite field was not resumed until the second week in September; consequently the output for the month is considerably below the 7 to 8 million tons normally produced. Recent reports show that anthracite production is now averaging about 2,000,000 tons per week.

Coke production, both beehive and by-product, increased in September. The price of coke declined somewhat. The same was true of the weighted mine average price of bituminous coal.

A Life-Preserver to Chinese-American Commerce

Secretary Hoover Issues Regulations for Carrying Out China Trade Act

It is safe to say that a large majority of Americans have been unacquainted with the handicap from which American traders in China have suffered. Great Britain, France and Japan long ago had freed corporations engaged in Chinese trade from the burden of their taxation, but American firms the stock of which was owned by Chinese or American residents of China were subject to American income tax regulation. Even some months ago, when a test case was put into the courts and a temporary injunction issued, little progress was made because firms hesitated to make themselves liable for accrued income taxes which might have been levied following an adverse court decision.

The China trade act became a law on Sept. 19 and it effectively removes the handicaps which have hitherto been felt. It provides that stock of corporations engaged in commerce in China, which is held by either Chinese or American residents of China, shall be exempt from federal income taxation. This will have the effect of attracting both Chinese and American capital into trade with America, which will be mutually advantageous.

Such trading is rather more difficult than ordinary exporting, for it means always a two-way trade. American goods can be distributed with a fair degree of ease, but the Chinese goods must be collected in small quantities over a wide area. Large production centers are a modern Occidental development.

A registration and a nominal fee of $100 are all that are required to incorporate a China trade company.

Such information as is necessary may be obtained from the Department of Commerce.

The act is looked on as a great step forward and it is distinctly to be hoped that some of the hundreds of companies which were forced out by the unfavorable conditions will be lured back into the work again.

The New York Market

NEW YORK, Oct. 30, 1922.

A few price changes were about the only features of the chemical market last week. New prices were announced on all grades of acetic acid on account of the upward revision on acetate of lime quotations. Heavy purchases of white arsenic have again caused dealers to advance prices. The prussiates tended to ease off during the past 2 weeks. Producers of chlorate of soda announced a reduction in selling prices. All barium products are being well sustained at recent quotations. Bichromate of soda is holding its firm tendency under a fair inquiry for moderate quantities. The domestic demand for caustic soda and soda ash continues exceedingly heavy and leading producers are quite satisfied with the volume of new business. The export inquiry was rather dormant during the interval. One of the strongest items on the list was phenol. Prices soared to 30c. per lb. early in the week for limited lots, with a very strong tendency toward much higher levels. Producers are sold ahead far into the future and there seems to be no relief for some time to come.

GENERAL AND SPECIAL CHEMICALS

Acetate of Soda—The spot market continues quite firm and sellers are offering limited lots at 8c. per lb. The scarcity of supplies is proving a sustaining feature to the market.

Acetic Acid—All producers announced a new advance on the various grades. Commercial, 28 per cent, packed in barrels, is quoted at $2.92½ per 100 lb. in carload lots. The 56 per cent is being held around $5.85 per 100 lb. in carload lots, and glacial 99 per cent at $11.16 per 100 pounds.

Arsenic Oxide—Spot quotations are slightly higher and it is doubtful if better than 10¾c. per lb. can be obtained. The range is from 10¾@11c. per lb. Recent heavy buying from the insecticides has reduced spot supplies.

Barium Carbonate—Imported material is offered on the basis of $75 per ton on spot. Several fair-sized sales were transacted at this level, with the range up to $80 per ton for smaller lots. Demand was moderate and in most cases for small quantities.

Bichromate of Soda—This market is in a firm position, with leading producers asking 7⅝@7¾c. per lb. Second hands report several sales at 7½@7⅝c. per lb. for spot goods.

Chlorate of Soda—Domestic producers have reduced selling prices to 6¼@6½c. per lb., f.o.b. works, for November shipment. Imported goods on spot is being held at 6¾c. per pound.

Fluoride of Soda—Sales of imported material are reported on the basis of 9¾c. per lb., with the market quite firm at this level. Recent buying has greatly reduced spot supplies.

Nitrite of Soda—Several lots of imported goods were offered at 9c. per lb. on spot and at 8¾c. to arrive. Domestic factors are unchanged in their views at 10c. per lb., f.o.b. works.

Sulphide of Soda—Domestic producers are quoting the market for 60-62 per cent fused at 4¾@5c. per lb. The broken variety is held at 5@5½c. per lb. Importers are offering fused material at 4c. per lb., carload lot basis on spot. Demand is only routine.

Zinc Chloride — Domestic factors quote the fused at 7c. per lb. in quantity lots. Ground material is quoted at 8c. per lb. Importers are offering goods at greatly reduced figures.

Phenol—This item was undoubtedly the strongest commodity on the list. Spot goods was extremely scarce and leading factors reported a well sold up condition. Several odd lots changed hands during the interval at prices ranging from 28c. per lb. early in the week to 31c. per lb. during the latter part. The general tone is quite firm.

VEGETABLE OILS

Linseed Oil—The spot and nearby shipment market is not very active, but futures were in fair demand during the interval. Spot oil held around 88@89c. per gal. in carload lots, with November shipments quoted at 86c.

Castor Oil—Although dealers in this product reported a very firm tone, producers announced a reduction of ½c. per lb. on all grades. The decline was primarily due to keen competition. The No. 3 grade was quoted at 12c. per lb., with the AA at 12½c. per lb. in barrels.

Olive Oil—There has been a pronounced scarcity in prime foots oil and prices on spot are up to 9¾c. per lb. Nearby shipments are being quoted at 9½c. per lb. Denatured oil closed unchanged at $1.15@$1.20 per gal. Edible oil was available at $1.70@$2.30 per gallon.

Peanut Oil—Prices for this material are merely nominal, due to the lateness of the new crop. Prices range from 8¾@9¼c. per lb., tank cars, f.o.b. mills. Refined oil on spot was in limited supply, with quotations heard around 12½@13c. per pound.

The Iron and Steel Market

PITTSBURGH, Oct. 27, 1922.

Steel ingot production is at 36,000,000 or 37,000,000 tons a year, or say 70 per cent of capacity. There has been no important change in the rate since the middle of September, merely a slight further increase after the sharp recovery from the August decrease. All present prospects are that the next change in the rate of production will be a decrease, through some mills not having sufficient orders to maintain their present production rate.

Shipping conditions have improved somewhat. All the current output of steel is being shipped, together with a little of the steel that accumulated recently on account of car shortages. Some embargoes remain, but on the whole there is not much inconvenience in this respect.

The current turnover in the finished steel markets is the lightest for any time this year. The market has been quiet for several weeks and may now be described as stagnant in the majority of lines.

BETTER DELIVERIES OF STEEL

There is no plain evidence that the rate of steel consumption, on the whole, has decreased. There is an easier situation because mills are making better deliveries. Many buyers are still seeking heavier deliveries. They now act upon this desire by urging mills to make heavier deliveries on old contracts, taken at prices below those now ruling, whereas a few weeks ago many buyers were going into the open market and making fresh purchases for early deliveries, paying the delivery premiums then ruling.

There were delivery premiums on bars, shapes, plates and sheets. These premiums have been decreasing for several weeks and they are now relatively unimportant, usually applying only on small lots or on extremely early shipment. In sheets there is the remarkable report that some independent mills are willing to sell, on attractive business, at the Steel Corporation prices, based on 3.55c. for common black, and this is not due to competition by the corporation, since the corporation has been sold out for more than a month, having no further offerings to make until it opens order books for the first quarter of the new year.

Basis Prices Unchanged

Basis prices for steel products, prices that do not contain a delivery premium, are unchanged. In all the products the latest change was an advance, but the only recent advance was that of Oct. 19, in pipe. Bars, shapes and plates are 2c., nails $2.70, tin plate $4.75 and merchant steel pipe 66 per cent basing discount.

The condition in the steel market is a familiar one, new buying having practically ceased, except in cases of new wants arising, in construction jobs, freight cars, etc., while the mills are engaged in filling old orders, taken at various prices during the rise. With the sales policy followed by all the large mills before the war order books would now be of about the same size throughout the industry, relative to capacity. Before the war mills normally sold at the same prices and there was never much difference between prices of the Steel Corporation and the independents. All the authorities in the trade would then have agreed that much difference was obviously impossible. Since the armistice, prices, as between the Steel Corporation and the independents, have been different more often than not. In the past 7 months, since the market passed its low point, there have been various prices, the result being that order books now are of various sizes. The trade, therefore, will not run for as long a time in a quiet period with prices unchanged. Some producers will be disposed to seek additional business by cutting prices while other producers are still well supplied with orders. The price cutting may not lower the general market level or force the mills provided with large order books to modify contract prices at once.

Large consumers of steel are exhibiting a desire to know what steel is going to cost them for 1923 delivery, but are indisposed to attempt to ascertain by starting negotiations. As mills have business on books to protect, they would not name as low prices now as they might be glad to quote a few months hence.

Coke and Pig Iron

Connellsville coke, which had a sharp slump from $12 to $8, as noted in last week's report, has since then merely become a trifle easier. Small lots pressing on the market go at $7.50, while fair-sized lots, for delivery over a week or two, are likely to command $8 and contracts to the end of the year would not be taken at less than $8.50 or $9. Operators are suggesting, as to contract prices, that December is likely to bring fresh car shortages and higher spot prices, whereby contract prices should be higher than the present spot market, to strike the average. It is not shown, however, that the spot market will not decline much more in the next few weeks.

Pig iron continues stagnant, there being scarcely any inquiry. While it is well recognized that the trend in prices is downward and that the market will scarcely halt until it finds a level much below the present, the absence of important inquiry prevents there being much pressure on prices. Bessemer has continued to sell in odd lots at $33 valley. A fair tonnage of basic has sold at last week's quotation of $30 valley. Transactions in small lots of foundry have developed a price of $30 valley, $2 below the quotation of a week ago.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.		$0.38 – $0.40
Acetone	lb.	$0.19 – $0.20	.20 – .22
Acid, acetic, 28 per cent	100 lb.	2.92½ – 3.00	3.05 – 3.20
Acetic, 56 per cent	100 lb.	5.85 – 5.90	5.95 – 6.25
Acetic, glacial, 99½ per cent, carboys,	100 lb.	11.16 – 11.20	11.25 – 11.50
Boric, crystals	lb.	.11 – .11½	.11¾ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.		.51 – .52
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11¾ – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04½ – .04¾	.05 – .05½
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg	lb.	.05½ – .05¾	.06 – .06½
Nitric, 42 deg	lb.	.06 – .06¼	.06½ – .07
Oxalic, crystals	lb.	.14¼ – .14½	.14¾ – .15½
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.		1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 – 10.00	
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.		.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.		.31 – .31¼
Tartaric acid, imported, powdered	lb.		.31½ – .32
Tartaric acid, domestic	lb.		.32
Tungstic, per lb. of WO	lb.		1.00 – 110c
Alcohol, ethyl (Cologne spirit)	gal.		4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.		.36 .38
Alcohol, denatured, 188 proof No. 5	gal.		.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03½ – .03⅝	.04 – .04⅛
Alum, chrome lump	lb.	.05 – .05¼	.05½ – 06
Aluminum sulphate, commercial	100 lb.	1.50 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½ – .07¼	.07½ – 08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.		2.35 – 2.50
Arsenic, white, powdered	lb.	.10 – .11	11¼ – 11½
Arsenic, red, powdered	lb.	.12½ – .12¼	.13 – .13½
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	100.00 – 102.00	103.00 105.00

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate		.09 – .09½	.09¼ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	
Blanc fixe, pulp	ton	45.00 – 55.00	
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)			
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	.27 – .38	.28½ – .35
Calcium acetate	100 lb.	3.00 – 3.15	3.20 – 3.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05¼
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.		1.40 – 1.50
Calcium phosphate, tribasic	lb.		.15 – .16
Camphor	lb.		.86 – .87
Carbon bisulphide	lb.	.07 – .07¼	.07½ – .07¾
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.		.60 – .75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	
Chalk, precip.—imported, light	lb.	.04½ – .05	
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.		.25 – .32
Cobalt oxide	lb.		2.00 – 2.10
Copperas	ton	21.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.21 – .21½	.22 – .22½
Copper cyanide	lb.		.58 – .600
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.		.26 – .27
Epsom salt (see magnesium sulphate)			
Ethyl acetate com. 85%	gal.		.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.		.90 – .95
Formaldehyde, 40 per cent	lb.	.13½ – .13¾	.14 – .14½
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	
Fullers earth—imported powdered	net ton	30.00 – 32.00	
Fuse oil, ref	gal.		2.75 – 2.90
Fusel oil, crude	gal.		1.65 – 1.85
Glauber's salt (see sodium sulphate)			
Glycerine, c.p. drums extra	lb.		.18½ – .18¾
Iodine, resublimed	lb.		4.40 – 4.50
Iron oxide, red	lb.		.12 – .18
Lead acetate, white crystals	lb.		.11½ – .12½
Lead arsenate, powd	lb.	.13 – .13½	13½ – 14½
Lead nitrate	lb.		.15 – .20
Litharge	lb.	.07½ 08	.08½ – .09
Magnesium carbonate, technical	lb	.06 – .06½	.06¾ – .07¾
Magnesium sulphate, U.S.P.	100 lb	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.		1.00 – 1.80
Methanol, 95%	gal.		.90 – .92
Methanol, 97%	gal.		.92 – .94
Nickel salt, double	lb.		.11 – .11¾

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Nickel salt, single	lb.	..... –	.12 – .12½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35½
Potassium bichromate	lb.	.10 – .10½	.10½ – .11
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.06 – .06½	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07¼ – .08	.08½ – .09
Potassium cyanide	lb	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.25 – 6.50	6.60 – 7.00
Potassium iodide	lb.	..... –	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.16 – .16½	.16¾ – .17
Potassium prussiate, red	lb.	..... –	.95 – 1.00
Potassium prussiate, yellow	lb.	.37¼ – .38	.38¼ – .38½
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .06¾	.07 – .07¼
Salammoniac, gray, granular	lb.	.08¼ – .08½	.08¾ – .09
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.08 – .08¼	.08½ – .09
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05½
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12 00 –13 00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09¾ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.45 – 3.50	3.55 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09 – .09¼	.09½ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.22¾ – .23	.23½ – .23½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40 00	..... – .....
Talc—domestic powdered	ton	18 00 –25 00	..... – .....
Tin bichloride	lb.	.10 – .10½	.10½ – .10¾
Tin oxide	lb.	..... –	.39 – .40
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07¾ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.29 — .31
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U. S. P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.53 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Diethylbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitrochlorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.85 — .90
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb	10 — .12
Nitronaphthalene	lb.	.30 — .35
Nitro-toluene	lb.	$0.15 — $0.10
N-W acid	lb.	1.20 — 1.30
Ortho-amidophenol	lb.	2.10 — 2.15
Ortho-dichlor-benzene	lb.	.17 — .20
Ortho-nitro-phenol	lb.	.80 — .85
Ortho-nitro-toluene	lb.	.12 — .15
Ortho-toluidine	lb.	.12 — .14
Para-amidophenol, base	lb.	1.20 — 1.25
Para-amidophenol, HCl	lb.	1.25 — 1.30
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .80
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.85 — .90
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.30 — .32
Pyridine	gal.	1.60 — 1.75
Resorcinol, technical	lb.	1.50 — 1.55
Resorcinol, pure	lb.	2.00 — 2.10
R-salt	lb.	.55 — .60
Salicylic acid, tech., in bbls.	lb.	.29 — .30
Salicylic acid, U. S. P.	lb.	.32 — .34
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.27 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.12 — .14
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — .....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — .....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.19½ —	$0.20
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.36 —	.40
Candellila, wax	lb.	.34 —	.36
Carnauba, No. 1	lb.	.40 —	.42
Carnauba No. 2, North Country	lb.	.25 —	.26½
Carnauba, No. 3, North Country	lb.	.19 —	.19½
Japan	lb.	.15 —	.15
Montan, crude	lb.	.03¾ —	.04¼
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	.02¾
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03¼ —	.03¼
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05½
Stearic acid, single pressed	lb.	.09 —	.09½
Stearic acid, double pressed	lb.	.09½ —	.09¾
Stearic acid, triple pressed	lb.	.10½ —	.10

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$7.00 —	.....
Rosin E-I	280 lb.	7.05 —	.....
Rosin K-N	280 lb.	7.10 —	$7.15
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	.....
Spirits of turpentine	gal.	1.65 —	1.70
Wood turpentine, steam dist	gal.	1.35 —	.....
Wood turpentine, dest. dist	gal.	1.25 —	.....
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.38 —	.....
Rosin oil, second run	gal.	.41 —	.....
Rosin oil, third run	gal.	.48 —	.....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.65 —	3.75
Blood, dried, f.o.b., N. Y	unit	4.60 —	.....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.35 —	2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	.....

Crude Rubber

Para—Upriver fine	lb.	$0.24 —	.24½
Upriver course	lb.	.18½ —	.18½
Upriver caucho ball	lb.	.18 —	.18½
Plantation—First latex crepe	lb.	22½ —	.22
Ribbed smoked sheets	lb.	22½ —	.22
Brown crepe, thin, clean	lb.	.20 —	.20
Amber crepe No. 1	lb.	.20 —	.20

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12¾ —	.12⅞
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¼ —	.08½
Cocoanut oil, Cochin grade, in bbls	lb.	.08¼ —	.09
Corn oil, crude, in bbls	lb.	.08¼ —	.09
Cottonseed oil, crude (f. o. b. mill)	lb.	.07½ —	
Cottonseed oil, summer yellow	lb.	.10¾ —	.10¾
Cottonseed oil, winter yellow	lb.	.11½ —	.11¼
Linseed oil, raw, car lots (domestic)	gal.	.90 —	.91
Linseed oil, raw, tank cars (domestic)	gal.	.87 —	.88
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.92 —	.94
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07¼
Palm, Niger	lb.	.06½ —	.06¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¾ —	.09
Peanut oil, refined, in bbls	lb.	.12½ —	.13
Rapeseed oil, refined in bbls	gal.	.77 —	.78
Rapeseed oil, blown, in bbls	gal.	.85 —	.86
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.08¾ —	.09

FISH

Light pressed menhaden	gal.	$0.51 —	....
White bleached menhaden	gal.	.54 —	.55
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$600.00	$800.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65.00 —	80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24.00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	16.00 —	20.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, No. 1 pottery grade	long ton	7.00 —	7.50
Feldspar, No. 2 pottery grade	long ton	5.75 —	5.90
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00 —	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	....
Kieselguhr, f.o.b. N. Y	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00 —	15.00
Pumice stone, imported	lb.	.03 —	.05½
Pumice stone, domestic, lump	lb.	.05 —	.05
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.66 —	.68
Shellac, orange superfine	lb.	.68 —	.70
Shellac, A. C. garnet	lb.	.70 —	.72
Shellac, T. N.	lb.	.65 —	.66
Silica, glass sand, f.o.b. Indiana	per ton	1.50 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00 —	16.00
Silica, building sand, f.o.b. Pa	per ton	2.00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00 —	17.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00
Chrome brick, f.o.b. Eastern shipping points	net ton	50
Chrome cement, 40-50% Cr_2O_3	net ton	23–27
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	35–40
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–28
Magnesite brick, 9-in. straight (f.o b. works)	net ton	60
Magnesite brick, 9-in. arches, wedges and keys	net ton	70
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	50–53
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	45–47
Silicon carbide refractory brick, 9-in.	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, Atlantic seaboard	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	37.00 —	38.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	63.00 —	65.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.75 —	.80
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19.00 —	20.00
Coke, foundry, f.o.b. ovens	net ton	10.50 —	11.00
Coke, furnace, f.o.b. ovens	net ton	8.00 —	8.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	
Manganese ore, chemical (MnO_2)	net ton	70.00 —	75.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00 —	8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	7.75 —	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.75–13.875
Aluminum, 98 to 99 per cent	20.00–21.00
Antimony, wholesale lots, Chinese and Japanese	6.75–7.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	35.875
Lead, New York, spot	6.50–6.60
Lead, E. St. Louis, spot	6.40
Zinc, spot, New York	7.30–7.35
Zinc, spot, E. St. Louis	7.00–7.05

OTHER METALS

Silver (commercial)	oz.	$0.67¾
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.35@2.40
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	275.00@300.00
Palladium	oz.	55.00
Mercury	75 lb.	73.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	16.75
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	24.75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@8.75
Lead, heavy	4.50@4.75
Lead, tea	3.25@3.50
Brass, heavy	5.50@5.75
Brass, light	5.00@5.25
No. 1 yellow brass turnings	5.50@5.75
Zinc	2.25@2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	$2.90
Soft steel bars	2.80	2.80
Soft steel bar shapes	2.80	2.80
Soft steel bands	3.40	3.40
Plates, ¼ to 1 in. thick	2.90	2.90

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

MONTGOMERY — The Woco Pep Co., recently organized with H. H. Gardner, Montgomery, as president, has plans under way for the construction of an oil storage and distributing plant on local site, with initial capacity of about 65,000 gal.

MOBILE—The Mobile Paint Mfg. Co. is planning for extensions in its plant for considerable increase in capacity. Additional machinery will be installed. W. A. Benson is president.

DECATUR—The Alabama Water Co., Albany, Ala., is planning for the installation of a new filtration plant at Decatur.

California

LOS ANGELES—The Pan-American Petroleum & Transport Co., 120 Broadway, New York, with branch at Los Angeles, has tentative plans under consideration for the construction of a new oil-refining plant at Los Angeles Harbor. Application has been made to the Harbor Commission for permission. The company is affiliated with the Mexican Petroleum Co.

LOS ANGELES—Fire, Oct. 9, destroyed a portion of the oil refinery of the Richfield Oil Co., Santa Fe and 24th Aves., including distributing plant, with loss estimated at about $250,000, including buildings and equipment. It is planned to rebuild.

LOS ANGELES—The Atlas Brass Foundry Co. has awarded a contract to V. P. Gilbert, 413 Citizens National Bank Bldg., for the erection of a new 1-story foundry, 36x73 ft., at 1901-3 Santa Fe Ave.

OAKLAND—The West End Chemical Co., producer of borax products, has work under way on extensions to its refining plant at Chauncey, N. Y. Construction of new refineries has also been commenced at Chicago, Ill., and Monongahela, Pa. F. M. (Borax) Smith, San Francisco, heads the organization.

LOS ANGELES — The Ventura Associated Oil Co. has preliminary plans in progress for the construction of a new storage and distributing plant at Los Angeles Harbor.

Florida

TAMPA—The Tampa Gas Co. is planning for extensions and improvements in its artificial gas plant, to include the installation of additional equipment. Roscoe Nettles is general manager.

PALATKA—R. W. Lyle, Palatka, has plans under way for the establishment of a brick-manufacturing plant on local site. The initial equipment will give employment to about 80 men.

BRADENTOWN—The Texas Oil Co. has plans in progress for the construction of a new oil storage and distributing plant on local site. A pumping plant will be installed.

Illinois

CHICAGO—Thayer & Co., manufacturers of soap products, have leased the 3-story building at Armitage and Mango Aves., comprising about 30,000 sq.ft. of floor space, for a new plant. Immediate possession will be taken.

ROCKFORD—The Rockford Malleable Iron Works, Inc., has construction under way on a 1-story plant addition, 90x120 ft., on People's Ave., fronting on the Chicago, Burlington & Quincy Railroad, to be equipped for annealing work. It will cost about $45,000. George C. Forbes is secretary and treasurer.

Indiana

VINCENNES — The Blackford Window Glass Co., recently reorganized with a capital of $1,000,000, has plans in progress for the erection of a new local plant for plate glass production. A tract of 6 acres of land has been secured as a site. The works will include a specialty division for the grinding, polishing and beveling of the output, as well as a clay plant for raw material service. Frank Bastin is president, and Ira D. Schaffer, treasurer.

LAFAYETTE—Fire, Oct. 14, destroyed the oil-distributing and storage plant of the National Refining Co., with loss estimated at about $100,000. It is planned to rebuild. Headquarters of the company are at 1404 East 9th St., Cleveland, Ohio.

Kansas

COFFEYVILLE—The Sinclair Consolidated Oil Co., 45 Nassau St., is making a number of changes and improvements at its local oil refinery, heretofore devoted largely to lubricating oil production, and plans to have the plant complete and in full operation by the close of the year. It will have a capacity of about 5,000 bbl. per day. The company is increasing production at its Kansas City refining plant, which has been handling about 5,000 bbl. daily, and a variety of refined oils are being produced. It is reported that the company is planning for the construction of a second unit at its refinery at Houston, Tex.

Louisiana

HOUMA — The Southern Synthetic Co., recently organized, has plans in progress for the erection of a new local plant for the manuafcture of synthetic marble from oyster and sea shells. It is estimated to cost in excess of $45,000. Robert J. Younger and R. E. Griffing, Jr., head the company.

LAFAYETTE—The Lafayette Sugar Refining Co., New Orleans, is reported to be planning for the rebuilding of its refining plant at Lafayette, partly destroyed by fire, Oct. 12, with loss estimated at about $275,000, including machinery.

SHREVEPORT—The Caddo Cotton Oil Co. has tentative plans under consideration for the rebuilding of its local mill, destroyed by fire, Oct. 11, with loss approximately $100,000, including machinery.

NEW ORLEANS—Fire, Oct. 10, destroyed a portion of the plant of the Atlantic Paint Co., Perdido St., with loss estimated at close to $35,000, including equipment.

Maryland

BALTIMORE—The Baltimore Steel Co., Eastern Ave. and Eden St., will soon commence the erection of two 1-story plant additions, estimated to cost close to $45,000. Other buildings are planned to cost approximately $50,000. Gilbert A. Wehr is president.

BALTIMORE—The Federal Yeast Corp., Colgate Station, recently organized, has acquired the local property of the Colgate Products Co., located on Colgate Creek, for a consideration said to be $182,000. It will be used as a new plant for the manufacture of yeast products. The company is headed by Francis W. Little and Sidney A. Goodman.

BALTIMORE—Loyola College, 700 North Calvert St., has commenced foundations for a new chemistry and biology building at the institution, to be 2-story and estimated to cost close to $200,000, including equipment. Otto G. Simonson, Casualty Bldg., is architect.

Michigan

RIVER ROUGE—The Detroit Sand Lime Brick Co., 1008 Vinton Bldg., Detroit, will soon commence the erection of its proposed new plant, on site acquired a number of months ago, estimated to cost close to $100,000, including equipment.

Missouri

KANSAS CITY—The Great Eastern Mills Co., 440 7th Ave., Pittsburgh, Pa., has leased a local building at 1222 West 9th St. for the establishment of a new branch mill for the manufacture of sugar. Machinery will be installed at once.

CARROLLTON—The Sinclair Consolidated Oil Co. is planning for improvements in its local plant. New power equipment and other machinery will be installed.

JOPLIN—The Osborn Paper Co. is planning for the erection of a new 2-story building, to cost about $37,000. Plans will be drawn at an early date.

Mississippi

MOSS POINT—The Southern Paper Co. has plans in progress for extensions in its plant, to include a new paper and pulp mill, to increase the output to about 100 tons a day. A new power house will be built. E. H. Mayo is general manager.

Montana

NEIHART—The new local concentrating mill of the American Zinc & Lead Co., for which a building contract recently was awarded, will have an initial capacity of about 450 tons daily. It will handle silver, lead and copper from the company's properties in the Silver Dike district in this section. The company is making extensions in its zinc oxide operations, and plans for enlargements in its plant devoted to this production at Hillsboro, to provide a total furnace output from all plants of close to 20,000 tons of lead-free material per annum.

New Jersey

CAMDEN—Fire, Oct. 20, destroyed a portion of the plant of J. Eavenson & Son, Penn St. and the Delaware River, manufacturers of soap products, with loss estimated at close to $375,000, including machinery. It is planned to rebuild in the near future.

LAMBERTVILLE—The Jeperson Newsprint Co., South Union St., is reported to be considering plans for the rebuilding of its local mill, devoted to the manufacture of newsprint papers, partly destroyed by fire, Oct. 20, with loss estimated at close to $300,000. The mill was formerly the property of the Perservance Paper Co., and secured by the Jeperson company several months ago. It has only lately been established and operated. Henry Weeks is general manager.

LAMBERTVILLE—The Lambertville Rubber Co. is perfecting plans for plant expansion to increase the present capacity. Additions will be made in the working force..

SALEM—The Salem Glass Works, Inc., is planning for the immediate rebuilding of the portion of its plant destroyed by fire, Oct. 17. Temporary structures will be erected pending the construction of permanent buildings. The company specializes in the production of glass bottles and jars.

New York

LONG ISLAND CITY—The Liberty Paint Co., 39 10th St., has awarded a general contract to the Commonwealth Engineering Co., 103 Park Ave., New York, for the erection of a 2-story plant, 100x100 ft., on Vernon Ave., near 10th St., estimated to cost about $50,000.

JAMAICA—The Bliss Waterproof Concrete Block Co., 34 Union Hall St., has plans in progress for the erection of a new 1-story plant, 100x200 ft., at Foley and Carroll Sts., estimated to cost approximately $50,000. H. T. Jeffrey, Jr., 308 Fulton St., Jamaica, is architect.

BUFFALO—The Iroquois Natural Gas Co., Iroquois Bldg., has plans nearing completion for the construction of a new 1-story regulator building at 338 Bailey Ave., with installation to include regulators, valves, piping, etc.

BROOKLYN—The Industrial Alcohol Mfg. Co., 90 Wall St., New York, has awarded a general contract to the William Kennedy Construction Co., 215 Montague St., Brooklyn for the erection of a new 2-story plant, 50x92 ft., at 9th and Henry Sts. Work will be placed under way at once.

Pennsylvania

CHESTER—The Stauffer Chemical Co., 624 California St., San Francisco, Calif., has acquired a local tract of land, about 10 acres, heretofore held by the Dantziger Paraffin Co. of America, as a site for an Eastern branch plant. Plans will be prepared at an early date for the initial plant unit, comprising a number of buildings, estimated to cost in excess of $100,000.

LANCASTER—The Burnham Boiler Works, Inc., Ave. A, Irvington-on-Hudson, N. Y., will commence the immediate erection of a new 1-story foundry on the Dillville Rd., to be used in connection with its proposed plant here. The entire works will cost close to $200,000, with equipment. Frank D. Chase, Inc., 645 North Michigan Ave., Chicago, Ill., is engineer.

BLOOMSBURG—Fire, Oct. 13, destroyed the local plant of the Bloomsburg Paper Co., with loss estimated close to $75,000. It is expected to rebuild.

ORVISTON—The Central Refractory Co., Newark, O., has acquired the local plant and property of the Center Brick & Clay Co., with firebrick works at Snow Shoe, near Orviston, and large fireclay deposits in Clinton County. The new owner will continue operations, and purposes making a number of extensions and improvements.

JACOBS CREEK—The S. A. Drug & Chemical Co. is taking bids on a general contract for the construction of a new plant on local site, to cost about $150,000, including machinery. Peter Rosello, 406 Congress Bldg., Detroit, Mich., is the architect. S. J. Ferguson is in charge of company operations.

HUNTINGDON—A portion of the foundry at the plant of the Extension Radiator Works was destroyed by fire, Oct. 18, with loss estimated at about $25,000. The company is operated by the Pierce, Butler & Pierce Mfg. Corp., Syracuse, N. Y.

Tennessee

CHATTANOOGA—The Southern Sheet Steel Co., recently organized with a capital of $1,100,000, has tentative plans under way for the erection of a new plant on local site, consisting of three 60-ton open-hearth furnaces, sheet mill and other buildings, estimated to cost in excess of $400,000, including equipment. W. M. Blecker is president, and W. J. Lynch, vice-president and general manager.

CHATTANOOGA—The Rabe Pipe & Foundry Co., North St. Elmo, Chattanooga, has plans under way for the erection of a new 1-story foundry, 100x150 ft., to be equipped for the most part for the manufacture of iron castings. R. R. Rabe is president and general manager.

Texas

HOUSTON—Walter D. Rogers, 708 Clark St., is organizing a company to establish and operate a local plant for the manufacture of seamless rubber products and other rubber goods. A list of equipment to be installed will be arranged at an early date to include ovens, dipping and forming, machinery, drying equipment, etc.

GORMAN—The Eastland County Gasoline Co., recently organized with a capital of $105,000, has plans in progress for the erection of a 3-unit refining plant, with initial capacity of about 5,000 gal. per day, estimated to cost approximately $80,000. The installation will comprise compressors, high and low pressure pumping machinery, tills, etc. J. T. Purdy heads the company.

OILTON—The Magnolia Petroleum Co., Houston, has plans in progress for the construction of a new storage and distributing plant on local site, estimated to cost in excess of $250,000, The plant will handle the output from the company's property in the Webb-Zapata oilfields.

ROBSTOWN—W. C. Craig, Brownsville, Tex., is organizing a company to construct and operate a local plant for the manufacture of brick, tile and other burned clay products. A site has been selected and work will be placed under way at an early date

Virginia

ROANOKE—J. W. Simpkins, Roanoke, has acquired mica properties in Patrick County totaling about 70 acres. Plans are being formulated for the organization of a company to develop the lands, and establish and operate a complete mill for pulverizing and other service for commercial production.

RICHMOND—The Fiber Board Container Co., manufacturer of fiber products, is planning for the rebuilding of the portion of its plant recently destroyed by fire with loss estimated at close to $100,000, including machinery.

Capital Increases, etc.

THE PENNSYLVANIA INDEPENDENT OIL CO., Allentown, Pa., has filed notice of increase in capital from $200,000 to $1,000,000.

THE SOUTHERN CLAY MFG. CO., Chattanooga, Tenn., has filed notice of increase in capital from $300,000 to $1,000,000, for proposed expansion.

THE INDEPENDENT PAPER MILLS, INC., 68 5th St., Brooklyn, N. Y., has filed notice of increase in capital from $100,000 to 200,000.

THE SINCLAIR CONSOLIDATED OIL CORP., 45 Nassau St., New York, N. Y., has arranged for a preferred stock issue of $45,000,000, a portion of the proceeds to be used for improvements and expansion.

THE EBSARY GYPSUM CO., 140 West 42nd St., New York, N. Y., has been increased in capitalization from $40,000 to $80,000, for proposed expansion.

THE BRADSTREET & BRADEN CO. OF DELAWARE, Oklahoma City, Okla., manufacturer of oil products, has filed notice of increase in capital from $65,000 to $100,000.

THE CONSOLIDATED COPPER MINES CO., 120 Broadway, New York, N. Y., has been reorganized, with plant and properties turned over to a new corporation to be known as the Consolidated Copper Mines Corp. William W. Mein is president, and Howard D. Smith, vice-president.

THE INTERCONTINENTAL RUBBER CO., George H. Carnahan, 120 Broadway, New York, N. Y., president, recently reorganized, is arranging for an issue of $2,903,000 in notes, of which $290,300 will be used for expansion and additional working capital.

THE MAMMOTH OIL CO., New York, affiliated with the Sinclair Consolidated Oil Corp., 45 Nassau St., has arranged for a stock issue in excess of $10,000,000, a portion of the proceeds to be used for the development and equipment of oil properties in the Teapot Dome district, Wyo.

New Companies

PETERS & RUSSELL, INC., Boston, Mass., has been incorporated with a capital of $50,000, to manufacture abrasive materials, grinding wheels, etc. Paul S. Peters is president, and Frank H. Russell, 75 Park St., West Roxbury, Mass., treasurer.

THE FINISHING SPECIALTIES & SERVICE CO., 4054 Greenview Ave., Chicago, Ill., has been incorporated with a capital of $25,000, and 250 shares of stock, no par value, to manufacture enamels, varnishes, etc. J. I. and Fred W. McClement, and Philip W. Carston are the incorporators.

THE ROSEBRAND CO., Atlantic City, N. J., care of Joseph B. Perskie, 513 Guarantee Trust Bldg., Atlantic City, representative, has been incorporated with a capital of $125,000, to manufacture chemicals and chemical byproducts. The incorporators are E. and Harold A. Brand, and Louis Rosenthal.

THE JOHN BRUNO CO., New York, N. Y., care of J. A. O'Brien, 1402 Broadway, representative, has been incorporated with a capital of $20,000, to manufacture polishing oils and kindred products. The incorporators are J. B. H. Guest, and H. Markowitz.

E. M. AND F. WALDO, INC., 904-7 Maryland Trust Bldg., Baltimore, Md., has been incorporated with a capital of $500,000, to manufacture chemicals, paints, pigments and affiliated specialties. The incorporators are Edward M. and Frank Waldo.

THE LAVEX CHEMICAL CO., Kansas City, Mo., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are Reynold and O. E. Barnum and W. R. Smith, all of Kansas City.

THE NATIONAL MOTOR CASTINGS CO., South Haven, Mich., has been incorporated with a capital of $250,000, to manufacture iron, steel and other metal castings. The incorporators are F. H. Gallagher, G. H. Wisting and R. B. Campbell, all of South Haven.

THE AIRTITE PAINT CORP., New York, N. Y., care of Avery & Whiting, 5 Nassau St., representatives, has been incorporated with a capital of $10,000, to manufacture paints, varnishes, etc. The incorporators are J. E. Whiting, E. B. Bender and G. O. Castell.

THE REX CHEMICAL CO., Houston, Tex., has been incorporated with a capital of $8,000, to manufacture chemicals and chemical byproducts. The incorporators are W. D. Plunkett, L. J. Jones and W. H. Schopmeyer, all of Houston.

THE EASTERN CHEMICAL CO., 75 Elmdale Ave., Providence, R. I., has filed notice of organization to manufacture chemical products. The company is headed by A. J. Kechigian.

THE H. H. ALLYN RUBBER CORP., Philadelphia, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, representative, has been incorporated under Delaware laws, with a capital of $100,000, to manufacture rubber products, automobile tires, etc.

THE PEERLESS PRODUCTS CO., First St., Mt. Washington, Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture varnishes, paints, and kindred products. The incorporators are Charles J. Harris, Floyd T. Macgill and Norman R. Eckard.

THE ACKERMITE CO. OF AMERICA, 130 North Wells St., Chicago, Ill., has been incorporated with a capital of 30 shares of stock, no par value, to manufacture chemicals, special metals, etc. The incorporators are Randolph Thornton, H Baar and Walter H. Eckert.

THE HARLEM CHEMICAL CORP., care of the Corporation Registry Co., 900 Market St., Wilmington, Del., has been incorporated under Delaware laws, with capital of $500,000, to manufacture chemicals and chemical byproducts.

THE BRASS FOUNDRY CORP., New York, N. Y., care of William Karlin, 132 Nassau St., has been incorporated with a capital of $15,000, to manufacture brass, bronze and other metal castings. The incorporators are L. Stein, J. Schlachter and J. Safer.

THE VALERICINE CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture chemical specialties. The company is headed by Fred Merrill Drake, 117 Arlington St., Hyde Park, Boston.

THE CHEMICAL PRODUCTS CO., East Chicago, Ind., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The corporators are Marris M., David and S. V. Milgram, all of East Chicago.

THE GRANT PAINT PIGMENT CO., Bensonville, Ill., has been incorporated with a capital of $50,000, to manufacture paint pigments, coloring products, etc. The incorporators are Max Grant and Frank S. Robins. The company representative is Bucklan & Scheuneman, Conway Bldg., Chicago, Ill.

THE BUCKEYE OIL & GREASE CO., Canton, O., has been incorporated with a capital of $25,000, to manufacture oils, greases and kindred products. The incorporators are Elbert J. Smith and David D. Herr.

THE ESSEX TILE CRAFT, INC., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture ceramic tile and kindred products. The incorporators are Leo E. Goddu, L. and William G. Anderson, 241 Summer Ave. The last noted represents the company.

THE NEW ERA CHEMICAL MFG. CO., 416 Belvedere Ave., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture chemicals, alkalis, etc. The incorporators are R. E. Lee Young, Richard E. Preece and William M. Travers.

THE FEDERAL ALLOY STEEL CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated with a capital of $12,000,000, to manufacture steel and steel alloy products.

THE INTERNATIONAL PAINT CORP., 1214 Walnut Ave., East St. Louis, Ill., has been incorporated with a capital of $50,000, to manufacture paints, linseed oil, white lead and kindred products. The incorporators are H. F. Dreimeyer, C. Pope and C. E. Altrogge.

F. W. WEBER & CO., INC., Keyport, N. J., has been incorporated with a capital of $50,000, to manufacture chemical products. The incorporators are Caspar O. Manx and F. W. Weber, Keyport. The last noted represents the company.

THE O. K. MFG. CO., Philadelphia, Pa., care of A. A. Watson, Dover, Del., representative, has been incorporated under Delaware laws, with a capital of $100,000, to manufacture cement products. The incorporators are H. P. Street, Haverford, Pa.; H. L. Maris, Penfield, Pa.; and J. C. Harrelson, Philadelphia.

THE MERION MAGNESIA CO., Phoenixville, Pa., has been incorporated with a capital of $5,000, to manufacture magnesia products. The incorporators are James Goodall, Samuel Carpenter and Clayton Ullman, 1027 West Bridge St., Phoenixville. The last noted is treasurer and represents the company.

THE PRIMROSE REFINING CO., Wichita Falls, Tex., has been incorporated with a capital of $100,000, to manufacture refined oil products. The incorporators are H. J. Stief and S. J. Brin, both of Wichita Falls.

THE ALLEGHENY CHEMICAL MFG. CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $100,000, to manufacture chemicals and chemical byproducts, waterproofing materials, etc.

THE KRASCO MFG. CO., 451 East Ohio St., Chicago, Ill., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture metals and metal alloys. The incorporators are Eric L. Anderson, Paul N. Dale and Frank J. Dowd.

THE CORKSTONE PRODUCTS CORP., 121-23 North Collington Ave., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture oxide-chloride cement products, composition specialties, etc. The incorporators are Leon H. Grossman, I. Weinberg and Solomon C. Berenholtz.

GEORGE A. MOLLESON & CO., INC., New York, N. Y., care of C. H. Molleson, 165

Broadway, representative, has been incorporated with a capital of $50,000, to manufacture oils, greases, etc. The incorporators are G. A. and S. H. Molleson, and W. A. Bunta.

THE SNOWDRIFT SOAP CO., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $250,000, to manufacture soaps, washing powders, etc.

THE INTERNATIONAL OIL CO., Lombard and 9th Sts., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture and deal in oil products. The incorporators are Morris Zemil and Louis Wolach.

Industrial Developments

GLASS—The Dunkirk Window Glass Co., Dunkirk, South Charleston, W. Va., has resumed operations at its plant after a shut-down of close to 4 months. About 200 men will be employed for the present, with early increase in working force in the future. The company is said to have orders on hand for at least 4 months continuous production.

Machine-operated window glass plants in Pennsylvania, West Virginia, Indiana and other parts of the coutnry are now running on a full 25-hour day basis giving employment to normal working forces. It is said that the demand insures production on this schedule for a number of months to come.

The United States Sheet & Window Glass Co., Shreveport, La., has placed its local plant in operation. It has recently been completed at a cost of about $1,000,000, and has provisions for a full working force of about 500 men. It is expected to advance production to this point at an early date.

LEATHER — The Griess-Pfleger Tanning Co., Natick, Mass., has advanced operations to a full production basis at its local plant.

The Ohio Leather Co., Girard, O., is running at full capacity at its local calfskin tannery, with employment of regular working force.

The Continental Leather Co., Bridesburg, Pa., has production under way on close to capacity basis at its local tannery, and carload shipments are now leading the plant.

The Lorraine Tanning Co., Peabody, Mass., formerly known as the Webber-Laemmle Tanning Co., is operating at close to normal at its tannery.

RUBBER—The Perfection Tire & Rubber Co., Fort Madison, Ia., is running on a basis of 1,200 tires a day, and will maintain this schedule for an indefinite period.

The Firestone Tire & Rubber Co., Akron, O., is planning to place its new rim plant in operation at an early date. The factory is now nearing completion and will have a rated capacity of 20,000 passenger car tire rims and 4,000 solid truck tire rims per day, said to be the largest plant of its kind in the world. A large working force will be employed.

The Seiberling Rubber Co., New Castle, Pa., is maintaining capacity production at its local plant, with full operating schedule also prevailing at its Ohio mills. Business is said to be averaging $500,000 per month.

The Kelly-Springfield Tire Co. is holding to capacity output at its Akron, O., plant, with production at the Cumberland, Md., mill at a point as high as labor supply will permit. There is said to be a scarcity of men in this section, necessitating the use of ordinary labor and giving a course of training. Current production at the plants is at a basis of 6,000 tire casings per day, with a relatively large output of tubes and solid tires.

IRON AND STEEL—The National Enameling & Stamping Co. has advanced production to close to normal at its steel sheet mills at Granite City, Ill., after a partial shut-down through the summer and early fall; 14 mills have recently been placed in service.

The Phoenix Iron Co., Phoenixille, Pa., has 5 furnaces in operation for the first time in the past 4 years. Production has been increased in the different operating departments and orders on hand insure continuance on the present basis for some time to come. The company has advanced the wages of laborers at the plant 40 cents a day, making a rate of $3.15 a day; skilled operatives have also received an increase.

The Jones & Laughlin Steel Co., Pittsburgh, Pa., has blown in the last of its Aliquippa group of blast furnaces at Woodlawn, Pa., making 11 out of 12 stacks in active operation. The last furnace, one of the Eliza group, is expected to go into blast at an early date giving 100 per cent operation for the first time in a number of months.

The Sloss-Sheffield Steel & Iron Co. has repairs under way at one of its blast furnaces at North Birmingham, Ala., requiring from 2 to 3 weeks. Shortly thereafter the unit will be blown in.

The Alan Wood Iron & Steel Co., Philadelphia, Pa., is planning to blow in its No. 3 blast furnace about the middle of November.

Steel mills at Gary, Ill., are now running on the basis of about 80 per cent of capacity, and are held at this point through labor shortage. It is said that the plants would employ at least 2,000 additional men if they were available. With the continued labor scarcity, it is said that another increase in wages likely will be made in the near future to hold present employees.

The Whitaker-Glessner Co. is running under heavy output at its hot mills at the Wheeling and Beech Bottom, W. Va., and Martins Ferry, O., plants. The wages of employees have recently been advanced 10 per cent.

The Falcon Steel Co., Niles, O., is said to be planning for the early resumption of operations at four of its sheet mills, recently closed down on account of car shortage.

METALS—The Eagle-Picher Lead Co., has advanced operations to a full capacity basis at its Henryetta, Okla., smelting plant, with day and night shifts. Five roasters and 6 blocks are in service.

The Success Mining Co., Wallace, Idaho, is advancing production at its local concentrating mill, and it is expected to give employment to 3 operating shifts at an early date. Production is devoted to lead and zinc, with small silver showings.

The Butte & Superior Co., Butte, Mont., is increasing production at its properties and is now shipping on a basis of 8,000,000 lbs. of concentrates a month to the zinc electrolytic plant of the Anaconda Copper Mining Co., at Great Falls, Mont.

The National Cast Iron Pipe Co., Birmingham, Ala., is arranging to increase operations about 50 per cent at its plant, including the installation of considerable special equipment.

The Bunker Hill & Sullivan Mining Co., Kellogg, Idaho, has blown in the second furnace at its local smelting plant, and plans to operate on the present basis for an indefinite period.

MISCELLANEOUS—The Hudsondale Ochre Works, Hudsondale, Pa., is planning for the early resumption of operations at its local plant, following a suspension caused by car shortage.

The Dill & Collins Co., Philadelphia, Pa., manufacturer of paper, is running on a 24-hour day working schedule at its local mills. It is planned to continue on this basis for an indefinite period.

The Sapulpa Refining Co., Sapulpa, Okla., is operating its local oil refinery on a basis of 5,000 bbl. per day. The plant has a rated output of 7,000 bbl., and it is planned to advance production in the near future.

The Diamond State Fiber Co., Bridgeport, Pa., is maintaining operations on a full-capacity schedule at its local plant, with employment of regular working force. An increase has recently been made in the wages of skilled operatives and laborers, ranging from 2 to 5 cents per hour.

New Publications

NEW U. S. GEOLOGICAL SURVEY PUBLICATIONS: Mineral Resources of the United States in 1921 (preliminary summary), introduction by G. F. Loughlin and statistics assembled by Martha B. Clark, published Sept. 14, 1922; I: 7, Manganese and Manganiferous Ores in 1921, by H. A. C. Jenison (Mineral Resources of the U. S., 1921, Part I), published July 8, 1922; I: 8, Lead and Zinc Pigments and Salts in 1921, by C. E. Siebenthal and A. Stoll (Mineral Resources of the United States, 1921, Part I), published July 10, 1922; I: 9, Bauxite and Aluminum in 1921, by James M. Hill (Mineral Resources of the United States, 1921, Part I), published Aug. 1, 1922; II: 7, Salt in 1921, by G. F. Loughlin and A. T. Coons (Mineral Resources of the U. S., 1921, Part II), published June 29, 1922; II: 8, Strontium in 1921, by George W. Stose (Mineral Resources of the U. S., 1921, Part II), published July 5, 1922; II: 9, Carbon Black Produced From Natural Gas in 1921, by E. G. Sievers (Mineral Resources of the U. S., 1921, Part II), published July 5, 1922; II: 10, Fluorspar and Cryolite in 1921, by Hubert W. Davis (Mineral Resources of the United States, 1921, Part II), published July 6, 1922; II: 11, Potash in 1921, by M. R. Nourse (Mineral Resources of the U. S., 1921, Part II published July 10, 1922; II: 12, Phosphate Rock in 1921, by K. W. Cottrell (Mineral Resources of the U. S., 1921, Part II published July 11, 1922; II: 12, Asphalt and Related Bitumens in 1921, by K. W. Cottrell (Mineral Resources of the U. S., 1921, Part II), published July 26, 1922; II: 14, Mica in 1921, by B. H. Stoddard (Mineral Resources of the U. S., 1921, Part II), published Aug. 3, 1922; II: 15, Magnesite in 1915, by Charles G. Yale (Mineral Resources of the U. S., 1921, Part II published Aug. 5, 1922; II: 16, Gypsum in 1921, by K. W. Cottrell (Mineral Resources of the U. S., 1921, Part II), published Aug. 4, 1922; II: 17, Talc and Soapstone in 1921, by Edward Sampson (Mineral Resources of the U. S., 1921, Part II), published Aug. 4, 1922; II: 18, Clay in 1921 by Jefferson Middleton (Mineral Resources of the U. S., 1921, Part II), published Sept. 20, 1922; II: 19, Feldspar in 1921, by Frank J. Katz (Mineral Resources of the U. S., 1921, Part II), published Aug. 8, 1922; II: 20, Salt, Bromine and Calcium Chloride in 1921, by K. W. Cottrell (Mineral Resources of the U. S., 1921, Part II) published Aug. 31, 1922; II: 22, Asbestos in 1921, by Edward Sampson (Mineral Resources of the U. S., 1921, Part II) published Sept. 19, 1922; II: 32, Asbestos in 1921, by Edward Sampson (Mineral Resources of the U. S., 1920, Part II), published July 7, 1922; II: 33, Clay-Working Industries, Clay and Silica Brick in 1919 and 1920, by Jefferson Middleton (Mineral Resources of the U. S., 1920, Part II) published Aug. 14, 1922.

Organic chemists will find of interest and value the recent publication of the National Research Council, entitled "Organo Magnesium Compounds in Synthetic Chemistry," "A Bibliography of the Grignard Reaction 1900 to 1921," by Clarence J. West and Henry Gilman. In addition to a comprehensive compilation of 1,485 separate references and an equally comprehensive index by compounds the bulletin contains a very interesting descriptive chapter of the Grignard reaction. Subheads in this chapter include a historical statement, the preparation of the Grignard reagent, its constitution and its reactions, and finally its use in the preparation of hydrocarbons, alcohols, ethers, aldehydes, ketones, acids, esters, nitriles and certain inorganic compounds. This bulletin is published as Reprint and Circular Series No. 24 and sells for $1.50.

Coming Meetings and Events

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club 52 East 41st St., New York City Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle. American Chemical Society, joint meeting March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting, May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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olume 27 — New York, November 8, 1922 — Number 19

erman Wages and Export Policy Retard Business Recovery

AT THE OPENING of the forty-fourth general meeting of the Society for the Protection of the Inters of the German Chemical Industry (Verein zur ahrung der Interessen der Chemischen Industrie eutschlands) in Leipzig last September, Dr. C. DUISRG, chairman, gave an address on the economic status f the German chemical industry in 1921-1922. Dr. UISBERG is the head of the famous Farbenfabriken rm. Fried. Bayer at Leverkusen and of the powerful erman chemical trust, Interessen Gemeinschaft. He , in fact, the active as well as the nominal leader of e German chemical industry. He is not a mere gurehead of the ex-Wilhelm II or Stinnes type, and ence his utterances not only carry much weight in ermany but must not be overlooked outside of that untry.

In his address Dr. DUISBERG spoke solely from the erman viewpoint and presented statements that can nly deepen the ill-feeling of the German intellectuals ward their former enemies. At the same time he did ot even remotely touch on matters that we know they ught to know. Thus he blamed the French for the resent German coal situation, when a mere analysis of fficial German figures made public April 1, 1922, will how that there is no foundation for this attitude. [is figures on comparative export values of German roducts in gold marks and paper marks are quite devoid f any units of weight or measurement that would give hem genuine value, especially when we know that erman export selling prices for the period he mentions ere only a fraction of the intrinsic value of the exported roducts. His wailing about the plight of German scienists, students and workmen presents the true situation, ust as true as the absence of German research, which e also bemoans.

But he does not mention the fact that all of these egrettable conditions are the inevitable result of the xploiting policy of industrials like himself, who pay heir workmen abnormally low wages and dump the roducts of their work at prices far below their inrinsic value.

The remedies he suggests, in addition to the everxed idea of the abrogation of the treaty of Versailles, re more work, more export and less import. But these re mere words, because no one knows better than e that this has been Germany's policy ever since the rmistice. What good can be accomplished by such a olicy as long as labor is remunerated with only a raction of its due reward and export prices are far elow the intrinsic value of the products?

It is high time for German industrials of the Duiserg type to inaugurate a policy that will prove to be genuine remedy—namely, the payment of wages ompatible with the honest due of the workmen and the ale of their products at prices commensurate with their intrinsic value. It is idle merely to repeat over and over again the present plight of the Germans. They must go to the root of the trouble and eradicate the cause which, besides sapping the vitality of the masses by undernourishment and mental discontent, is gradually bringing the country to the brink of irremediable weakness.

Honest work and honest competition should be the slogan of the German industrials, and it is incumbent upon men like Dr. DUISBERG to lead in this direction.

It may be set down as fundamental in the restoration of normal industrial conditions in Germany that the German workman must be honestly paid for his work.

Strikes and the Public's Rights

IT IS specious reasoning that couples "the right to strike," as a general principle, with "human liberty" and the impropriety of "compelling any man to work against his will." The right to strike, as supported either by law, by ethics or by the public conscience, is merely the right of collective bargaining, granted for the purpose of placing employees on equal terms with employers. Human liberty requires that the employee be at no disadvantage.

But when a strike is directed against the general public, or when the general public is seriously affected by it, an entirely different case is presented. The difference is illustrated by the recognized illegality of the secondary boycott. That illegality rests upon the fact that the secondary boycott seeks to get a third party to enter a dispute between the two original parties.

That strikes, as we have been having them lately, work an injury to the general public is already well recognized. Remedy is another matter, for means must be developed. Even if a suitable remedy were fully and clearly formulated, however, there would still have to be a much stronger public sentiment than now exists in order to make it effective. The inherent difficulty is that majorities feel that their interests will naturally be taken care of, while minorities realize that they must organize and fight. The general public does not realize how much it has lost by the recent coal strike. It comforts itself in paying present coal prices by reflecting that they might be higher still, largely overlooking the fact that the price for bituminous is about double that ruling before the strike. It looks as if the United Mine Workers had obtained a large advance in wages, when what really happened was that the operators lost in their effort to reduce wages.

The public can formulate a doctrine that it will protect workmen to the extent of seeing that they are placed upon equal bargaining terms with their employers. But it will certainly deny that they have a right to be stronger than their employers, just as it has refused to support a system that would make the em-

ployers stronger than their employees. At the same time it must insist that the parties do not get into a dispute that will be inimical to the general welfare. This is no unreasonable bill of rights for the public to adopt. What is needed is a crystallization of sentiment and a recognition of the fact that the majority needs to be organized and articulate.

Enlightened Conduct Of Corporations

WE HAVE lately observed a great combination of manufacturers of chemicals, the principal figure in which is said to have felt that the separate concerns did not avail themselves of all the profits which the market afforded. But we are reminded that the U. S. Steel Corporation saved itself from the charge of monopoly by this very apparent fault. In an article on "The Revival of Mergers," by J. BARTON NEALY in *The World's Work* for October, he says of the Steel Corporation: "In times of prosperity it sold at a uniformly low price, satisfied with a fair return, while its competitors charged all the traffic would bear. In times of depression it became one of the country's most stabilizing influences, spending millions in expansion to maintain employment, extending millions in credit, both here and abroad, thereby retaining its foreign and domestic trade, and last, but not least, loaned millions in the open market to those less fortunate." Under less enlightened administration of the corporation there would have been far greater dividends, but the company would have been disbanded.

Let us cite another example of what our old friends Uncle Dan'l Dollardoodle and Mr. Quickturn Capital would probably call the silly foolishness of the Standard Oil Co. We quote from a letter of the late Lord NORTHCLIFFE to the late WALTER H. PAGE. The letter was dated Manchester-by-the-Sea, Mass., Aug. 13, 1917:

> In great privacy let me tell you of an enormous responsibility that was placed on my shoulders one midnight, in the form of a desperate cable from A. J. B. (Mr. BALFOUR) as to the immediate putting of our fleet out of action owing to an apparently suddenly discovered great shortage of oil. I had been here only a few days, but long enough to know that such fuel was already scarce here. I knew that such a cable, if disclosed, could cause such a jump in the oil market as had never been known. I was up bright and early, I can assure you. A little cautious pussyfooting as to the oil fuel situation brought no comfort—great demand, small supply—nothing doing. I read and re-read that telegram, and finally called up the Standard Oil head man. We met, and I gave him the cable to read, despite its "*Most Urgent Most Secret*" inscription. He read it slowly twice, gave it back to me, saying, "If it can be done, it will be done." I said nothing whatever about price. Those people started right in there, and oil is pouring across the Atlantic with giant strides and at a lower price than we have averaged over here. They could have squeezed millions out of our trouble, if they had chosen. When I thanked them they merely remarked, "It's our war as well as yours."

These are obligations that the purely commercial mind cannot see. Such acts cost money and "waste" dividends. And yet the old captains of industry who direct the affairs of these corporations have learned from experience that a corporation is a thing with obligations and duties that cannot be found in any book of rules that may be compended. It is difficult for the speculator to learn this, and indeed some manufacturers never learn it. The bigger a corporation is the harder it is to practice it, and yet that very human quality is necessary to long-abiding and eventual success. Failure to attain it may encourage quick profits, but it also instigates slow death.

Cementing Anglo-American Friendship and Unity

FRESH impetus was given last month to the cau of Anglo-American friendship and unity by tl visit to the United States of a group of editors ar publishers of English business and technical paper They came as delegates to the annual meetings of th Associated Business Papers, Inc., and the Nation Conference of Business Paper Editors. In additio to participating in the sessions of these two organiz tions and exchanging views on publishing and editori problems, they subsequently visited appropriate indu trial centers and gathered impressions of business an economic conditions in this country. In the short tim at their disposal they doubtless saw so much and i such rapid succession that their impressions resemble nothing so much as the striking but fleeting pattern of a kaleidoscope. But out of it all there crystallize certain general views in the minds of our visitors tha must inevitably make for a better understanding i England of some American problems and conditions.

Prominent among the British visitors was F. H HAMER, editor of *The Chemical Age*, London, who, w are happy to say, was a most creditable representativ of British chemical industry as well as its technica press. In the Chemists' Club, where he resided durin his stay, he proved himself a delightful companion, an on several occasions demonstrated his capacity as forceful and well-informed speaker.

The note of Anglo-American friendship that h sounded in his speech at the banquet of the Associate Business Papers and which was reflected also in mes sages that he brought from Lord RIDDLE, Earl BALFOUR Lord ROBERT CECIL, Viscount BURNHAM, Sir ERNES BENN, Sir WILLIAM BERRY and C. P. SCOTT, editor o the Manchester *Guardian*, gave additional evidence o the spirit of harmony prevailing among the leaders o thought in the two nations. Mr. HAMER'S own impres sions of the United States, penned briefly before h sailed and published elsewhere in this issue, will b read with no little gratification by chemists on both sides of the Atlantic.

Proposing a Chemical Exposition Course of Study

AMONG the recognized purposes of the Chemical Ex position as it has been conducted for the past 8 years, is that of educating not only the public to a appreciation of the value of chemistry in our nationa life but also students of chemical engineering and indus trial chemistry who are still in their undergraduat years. No doubt both these classes have been benefited in large measure as a result of the efforts that have been made in their behalf, but it begins to look a though a great opportunity for service has been over looked in connection with the student group.

The particular attention of teachers of industria chemistry and chemical engineering is directed to a communication in this issue from Prof. W. T. READ, o the Sheffield Scientific School of Yale University, i which he outlines a plan followed with undergraduat students of chemistry for the past 3 years. He has made use of the Chemical Exposition as a vast labora tory for instruction in chemical equipment and funda mental processes. The success of his work has been s striking that the annual visit to the exposition has be come a requirement in Sheffield courses in industria chemistry and chemical engineering.

But this is not enough. As Professor READ point

ct, the plan is capable of extension by simply multiplying the number of institutions participating. If this ere accomplished, however, it would be necessary to ganize the work thoroughly so that there would be duplication of work and no conflict of groups of udents going unsystematically about the exposition. e think we can see in Professor READ'S suggestion the ssibility of organizing a one week's course at the position for students from nearby colleges and univerties. Arrangements could be made with specialists for tures on fundamental processes, and such lectures uld be supplemented by explanation at the booths of pical apparatus on exhibition. Professors in charge the different groups of students could hold their own tures and quiz sections and use their own devices r making the most out of the week's study.

The exposition management has here an exceptional portunity to render service of immeasurable value. e suggest that an impartial committee be appointed draft a tentative schedule of lectures and systematic spection of exhibits, and submit the plan to professors colleges within a radius of a few hundred miles of ew York, soliciting their co-operation. With this as a ucleus it will be possible to evolve an excellent course; nd if a high standard is maintained in the selection of cturers and if the attending professors make the most the exhibits, we think that the annual "Chemical xposition Course" will become a popular requirement universities that are close enough to New York to ail themselves of it.

hat Is Steel?

THAT question ought to be easy to answer. We have a very large and very authoritative dictionary and e shall go to it. It says:

> Steel. A variety of iron intermediate between cast iron and wrought iron, very tough and, when tempered, hard and elastic.

Evidently, to understand this, we shall also have to ok up two more definitions.

> Cast Iron. The direct product of the blast furnace or of the cupola, fusible and brittle. It can be tempered, but not welded or forged.
>
> Wrought iron. The purest form of iron commonly known in the arts, containing only about half of one per cent of carbon. It is tough, malleable and ductile.

It's pretty difficult to strike a position "intermediate" tween these two definitions, except for carbon content, nce the terms used to describe the properties are lative. As a matter of fact, cast iron usually contains to 4 per cent of carbon, steel anywhere from 0.1 1.4 per cent, and wrought iron is quite low in carbon .05 per cent, rarely going higher than 0.25).

But how about the ordinary physical properties? rom a recent textbook on strength of materials we nd the following data:

	Gray Cast Iron	0.4 Steel (Hot-Rolled)	Wrought Iron
nsile strength	26,000	85,000	50,000
eduction in area....	Very low	43	30
rinell hardness	150	165	85

Evidently this particular steel is not intermediate in rength, ductility or hardness; it is intermediate only its chemical composition. The dictionary definition scarcely satisfactory.

Now turn to the steel makers, who certainly ought to e able to recognize their product. Dr. JOHN A. ATHEWS recently commented on the fact that steel has ten been defined as the product of certain commercial anufacturing processes. But that leads to an argument every time a new process is discovered—can its products be called steel truthfully? Since his corporation makes steel by various methods, he should be free of prejudice toward a definition by method, and he says: "Steel of commerce is that form of iron which has been produced by melting to yield a finished product which is malleable." That is, malleability must be possessed by a metal before it can be called steel.

This definition (and that which may be discovered hidden among seven pages of qualifications in Dr. HENRY M. HOWE'S last book) includes the open-hearth product which contains not more than 0.01 per cent carbon. It takes little account of ancient usage, deep rooted in metallurgical lingo, that steel is a kind of iron *which will harden*, and as far as modern research has enabled us to understand the true mechanism of hardening by heat-treatment, it is necessary that the iron be alloyed with at least a little carbon before it will harden upon quenching. It seems illogical to call the purest iron of commerce—an iron much purer than wrought iron—a steel simply because it was tapped molten from a furnace. As it comes spouting into the ladle, a casual observer could not tell it from a carbon steel, but in the ingot and forever after it can easily be distinguished.

Is it not time to permit our definitions to be illuminated by the great light of metallography? Why not recognize that steel is an alloy of iron and iron carbide? Ah, yes, you will object, but where is the dividing line; if the stuff contains 0.01 carbon is it iron or is it steel? Or is the boundary 0.025 per cent?

As a matter of fact, it is not necessary to split hairs so fine as that. In commercially pure iron all impurities total 0.05 per cent or less. On the other hand, dead soft rivet steel from the converter contains a lot of gas and a total of 0.10 per cent or more impurities found by analysis; but to bring this metal to workable form carbon must be increased to 0.08 per cent and other elements (mostly deoxidizers) to a total of 0.35 per cent or more. In other words, the purest, softest steel of commerce contains nine times as much impurity as commercially pure iron. A man with a microscope need never confuse wrought iron with either.

Steel is a malleable alloy of ferrite and cementite. The definition includes all varieties from low to highest carbons, and differentiates them neatly from cast irons and pig irons—gray cast iron contains graphite and is not malleable; while white cast iron may contain iron carbide and be free of graphite, it is not malleable; and lastly annealed cast irons may be malleable, but they contain most of the carbon as graphite. Of course steels may easily lose their malleability by quenching; on the other hand, they are malleable when cast or can be remade malleable by the proper heat-treatment. By heat-treatment the iron carbide may also be suppressed, almost seem to be destroyed, yet it may again be regenerated and always returns as cementite and not as graphite. In alloy steels the ferrite is not pure iron, but often contains most of the added element in solid solution; the cementite may also be a complex carbide —in some cases there may be more than one carbide distinguishable under the microscope. Yet the most complex alloy steel is essentially of ferrite and cementite. Nor is there any doubt that austenitic steels (such as high-manganese steels) would break up into these constituents under a correct conjunction of temperature, pressure and time.

Many adjectives may qualify the word, noting its principal impurity or alloy, its method of manufacture, its heat-treatment, its use or its maker, but essentially, "Steel is a malleable alloy of iron and iron carbide."

Readers' Views and Comments

Students at the Chemical Exposition

To the Editor of Chemical & Metallurgical Engineering

SIR:—For a number of years the Sheffield Scientific School of Yale University has given a special summer course to all engineering students. The civil engineers go to a camp, while the mechanical, electrical and metallurgical engineers visit power plants, foundries and machine shops. When the course in industrial and engineering chemistry was established at Yale, in 1919, it was arranged that students in this course should also take summer work along with other engineering groups. It was first proposed that part of their time be devoted to visiting chemical plants. This portion of the work was assigned to me. Noting that the week in which I was to have charge of this group of men coincided with the time of the Sixth National Exposition of Chemical Industries in September, 1920, I made the request that I be permitted to take my class to New York to attend the exposition, supplementing, if necessary, with plant trips in the limits of Greater New York. Prof. T. B. Johnson, director of the Sheffield Chemical Laboratory, agreed heartily with this suggestion, but felt that the exposition would be sufficient in itself. Experience has shown this to be entirely true.

After two days in New Haven given to lecture and sketching periods, the class of 1922 in industrial and engineering chemistry was brought to the exposition for three days' work, followed by a final examination. Our experience was so pleasant and so satisfactory that this visit has been made a permanency. I have recently concluded the third of these courses, devoted mainly to chemical apparatus of manufacturing size. More than sixty men have taken this course in three years. In the past two years the students have spend the entire week in New York, lectures being given in the morning and the afternoons being devoted to visits to the various booths and study of the apparatus and machinery there shown. We have been treated with the utmost consideration and courtesy both by the management and the exhibitors. In my opinion and in the opinion of the entire faculty of the department of chemistry of Yale, this plan has been an unqualified and complete success. Not only do our students gain a conception of the construction and operation of chemical apparatus but they are infinitely more benefited by the revelation of the vast scope and power of the chemical industry and by the inspiration and vision which could not possibly be gained any other way.

The wish has been expressed that other universities might take advantage of this opportunity to send their classes to the exposition as a part of the required work in chemical engineering, and the suggestion has been made that experts in each line could be induced to talk to the collected groups of students. I wish to indorse this plan and express the hope that it may be realized. I am sure that all this could be arranged. Headquarters could be established in a booth devoted to visiting university and college students. Catalogs and trade literature could be filed under proper classifications: photographs and drawings could be mounted for easy accessibility; and the various exhibits could be cross-indexed in such a way that students could find mos easily all the things they needed to see. If there wer groups of different advancement, proper divisions coul be made, so that students seeing heavy apparatus fo the first time could be taught separately from thos already familiar with the basic principles of such ap paratus, leaving them opportunity to study details improvements and new developments.

A wise choice of experts, whose principal object woul be instruction rather than sales talk, would give thes college students a corps of teachers, authorities i their special subjects, that could not be equaled. In stead of our small group from Yale and men fron Columbia and other New York institutions who nov come independently, there is no reason why hundred of students from all over the United States could not b drawn to the most instructive week of training eve given to college men.

Speaking for myself and for Yale, I am only too gla to pledge our time and efforts to such a movement.

Personally and in behalf of my students and of Yal University, I desire to express thanks and appreciatio for the uniform kindness and courtesy we met on ever hand, and most of all for the splendid opportunity t see and appreciate the chemical industry of the Unite States.

W. T. READ.

New Haven, Conn.

Black Fractures in Carbon Tool Steels

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your journal for Aug. 9, 1922 (vol. 27, p 265) Arthur W. F. Green has directed the attention o readers to an interesting phenomenon regarding black fractures sometimes observable in carbon tool steels.

The present writer considers that black fracture owe their origin to the segregation of the impurities i the ingot. According to the theory of graphitization advanced by Dr. T. Murakami and myself, graphitiza tion is not caused by the direct decomposition o cementite into ferrite and graphite, but is due to a catalytic action of carbon monoxide or dioxide.

In steel ingots, segregation is always formed in por tions somewhat inside the surface, but not in thei central portion, where the cooling is uniform. In square ingots, the segregation is found in the transverse sec tion as a square zone parallel to the sectional form, it corners being rounded. During the forging of th ingot into a circular rod or a billet, the segregated por tion may preserve its original form. By a prolonge heating, the graphitization takes place by the catalyti action of carbon monoxide or dioxide in portions where such gases are concentrated to a considerable extent the oxides which are favorable for graphitization[1] ar also found in these portions. Hence the graphitizatio begins in the segregated portion and gradually extend outward and inward, thus increasing graphitized area If the above view be correct, black fractures can b avoided, if the segregation be absent or very slight

[1] *Science Reports*, vol. 10 (1921), p. 273.

That black areas have never been noted except in steel after it had been annealed shows that the graphitization took place during the prolonged annealing; the spheroidization of cementite has no direct connection with the graphitization, indicating only that the heating interval was sufficiently long. Even in black areas, some cementite still remains undecomposed; this cementite, as well as some of the decomposed graphite, especially fine graphite particles, dissolves at the A_1 point in ferrite. Hence it is easily understood that thermal curves for black portions show no abnormality, and that the black portion can equally well be hardened by quenching. The fact that annealing of the quenched specimen (which was originally black) at a temperature a little below its critical point for 2 hours restores its original black fracture indicates that the cause of the graphitization—that is, the segregation—does not disappear by quenching. This is as would be expected.

The above explanations are given by way of examples, but other facts as enumerated by Mr. Green are satisfactorily explained by the above view.

Sendai, Japan. KOTARO HONDA.

A British Editor's Impressions of the United States

By FREDERICK E. HAMER
Editor, *Chemical Age*, London

MY FRIEND the editor of *Chemical & Metallurgical Engineering* has asked me to set down some impressions of American industrial conditions gained during a stay of 4 weeks in the United States as a delegate from the Weekly Newspaper Proprietors Association of London to the Associated Business Papers, Inc., of America. It is inevitable that one's observations should be more or less superficial in such circumstances; at the same time, on the principle that the spectator sometimes sees most of the game, they may be worth recording.

Unity of Types and Similarity of Problems

My chief and most lasting impression is one of the essential unity between the British and American types of character and of the similarity between the industrial and economic conditions and problems in both countries. An Englishman visiting the other European countries—Germany, Italy, Switzerland, France or Belgium—invariably feels, however friendly the people may be, that he is in a foreign land. Here it is entirely different. Though this is my first visit to America, I at once sank into American conditions as into a comfortable armchair, and after a little over 3 weeks I feel as much at home in New York as I do in London. The language no doubt largely explains it; that in itself is a great and vital bond. But the likeness extends to our sympathies, our moral outlook and our general point of view. It is a great comfort to feel that the foundation principles of the founders of the American republic are still the basis of national thought and policy, and while that remains I feel that America cannot go far wrong. The future of the world rests with the English-speaking race, and if America beats England in its efforts for the welfare and progress of mankind we shall applaud and never envy your success.

Economically, both countries seem to be running on almost parallel lines. Taking the chemical industry as an example, the armistice was followed by an unprecedented boom, during which money was made with astonishing facility. One result was to bring into the chemical industry large numbers of people who knew nothing about chemicals. They bought up chemicals as they bought up anything that came along because the scarcity was such that the speculator could sell anything he possessed at almost any price he cared to ask. That unhealthy condition disorganized trade, produced a false sense of prosperity and encouraged wild speculation. This stage ended with dramatic suddenness. In a moment trade came to a stop; the speculator was left with heavy stocks on hand, and the genuine trader found that instead of being able to sell anything he could sell nothing. The "slump" lasted about 18 months. It was the most severe in the history of British chemical industry. The large firms had to hold expensive organizations together. Many of them lost heavily, and I know of several instances where people had to sell their war bonds to pay income and other taxes. Now, fortunately, the depression has passed the lowest point, and a steady revival is in progress. That, in brief, is the history of chemical industry in England since the close of the war, and I gather that it is very much the history of it in America. Let us hope that for both there is a long period of prosperity ahead which will compensate for the losses and anxieties of the past.

Similarity of Conditions Is General

But the similarity between English and American conditions appears to be general. The finest address I have heard in America was one by Mr. Barnes, the president of the United States Chamber of Commerce, reviewing generally the present condition of American industry. Passage after passage might have been taken bodily out of that address and if put into the mouth of our Chancellor of the Exchequer or President of the Board of Trade they would have described exactly the condition of things in England. The primary need of settling down to work as the only real remedy, the damage caused to industry by strikes and the continual fear of strikes, the unwillingness of employers to embark on new enterprises until conditions have become reasonably stable, the irritation caused by meddlesome government restrictions, and the demand of the trader for freedom to get on with his business—these were the things that Mr. Barnes emphasized, and they are exactly the things which British economists and business men like my chief, Sir Ernest Benn, have been continually emphasizing at home.

Incidentally I have been impressed with the thoughtful and rseponsible tone of the American public men I have met. If one judged of America solely from the jumpy headlines splashed all over the pages of the daily press, one might assume the American to be a particularly blatant and noisy person, having, like the seed which fell by the wayside, no depth of earth. The truth is the very opposite. Most of the speeches I have heard have been distinguished by moral earnestness and sincerity, by great analytical and penetrative thought, by a desire to go quietly to the root of the matter, and by a sense of exactitude in the use of words excelling even our own standards.

Important Role of the Technical Press

This brings me to the question of the business and technical press of America. I came over to America as a delegate from the trade and technical press of London to the business press of America. I brought with me messages of greeting from a number of distinguished

journalists and public men, and nothing was more significant than their unanimity in emphasizing the important part the business press of both countries must play in getting national business once more on to sound lines. Politics here seems to be even more of a game than with us. It is a game of personalities and parties, and the daily press is largely a reflection of these conditions. The result is that business is often the sport of politics, and economic problems are handled not on sound economic principles, but with a view to catching the popular vote. There is a growing feeling with us that the genuine commercial community does not bring its proper weight to bear on national policy, and if it is to do so it must be largely through the medium of the commercial and technical press. The great journals, for example, of the McGraw-Hill Co. understand the conditions of the various industries they serve in a way the daily journal cannot pretend to do. They can ascertain and explain the bearing of legislative changes, like the substitution of a tariff for the dye embargo, with direct authority derived from first-hand acquaintance with industrial conditions. They are in a position to serve industry in a twofold sense—first, by acting as the spokesmen of commercial interests, and second, by informing legislators and public officials on questions about which they must otherwise remain ill-instructed. The commercial and technical press of America is a magnificent instrument for the service of American industry. It has already attained an influence and reputation extremely creditable to itself, and I am impressed by the extent to which it is used, both technically and commercially, by the great industries it serves. It has, however, not reached the limits yet. My impression is that it has a still larger mission, not only in educating the industries themselves and spurring them on to the very best commercial and technological methods but equally in educating the government in relation to industry and seeing that public legislation and regulations are based on a sound knowledge of industrial conditions.

Finds Americans Interested in British Affairs

One word more. It is pleasant to find how keen over here is the interest in British politics and trade. That does not support the theory that America has no interest in Europe. On the contrary, everywhere I go the inquiry has been, What is the future of Lloyd George? What is the present position of English political parties? What are England's economic and industrial problems and how is she going to face them? In spite of themselves Americans are interested in England and in Europe. Morally they cannot afford to live to themselves, even if that were commercially possible. America, as a land built on the principles of liberty and equal justice for all, has a moral duty to civilization which it cannot ignore without damage to its own moral fiber. I have formed the impression that the real wealth of America lies, not in its gold, but in its deep human sentiment and in its sense of the moral side of life. It is in these fundamentals that the essential unity of the English-speaking peoples come out. We in England speak but little perhaps of Anglo-American unity because with us it is so natural and inevitable that it does not need to be put into words. But it is good sometimes to give expression to what is in the hearts of both peoples, and I believe that the interchange of visits and ideas is equally good for both nations, and is good for the whole world. I shall carry back with me lasting memories of American hospitality and kindness, and the impression that, underneath our external divergences, there is a unity of mind and soul that must never be severed.

Chloride Volatilization

Notices of work done by the Bureau of Mines on chloridizing volatilization of complex ores have appeared from time to time in these columns. The process consists, in general, of calcining a mixture of ore and calcium chloride in a rotary kiln, whereupon metallic chlorides fume away, being recovered by a Cottrell treater. Values are then extracted from the fume (with recovery of the chlorine) by a simple melting with a limestone flux.

For several years the chemistry of the process has been under investigation at the Berkeley station. The vapor pressure of lead chloride and of silver chloride has been measured. In connection with the formation of silver chloride vapors in the furnace atmosphere it was necessary to study the hydrolytic dissociation of silver chloride and the necessary concentration of hydrochloric acid and chlorine to prevent this dissociation. Similar work is contemplated for the chlorides of zinc and copper as well as for sodium chloride. With a knowledge of the vapor pressures of the various chlorides it will be possible to gain an idea of the ease of formation of such chlorides in a furnace, and a study of the hydrolysis of these chlorides will give data as to the necessary furnace atmosphere in order to chloridize compounds of the metals involved.

During the original investigations at Salt Lake City, an excessive loss of copper and chlorine was noted when smelting the recovered fume, especially from copper ores. Experiments are now under way at the Seattle station of the Bureau of Mines, looking toward the design and construction of an electrical furnace for this duty, expecting it will not cause the losses which occur in fuel-fired furnaces. Experiments have also shown that the latter will not fume excessively if operated at less than 1,150 deg. C. and the fume introduced below the slag line.

Many valuable data on the commercial aspects of the process have been collected by observation of the operation of a volatilization plant at the Yellow Pine Mining Co.'s property, at Goodsprings, Nev. Some experiments were carried on at a plant in Harbor City, Calif., and a high-grade zinc oxide was manufactured direct from zinc carbonate ores. The volatilization tests on ores carrying less than one-half of 1 per cent lead gave complete volatilization of the lead. The results of the tests indicate that volatilization would free the zinc ores of sufficient lead content to make a commercial zinc oxide usable for all purposes other than for making automobile tires. (Zinc oxide for making automobile tires must contain less than one-half of 1 per cent lead.) The experiments proved satisfactory, a company is now being organized to construct a larger and more up-to-date plant to commercialize the process.

A great many experiments have been conducted on different low-grade and complete ores from Utah and other states. Practically complete extractions of lead and copper have been obtained, and the extraction of silver has been from 50 to 90 per cent. Most of the experiments were confined to complex and carbonate ores. It has been found that copper ore carrying its principal value in the form of chrysocolla is very difficult to volatilize.

European Conditions as I Saw Them*

Industrial Status of Belgium and Extent to Which She Is Suffering From German Competition—Comparative Transportation and Food Costs in Belgium and Germany Show the Abnormality of Conditions in Germany—Belgian Market for American Products

By J. S. Negru

IN RELATING impressions gathered through a series of interviews with industrial leaders, economists, labor leaders and the common people, it is not to be expected that one shall speak as authoritatively as if in possession of written proof of his statements. This is particularly true when, as is frequently the case, the opinions of those interviewed are diametrically opposed to one another. Similarly, visits to plants when limited to a few hours per plant seldom furnish material on which to base unquestionable statements. Such visits usually develop into mere sightseeing tours that may be interesting to those who have never seen similar plants before, but which, as a rule, become boresome to engineers familiar with more modern installations.

Factors Considered Before Reaching Conclusions

During my trip through Belgium I tried to follow a course with respect to interviews and plant visits that would give me a happy medium of results. Thus in my interviews I gave due consideration to everyone's point of view and opinion, but seasoned it later with my own personal deductions. When visiting Belgian plants I kept in mind the very important fact that, whereas in America labor-saving devices are a *sine qua non*, similar plants in Belgium would not be so equipped, due largely to labor conditions. In America, for example, there is a larger floating untrained class of workmen, whereas in Belgium it is possible to employ steadily a group of men with long years of training in their particular lines of work. Another factor considered in reaching my conclusions was that mass production is not yet, and never may be, as pre-eminent in Belgian industry as it is in American industry.

Status of Belgium Before and Shortly After the War

With these considerations in mind, the reader will get a clearer idea of the impressions I carried away after my trip through Belgium. This is a country with a population of nearly 8,000,000, on an area of about 11,800 square miles. The principal and practically the only valuable natural resources are a very industrious population and coal that can be mined only at the rate of 22,000,000 tons per year. From this it will be clear that the country has always had to depend on export business for its daily existence, and apparently always must so depend.

When the war came on and Belgium was invaded, the coal-mining industry alone was continued under pre-war conditions. All of the other industries suffered in a greater or less degree due to the lack of raw material and a lack of facilities for export. Another factor that seriously affected the Belgian industries was the policy of the invading army of forcibly employing a number of Belgians in war work for the enemy. When peace came, Belgian machinery of production was partly destroyed and the remainder badly disorganized. The people were still in a kind of stupor after a bad dream of over 4 years' duration. The immediate result was a transitory stagnation due to the difficulty of arriving at some practical readjustment. Then began the struggle accompanying the ever-increasing cost of needed raw materials, rapidly increasing wages, reduced hours of work, and particularly a very depressing and discouraging slowness in the resumption of their export business when confronted with German competition.

Present Status of Belgium

No doubt it would have been possible for me to collect such statistics as were available, and write with the documents at hand regarding production, imports, exports, wages, index numbers and the like. What I tried to get instead was the views of employers and employees, and some typical examples of the difficulties under which Belgian industry in general was laboring. By so doing I was in a position to draw conclusions as to the causes leading to the then existing situation in Belgium.

With few exceptions Belgian plants are working with machinery similar to that of pre-war times, but the status of employees has undergone quite radical changes. I learned from Mr. B., a Belgian labor leader, that the stand taken by him and his followers is something like this: "During 1920 and part of 1921 the employers grew fat; now it is the employees' turn." This summarizes clearly, I think, the existing friction between employers and employees.

The relatively high wages, averaging, say, $2, as compared with 60 cents in Germany[1], and a stringent application of the 8-hour law have made the fight for the resumption of exports almost an impossible task. The principal exceptions are for those commodities which it was a physical impossibility for Germany to supply due to the fact that she was crowded with previous orders.[2]

Extent to Which Belgium Is Suffering From German Competition

The great extent to which Belgium is suffering from German competition is well illustrated by the following incident. When I was in Aachen, Rhineland, a few miles from the Belgian boundary, early in April, I witnessed the very striking sight of hundreds of Belgian men and women carrying heavy baskets and bundles of newly bought cheap German products, which, I learned, they would sell the same evening to merchants in Belgium. In this manner a thriving business is carried on every day on a small scale with made-in-Germany pipes, cigarette holders, knives, watches, jewelry, pocketbooks,

*This is the third of a series of articles by Mr. Negru on this subject. The first appeared in the Oct. 18 issue, the second in the Oct. 25 issue.

[1] When comparing money values I will use the average exchange prevailing at the time. In round figures $1 equals 12 Belgian francs, equal to 300 German marks.

[2] In confirmation of these observations made during the latter part of March, I may cite the following paragraph from the *Bergwerk Zeitung* of Essen published in the New York *Times* for Sept. 10, 1922: "It is characteristic of the situation that a large concern was not in a position to deliver in time to the factory the sheet iron required for the manufacture of trams for its own mines, although these trams were urgently required. The requirements of the mines for trams has greatly increased. The factories in question are fully occupied until February."

stationery and the like, all being commodities that require large amounts of hand labor. Belgian customs men were very lenient with this class of "importers." Similar traffic on a trainload scale is the rule.

Discrepancy Between Buying and Selling Prices

In order to give an idea of the great discrepancy between the buying and selling prices of commodities thus imported into Belgium, I will cite a few examples from my personal experience. A pipe bought in Germany for 40 marks sold in Belgium for 8 francs, respectively about 13 and 70 cents; a cigarette holder of material looking like Bakelite which sold in Brussels at 1.75 francs could be bought for 8.50 marks at the Tietz department stores in Berlin, respectively about 15 and 2.8 cents; an umbrella bought in Aachen for 380 marks was for sale in Belgium at 40 francs, respectively about $1.30 and $3.30; a pocketbook which in a Berlin store cost 125 marks was for sale at the Brussels Grand Bazaar for 22 francs, respectively 40 cents and $1.85. These comparisons could be continued indefinitely for practically all of the supplies constituting the great bulk of wares sold in the Belgian bazaars and department stores.

With machinery and apparatus it is quite the same. Both Mr. P. and Mr. S., contracting engineers, answered my question as to where they obtained their electrical and other supplies with the very suggestive, "En Bochie" (in Germany).

Is it then to be wondered at that Belgian domestic industry suffers so very severely from German competition?

Neither the German workingman nor the German manufacturer profits from this superdumping policy. On the other hand, a few middlemen and merchants are rapidly growing rich at the expense of German labor to the detriment of the Belgian workingman and merchant.

The extent to which Belgium relies on German-made goods is well illustrated by a short news item published in *La Gazette* of Brussels, April 14, 1922. It has its amusing side, but it is very suggestive of the practical difficulties confronting Belgium in the recovery of her industrial life. I give a translation:

> Last Sunday a flag was presented at Mons to the Amicale des Sous-Officiers Anciens Combattants [Society of Veteran Non-Commissioned Officers]. On the occasion of this patriotic demonstration illustrated postal cards were sold for the benefit of the war invalids.
>
> We have on hand one of these postal cards. It represents the Arcade of the Cinquantenaire.[3] Under the French text one can read: "Brussel, Die Arkade des 50 jährigen Jubiläums."
>
> On the address side there is a brief description of the arcade, but in German only.
>
> Germans furnishing illustrated postal cards for Belgian patriotic demonstrations! You recognize them there.

Comparative Transportation Costs in Belgium and Germany

The cost of railroad and street car transportation in Belgium deserves attention in comparison with similar costs in Germany.

The shortage of coal is far more acute in Germany than it ever was in Belgium, yet the cost of transportation by railroad and street car is, respectively, about one-fifth and one-third what it is in Belgium. Thus the fares from Hamburg to Cologne and from Cologr to Brussels for similar comforts were, respectivel $2.60 and $5.30, although the distance as the cro flies between each two points is about as 2 is to 1. Th uniform street car fare in Germany was 3 marks, sa 1 cent, while in Brussels the fare varies with the di tance, the minimum in the so-called second-class con partments being 0.25 franc, or over 2 cents.

Is this not a clear indication of the reason for suc great deficits in the operation of German transport tion systems, even when taking into consideration th very low average wages of German employees, about 5 cents per day as compared to about $1.70 in Belgium

Comparative Food Costs in Belgium and Germany

In like manner it might be interesting to give a insight into the difference in the cost of food in th two countries.

It would be confusing to take restaurant prices, a they vary with the class of restaurant. I will consider therefore, the prices in the dining cars of railroads o the respective countries, as these are officially fixed fo table d'hôte meals. The cost is about two and a hal times higher in Belgium, although the German meal i perhaps the more generous of the two. As to the cos of food in homes, I learned from conversations wit ordinary citizens of the laboring class that it is abou four times higher in Belgium than in Germany.

From my own experience I know that in pre-wa times the average living costs in Germany and Belgiur were in proportion of 1 mark (25 cents) to 1 fran (20 cents). The present conditions become more strik ing when it is realized that Germany must import eve more now than before the war.

Does it not follow logically from these figures that th cheap living for Germans in Germany on their minimum for-existence wages is utterly abnormal, especially whe we consider that the intrinsic value of German product is now even somewhat higher than it was befor the war?

Research in Germany

To some it may seem beside the mark that I shoul dwell on these matters when I might have been lookin for information regarding research and technical proc esses in Germany, but in my judgment these facts an figures show that people living under such condition have little, if any, opportunity for scientific researc and for changes that are not absolutely necessary.

I can assure my readers that research and experi ments on how to make ends meet with the presen wages are conspicuously and steadily carried out b the wives of scientists in these countries.

Fallacy of Statistics on American Imports From Belgium

During a conversation with Louis Strauss, repre sentative in the Belgian Chamber of Deputies, Alder man and for many years in charge of the harbor o Antwerp, I brought up the subject of Belgian export to America. I explained that our Monthly Summar of Foreign Commerce of the United States gave, unde the heading "Imports from Belgium," figures whic appeared to be quite important, whereas it was m impression from what I had seen and learned that the represented business far beyond what Belgium reall was doing. Mr. Strauss then explained to me that th figures given in these reports represents merely th

[3] The arch in Brussels commemorating the fiftieth anniversary of the independence of Belgium.

products reaching America via Antwerp without due consideration of their original source, and that the greater part of the products classified as Belgian is in reality foreign. Most of them come from Germany and are merely shipped through Belgium. This fact has to be kept in mind when studying such figures.

Policy of Selling Below Cost

When I was in Düsseldorf I learned from Mr. H. some facts that gave me the impression that certain Belgian metallurgical plants are selling for export at prices below cost. When I was again in Belgium a few days later I succeeded in getting some very reliable data that fully corroborated my first impressions.

It will suffice to mention the case of the Providence Company of Charleroi, which underbid the Germans for 5,000 tons of rails for Bulgaria. The bid was 368.5 francs per ton c.i.f. Bourgas, Bulgaria, which represents 314 francs per ton at the plant. At the same time the quoted price in Belgium was between 400 and 425 francs per ton. The explanation given to me was that the Belgian metallurgical industry was forced into this emergency policy in order to avoid shutting down the plants.

In order to learn how the Belgian metallurgical workers looked upon this policy of selling below cost, I interviewed Mr. Baeck, general secretary of the Syndicate of the Belgian Metallurgical Workers. From my conversation I gathered the impression that the workmen give practically no thought to the economic conditions that force their employers to adopt a policy of selling below cost. He summarized the situation by saying briefly, "Ca, c'est leur affaire" (it's their business).

I left Belgium under the impression that industry there is recuperating quite rapidly. This is due not so much to the recent reduction in wages, which are now about $1.70 per day of 8 hours, but to the inability of the Germans to continue much longer their abnormally low cost of production and their superdumping selling price. These conditions make Belgian products accessible in foreign markets and will tend to stimulate local industry. Fortunately, the Belgian experience of selling for export at prices below cost was short lived.

Belgian Market for American Products

Practically all those with whom I spoke regarding opportunities in Belgium for the sale of American products stated that there is a big field for American labor-saving machinery and apparatus and other products, but that present prices are beyond their reach.

With reference to the cost of American products in Belgium, I had a few experiences that led me to the conclusion that one reason why American products are beyond the reach of the average Belgian is plain profiteering by Belgian merchants. As an illustration I may cite the case of a well-known pencil which sells in America for $1 but which was selling in Brussels and other Belgian cities at a fixed price of 25 francs, then about $2.15. From a conversation with Mr. N. of the Musée Commercial in Brussels I learned that the tariff cannot be held responsible for this discrepancy in prices, nor can the cost of transportation be held to blame. In the store where I bought one of these pencils it was explained to me that the price was fixed in the American office, but that does not seem well founded.

I am under the impression that Belgian representatives of American firms are charging for American-made goods as much as the traffic will stand. This may appeal to some as good business, but in reality it keeps the market opportunities within very narrow limits and creates the wrong impression that good American products cannot be had at reasonable prices even in a country with depreciated money such as Belgium.

This and other similar incidents were the subject of an interview with the European representative of a large American electrical manufacturing company, from whom I learned that many American firms are quite satisfied to be represented in Europe solely by natives, and give very little thought to the need of exercising some kind of supervision over the policies adopted by these representatives.

There is a great market in Belgium for American products, especially now when they seem to appreciate the advantages of American industrial equipment. Other favorable conditions already mentioned are the slow but sure elimination of abnormal competition from Germany and the gradual recuperation of domestic industry.

A plan that I think might appeal to American manufacturers is to sell modern industrial equipment to Belgium on a basis that will permit payment to be made from increased production efficiency. I know that such a plan would appeal very favorably to the Belgian industrials, who are already beginning to feel the need of modernizing their plants.

Other articles on this subject by Mr. Negru will be published in subsequent issues.

Candelilla Wax in Mexico

Since the close of the world war production of candelilla wax has shown little life, says a report from Consul F. R. Robinson, at Saltillo, Coahuila. Recently reports have been current of a revival of interest in this line, and it is understood that European interests have gone so far as to make inquiries with the object of contracting for the local output. In former years practically the entire output went to Germany, and Europe has continued to be the best market for this commodity. In 1917 a considerable amount was shipped to the United States, and was found to be very satisfactory. The cost of the local product has advanced about 25 per cent over pre-war prices, labor and other incidental costs having increased.

From 2 to 5 years, dependent upon the amount of rainfall, is required for the production of the candelilla weed, from which the wax is obtained. Primitive methods are still employed in Mexico, the present yield of wax being only about 2 per cent of the weed employed, but it is expected that improved methods will soon be perfected whereby 3 per cent of pure wax together with about 2 per cent of valuable resins will be obtained.

Limestone Quarry Studies

The United States Bureau of Mines has recently undertaken a study of limestone quarrying for lime manufacture, in connection with which a series of short papers on various phases of the industry will be issued. The purpose of these reports is to discuss conditions, methods and equipment, in order to permit higher efficiency and safety in the operation of the quarries. The first of these papers, Serial 2401, "Stripping Problems in Limestone Quarries of the Shenandoah Valley," by Oliver Bowles, is now available and may be obtained from the Bureau of Mines, Washington, D. C.

Atlantic City Meeting of the American Gas Association

Record Attendance and Exceptional Exhibit Combined With Numerous Papers and Committee Reports Make an Exceptional Convention—Papers on Carbonization, Coke Production and Cooling and Condensing of Gas of Greatest Engineering Interest

EDITORIAL STAFF REPORT

ANY convention which has 2,500 members and guests registered cannot help being enthusiastic. And when this large attendance is supplemented by a well-planned exhibit of wide interest to the industry and a fine program of technical papers and committee reports, there is no excuse for any one failing to have a profitable time. It is safe to assume, therefore, that with all these advantages the American Gas Association meeting at Atlantic City, Oct. 23 to 27, establishes a record for the industry.

OFFICERS AND MEETING FOR 1923

For the coming year the work of the association will be guided by the newly elected president, R. B. Brown, general manager of the Milwaukee Gas Light Co., and J. B. Klumpp, of the U. G. I. Co., Philadelphia, the newly elected vice-president. H. N. Brundage, of New York City, was re-elected treasurer, the only other elective office filled by action at this session.

For the 1923 meeting the committee reported in favor of Chicago, if adequate facilities can be arranged, or, failing that, for Atlantic City as an alternate place. There is considerable sentiment in favor of another meeting at this latter city, for the Steel Pier affords to the industry excellent facilities for exhibit of all types of manufacturing and gas-burning equipment that are of interest, as well as adequate space for convention meetings. The 1923 meeting will probably be held early in October, as there is strong sentiment, as indicated by the committee report, in favor of slightly earlier time of meeting than this year.

The Technical Section of the association for the coming year will be under the chairmanship of F. C. Weber, of the Henry L. Doherty Co., and the vice-chairmanship of H. C. Wehnert, of St. Louis. It is in this branch of the association that practically all the engineering and chemical work is done.

EXHIBIT FEATURES

The active interest of all branches of the industry was greatly stimulated by the splendid exhibit of gas-making, gas-distribution and gas-utilization equipment. Evidence of engineering in gas utilization was clearly shown; and the gas appliance men are evidently coming to appreciate that they must give as much attention to appliance appearance and to refinement of detail as has been characteristic of electric appliances in the past.

It is notable that at least three types of automatic control equipment for water-gas operation were on display. Several types of coke ovens were also exhibited by models in a most effective way. Other plant equipment was also shown by several dozen exhibitors.

Gas-metering devices of new types were especially conspicuous. The automatic continuous recording calorimeter of the Cutler-Hammer Co. was shown as a companion instrument to the well-known Thomas meter for measuring gas volumes. These two were accompanied by a third "B.t.u. meter" which was an indicating and continuous recording device for showing the total B.t.u. in the gas. This device is really an indicating, recording watt-hour meter producing a record of the product of B.t.u. per foot (normally measured by a continuous recording voltmeter), and the cubic feet per hour (ordinarily shown by an ammeter).

Another meter that aroused much interest among the engineers present was of the positive displacement type using the same general form of construction as the Root-type exhauster. This device, made with frictionless bearings and somewhat greater precision in other respects than the usual exhauster, was exhibited by the Connersville Blower Co. The meter on exhibit, though taking only a few square feet of floor space, was capable of handling 60,000 cu.ft. of gas per hour. As set up there it was operated by the breeze from a small desk fan directed against the inlet of the meter, showing that with 0.1 in. of water pressure the meter could be started and operated without difficulty. At maximum capacity only 0.5 in. of water pressure is required as a differential between the inlet and outlet. This device is suggested not only for station metering but also for use on industrial consumers' premises. It promises on further development to be of considerable interest in many other industries, for a meter of this simple type would probably lend itself very well to many chemical engineering problems where the metering of gas flow is one of considerable difficulty.

PRESIDENT'S AND TREASURER'S REPORTS

D. D. Barnum, of Boston, the retiring president, emphasized in his address the magnitude of the technical problems of the industry, but pointed out that these increased problems really represented increased opportunity for the industry. Adequate supply of raw material, a decreased unit charge for gas-making investment and low cost generation of the gas were problems of special importance emphasized in this address. The commercial necessity of handling much larger volumes of gas in order to meet heating loads and give good service were also stressed, as well as the usual problems of the relationship between management and employee and between the company and the public.

The report of the treasurer was received with great enthusiasm, for it showed the finances of the association to be in splendid shape and outlined extensive operations in the past and the coming year which are covered by a budget of approximately $250,000 per year. The assets of the association in securities, cash on hand and other property now exceed $100,000.

GAS DISTRIBUTION PROBLEMS

A further presentation of the "Doherty Ideal Distribution System" was made by R. G. Griswold, of the H. L. Doherty Co. He discussed in this paper the basic

principles which underlie selection of piping systems for gas distribution involving the minimum investment and the minimum annual total cost per unit of conductivity furnished. The scheme of judging proper distribution pipe size by the minimum cost per unit of conductivity per year was emphasized. Henry L. Doherty personally contributed a written discussion to this report, bringing out further the ideas upon which this system was originally based when proposed and tried out on a small scale in a number of cities some years ago. The principles discussed would be equally applicable to selection of pipe-line sizes for any other types of gas and hence they afford rather wider interest than is customary for papers dealing with city gas distribution.

Standard Pipe and Meter Sizes

Standard specifications for cast-iron pipe and specials were adopted in revised form by this convention. Full engineering details regarding these pipe sizes are given in the printed committee report already available.

The meter committee of the association took a definite stand in favor of changing meter size nomenclature. Under the new scheme proposed the case and pipe-connection sizes would be indicated by the first part of a meter size number and would correspond to the meter numbering now in vogue under the system of designation by "lights." The committee, however, proposes to add the rating in cubic feet of gas passed per hour through the meter with a standard loss in pressure between inlet and outlet. This rating would form the second part of the meter size number. Thus a meter designated as "30-600" would be one having case and pipe connections the same as an old style 30-light meter and a gas capacity of 600 cu.ft. per hour with a loss of one-half each water pressure between inlet and outlet.

Deposits in Gas Pipes and Meters

A committee on deposits in gas pipes and meters under the chairmanship of R. L. Brown, of the Bureau of Mines, reported on research done in the laboratory of the chairman of the committee. The investigation thus far shows that a number of the organic compounds such as styrene and indene, which polymerize and oxidize readily, are probably the usual gum-forming constituents of the gas. The cause of the very great increase in trouble due to gum in meters and pipes was suggested by the tentative conclusions announced. The high oxygen content in manufactured gas today, particularly carbureted water gas, is believed to be a prime factor in gum formation. The presence of excessive condensable vapor in the gas, of course, would be serious and the high rate of oil input practiced today in many water-gas plants probably gives rise to incomplete cracking of the oil and consequent production of gum-forming bodies. The committee recommends as practical preventives for the trouble (1) reducing the oxygen content of the gas to a minimum, (2) as complete condensation of gum-forming constituents in plant and holder as possible, and (3) so far as practicable prevention of the formation of these gum-making constituents by more efficient oil cracking in the carburetor of the water-gas set. The most feasible method of getting this better oil cracking is to reduce the rate of oil input into the carburetor.

Condensing and Scrubbing of Gas

Two very important articles on cooling (or "condensing," as the gas man calls it) and scrubbing of gas were presented. In an article on "The Use of the Doherty Washer-Cooler as a Water-Gas Condenser," by F. W. Steere, of Detroit, gave a very excellent report on the principles underlying washer-cooler equipment design. The principles brought out in Mr. Steere's paper are applicable in a wide variety of gas-handling equipment.

Scrubbing and condensing facilities for a coal-gas plant were discussed by J. H. Wohrley, a member of the committee on gas plant and production. Some of the more important points brought out by Mr. Wohrley's discussion are as follows:

"A desire to obtain the maximum capacity and efficiency at the smallest investment, and at the same time utilize a minimum amount of valuable space, has led to the investigation of the possibility of designing a form of apparatus which would provide for combining the condensing scrubbing, extraction of tar and removal of ammonia in a single shell or a series of shells.

"The complete scrubbing of the gas is a matter of vital importance, as it is necessary to admit a clean gas to the purification system, even though it may require that a small percentage of vapors be sacrificed to do so. The ultimate results attained will in general be more satisfactory when viewed from the financial standpoint.

"In considering the general lay-out of a system which is believed will provide for the proper cleaning of the gas, removal of the byproducts and incidentally the removal of a portion of the impurities, a diagram is given.

"The apparatus consists of a primary scrubber located ahead of the exhauster. The cooling of the gas from the foul main temperature to approximately 70 deg. F. is brought about in this scrubber.

"A curve shows the amount of heat that theoretically must be removed per 1,000 cu.ft. of crude coal gas in cooling through various ranges of temperature. From this the theoretical amount of liquor can be calculated. The degree to which the actual and theoretical amounts will agree will depend largely upon how intimately the gas is brought into contact with the saturated liquor.

"The following table shows the amount of liquor necessary and the sq.ft. of cooling coil required per 1,000 cu.ft. of gas passed for various inlet temperatures where the gas is to be cooled to 70 deg. F.:

Inlet Temp., Deg. F.	Gal. Per Min.	Sq.Ft. Coil Area
120	0.26	6.6
125	.29	7.9
130	.31	9.3
135	.34	11.1
140	.37	12.8
145	.38	14.4
150	.45	17.9
155	.51	21.6
160	.59	26.3

"The ultimate temperature to which the gas may be reduced upon leaving the primary scrubber will, of course, be limited by the temperature of the cooling water used on the cooling coils, and upon the surrounding atmospheric conditions. However, with cooling water of approximately 60 deg. F., there will be no difficulty in bringing the temperature down to 70 deg. F. This differential of 10 deg. F. should represent a maximum when proper adjustments of liquor flow and cooling water flow have been made and when due consideration has been given to the area of the cooling coil surface, the distribution of the scrubbing liquor and the design of the filling used in the shell."

Sketches show the difference in action in an ordinary

tubular condenser and that taking place in a tray-filled shell. The difficulties and advantages with the direct contact system as compared with the indirect system of cooling are fully treated in the complete paper. The different types of scrubber fillings and methods for making sprays for wetting the grids or other filling are also discussed. Results of operating tests are presented to bring out the practical results which can be expected from different kinds of equipment.

As a result of the investigation the author concludes that the washer-cooler installation permits minimum cost of maintenance and operation, has a minimum space requirement, requires no buildings except for pumping equipment, has simplest construction with no moving parts, has maximum cooling efficiency and is capable of reducing the temperature to a point most favorable for complete removal of ammonia. The results achieved with such apparatus provide for delivering only clean gas to the purifiers and for the maximum recovery of both tar and ammonia, the two important byproducts involved.

The report by Mr. Wohrley also discusses the various kinds of loss and methods of computing and controlling loss of ammonia during recovery from coal gas. The principles involved in this discussion would, of course, be equally applicable to coke-oven systems.

Accident Prevention

The committee on accident prevention had rather a full report discussing resuscitation, first-aid equipment, gas masks for plant and distribution department use, and the methods of organizing safety work. Of widest technical interest is the detailed report which forms one of the appendixes of the committee report, dealing with resuscitation from carbon monoxide asphyxiation. This report is based on an extended experimental study of treating carbon monoxide poisoning by means of oxygen plus carbon dioxide. The work was done by Dr. Yandel Henderson and Dr. H. W. Haggard, assisted by a number of collaborators and assistants.

These investigators conclude that manual artificial resuscitation by the prone pressure method should be employed whenever respiration has ceased, but that using oxygen plus carbon dioxide simultaneously aids greatly. The breathing of oxygen plus 5 per cent carbon dioxide causes very complete ventilation of the lungs and greatly accelerates elimination of carbon monoxide from the blood. There is nothing difficult about this administration and it requires no more careful supervision than any case of asphyxiation. The authors believe that this rapid elimination of carbon monoxide greatly decreases the likelihood of nervous disorders or pneumonia following carbon monoxide asphyxiation.

A separate report on masks for gas plants recommends the hose type of mask with air blower for all-around use and warns against promiscuous use of army masks and advises against depending upon the oxygen-type mask for simple work or the cannister-type unless adequate oxygen supply is known to exist. The first-aid equipment and methods of safety organization recommended are suited to general industrial plant purposes.

Carbonization Committee Report

The carbonization committee of the association presented one of the most complete and valuable reports ever given to the gas industry by any association committee. The work, as in former years, was divided in several parts, typical operating results being considered by one sub-committee, low-temperature carbonization by a second, complete gasification by a third and new types of construction by a fourth.

The committee announced that further work would be done during the coming year with an appropriation of $3,000 which has been granted for experimental research at Ohio State University, using the vertical retort installation already there and a new horizontal retort which is to be installed. The present equipment represents a single full size U.G.I. vertical. The horizontal retort to be installed is being contributed by the Improved Equipment Co., representing typical small-plant construction of a modern sort.

Typical operating results were not reported by the committee this year, because it felt that the basis of reporting had not been adequately studied formerly. The committee, therefore, gave a great deal of time to the revision of the forms on which coal carbonization results should be recorded and reported. These revised forms are given in full and are now proposed for comment and criticism, before adoption for use during the coming year by the new committee.

Operating results were reported by the committee from the plant at Racine, Wis., where "outside producers" are used. This work is similar to that presented at the 1922 convention of the Wisconsin Gas Association.

Firing Coke Ovens With Blue Gas or Producer Gas

W. R. Morris, assistant superintendent of the Seaboard Byproduct Coke Co., gave a full report on an experience at that plant using blue gas and producer gas for firing coke ovens. The results with the two fuel gases were strictly comparable, because the work had been carried out simultaneously on almost identical batteries of ovens and had extended over considerable periods of time. Full operating data are given from which the author draws the following very important conclusions:

(*a*) The overall or the gasification and combustion efficiency of producer gas is much greater than that of blue gas as shown by the following comparison:

	Producer Gas	Blue Gas
Pounds dry fuel to carbonize a ton of coal	225	295
Pounds of carbon to carbonize a ton of coal	199	261

In other words, only 76.3 per cent as much fuel is required with producer gas as blue gas to carbonize coal.

(*b*) Poorer and less salable grades of coke can be more readily used in a producer plant.

(*c*) Producer operation requires much less labor per ton of fuel gasified.

Since the collection of the operating data given above, we have put through our six producers for a period of 3 weeks almost 300 tons of coke per day, or from 45 to 50 tons per producer per day without any appreciable difficulty and no addition of labor.

Carbonizing 50 tons per day per producer and 50 tons per day per blue gas generator the labor is:

Producer 0.51 man-hours per ton gasified;
Blue gas 1.50 man-hours per ton gasified.

In the entire producer plant there is required no labor whatever of the particularly heavy or arduous type, while no one questions the strenuous task of clinkering a water-gas generator.

(*d*) Continuity of operation of a producer plant is such that the machines run for weeks and months at a time with no attention other than watching that the conditions set are regularly maintained. The possible mechanical derangements are a minimum. This must appeal particularly to the water-gas man, familiar as he is with the intermittent operation required with a water-gas generator.

(*e*) Mixing the blue gas and producer gas with coal gas for the purpose of obtaining a specified B.t.u. can be done with equal ease.

(*f*) The manufacturing cost of blue gas per million B.t.u. is fully 40 per cent greater than producer gas. This cost is based on the same value for generator fuel in each case, which is decidedly unfair to producer gas as it uses inferior and therefore cheaper grades of coke.

Conclusions—As a part of a large byproduct plant furnishing gas for city use a blue-gas plant has advantages over a producer plant in times of coal shortages, caused by strikes or other contingencies beyond the control of the manufacturer. Also in a business depression, when the market for coke is poor and prices low, a blue-gas plant is desirable because more blue gas than producer gas can be mixed with the coal gas, which also means that a greater percentage of coke can be turned into gas.

However, for anything like a steady operation a producer plant is a far better proposition:

First, because of its greater efficiency in changing heat units in the form of carbon to a combustible gas.

Second, because of the simplicity and ease of operation.

Third, because of the far lower manufacturing cost.

Low-Temperature Carbonization

The sub-committee on this subject reported by means f three technical papers. The first, by J. D. Davis, of he Bureau of Mines, who was chairman of the sub-ommittee, discussed "Low-Temperature Tar and Its valuation." Two of the important conclusions reached y this author are as follows:

Low-temperature tar may vary considerably as regards yield and character of its constituents, depending on the conditions under which it has been generated. If, for example, it is desired to produce a tar in which the constituents have suffered the least alteration, it is necessary to carbonize at the lowest practicable temperatures and to remove the tar vapors quickly from the heated retort, either by evacuating or by circulating inert gases. This procedure reduces the gas yield to a minimum and results in the production of an inferior semi-coke. Tars generated at intermediate temperatures and distilled at atmospheric pressure undergo more or less thermal decomposition, with the result that the gas yield rises and a coke dense enough for domestic use is produced.

In the United States it may pay to develop a low-temperature carbonization industry primarily for the production of a domestic fuel with motor spirit as a liquid byproduct. Certainly such an industry would effect a conservation of our fuel resources and tend toward abatement of the smoke nuisance caused by the domestic consumption of soft coal. It would not greatly affect present established carbonization industries. Another possibility is complete gasification of bituminous coal with preliminary carbonization at low temperatures, the tar to be worked up primarily for motor spirit. In any case, the main tar product will probably be motor spirit, and low-temperature tars should be evaluated with this idea in view.

Internal and External Heating of Retorts

The second paper presented by this sub-committee as by Charles V. McIntyre, of New York City, who iscussed "Internally Heated Retorts." Problems and rocesses for internal heating with producer gas, water as, coal gas, superheated steam and products of combustion were all presented. The author gives the impression that the most encouraging of these processes re those which contemplate the use of water gas as the iedium of heat transfer. Of course, such method eally results in a complete gasification process or some ear approach to that result.

Internal heating of retorts must be done at extremely w temperature to prevent the coal from becoming lastic or the retort must be equipped with mechanical irring devices. As a result internal heating of re-rts results in producing a char instead of a coke. his material is granular and dusty and suitable, in eneral, only for grinding into powdered fuel for stok-s or for briquetting or for use in producer-gas or water-gas making. The author concludes that "the most successful internally heated processes operate in conjunction with, and deliver their entire residue to, gas producers or water-gas generators.

External heating of retorts for low-temperature carbonization was discussed by Dr. Harry A. Curtis, of the Clinchfield Carbocoal Corporation, who gave special attention to the problem of transferring heat to the coal mass through the retort body. As a very complete discussion of this general subject has been prepared by Dr. Curtis for publication in *Chem. & Met.* at an early date, no further discussion is required here.

Complete Gasification of Coal

The sub-committee discussing complete gasification reported through its chairman, R. G. Porter, of Chester, Pa., regarding a number of the fundamental problems of city gas supply using very lean gases. Emphasis was laid upon service problems involved with such gas and the possibilities of house heating and other extension of gas service for replacement of solid fuel. As appendixes to the report there are given descriptions of a number of the successful processes for complete gasification that have been used for short periods in a few localities. These descriptions include the Tully gas plant, the J. U. McDonald process as applied at Valparaiso, Ind., and the Doherty complete gasification plant at Toledo, Ohio.

New Gas-Plant Construction

The builder's section of the committee furnished a number of brief reports on new types of gas plant construction and new plant machinery. This group of reports included a description of the Roberts oven, by H. V. Patterson; a description of charging and discharging machines of the Bartlett-Heyward type, by H. L. Underhill; carbonization apparatus of the Gas Machinery Co., by W. E. Steinwedell; continuous type Glover-West vertical retorts, by E. G. Blackwell; new type Koppers oven, by H. J. Rose; the new carbonization plant built by the Russell Engineering Co. at Lowell, Mass., by Vernon Baker; the new Semet-Solvay byproduct coke and gas ovens, by C. R. Bellamy; and further details on the U. G. I. Contracting Co. installations of vertical retorts, by J. H. Taussig. Mr. Taussig is chairman of this sectional committee.

Preparation and Merchandising of Coke

W. G. Rich discussed the commercial problems in merchandising coke, giving as illustrations of the methods discussed a full report on the domestic sale of coke in Providence, R. I. Special emphasis was laid on the problems of advertising the product effectively.

"The Manufacture and Preparation of Coke" was the title of an article by R. L. Fletcher, who is also connected with the Providence Gas Co. Although written from the standpoint of a gas man, the author laid great emphasis on the necessity of treating coke as a principal product, instead of merely a byproduct of gas. The preparation of coke to form a satisfactory substitute for coal, of equal or greater efficiency for general use, was shown to be an entirely feasible matter.

Mixing of coal and pulverizing the mixture were urged to produce good water-gas coke as well as high-grade domestic fuel. The methods and equipment for handling the coal for charging and the proper methods for screening and crushing of coke were described. It is especially notable that the equipment recommended

by this author for gas-works is almost exactly that commonly employed in the byproduct coke-oven plants. Problems of storage, sizing, sampling and analysis were also discussed briefly.

Availability of Papers

The Gas Association had preprinted the principal papers and committee reports, hence those specially interested can procure most of the material of greatest value by application to the association headquarters, 342 Madison Ave., New York City.

Balls Used for Hardness Testing

J. J. Curran, of the Henry Souther Engineering Co., speaking before the Detroit meeting of the American Society for Steel Treating, described some tests made on four different kinds of balls intended for use in Brinell machines. One lot of plain carbon steel was made by a foreign manufacturer, another of chromium-tungsten steel was made by the Hoover Ball-Bearing Co., and the two others were chromium steels of local manufacture.

Surface polish—an essential for durability in a ball bearing—seemed to have little to do with their utility for Brinell testing. The best balls (as it developed) had a very inferior polish. All of the balls of all varieties were measured and passed a rigid inspection for shape.

When testing by a scleroscope, mounted in a special fixture, the balls of carbon steel seemed to be hardest. When mounted three above each other and crushed, the results were so erratic that conclusions could not be drawn. Finally, two disks of Cr-W steel (ball steel) were hardened carefully, a ball placed between them, and 3,000 kg. load applied. This test was repeated on three balls of each variety, the disks being indented in a different place each time. Invariably the two indentations made simultaneously by a single ball were identical, so it appeared that the disks were of uniform and equal hardness. However, the carbon steel ball gave the smallest impression—i.e., indicated the highest hardness in the disk (approximately 700). Other varieties of balls indicated valves as low as 600. Lastly, each ball was remeasured for permanent deformation. Each one was flattened by the single test it had performed, but the flattening was least in the hardest ball (carbon steel).

From these results it seems desirable to get the hardest ball possible for use in a Brinell machine.

Evaporation Losses of Petroleum Products

In the general study of evaporation losses of crude oil and refined products, being made by the Bureau of Mines, an elaborate series of tests has been made at a Ponca City, Okla., plant to determine the relative rates of evaporation of gasoline when stored in ordinary tanks and tanks fitted with water-sealed roofs. Tests were also made to determine the amount of gasoline that was lost in filling a tank car with straight-run gasoline of 56 to 58 deg. Bé. gravity. Temperature measurements are being made to determine the temperature of oil in three different types of tank—one of the ordinary 55,000-bbl. type, one an 80,000-bbl. insulated tank, and one a 55,000-bbl. insulated tank on which a water spray is used. Arrangements have been made for conducting a series of tests to determine evaporation losses at an Okmulgee, Okla., refinery.

A Practical Method for Preventing Explosions Due to Accumulations of Static Electricity

By Hilton Ira Jones
Director of Research, The Redpath Bureau

In JANUARY, 1919, we were working on the preservation and sterilization of eggs.[1] In the course of this work we employed an R.U.V. ultraviolet light outfit, and also produced enormous pressures according to the system of Hite (University of West Virginia) followed by sudden vacuums. This was accomplished by placing the eggs in an equal molecular mixture of oxygen and hydrogen gas, exploding the mixture and condensing the water vapor. In the course of this work we observed a marked change in the discharge of the Ruhmkorff coil whenever the ultraviolet machine was operating near it. Also we employed a Cenco Hyvac pump and on several occasions got the ordinary spark discharges from the belt when the machine was running, and we observed that these immediately disappeared as soon as the ultraviolet outfit was started. We have also for several years performed as a regular demonstration in general chemistry the explosion of powdered starch in an inclosed chamber. We used a sewer tile set in a cement base and covered with strong paper, tightly tied. A small amount of finely divided starch was blown in a small hole at the base. The mixture was exploded both by placing a flame at the hole and also by a spark discharge between two points within the tile. On this particular day we prepared the demonstration in the room where an X-ray was running and we were disappointed at our inability to make the explosion take place with the spark as usual.

Investigations on Cause and Prevention

During the past year we have been carrying out experiments in connection with the work of the dry cleaners, mainly in the revivification of the waste gasoline by a new process, soon to appear. An explosion of the gasoline vapor in the "tumbler" of one of the plants in the city led us to investigate the cause and possible prevention.

Our experiments and observations have led us to see that most "mill dust" explosions, gasoline "tumbler" explosions and indeed a majority of powder mill explosions are caused by sparks of static electricity. These may be prevented, at least in nearly all cases, by ionizing the air. This has the effect of causing the static to "drain off" quietly and harmlessly as fast as produced. In fact it is quite impossible to produce static or other electric spark explosions in the presence of highly ionized air.

The air may be thus protectively ionized in many different ways, by ultraviolet light, by X-ray, by radioactive substances or any other means that will cause the emission of electrons in sufficient concentration. A tube of the type of the old Crookes tube we have found best. Some glasses are much more permeable to the electrons than others. We are now taking up with the Corning Glass Co. the production of a special glass for the manufacture of a tube for the ionization of the air in factories and mills. We are hoping that these may be placed on the market soon. Appropriate patents are of course being applied for.

Chicago, Ill.

[1] *J. Ind. Eng. Chem.*, August, 1920.

Accounting Needs of Technical Men in Executive Positions

Accounting Needs Technical Balance as Much as the Technical Executive Needs Accounting—Pertinent Examples Are Discussed—Finally the Type of Accounting Knowledge Needed by the Executive and the Means of Obtaining It Are Outlined

By F. W. Thornton, C.P.A.
Price, Waterhouse & Co.

From articles that have already appeared in this publication, it seems that there still are executives in the chemical and metallurgical industries who believe cost accounting to be without value, at least for them. This belief is probably held by technical men with small accounting knowledge who now occupy executive positions. On the other hand, there are in all lines of industry executives who are not technical men but who have a good knowledge of accounting and who think they can prove from cost accounts many things that are not so. Both classes of executives are half wrong and half right, due to the fact that they are only half equipped for their positions.

Perhaps in no other business is the need for technical knowledge to direct cost accounting so great as in the chemical and metallurgical industries.

Executive heads if not originally technical men cannot be expected, after they have become immersed in business, to acquire a sufficiently exhaustive knowledge of the technical side of a chemical or metallurgical industry to serve them as they should be served. Executives can and generally do obtain some knowledge of the technical side of their business, but the ideal executive is one who, originally a technical man, has obtained a good knowledge of accounting and gone forward into the executive department. Nothing produces more unsatisfactory results than a strict separation of the lines of promotion of technical and non-technical men similar to the division between the line and the staff in the Army.

An Example of the Need of Technical Guidance

The history of LeBlanc soda offers one of the best examples of the need for technical guidance in cost accounting. Originally soda (soda ash or carbonate) was the only product aimed at. Hydrochloric acid was a byproduct of little value, often a waste product; salt cake was not then used in glass manufacture, so-called "sulphate" paper was not manufactured, and except as horse medicine there was little if any sale for sodium sulphate. At that time correct cost accounting would have taken as the cost of the soda ash the entire cost of manufacture less whatever was recovered for HCl or other byproducts.

Then the ammonia process came, producing better and cheaper soda; it produced no HCl; and this latter product rose in price. Eventually the LeBlanc process was continued only because of the HCl—or bleaching powder—which it produced. At this time correct cost accounting would have shown as the cost of bleaching powder the entire cost of manufacture less whatever was received for soda, which became a byproduct, or for recovered sulphur.

Finally electrolytic soda and chlorine have come; the LeBlanc process is almost dead except that the first step—the manufacture of sodium sulphate—continues, the salt cake being sold as such.

Clearly the only present reason for continuing is the production of sodium sulphate, the HCl being a byproduct. Correct cost accounting will show as the cost of the sodium sulphate the entire cost of manufacture less whatever is received for HCl or other byproducts.

"Process," Not "Product," Should Be the Cost Basis

It will be noted that a great error into which non-technical cost accountants fall is the endeavor to show separate costs for each *product*, whereas a better basis is the cost of each *process*. In the issue of Aug. 16 there is pointed out (page 296) an absurd result that could be arrived at by the application of doctrinaire cost accounting—namely, a profit on Na_2SO_4 with a concurrent loss on HCl, and as a result the suggestion that the business be pushed in salt cake but not in HCl. We can go much further with process costs. The product is Na_2SO_4 plus HCl, and assuming for illustration that the salable forms were (Na_2SO_4, $6H_2O$) and aqueous acid containing 19 per cent HCl, the output of each will be, approximately, in the ratio of 1 lb. salt cake to 1½ lb. hydrochloric acid. The cost account should show as the unit of cost 1 lb. salt cake plus 1½ lb. hydrochloric acid, whereupon the possible selling price of the sodium sulphate could readily be computed by deducting from the unit cost the current market value of 1½ lb. hydrochloric acid, then adding profit expected. Much mental discomfort awaits the cost accountant who attempts to show separate costs for joint products.

What Is a "Process" for Cost Accounting Purposes?

But if the process were to be continued further, the HCl converted into hydrochlorite and salt cake into soda ash, what should be done?

In speaking above of the "process" as the basis of a cost account, it is considered that for this purpose a "process" is complete when a freely marketable commodity is arrived at. The object of every cost account should be to show whether the manufacturer is making (1) a profit, (2) how much profit, (3) the greatest possible profit.

In the case under consideration, we have arrived at a point where we have two readily salable products with current market prices easily ascertainable; then if the products are to be used as the raw material for bleaching powder and soda ash, the first process of manufacture should be credited with the salt cake and HCl at the current market prices; for if the succeeding processes cannot make a profit on this basis, it would pay better to sell the salt cake and HCl as such; a transfer at any other price would hide the truth. If, for instance, the salt cake were transferred to the next

process at cost, the manufacture of soda ash might show a profit, which might be correct. But it would not show whether the greatest possible profit had been obtained. If it had been charged with sodium sulphate at the price that could be got in open market and had then made a profit, it would be evident that the conversion had paid.

Some cost accountants would say this was "not fair to the HCl." Not fair! Then have chemicals rights not only independent of but contrary to the interests of their owners?

During all this time a person with an excellent knowledge of cost accounting but no knowledge of chemistry would have produced cost accounts that could only be called silly, and a chemist without any knowledge of cost accounting would have done no better.

Technical Judgment Essential in Considering Obsolescence and Depreciation

It is to be noted that there are spoken of above only those periods when changes of trade conditions had arrived at a definite stage; there were, in between, periods when the ammonia process was making slow headway and when the electrolytic process was not an assured success. It is precisely during such periods of changing conditions that there is most need for the technical man to direct the cost accountant, having in view probable early obsolescence of plant.

The questions of depreciation and obsolescence also call for much technical knowledge. The bookish cost accountant often holds that the "only correct" method is, say, the setting aside of a percentage of cost—or of diminishing value—or a rate per unit of product, etc. This is mere foolishness. Again it may be repeated that cost accounting is useful only to show what profits are or can be made. Some assets have a life that can be computed within reasonable limits and give substantially 100 per cent service during that life—a steam boiler, for example. Others may have a relatively indefinite life, subject to frequent repair or with a gradually increasing inefficiency.

Freight steamships have a life, generally speaking, of about 20 years; they are usually depreciated at 5 per cent of cost each year; they become somewhat more troublesome and inefficient as they age. At first sight it would seem that the rate for the first years is too low, but here a factor enters that is too often ignored—namely, the interest on the capital absorbed. Thus, for a ship costing $1,000,000 the real carrying and depreciation cost for the first year is 5 per cent on investment plus 5 per cent depreciation—in all $100,000. At the end of 10 years the cost is 5 per cent on investment (now reduced to $500,000) plus 5 per cent depreciation —in all $75,000. It is because of this drop in interest on investment that plants long in use, with the average of all items half worn out, are valued usually at more than half the replacement cost. The interest on investment does not and should not appear in the books.

Where a plant gives increasingly inefficient service as it becomes older, the need for high depreciation rates during the period of high efficiency becomes greater; if 100 per cent service is given during the entire life of plant, the distribution of its cost equally over its whole life rather favors the later periods when the invested value has become reduced. Common sense must decide, not arbitrary rules.

Precisely similar conditions are presented in chemical and metallurgical industries. A simple knowledge of how long a tank furnace making glass will live, without a knowledge of its increasing demand for roof repair as it grows older, will not enable a cost accountant to depreciate it properly; and who but a technical man could say how much more rapidly it would wear out if a change were made to use a new sand containing, say, 2 per cent more Al_2O_3, with perhaps 100 deg. increase of temperature?

Flexibility of Cost System With Changes in Process

Suppose that at this moment the ammonia soda process should be so changed that at small extra expense the HCl were obtained free. What would be the cost of that HCl? Surely not the amount of the additional manufacturing cost, for such a change would certainly bring about a drop in the price of soda. Then the cost of the HCl would be the additional expense plus the loss on the price of soda. Who could separate the amount of that loss? Cost accounts dealing with the process, not with each product, solve the difficulty.

The distribution of joint costs, burden and other expenses is simplified by the substitution of process costs for costs of each product. There are also cases where a group of joint products may partly be varied at the will of the chemist; a byproduct might be either ethyl alcohol or acetic acid, as he chose. A knowledge of what can be produced and the relative cost of production for alternative products, and the selling prices, all enter into the problem of the best selection of processes. The chemist must be an accountant or the accountant a chemist to meet such situations.

All this is now recognized to such an extent that the student who is preparing for a career as chemist or metallurgist usually takes some accounting course, and we may leave the colleges to deal with him. But no reasonably adequate provision has been made for the men who have gone far in technical work and are in line for executive positions but are without the accounting knowledge that an executive must have, nor for technical men who are so responsible for profitable operation that they must, to some extent at least, supervise and check the cost accounting of their departments.

To suggest that they go back to school and take a regular course in accounting may be a counsel of perfection—it is impractical. Such men already have developed an intelligence that should make it needless to go through the drudgery of learning bookkeeping, etc., in the ordinary way; it is not necessary for an executive to know all the details of bookkeeping. They should, indeed, understand the general principles of books—the old simple theory of ledger, cashbook and journal—and should understand cost accounts. They *must* be able to read and understand operating statements, profit and loss accounts, and balance sheets, and must be able to interpret them so as to get from them all the information they can give as to the progress of the business.

Where changes of process, raw materials or machinery occur, it is easy enough to find whether, and how much, a department has increased its profit; but in addition to the specific change there are constant other changes that affect profits, such as variations in water and coal supply, hours of labor, disposition of employees —and the executive head should be able so to dissect and analyze operating statements as to determine the effect of any given factor.

The course of study for technical men of experience should, therefore, be individual and not class study. The instruction of a really able accountant, if possible one with some technical knowledge or a public accountant

ith experience in chemical or metallurgical work, ould be obtained. An elementary knowledge of simple ookkeeping is assumed—almost every educated man as it. Then the course of study may well be similar) that outlined below.

First the student should take up "process" cost ac-ounting. This is the simplest and most satisfactory orm of cost accounts. "Job" costing may well be mitted, as it is not of much use in either chemical or etallurgical work, is far more difficult to master and less satisfactory under the best conditions.

"Process" costing is that species of cost accounting hat deals with the continuous manufacture of a product -such, for instance, as the manufacture of glycerine, f beer, or raw photographic film, of pig iron. "Job" osting deals with the production either of single large nits, such as locomotives, ships, pianos or with the anufacture in batches of smaller articles, such as anicure sets (in lots of, say, 10,000) watches, scientific nstruments, machines.

Generally, chemicals, metals, alloys, glass and all bulk roducts are covered by process costing, while elaborat-ng processes resulting in finished articles are usually overed by "job" costing. Continuous production of mall articles in great numbers may be the subject of rocess costing. Single lots of special chemicals may e the subject of job costing.

It will not be necessary for the student to take all is examples of process costing from his own business; here is such a family resemblance between process osts of all trades that benefit will be had if costs of ther trades are studied. It will even tend to enlarge he student's knowledge of the resources of process osting methods beyond what could be got from con-ideration of the accounts of his own industry.

Operating Reports, Profit and Loss Accounts and Balance Sheets

Then, to fit the technical man for the highest execu-ive positions, he should make a study of a series of perating reports, profit and loss accounts, and balance heets, all preferably of the enterprise with which he s connected and if possible bearing notes of changes n methods, processes, etc., with dates of introduction f the changes. First he should compare the successive eports, trace the results of changes, trace the results hown in daily or weekly operating statements to the rofit and loss accounts, and trace the effect on the alance sheet of the profits and losses shown. All this hould first be done alone. Then the teacher should go ver the same matter, the student noting the conclusions rawn by the teacher and, most particularly, the eacher's reasoning on which those conclusions are ased. The student need not accept either the reason-ng or the conclusions; that is immaterial, as the object f the study is to acquire the working tools of ac-ounting.

Suppose you have certain plant that has become obso-ete; it can be used to produce a certain article, but is otherwise valueless. Assume further that the article an be produced and sold at a profit provided that noth-ng is charged for depreciation of the plant. Many doctrinaire cost accountants insist that full depreciation be charged to cost, showing a net loss less in amount than the depreciation charged. Such cost ac-ounts, showing a loss in operation, would lead to the abandonment of the work, although the owners would be better off to continue it while the old plant lasted, using all profit in the amortization of the old plant. The remaining loss on the plant should be taken up separately. Much contention is avoided by making up cost accounts showing, first, cost before depreciation and obsolescence, then the provision for these purposes, and finally cost including depreciation and obsolescence. You can even add to cost an amount representing interest on capital, although that is by no means recommended. As Mark Twain has it, "First get your facts and then you can distort them as much as you please."

No Special Literature Needed for Chemical Accounting

The literature of cost accounting is not lacking in correctness, volume or variety, the problems of the chemical and metallurgical industries are those of other industries with such modifications as local conditions may indicate. A competent technical man with an accounting education that had not been in any way directed to the special work of his industry would have no difficulty whatever in adapting his accounting knowledge to his needs. There is an accounting variation between individual enterprises within these industries far greater than the variation between the industries as a whole and other lines of business. One company makes a thousand and fifty-seven varieties of chemicals and drugs, from sirup of squills to kakodyl cyanide, and has thousands of small customers, while another confines itself to the production of acid phosphate manure and sells its entire product to one other company. No special literature for chemical or metallurgical accounting seems to be needed.

In studying profit and loss accounts and balance sheets, particular attention should be given to the burden of excessive inventories, of idle capital caused by plant not in use, of excessive deterioration of plant due to corrosive materials handled, and the loss of operating time due to repairs. All these considerations are of a character that cannot be fully understood and correctly dealt with either by the accountant alone or the chemist alone. After making a study of such reports and accounts as are available from the enterprise in which the technical man is engaged, there should be obtained similar series of balance sheets and profit and loss accounts from other businesses, preferably businesses where the history of changes is known to the teacher and the accounts have been published so that they are no longer private in character; these should be worked over as outlined above.

A course of this kind will be found deeply interesting and will give the intelligent technical man a working knowledge of accounts in far less time than such a knowledge could be acquired in any other way. It will cover exactly the ground that in an executive capacity he may be called upon to cover.

Finally, to the advanced technical man some advice may be given that could scarcely be given safely to a young student; do not permit yourself to imbibe from any teacher the idea that any form of cost or other accounts is the only correct one, or that any statement or cost account that brings out clearly the facts is in contravention of the "true principles of accounting." As the greatest accountant of them all has said, There is but one true principle of accounting and that is to make accounts up in such a way as to show with the greatest clearness possible all the facts. Let your teacher have his way, but in your own mind remember that you are arming yourself with the tools of accounting and afterward will do with them whatever you think right.

Tests on High-Tin Bearing Metals

High-Speed Gas Engines Require Bearings of Highest Quality—General Remarks on Chemical Composition and Microstructure of Suitable Alloys — Detailed Directions for Casting in Bronze Shells—A Series of Commercial Alloys Were Tested for Hardness, Compressive Strength, and Coefficient of Friction — Bearings Were Also Run Dry Until Destroyed

By P. W. Priestley

ANTI-FRICTION bearing metals do not appear to have received the attention of investigators which they deserve. In view of the large quantities employed in the automotive industry alone, it is surprising to find that very little information is available which is of direct value to the engineer in the selection of white metal bearing alloys. Recently a number of investigations have been made by eminent workers and the data now on record form an admirable help in proceeding to examine the mechanical properties of these alloys.

It appears urgently necessary to establish a commercial form of test (applied particularly to durability and wearing properties). The test might directly indicate a definite unit property, or alternatively a formula showing relative merits between commercial mechanical tests. Service records would prove of extreme value to those concerned in the design, construction and application of machinery incorporating anti-friction bearing metals.

The following remarks apply mainly to a number of high-grade proprietary bearing metals of British origin, tin-base mixtures which have been successfully applied in high-speed internal combustion engine construction. It is hoped that serviceable information will also be found by those engaged in wider fields.

Microscopical

It is considered that the essential characteristic of a desirable alloy is to have hard grains imbedded in a relatively soft material. The function of the hard material is to resist wear and to provide a surface having a low coefficient of friction. The softer constituent permits a uniform distribution of load due to the possibility of adjustment, partly by distortion and partly by rapid wear, leaving the particles of the hard constituent in slight relief. It is further claimed that the hollowness of the softer areas assists in promoting lubrication. It is, therefore, necessary to obtain an alloy too hard to permit lateral flow and yet soft enough to adjust itself under load. Microscopical examination of a typical tin-antimony-copper alloy reveals cuboids of antimony-tin and long needle-like crystals of copper-tin forming a series of long bearing points imbedded in a matrix or cushion formed by the tin ground mass.

Chemical

Satisfactory results are obtained with the binary alloys of copper-tin, tin-antimony and lead-antimony, but the ternary alloys tin-antimony-copper, tin-lead-copper and tin-antimony-lead are better. Unfortunately the ternary alloys have not been thoroughly investigated, but it may be stated that the tin-antimony-copper mixtures are at the present stage most successful in the motor car under actual working conditions. There is little difference in the coefficient of friction of the tin-base alloys and the lead-base alloys; it is the ground mass which characterizes the two types. The lead-rich alloy is considerably weaker in compression and tension at normal working temperatures than the tin-rich allo and it is now generally accepted that the service to b obtained is controlled by the strength of the groun mass.

Antimony increases hardness, wearing qualities an brittleness. High casting temperatures cause heav antimony losses.

Bismuth may be introduced to the extent of a trac in the capacity of a flux.

Copper is comparatively readily soluble in tin, an prevents segregation and increases hardness. Whe present in quantities exceeding approximately 5 pe cent, copper promotes brittleness and a tendency t crack when used in high-speed engines. Casting tem perature is increased by increasing amounts of coppe with a consequent coarsening of the structure. I alloys containing this element, rapid cooling consider ably increases the hardness as compared with slowl cooled alloys.

Iron increases hardness and brittleness, and is con sidered an undesirable impurity.

Lead in small proportions is permissible, since it presence increases fluidity during casting. In th solidified metal lead promotes ductility and resistanc to rapid changes of loading. American practice per mits quantities up to 0.35 per cent, and it is present i the ground mass of the alloy, having little effect upo the melting point. English practice generally exclude this element in quantities exceeding 1 per cent. Larg quantities produce a soft alloy and cheaper product and it is possible that lubricants containing an exces of alkali will pit lead-rich mixtures. One of the alloy selected for this investigation contained approximatel 20 per cent lead. The tests showed that while th metal exhibits the smallest dimensional change unde compressive load (greatest Brinell hardness), it wil withstand only a comparatively moderate load withou cracking. This fact must materially affect lateral flow and at the same time prevent adjustment of the groun mass.

Nickel in quantities not exceeding 0.50 per cent in creases ductility and removes the liability to crack with out affecting the wearing qualities. In the tests t be presently described it is seen that a high-tin allo having 0.53 per cent Ni withstood the highest com pressive load without sign of cracking, but that thi property was accompanied by the greatest dimensiona change under load (smallest Brinell hardness) of an of the metals selected for examination.

Tin in large percentages promotes rigidity and in creases wearing qualities. The cost of a bearing meta is controlled by its tin content, since this element i by far the most expensive ingredient contained in an form of anti-friction bearing alloy.

Zinc creates a tendency to seize and increases hard ness and brittleness. It is possible that a detrimenta action may take place in the presence of salt water o benzol when zinc is present. This element is considere

a undesirable impurity. It is interesting to note that periments have been made in France and England ith zinc base bearing metals. An alloy which has met certain amount of favor is one containing 70 per cent nc and 30 per cent tin. A binary series of alloys zinc and tin will not contain the relatively hard nstituents necessary, and a ternary alloy having a ser resemblance to the tin-antimony-copper mixtures der consideration is developed by the introduction of nall quantities of antimony and copper. A mixture hich has been utilized for relatively heavy duty con- ins 80 per cent zinc, 15 per cent tin and 5 per cent pper. A bearing metal of French origin introduced ith the object of reducing to a minimum the use of e more expensive metals has a composition 63.3 per nt zinc, 21.3 per cent tin, 12 per cent lead and 3.3 r cent copper. In the absence of data relating to ese comparatively complicated mixtures the ternary loys maintain their established position in Great ritain.

Casting Practice

The initial preparation of the alloys, alloying proce- re and handling during pouring influence the struc- re considerably and in turn the service attainment any bearing mixture.

When a warm sand mold is employed, slight differ- ces of temperature do not materially affect the struc- re of the tin-antimony-copper mixtures except that e arrangement of copper-tin needles is more regular an when a cold sand mold is employed.[1]

Cold metal molds or molds warmed to a temperature proximately 100 deg. C. produce a metal with chilled rders, and a rise in pouring temperature from say 0 to 400 deg. C. increases the depth of the chill. hen the temperature of the mold is raised to 200 deg. and a casting temperature of 350 deg. C. is employed, e structure is uniform and fine grained throughout, coming somewhat finer at the extreme edges. Brinell sts[1] indicate that chill-cast specimens are generally rder than sand-cast examples.

In sand castings there is a marked diminution in e number of relatively large crystals at the bottom of e casting ingot and a corresponding increase the top, showing that the crystals have a lower ecific gravity than the liquid tin-rich matrix in which ey are found, and a tendency to rise to the top is ted when slow solidification is permitted.

The structure of these alloys should not be excessively ne or coarse, and the best results are obtained when ured at a temperature slightly over the freezing int. A casting or pouring temperature of 300 deg. C. not likely to produce a uniform structure, since this mperature is just below the liquidus of the alloy and e liquid already contains crystals of one of the nstituents.

On the other hand, a casting temperature of 600 deg. produces a coarse crystalline structure with large ntimony-tin cuboids. A casting temperature of 400 g. C. produces cuboids of smaller dimension, but the pper-tin constituent does not form the network char- teristic of slow cooling when warm sand molds are mployed. In chill castings there is considerably less ifference between castings poured at 300 and 400 deg. respectively than in sand castings. A fine granular ructure is seen in both cases, but it is more uniform hen poured at the higher temperature.

[1] "Observations on a Typical Bearing Metal," by Fry and Rosenhain; British Institute of Metals, 1919, vol. 2.

The antimony-tin cuboid crystals in chill-cast alloys are uniformly distributed throughout the entire section, whereas a concentration of these crystals is found at the top of sand castings. During solidification there is a tendency with certain mixtures for the antimony-tin cuboids to rise to the top of the metal, and the only method of prevention lies in chilling the molten metal to bring about rapid solidification.

A distinct softening is noticeable at a temperature of 100 deg. C. and it is thought that the hardening effect of rapid cooling indicates that the rate of cooling rather than the casting temperature controls the ultimate hardness.

Under scleroscope test a chilled alloy has a hardness practically double that of the slowly cooled metal (12 or 13 against 6 or 7), while the Brinell impressions are almost identical (28 and 25 respectively). Hence the hardness produced by rapid cooling is more apparent under comparatively light load than under a heavy load. It becomes necessary therefore to review carefully the duty which a bearing metal has to perform in considering the desirability of heat-treatment. Extremely slow cooling of the molten metal produces a dangerous crystalline structure which may lead to the development of cracks under service conditions in a similar manner to that which may obtain as the result of a high pouring temperature.

Service results depend very largely upon careful and skilled manipulation during pouring operations, and the procedure listed below is a very successful method of lining a bronze shell of the class employed in automotive construction. To prevent oxidation and loss of the antimony constituent it is essential that small quantities of metal only are melted. Where a large number of shells are manipulated, it is very desirable to have a number of small melting pots conveniently arranged with spouts and handles which are in turn immersed in a superheated bath of old metal for the purpose of melting the new metal. Extreme cleanliness and considerable attention to detail are necessary in the production of high-grade bearings.

To prepare the shell:

(1) Heat it in a bunsen flame to dull red.

(2) Immerse it in strong boiling solution of caustic soda for one minute.

(3) Tin carefully and completely over a bunsen flame with solder containing 30 per cent Pb and 70 per cent Sn, employing the following flux: anhydrous zinc chloride 50 per cent, ammonium chloride 49 per cent, and sodium fluoride 1 per cent.

(4) Wash in clean boiling water to remove flux.

(5) Mount in a fixture which should set the horns of bearing in the highest position and provide a suitable header.

Preparation of metal:

(1) Employ small melting pots conveniently arranged with spouts and handles.

(2) Carefully clean and coat pots with black lead prior to each pour.

(3) Do not melt more than 1 or 1½ lb. of metal in each pot.

(4) To melt metal immerse pots in a bath of old molten metal provided with suitable burners to maintain between 325 and 350 deg. C.

(5) Stir well and frequently.

(6) Graphite may be used as a flux to prevent oxidation.

Pouring:

(1) Preheat fixture and shell by immersion in bath of molten metal at 325 to 350 deg. C.

(2) Puddle cast with clean wire to insure that air or gas bubbles rise to header.

(3) Quench in water when metal solidifies.

Thermal Treatment

Heat-treatment is unnecessary in small bearing shells,

since no difficulty is experienced in cooling them with sufficient rapidity to obtain the desired structure. It is advisable to heat large bearings to a temperature of approximately 150 deg. C. and quench in water. This eliminates segregation of the antimony-rich cuboids.

Physical Properties

The resistance to tension of a bearing metal has no direct relation to its anti-friction qualities. Since no bearing alloy is ever expected to sustain tension strains, no information is available. Elongation and reduction of area are the only data resulting from a tensile test which could possibly be considered of value. It may be assumed that a large reduction of area indicates great ductility which under service would cause a bearing to spread or squeeze out under relatively small loads. Conversely, it may be expected that a comparatively high tensile strength, accompanied by little or no reduction of area or elongation, is best suited for bearing purposes.

The general rule that the brittleness of an alloy increases rapidly with hardness does not obtain in the tin-rich alloys, which, even with relatively high hardness values, show no signs of brittleness under impact stresses. The presence of nickel up to say 0.50 per cent considerably increases the ductility of tin-antimony-copper bearing metals. Cracks may develop as the result of a high casting temperature, particularly if the bearing be subjected to repeated shock or vibration.

It is thought by some authorities that the scleroscope hardness test excels the Brinell method on account of greater differences revealed after heat-treatment. The writer is strongly of the opinion that the scleroscope test has little value, since considerable variation in the readings must obtain on account of the essential characteristic of the alloy, which demands hard bearing points imbedded in a cushion or matrix of softer material. It is evident, in the absence of any definite relationship between hardness and wearing qualities, that any form of hardness test applied to this type of material has little merit in the consideration of endurance qualities.

However, there is a relationship between Brinell hardness and compressive strength in tin-rich alloys. It may be noted here that a mixture having a Brinell hardness 34 has an approximate compressive strength of 24,000 lb. per sq.in., and that with a decrease of hardness value there is a proportionate increase of strength under compressive load within a range terminated by an alloy having a Brinell hardness 20 accompanied by a compressive strength of about 42,000 lb. per sq.in. The compression figures indicate the load which the metal will withstand without cracking, and the limits of the range quoted represent the extreme conditions observed by the author. Chemical composition and rate of cooling considerably affect the hardness values and the ability of an alloy to withstand compression stresses.

Mechanical Tests

The writer recently examined very exhaustively nine high-grade proprietary tin-rich bearing metals with the object of determining their relative suitability for high-powered automobile engine construction. Table I shows their chemical composition.

Each alloy was poured at the respective temperature recommended by its maker, as shown in Table II, and all test-pieces and test-bearings were heated to th temperature named and quenched in water with th object of eliminating the segregation of antimony-ric cuboids.

Brinell hardness tests are noted in Table II, and r sults of compression on cylinders 1 in. diameter ar 1 in. long are given in Table III.

Coefficients of friction varied from 0.002 to 0.0(depending upon the temperature and bearing, as show in Table IV. In performing these tests, a bronze bea ing block was given a $\frac{1}{2}$-in. white metal lining.

A 6-in. journal was rotated, at 360 r.p.m. (565 ft. p min.) for several days, both in forward and rever direction, in order to obtain a perfectly smooth bearir surface. The surface of the bearing measured 4.8 sq.i and was loaded with 4.800 lb., or 1,000 lb. per sq.i Lubricant used was sperm oil. Tests were run for hours, with the journal rotating in either direction, ar average results are given in the table.

It was intended to test the resistance to wear, usir a standard bearing and journal, and under varyir conditions of load, oil pressure and temperature, ar journal speed. Preliminary trials with two of the bea

TABLE I—CHEMICAL ANALYSES OF ALLOYS SELECTED FOR INVESTIGATION

Alloy No.	Chemical Analysis				
	Tin	Antimony	Copper	Lead	N
1	90.8	4.1	3.8	1.02	..
2	83.3	11.0	3.9	0.92	..
3	80.9	10.7	4.2	3.3	..
4	89.9	4.3	4.2	1.3	..
5	86.3	10.3	3.2	nil.	..
6	60.2	12.0	6.3	19.9	..
7	90.8	4.3	3.9	trace	0.
8	87.3	7.5	4.6	0.62	..
9	77.5	11.2	10.0	0.75	..

TABLE II—HANDLING TEMPERATURES AND BRINELL HARDNE

Alloy No.	Pouring Temperature, Deg. C.	Annealing Temperature, Deg. C.	Brine Numb
1	370	150	26
2	350	150	28
3	350	150	31
4	370	150	30
5	400	150	30
6	400	150	34
7	350	150	20
8	400	150	33
9	400	150	31

TABLE III—COMPRESSIVE TESTS ON 1-IN. CYLINDERS, 1-IN. LON

Alloy No.	Deformation Under 8,000 Lb. Per Sq.In. Increase in Diameter	Deformation Under 8,000 Lb. Per Sq.In. Decrease in Height	Deformation Under 16,000 Lb. Per Sq.In. Increase in Diameter	Deformation Under 16,000 Lb. Per Sq.In. Decrease in Height	Load to Produce Crack, Lb. Per Sq.In.	Dimensions at F Diameter	Dimensions at F Heig
1	0.0050	0.0060	0.0490	0.0680	40,000	1.58	0.4
2	0.0020	0.0037	0.0340	0.0490	29,550	1.35	0.6
3	0.0010	0.0020	0.0170	0.0270	34,340	1.32	0.6
4	0.0020	0.0020	0.0330	0.0500	30,000	1.36	0.6
5	0.0028	0.0030	0.0420	0.0600	30,000	1.38	0.5
6	0.0018	0.0030	0.0138	0.0210	24,100	1.33	0.6
7	0.0105	0.0130	0.1259	0.1980	42,800	1.74	0.3
8	0.0020	0.0022	0.0450	0.0450	30,000	1.32	0.6
9	0.0040	0.0040	0.0300	0.0500	30,000	1.27	0.6

TABLE IV—COEFFICIENT OF FRICTION OF ALLOYS

Alloy No.	Temperature Initial	Temperature After 4 Hr.	Temperature Increase	Friction in Lb. at Journal Surface 120 Deg. F.	Friction in Lb. at Journal Surface 140 Deg. F.	Friction in Lb. at Journal Surface Maximum Temp.	Coefficient of Friction 120 Deg. F.	Coefficient of Friction 140 Deg. F.	Coefficient of Friction Maximum Temp.
1	60	137	77	15.94	11.56	11.56	0.0033	0.0024	0.00
2	60	144	84	30.00	20.94	18.75	.0062	.0044	.00
3	60	160	100	27.19	21.56	19.38	.0057	.0045	.00
4	60	167	107	15.00	13.44	10.94	.0031	.0028	.00
5	60	144	84	21.87	16.25	16.25	.0046	.0034	.00
6	60	144	84	19.69	14.37	12.50	.0041	.0030	.00
7	60	149	89	18.12	12.50	11.25	.0038	.0026	.00
8	60	139	79	16.87	14.69	13.75	.0035	.0031	.00
9	60	139	79	17.81	14.37	14.06	.0037	.0030	.00

TABLE V—TESTS ON BEARINGS RUN DRY

Time Elapsed, Min.	Alloy No. 1		Alloy No. 3		Alloy No. 3		Alloy No. 4		Alloy No. 5		Alloy No. 6		Alloy No. 7		Alloy No. 8		Alloy No. 9	
	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)	Bearing Temperature, Deg. F.	Journal Surface Friction (Lb.)
5	73	20.0	79	32.5	77	27.5	77	32.5	78	45.0	72	30.0	71	21.2	75	26.2	79	23.7
10	85	31.2	92	27.5	87	25.0	87	26.2	90	41.2	81	26.2	81	20.0	86	21.2	90	27.5
15	128	88.7	104	25.0	140	140.0	100	35.0	138	85.0	101	43.7	102	23.7	106	30.0	106	30.0
20	155	67.5	110	23.7	171	80.0	114	41.2	169	147.5	125	130.0	149	85.0	111	38.7	123	160.0
25	184	80.0	114	22.5	182	55.0	123	43.7	178	65.0	165	80.0	184	148.7	143	47.5	145	30.0
30	182	50.0	118	22.5	177	48.7	130	45.0	194	80.0	157	45.0	200	60.0	144	21.2	151	30.0
35	180	43.7	122	35.0	193	78.7	143	48.7	253	240.0	157	43.7	212	80.0	142	21.2	159	37.5
40	183	50.0	132	35.0	266	290.0	160	95.0	320(*M*)	(*c*)	157	43.7	234	60.0	142	21.2	162	22.5
45	187	50.0	139	32.5	297	(*b*)	172	65.0	...	...	158	42.5	253	158.7	143	21.2	181	40.0
50	192	47.5	143	46.2	...	...	184	63.7	...	...	159	42.5	307	180	144	20.0	178	31.2
55	192	40.0	162	45.0	...	...	188	70.0	...	...	159	42.5	331(*M*)	(*a*)	150	28.7	176	35.0
60	191	37.5	253	287.5	...	...	212	105.0	...	...	195	180.0	...	...	151	30.0	190	30.0
65	193	40.0	302(*M*)	(*a*)	...	...	248	80.0	...	...	257	165.0	...	...	169	150.0	221	40.0
70	205	52.5	...	...	...	...	255	97.5	...	...	277	112.5	...	...	235	155.0	264	140.0
75	205	42.5	...	...	...	...	273(*M*)	(*b*)	...	...	282(*M*)	(*a*)	...	...	255	158.7	325(*M*)	300.0(*a*)
80	243	82.5	...	...	...	...	...	...	...	...	...	...	...	...	318(*M*)	(*a*)	...	...
85	243	75.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
90	298(*M*)	(*a*)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

(*M*) Bearing melted.
(*a*) Bearing slightly fused but none adhered to journal.
(*b*) Bearing badly fused, and metal adhered to journal.
(*c*) Bearing badly fused but none adhered to journal.

ıg metals indicated that the wear exhibited after a onsiderable period was infinitesimal. Since little inormation of value was likely to be obtained from tests xtending over many months, it was decided to abandon his project and to proceed with durability tests (which orm the subject of Table V) in order to obtain comparative values with respect to the behavior of each alloy ı the unlubricated condition. The same bearing and ournal used to determine the coefficient of friction was sed. However, the load was reduced to 500 lb. per q.ft. On starting the test, the bearing was flushed ith sperm oil at 60 deg. F. for a period of 10 minutes, hen the bearing was drained. From then on the temerature and friction were observed at intervals of 5 inutes until the alloy fused.

The interpretation of the mechanical tests recorded ıust be governed by the particular application for hich the bearing alloy is required, and while the investigation indicates that the metals examined are without exception of a very high order, it should be noted that the order of merit has particular reference to their suitability for high-powered automobile engine bearings.

First place must be given to alloy 1, which can withstand exceptionally high compression load without cracking, has a moderate dimensional change under excessive load, an exceptionally low coefficient of friction, and will run longest when dry. Second place was assigned to alloy 8. It also stands great loads before cracking, has a moderate dimensional change under high load, has a low coefficient of friction, and will run over an hour dry without melting. Alloy 9 is a close third, attaining the desirable qualities to only a slightly lesser degree. Alloy 4 is ranked next, its rather quick failure when running dry being counterbalanced by an exceptionally low coefficient of friction.

The German Vegetable-Oil Crushing Industry

The present condition of the German vegetable-oil rushing industry with regard to the number of mills, ıe working force, amount of raw material treated, and ıe output, as compared with the last pre-war year, ras reported in *Commerce Reports* of Aug. 14, 1922, nd is shown in the following table:

	1913	April 1, 1921, to April 30, 1922
umber of mills	134	95
umber of workmen employed	6,700	10,000
mount of tons of oil fruit crushed	1,800,000	670,000
utput of oil in tons	650,000	265,000

The present capacity of all the German oil mills mounts to about 2,200,000 tons of oil fruits—i.e., more ıan three times the actual output. In 1913 Germany xported about 70,000 tons of oil. In 1921 the imports mounted to 163,000 tons.

The share of Greater Hamburg in the German oil industry compared with the provinces of Mecklenburg nd Schleswig-Holstein is about 55 per cent. Harburg, thriving industrial city near Hamburg, is an especially nportant oil center.

It is of interest to note the increase in the number of borers, the main reason for which is stated to be the ıtroduction of the 8-hour working day.

Dutch capital is strongly interested in German oil ills, and at present no legal discrimination exists gainst foreign capital.

Collapse of the Carbide and Cyanamide Industries at Odda

Recently the plant of the Alby Carbide Co. at Odda was sold at auction for 50,000 crowns to satisfy judgments amounting to 1,900,000 crowns, and the plant of the Northwestern Cyanamide Co., a subsidiary of the Alby Co., for 200,000 crowns, to satisfy debts aggregating more than 11,000,000 crowns. Both plants were bid in on behalf of the Tyssefaldene Power Co., which was the chief creditor of both concerns. This marks the final collapse of two of the largest industrial undertakings in western Norway and the practical bankruptcy of the community of Odda, which is now petitioning the state for a moratorium and for cancellation of taxes. These plants employed from 800 to 1,100 men.

The Alby Co. was a British corporation organized with a capital of £725,000 and registered in Norway in 1907. Between that time and 1918 the capital was increased to a total of 15,000,000 crowns. Its plant was built on ground leased from the Tyssefaldene Power Co., and at maximum operation had an annual output of about 90,000 tons of calcium carbide. The Northwestern Cyanamide Co. was organized with a capital of 2,000,000 crowns to utilize part of this output and for several years took from 50,000 to 60,000 tons annually of the product for conversion into cyanamide, a fertilizer material. The remainder of the product was exported.

Properties of Salt Solutions

By W. L. Badger
Professor of Chemical Engineering, University of Michigan

IT HAS BEEN the experience of the writer in connection with his consulting work in salt manufacture that it is often difficult to obtain usable data on the properties of sodium chloride solutions. Some of the data which have been found most useful in connection with problems of design and operation of equipment for salt refining have been collected and plotted on a comparatively large scale. These curves are reproduced in the accompanying charts in the hope that they might be of service to other workers in this field.

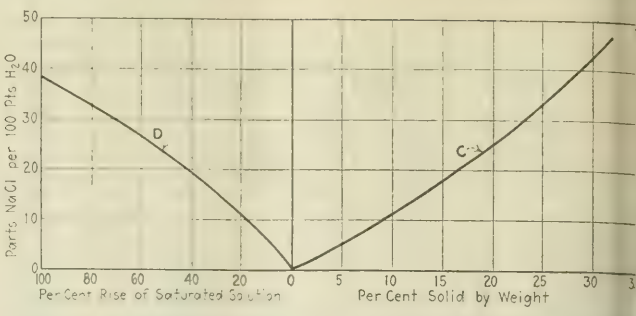


FIG. 2—COMPOSITION OF SALT SOLUTIONS; BOILING POINT OF UNSATURATED SOLUTIONS

How to Use the Curves

Boiling Point of Saturated Solutions. In Fig. 1 curves *A* and *A′* are for saturated salt, and curves *B* and *B′* for water. Enter the chart at the bottom with the temperature at which water boils under the pressure considered, go up to Curve *A*, and read the boiling point at the left. The vertical distance between *A* and

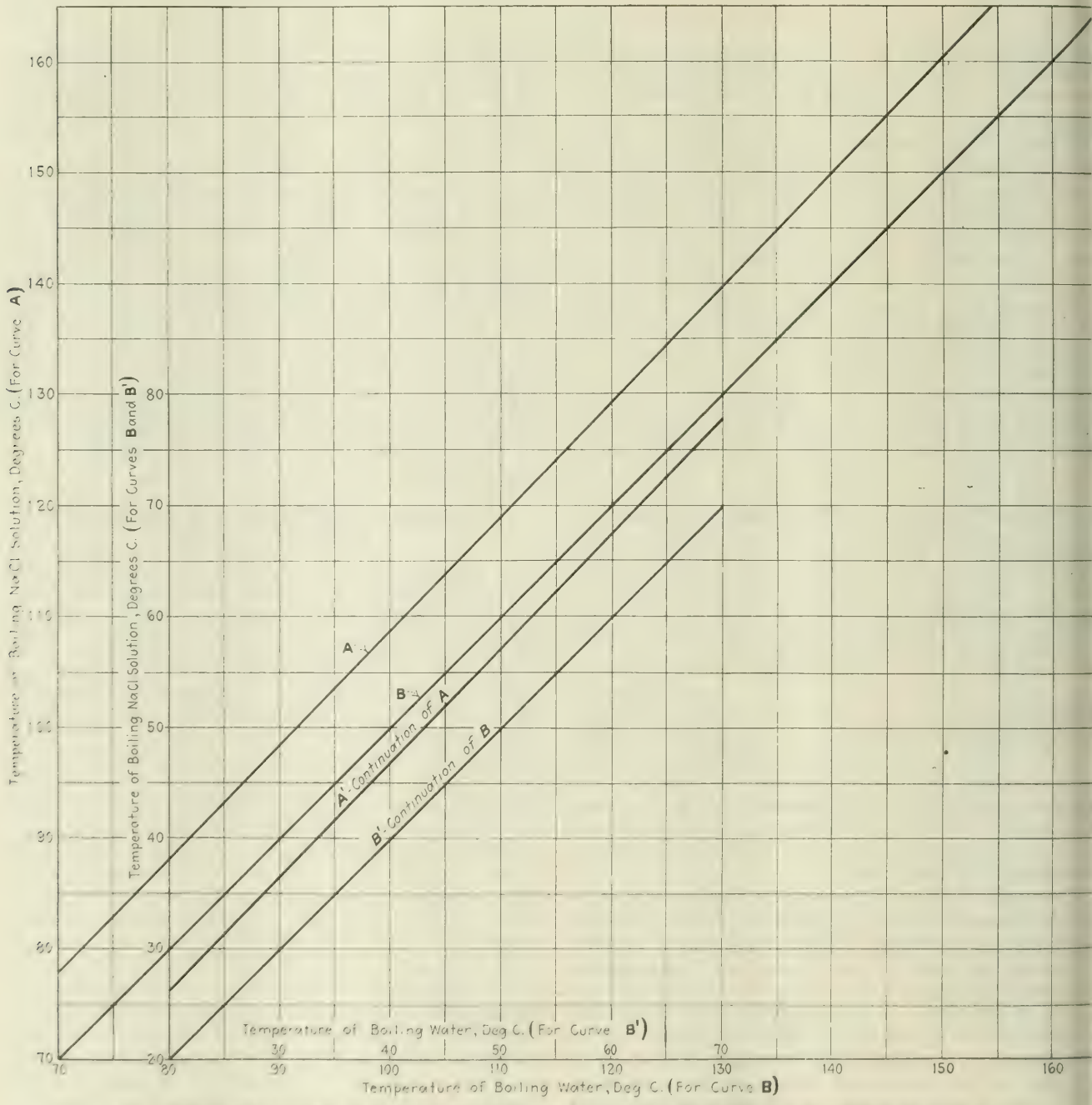


FIG. 1—BOILING POINTS OF SATURATED SALT SOLUTIONS COMPARED WITH TEMPERATURE OF BOILING WATER AT VARIOUS PRESSURES

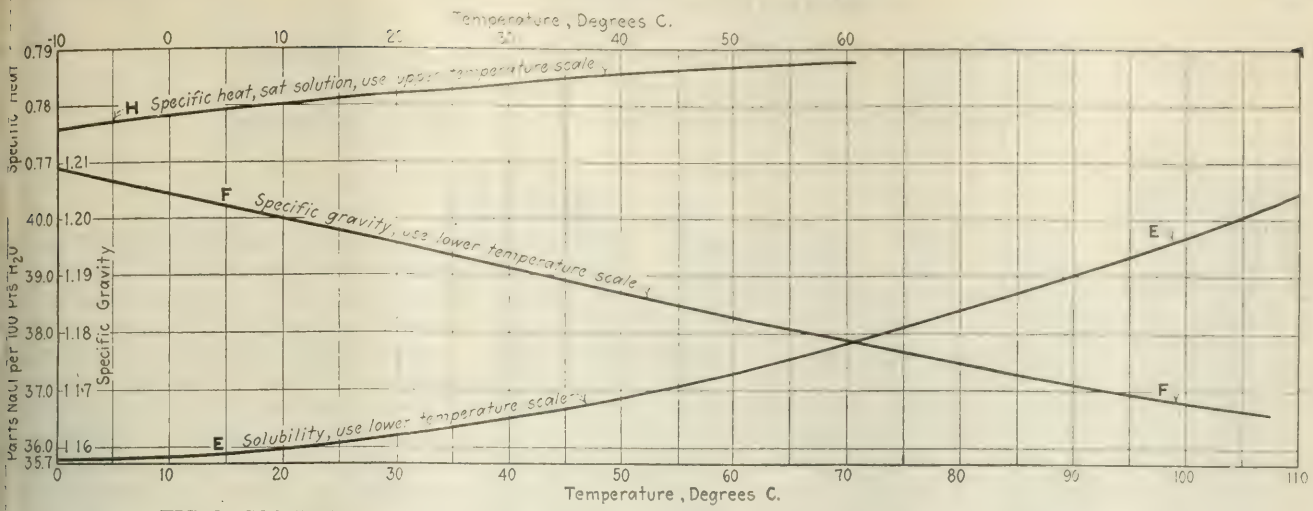

Temperature, Degrees C.
H Specific heat, sat solution, use upper temperature scale
F Specific gravity, use lower temperature scale
E Solubility, use lower temperature scale
Specific Gravity
Parts NaCl per 100 Pts H2O
Temperature, Degrees C.

FIG. 3—SOLUBILITY, SPECIFIC GRAVITY OF SATURATED SALT SOLUTIONS AND SPECIFIC HEAT OF SATURATED SALT SOLUTIONS

B is the rise in boiling point of saturatetd salt solutions. Data from Badger and Baker (*Chem. & Met.*, vol. 23, No. 12, Sept. 22, 1920) plotted as described by Baker (*Chem. & Met.*, vol. 25, No. 25, p. 1137, Dec. 21, 1921).

Composition of Salt Solutions. Parts salt per 100 parts water may be converted to per cent solids by weight, and *vice versa*, by Curve *C* shown in Fig. 2.

Boiling Point of Unsaturated Solutions. Enter Fig. 2 at the lower right-hand corner with composition of solution. Go up to Curve *C*, across to the left to Curve *D*, and then down to per cent rise. Determine the rise of a saturated solution at the pressure in question, and multiply this by the per cent just found. Based on data of Badger and Baker (*loc. cit.*).

Solubility. (Curve *E* in Fig. 3). Use the temperature scale immediately below the curve, and read parts salt per 100 parts water at the left. See Badger and Baker (*loc. cit.*).

Specific Gravity of Saturated Solutions. (Curve *F* in Fig. 3.) Use the same temperature scale as for solubility.

Specific Gravity of Unsaturated Solutions. (Curves *G* in Fig. 4.) This gives specific gravity at three temperatures.

Specific Heat. (Curve *H* in Fig. 3.) Use temperature scale above the curve. (Marks, Mechanical Engineering Handbook, original source not given.)

Authorities. Where no special reference is made, the data were taken from Landolt-Börnstein, Seidel, Comey, or other standard reference work. All the data found were plotted and a mean curve drawn, though in drawing the curve extra weight was given to those data which seemed most reliable.

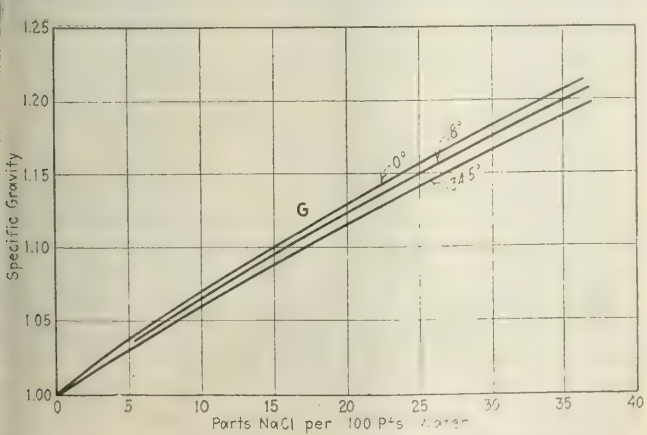


FIG. 4—SPECIFIC GRAVITY OF UNSATURATED SALT SOLUTIONS

Blueprint copies of these curves, assembled on a sheet 18x24 in. in either English or metric units, may be obtained from the author.

Evaporator Experiment Station,
University of Michigan,
Ann Arbor, Mich.

The Dye Situation in France

Industrial and technical publications, together with information drawn from local sources, reports Vice-Consul H. S. Fullerton, at Lyons, tend to strike a discouraging note in their survey of the French manufacture of colors. Expectations of extensive exports have not been realized and the creation of customs barriers against German dye imports into France have only partially succeeded in protecting French domestic manufacture, while competition with German and American products in foreign markets is fraught with increasing difficulties.

Import tariffs, whose purpose was the protection of the domestic dye industry, cannot cope with the situation, due to the infiltration of foreign dyes through countries enjoying immunities of minimum tariff and acting as intermediaries. Government subsidy is looked upon in many quarters as at least a temporary solution of the situation, it being estimated that a state grant of 40,000,000 to 50,000,000 francs annually might restore the vitality of these industries.

The alternative plan of government control is generally rejected. The accepted principle of the national necessity, especially in time of war, of active chemical industries of this order gives ground for the belief that some plan may be devised for their artificial stimulation, should such stimulation prove essential.

It might be added that the depression which has been noted in the dye industries would appear symptomatic of industrial chemicals in general in France.

Electrical Resistivity of Carbon

Determinations of the electrical resistivities of a number of different forms of carbon at different temperatures have been made at Seattle, Wash., by the United States Bureau of Mines. Different grades of coke, charcoal and carbon residues were studied. A paper describing the results is being prepared by Clyde E. Williams and Gordon R. Shuck.

Maturing Flour—II

Description of Commercial Equipment for Developing the Optimum Baking Capacity of Flour Through Treatment With a Mixture of Chlorine and Nitrosyl Chloride—Application in Milling Technology

By Frederick L. Dunlap, Sc.D.
Consulting Chemist, Industrial Appliance Co., Chicago, Ill.

In THE first part of this article[1] a brief summary was given of our present knowledge of the principles underlying the process of maturing flour and a parallel was drawn between a flour which had been "matured" and one that had been "aged." It was shown that the most important single factor which influenced the baking capacity of any flour is the intensity of the acidity of the flour and that the optimum baking capacity of a flour is developed when H-ion concentration in the dough is equivalent to a p_H of about 5.

There are many reasons for developing the intensity of the acidity of a freshly milled flour, as has been set forth. That this can be done successfully in a commercial way and that the results are all that have been claimed for them is clearly evidenced by the experience of 10 years of practical application of the Perfect Flour Maturing System.[2]

Although the discussion in Part I of this article was limited to the effects of pure chlorine on flour, there is also used in operating the Perfect Flour Maturing System a mixture of 99.5 per cent chlorine and 0.5 per cent nitrosyl chloride.[3]

Action of Nitrosyl Chloride

Nitrosyl chloride is undoubtedly one of the most effective agents known for treating flour. Experiments have demonstrated that 1 lb. of this reagent will handle 2,500 bbl. of flour in an efficient manner, while it is customary to use chlorine at the rate of 1 lb. for each 30 bbl. It is more efficient than chlorine for whitening flour, but less efficient for increasing the intensity of acidity. At present, however, the commercial distribution of this product is not feasible. It is readily obtained in a liquid state, but metallic containers which will stand up under commercial conditions have not as yet been developed. Liquid chlorine is, on the contrary, easily handled in containers of all sizes, up to and including tank cars, the latter having a 15-ton capacity. Experience has shown that the usual type of containers for liquid chlorine will resist the action of chlorine containing as much as 5 per cent of nitrosyl chloride, so that no difficulty is experienced in handling the mixture used in this system. This mixture of liquid chlorine and liquid nitrosyl chloride is made by the Electro Bleaching Gas Co., Niagara Falls. It is supplied to the trade in 100- and 150-lb. cylinders, and designated as Beta Chlora, to differentiate it from straight chlorine. Shipments are, of course, made in careful accordance with the government regulations for handling liquefied gases, and while many thousand cylinders have been shipped throughout all parts of the United States and to foreign countries as well during the past 10 years, there has never been a single instance of trouble arising from the handling of the containers.

As flour is aged, it becomes of a whiter color. In fact one of the gages used in judging the character of a flour is its natural color. In a natural flour this is not always a reliable test, but it is nevertheless one that is used, and a flour buyer has every reason to expect such a flour to bake to its color. An aged flour with its whiter color bakes better than the same flour freshly milled and, except in an over-aged flour, such flours will show baking quality in accord with the improved color—that is. in an aged flour color is an index of its developed quality.

Now chlorine *per se*, when used to improve the baking quality of flour by increasing the intensity of acidity, does not improve the color of such a flour in keeping with its baking value. Experience has shown that the addition of only 0.5 per cent of nitrosyl chloride improves the color as well as aids in increasing the intensity of acidity, so that this mixture of 99.5 per cent chlorine and 0.5 per cent nitrosyl. chloride simulates the baking as well as the color value of a naturally aged flour. In other words, Beta Chlora produces a flour with a whiter color, but such flours have the improved baking capacity which the color would lead one to expect.

In the handling of flour in the mill to develop the proper intensity of acidity, there are two variable factors to deal with, the character and volume of the flour stream and the quantity of gas to be applied to the flour.

It is always preferable to apply the gas to the primary grades before these are blended to constitute the particular brands that the mill markets. Experience has shown that better results can be obtained by treating the several grades according to the requirements of each, and then subsequently blending percentages of these to form the finished brands, than in attempting to treat the flour after blending has been accomplished.

While the separate streams subjected to treatment in any plant do not vary materially in their character, still they do vary somewhat in character and volume. This calls for equipment which can deliver the gas in a variable flow as conditions require, yet the equipment must be so constructed that each stream can receive only a standardized quantity of gas, which is always below that point where the flour would be overtreated and thereby develop too great an intensity of acidity, a condition similar to that occurring in over-aged flour.

Each Stream of Flour Receives Optimum Treatment

When equipment is installed in a mill, the character of the several streams of flour to be treated is determined in order to give to each the degree of treatment required to produce the optimum effect. This determination is made by a complete chemical analysis and the use of a standard outfit fully equipped, installed in the laboratory of the Industrial Appliance Co. Commercial bakes of the flour are then made, running in parallel the fresh and matured flour, so as to determine the effectiveness of the treatment given. This is

[1] *Chem. & Met.*, vol. 27, p. 174; July 26, 1922

[2] This system is controlled by the Industrial Appliance Co., Chicago, Ill.

[3] U. S. Pat. 1,071,977 covers the use of chlorine; U. S. Pat. 1,654,459 covers the use of the mixture of chlorine and nitrosyl chloride.

peated, if necessary, in order to arn as accurately as possible the xact degree of treatment which will evelop the flour stream in question its optimum baking capacity. With his knowledge, the equipment which installed in the mill is standardized deliver the amount of gas necessary r the proper development of the rticular flour passing through each gitator.

Standardization of the equipment r supplying a constant flow of gas is ffected by means of a silver disk. his disk contains an orifice of such size that with a constant head of gas ack of it, it cannot deliver for use ore than a rated quantity of the gas.

Control Equipment

The simplest plan for discussing the ontrol equipment is to use a single-ontrol machine as the basis. This achine treats but a single stream of our—i.e., the finished flour—and is he type for use in small mills only, ay those of a daily capacity of 50 to 00 bbl. of flour. The equipment is hown in Fig. 1.

Before describing the flow of gas in his type of equipment, it should be ointed out that in the single- as well as the multiple-ontrol machines, the gas, before entering into contact with the flour, is highly diluted with air, thus insuring more even contact and distribution within the agitator.

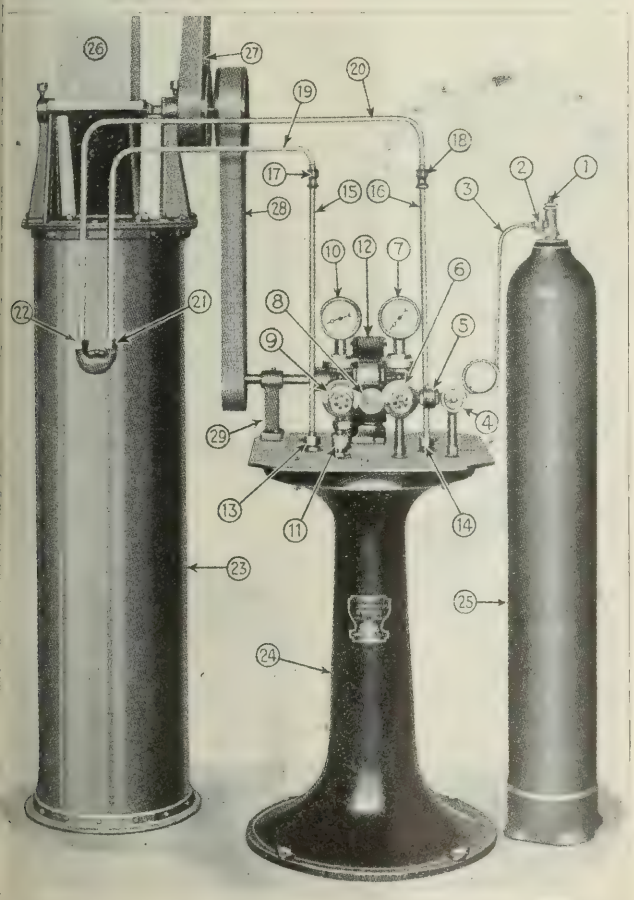


FIG. 1—SINGLE-CONTROL MACHINE FOR TREATING FLOUR

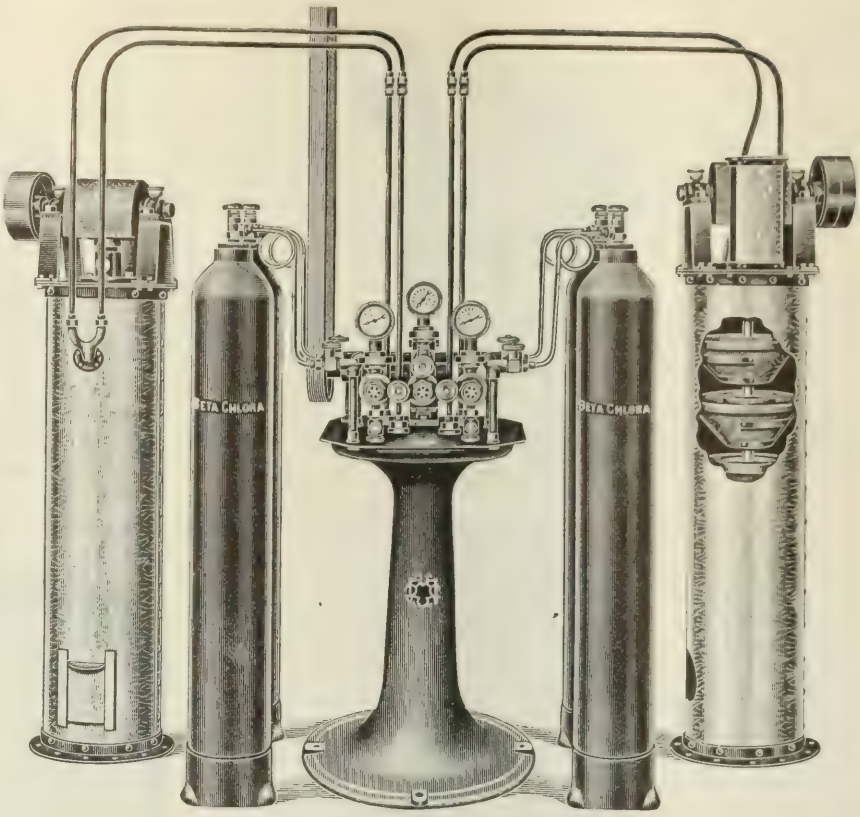


FIG. 2—TWO-CONTROL MACHINE

In the equipment shown in Fig. 1, the course of the gas is from cylinder 25 through valve 1, copper tube connection 3, main connection valve 4, gas strainer 5, initial regulating valve 6, control cut-out valve 8, control valve 9, orifice in silver disk 11, gas line 13, 15, 17, 19 and 21 into distributor in agitator 23.

The air current from blower 12 passes through air line 14, 16, 18, 20 and 22, mixing with the gas in distributor and circulating it through the suspended particles of flour in the agitator.

Gage 7 gives the pressure of gas in the cylinder in pounds and indicator 10 registers the amount of gas (in ounces and fractions thereof per barrel) going to agitator to be applied to the flour.

To start operation it is only necessary to open cylinder valve 1, then valves 4 and 8 and screw in handwheels on valves 6 and 9 until indicator 10 registers the degree of treatment desired. The degree of treatment may be regulated within prescribed limits at the will of the operator, by adjustment of the handwheels on valves 6 and 9.

Irrespective of the pressure of gas in the cylinder, the control apparatus automatically maintains a constant flow of gas at whatever point the operator has adjusted it—that is, while the standardized silver disk in this case will limit the maximum flow of gas, it is within the power of the operator to use a smaller quantity of gas if necessary and desirable.

Fig. 2 shows a two-control machine to which are attached reserve cylinders, so that the treatment may proceed without interruption when empty cylinders are replaced. This machine treats two streams of flour simultaneously. A separate control is provided for each stream of flour, graduated to meet its special requirements. An indicator on each control registers

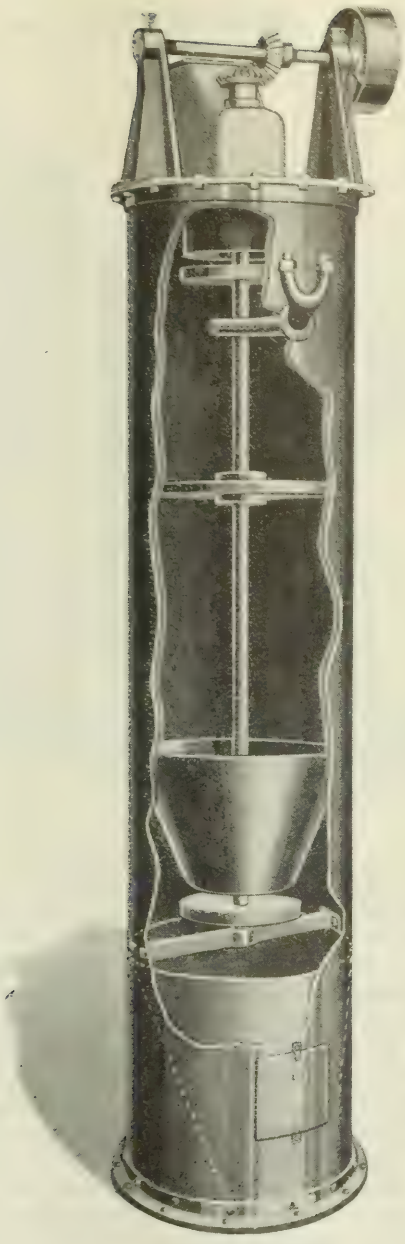


FIG. 3—AGITATOR

the amount of treatment to be given each stream. After passing through the control machine, the active agent is conveyed to the agitator through a $\frac{3}{8}$-in. lead tubing. The air current is pumped from the control machine through a similar tube and mixed with the active agent as it enters the agitator.

This fills the space inside the agitator with the active agent diluted with air and circulated so that it reaches each separate particle of the flour, insuring full and uniform results.

The Agitator

So great are the absorptive properties of flour for the maturing agent that the method of agitation is of paramount importance in obtaining the best results. A standard agitator has been designed to obtain the highest efficiency in results on the product and to provide for the greatest durability in service.

This agitator embodies the following essential features:

1. It suspends the particles of flour in the air in a manner that insures uniform treatment. The flour enters the agitator through a center spout into a feed ring, from where it is distributed in an even spray by means of a revolving disk. Immediately under this disk the gas is forced with a current of air through a perforated hard-rubber siphon, insuring its even distribution and circulation through the suspended particles of flour. In the middle of the treating chamber a hard-rubber wheel serves further to agitate the flour and bring it into more intimate contact with the active agent.

2. It does not admit of any flour lodging, accumulating or remaining in the agitator for overtreatment.

3. The interior of the agitator is constructed of materials which will withstand the action of gas without deterioration. The metal case is lined, a hard-rubber sleeve protects the shaft, and all the interior fittings are of hard rubber.

4. It is adjusted to prevent the escape of gas through the intake or outlet spouts.

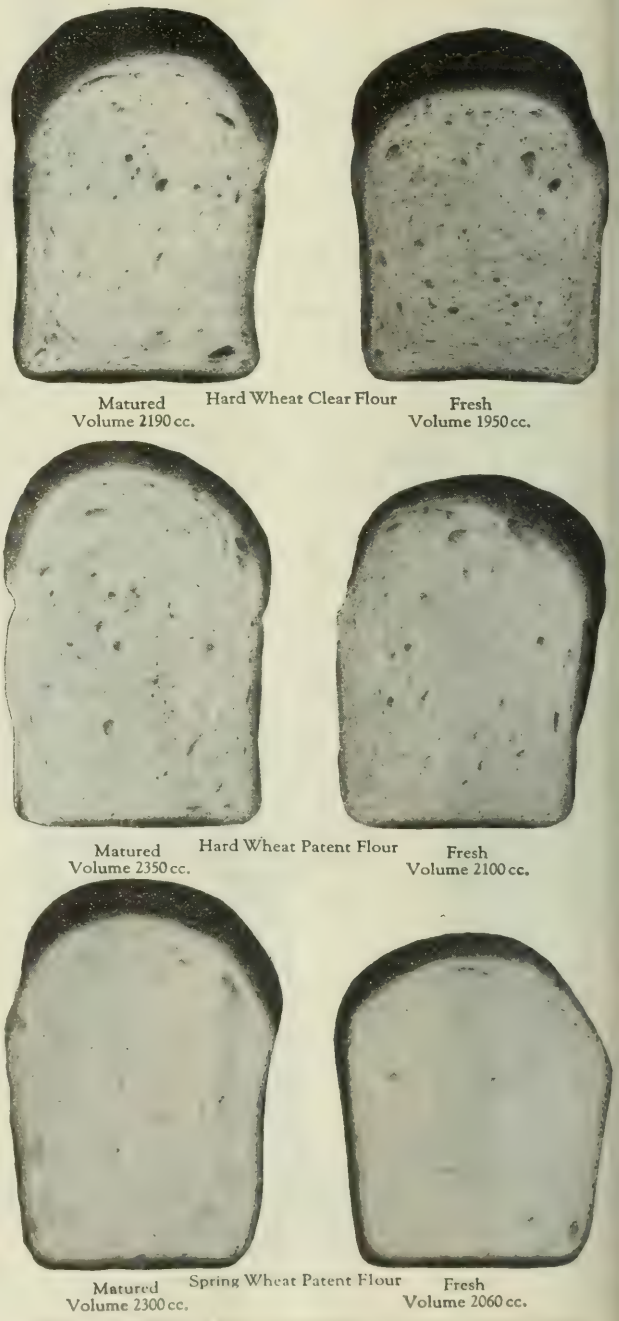


FIG. 4—FRESH AND MATURED FLOUR COMPARED

5. It is easily accessible for inspection or adjustment.

6. It is equipped throughout with ball bearings to provide for easy running with the least amount of attention.

While Figs. 1 and 2 illustrate the general principle of the relation of one part to another in the assembled equipment, it is not essential that this particular arrangement should be followed in the installation in the plant. The agitators can be placed where convenient in the flow of the finished flour ahead of the packers and the control machine can be located where preferred. Its distance from the agitators does not affect results.

The system has been perfected and constructed, both as to materials and arrangement, with the end in view that it may be effective and practical and not require undue care and attention.

Its operation does not entail any discomfort or casualty risk to the operatives, or fire hazard to the proprietors.

Additional controls assembled on the same stand to meet the requirements for the treatment of a greater number of streams of flour are simply duplicates of the initial units which have been described in detail. Standard machines are made with as many as eight separate controls. When there are a greater number of separate streams of flour in any plant, duplicate machines are provided.

Photographic Evidence of Improved Baking Qualities

Fig. 4 gives photographic reproductions of bread made with fresh and matured flour, the latter produced with Beta Chlora. It is difficult in a pictorial way to show adequately the improvement both in color and texture which this treatment brings about.

These were actual commercial bakes, but each flour was handled in accordance with its nature, so as to produce the best loaf of which it was capable and just as it would be handled by any competent baker.

Summary

In the first part of this paper the scientific grounds for the treatment of flour with chlorine were set forth. This treatment increases the intensity of the acidity in the flour to that point where the flour so treated develops its best baking strength. In other words, when chlorine is used properly, the flour takes on those optimum baking properties which develop in an aged flour. Other advantages also result from the chlorine treatment—namely, the stabilizing of this optimum baking value and the development of the color commensurate with the baking value of the flour, just as in the natural aging process. The development of rope is also controlled successfully and, while no great stress was laid on it, the treated flour may be successfully used by the baker with less yeast and sugar. Considering the enhanced quality of the finished flour as well as the oven products produced from it and the fact that the treatment may be applied at a cost not to exceed one cent per barrel, the application of this principle should meet with great commercial success.

The application of the Perfect Flour Maturing System in a practical way extends now over a period of many years. Experience has developed the mechanical features, which have been discussed in the present article, so that the system works with little or no attention on the part of the mill operative. The results claimed for this method of treatment have been substantiated through its years of actual use in the mill and have met with such favor that the Perfect Flour Maturing System is now in mills having a daily capacity of treated flour of over 300,000 bbl. so far as the United States is concerned, and in addition of over 200,000 bbl. in foreign countries, where its use is rapidly extending.

The system, because of the marked beneficial results produced, has become practically an economic necessity, for it brings to the consumer, to the baker or householder, the flour in a condition to render its most perfect service. Because of this it may be truthfully said that the extended use of the Perfect Flour Maturing System has meant a marked advance in the art of milling.

Accidents in Mills and Smelters in 1921

Accidents at all mills and smelters, excluding iron blast furnaces, operated in the United States in 1921 resulted in the death of 27 employees and the injury of 4,494, according to reports received from operating companies by the federal Bureau of Mines. In the preceding year 61 employees were killed and 8,863 were injured.

At milling plants 10,047 men were employed, of whom 4 were killed and 1,214 were injured, as compared with 21 killed and 2,624 injured during 1920. The fatality rate in 1921 was 0.50 and the injury rate was 151.05 per thousand employees, based upon a standard of 300 work days per year, as against rates of 1.31 killed and 164.24 injured the year before. The total working time was 2,411,148 shifts, and represents an average of 240 days per man. The number of men employed represents a reduction of 37 per cent.

At the smelters 18,656 men worked 5,733,969 shifts, an average of 307 days per man, as compared with 24,944 men, 8,741,116 shifts and 350 days per man in 1920. Fourteen men were killed by accidents and 2,129 were injured, or 0.73 killed and 111.39 injured per thousand 300-day workers. The corresponding rates in 1920 were 0.69 killed and 142.33 injured.

At the outside or auxiliary plants operated in connection with the mills and smelters, 9 fatalities and 1,151 injuries occurred among 8,762 employees. The fatality rate per thousand 300-day workers was 1.08 and the injury rate was 138.54, as compared with rates of 1.11 killed and 116.19 injured in 1920.

As compared with the year 1920, reports submitted to the Bureau of Mines for 1921 showed a heavy reduction in the number of shifts worked in nearly every state in the Union. The total number of shifts worked by employees at mills was only 50 per cent of the number worked in 1920; employees at smelters worked only 34 per cent as many shifts, as in 1920; while employees at auxiliary plants worked only 54 per cent of the number worked in 1920.

Solubilities of TNT

Many organic explosives are purified by recrystallizing from solvent, but there is little accurate information on the solubilities. During the past year the explosives chemical laboratory of the United States Bureau of Mines at Pittsburgh, Pa., has prepared a paper for publication giving the solubility of TNT in eleven different solvents. The laboratory is now determining the solubility of tetryl and tetranitraniline.

Production Costs in the Whiting Industry During 1914, 1921 and 1922

AN INTERESTING byproduct of the recent tariff debate in the Senate and an example of an intensive effort accurately to appraise competitive conditions within one of our domestic chemical industries are found in an informal report of the United States Tariff Commission addressed to the chairman of the Senate Finance Committee. Some extracts from that report and the tabulated costs of production are presented in the following paragraphs:[1]

Summary of Conditions in the Industry

The weighted average cost of producing whiting for the first 4 months of 1922 was $18.47 per short ton. This represents a decrease of 9 per cent from the cost of $20.32 in 1921 and an increase of 108 per cent over the pre-war cost of $8.86 in 1914. It was found that the average cost of imported whiting, c.i.f. New York, duty not paid, for the months of April and May was $12.80 per short ton. This cost for imported whiting when contrasted with the average domestic cost in 1922 shows a margin of $5.72 per short ton in favor of the imported product. The difference between the lowest domestic and the average imported cost was $3.99 per short ton.

In connection with costs in the domestic industry, the commission must point out the evident lack of labor-saving devices in the grinding of chalk for the production of whiting. The manufacture of whiting is a comparatively simple operation involving the mechanical operations of grinding, floating with water to classify the production into various grades of fineness, filtering, drying and further grinding of the finished product being packed for shipment. From a mechanical engineering viewpoint there is no reason why the product should be handled from the time the crude chalk enters the grinders until the finished product is packed.

TABLE I—COMPARISON OF PRODUCTION AND IMPORTS, 1914 TO 1922 INCLUSIVE

Year	Imports* Short Tons	Imports* Percentage of Production	Production, Short Tons
1914	1,181	1.8	†66,000
1915	2,693	. . .	. . . . .
1916	1,828	. .	. . . .
1917	1,074	. . .	. . . .
1918	1,223	.	. . . . .
1919	765	. .	. . . . .
1920	8,875	. . .	. . . . .
1921	8,826	20.6	43,104
1922 (4 months)	‡2,379	11.5	§20,766

* Imports are fiscal years ending June 30 for 1914 to 1917 and from then on are calendar years.
† Figure is low, as does not include production of one firm.
‡ Total imports for first three months plus imports at New York for April.
§ Includes production of two firms for 6 months and does not include output of one firm.

The production of whiting is an industry which has been long established in this country, and with a few exceptions there has evidently been a lack of effort to keep labor costs at a minimum by the installation of modern and improved machinery. This statement cannot be applied to all manufacturers, as there are at least two firms which are working along progressive lines to install continuous apparatus which will result in a saving of labor and a reduction in cost. An examination of the costs by companies (Table III) shows that the labor cost ranged from $2.23 to $5.16 per short ton during 1922. From this wide variation it is apparent that certain manufacturers can reduce costs by improved equipment and design of plant.

[1] *Congressional Record*, pp. 12,382-5, Aug. 15, 1922.

TABLE III—DETAILS OF WHITING COST, BY COMPANIES, 1914, 1921, AND FOUR MONTHS 1922.

(Per short ton)

Company No.	Total Cost	Material	Direct Labor	Total Factory Overhead	Administration and Selling	Packages	Net Price	Profit or Loss
Four months of 1922								
1	$15.79	$6.55	$2.23	$3.25	$3.56	$0.20	$19.16	$3.37
2	18.74	6.36	5.16	4.23	2.99	*	22.04	3.30
3†	21.89	7.73	3.57	6.87	4.17	‡.45	27.66	2.11
4	17.69	8.62	3.43	3.00	2.03	.61	20.87	3.18
5†	20.41	8.93	4.87	3.78	2.71	.12	26.86	6.45
Weighted average..	18.47	7.39	4.04	3.87	3.05	.12	22.78	4.31
1921								
1	17.06	6.17	2.57	3.69	4.44	.19	22.54	5.48
2	22.29	6.18	5.62	5.51	4.85	.13	28.90	6.61
3	24.89	8.90	3.56	8.14	5.00	‡.71	24.26	—.63
4	21.04	9.76	5.39	2.65	2.79	.45	25.08	4.04
5	21.28	7.97	4.89	4.56	3.68	.18	24.72	3.44
Weighted average..	20.32	7.02	4.33	4.54	4.27	.16	24.52	4.20
1914								
1	7.96	3.21	1.05	1.88	1.69	.13	10.62	2.66
2	8.74	3.61	1.97	2.21	.93	.02	10.84	2.10
3	9.31	4.16	1.57	2.35	1.19	.04	9.81	.50
4	9.36	4.05	1.76	1.18	1.73	.64	10.51	1.15
5	9.98	3.93	2.12	2.96	.93	.04	12.01	2.03
Weighted average..	8.86	3.64	1.71	2.17	1.23	.11	10.65	1.79

* Profit of $30.60 for period on bags. † Costs covering 6 months, 1922.
‡ Indicates profit.

Foreign and Domestic Competition

The wide spread between the domestic and imported cost of whiting is in no small part due to existing exchange rates and will decrease as the Belgian and French exchange approaches normal. A factor in favor of domestic product, which is not shown in the cost figures, is the service to domestic consumers. The consumer in dealing with domestic manufacturers has the assurance that in the case of delivery of inferior goods immediate and satisfactory adjustment can be secured from the domestic producer, whereas in the case of the imported product it is evident that such adjustment is considerably more difficult. The point at which the price of imported whiting becomes sufficiently attractive to warrant a change from a reliable domestic source to an imported one cannot be measured accurately. For tariff purposes care must therefore be exercised in basing duties wholly on the spread between the domestic cost and the cost of the imported product landed in the United States.

A comparison of production and imports of whiting shows that imports have increased greatly since 1919. Table I shows a comparison of imports and production from 1914 to 1922, inclusive. In 1914 imports represented approximately 2 per cent of the domestic production and prior to 1920 never exceeded 2,700 short tons. During 1920 and 1921 they approximated 9,000 tons per annum, or about 20 per cent of the domestic production during the latter year. A comparison of imports and production for the four months in 1922 shows that imports were approximately 12 per cent of the domestic output. It is apparent that domestic producers since 1919 have received active competition from imported whiting.

Summary of Costs

Table II compares the costs of whiting for 1922, 4 months, with 1921 and the pre-war year 1914. This table also

TABLE II—COMPARISON OF THE TOTAL WHITING COSTS, 1914, 1921, AND 1922 (FOUR MONTHS)

(Costs are per short ton)

Period	Production Short Tons	Sales Short Tons	Total Cost	Material	Direct Labor	Factory Overhead	Administration and Selling	Packages	Net Price Received	Profit
4 months, 1922	*20,766	20,231	$18.47	$7.39	$4.04	$3.87	$3.05	$0.12	$22.78	$4.31
1921	40,019	39,755	20.32	7.02	4.33	4.54	4.27	0.16	24.52	4.20
1914	61,627	62,008	8.86	3.64	1.71	2.17	1.23	0.11	10.65	1.79
			(Percentage of total cost)							
4 [illegible] 1922		.....	$100.0	$40.0	$21.9	$21.0	$16.5	$0.6	$123.3	$23.3
1921		.....	100.0	34.6	21.3	22.3	21.0	0.8	120.7	20.67
1914		.....	100.0	41.1	19.3	24.5	13.9	1.2	120.2	20.20

* Includes production of two firms for 6 months.

TABLE IV—DETAIL OF COST OF WHITING IMPORTED AT NEW YORK, APRIL AND MAY, 1922

Country of Origin	Quantity (Short Tons)	Cost c.i.f. New York (Without Duty) (Per Short Ton)	Ocean Freight (Per Short Ton)	Insurance, Consular Fees, Other Expenses (Per Short Ton)	Cost f.o.b. Foreign Port Packed (Per Short Ton)	Packing Cost (Per Short Ton)
Belgium.....	143.3	$11.79	$3.04	$0.085	$8.66	$1.99
	104.7	13.27	3.11	*.049	10.11	2.42
	84.0	11.25	2.12	.078	8.03	1.91
	117.6	10.99	2.96	.080	7.95	1.89
	44.8	9.89	2.95	.128	6.81	1.89
	33.1	15.50	3.03	.210	12.25	4.55
	40.5	18.89	3.07	.188	15.63	4.59
Germany.....	5.5	20.52	2.45	†.428	17.64	3.68
France.....	110.2	14.36	.....			
England.....	5.7	16.58	3.90	.....	12.68	3.90
Weighted av.	689.4	12.80	2.90	.09	9.36	2.39

* Insurance only. † Consular fee only.

shows the percentage of total cost represented by the items of material, direct labor, factory overhead, administration and selling, and packages. The total cost for 1922 was $18.47 per short ton. Of this total, $7.39, 40 per cent, was for material; $4.04, about 22 per cent, was direct labor; $3.87, 21 per cent, factory overhead; $3.05, 16½ per cent, administration and selling expenses; and 12 cents, less than 1 per cent, was for packages. The average net price received for whiting during 1922, 4 months, was $22.78 per short ton. A comparison of this price with the total cost indicates that the industry as a whole made an average profit of $4.31 per short ton, or about 23 per cent of the total cost. The cost for 1922 was more than double that of the pre-war year 1914. The material cost for 1922 was more than twice that of 1914; direct labor nearly two and one-half times as much; factory overhead about one and eight-tenths times; administration and selling about two and one-half times the same items in 1914. The average profit per ton of $4.31 in 1922 may be compared with $1.79 per ton in 1914; on the basis of percentage of total cost, however, the profit in 1922 was 23.3 per cent, as compared with 20.2 per cent in 1914.

Table III shows the variation in the cost of whiting according to companies. The costs listed under a given number are those of the same company for the three periods given.

A study of this table shows that the total cost in 1922 ranged from a low of $15.79 per short ton to a high of $21.89, a variation of about 40 per cent of the low cost. The greatest variation in the various items of cost occurs in that of direct labor. This item ranged from a minimum of $2.23 per short ton to a maximum of $5.16, or a variation of about 130 per cent of the low cost. The net price (freights and commissions deducted) received for whiting during 1922 (four months) ranged from $19.16 to $27.66 per short ton.

This table also shows that the average profit during the 4 months of 1922 ranged from $2.11 per short ton to $6.45:

Details of Cost of Imported Whiting

In Table IV is shown the detail of representative shipments of whiting entered at the port of New York—the point at which most of the whiting is imported—during the months of April and May, 1922. This information was obtained from the original invoices on record at the New York custom house. The shipments included in this tabulation represent in quantity a little over one-third of the total imports—1,981 short tons—at the port of New York for the months of April and May. By far the larger part of the whiting entering the United States at this time originated in Belgium, with France ranking second in importance. Very little whiting was imported from England and Germany.

This table shows that the weighted average cost of ten shipments of whiting aggregating nearly 700 short tons was $12.80 c.i.f. New York, duty not paid. This cost may be compared with a cost of $9.36 per short ton at foreign ports packed ready for shipment.

It should be noted that the difference between these two costs is not represented by the items of freight, insurance, consular fees, and other expenses, as it will be seen from the table that these items were not available in the case of all shipments. They are, however, included in the total cost c.i.f. New York in all cases. A study of this table shows that the total cost at New York ranged from $9.89 to $20.52 per short ton.

Legal Notes

By Wellington Gustin

Rules Governing Interpretation of Written Contracts Where Parties Dispute the Agreements

A statement of the rules governing the construction and interpretation of written contracts where parties dispute the agreements is aptly put in a case before the United States Circuit Court of Appeals by Judge Woolley. The case presents an action at law by the General Supply Co. and others against the Marden, Orth & Hastings Co., Inc., and another on a written contract. (276 Federal, 786.)

Verdict of Trial Court

The trial court under its interpretation of the contract directed a verdict in part—for the plaintiff it directed a verdict in the sum of $12,512.18, subject to a possible deduction of $3,000 according as the jury should or should not find this item a proper credit in defendant's indebtedness; and it submitted to the jury a counterclaim of defendants for $50,000, made up specifically of items for raw materials belonging to the defendants in the possession of the plaintiffs at the termination of the contract, valued at $38,416; work in process $2,620; containers, carboys, drums, etc., $7,727. The jury rendered a verdict for plaintiffs for the $12,512 as directed without deducting a $3,000 credit; and for the defendants it gave a verdict for $44,951. Judgment for the amounts followed.

From this judgment the plaintiffs alone sued out a writ of error challenging as insufficient, because of the court's alleged misinterpretation of the contract.

Intention of Parties to Contract Governs Interpretation

The Court of Appeals laid down the cardinal rule that the intention of the parties to the contract governs its interpretation. The law presumes that the parties understood the import of their contract and that they intended what its terms express. When a contract is clear and unequivocal its meaning must be determined by its contents alone; another meaning cannot be added by implication or intendment, but where the language is ambiguous or susceptible of several significations its meaning may be found in the subject matter, viewed in the light of the circumstances under which it was entered into.

Writing, if Reasonable, Is the Contract

Each party to the contract urged that the interpretation given it by the other was such that no reasonable person would ever have entered into the agreement. But the Court of Appeals regarded the language of the contract as expressing a reasonable and workable arrangement such as men in the respective positions of the parties might enter into with reference to the peculiar subject matter and in the light of the unusual circumstances surrounding the transaction. Now, it says, if the writing itself shows a reasonable undertaking of the parties and in this respect shows what they intended and all they intended, that undertaking is the contract. The court cannot go outside of its terms

to find something different, better or even more reasonable. With these observations the court sought the intention of the parties in the circumstances.

Terms of Contract

The important circumstance was that the war was on. Both parties needed production alone to make money. Defendant Chemical company was a large dealer, and, through subsidiaries, a manufacturer of chemicals, with ample capital. The plaintiff corporation, here called the Supply company, had a chemical plant at Perth Amboy, N. J. The stock of this company was mainly owned and the plant was operated by its president and treasurer. The plant was a small affair, costing about $6,000. The financial resources of the corporation, says the court, and the experience of those who conducted its business were not extensive. In short, the Supply company had a plant and little money; the Chemical company had money and wanted a plant. Both wanted more production. This desire was the reason for the contract in dispute, whereby the Supply company undertook for a period of 14 months—later extended to 36 months—to devote its factory exclusively to the manufacture of chemicals from raw materials exclusively supplied by the Chemical company and to sell the manufactured product exclusively to the Chemical company at a profit to the Supply company of 10 per cent on a cost reckoned on a basis agreed upon. Cost as agreed upon included monthly salaries of $150 to each of the operating officers of the Supply company and a monthly amortization of advances by the Chemical company for the enlargement of the plant.

Dispute Over Minimum Monthly Tonnage

Under this contract the Supply company enlarged its plant and increased production. At times the Chemical company showed an inclination to lag and thereupon the Supply company complained to the Chemical company that it was not delivering raw materials and supplying orders sufficient to enable it to make a "minimum monthly output of 7 tons of aniline oil, 4 tons of sulphanilic acid, and 4 tons of Orange II," a production to which the Supply company regarded itself entitled as a base for its minimum monthly profit. Thereupon the Chemical company increased its deliveries and maintained the same quite constantly until July 1, 1918, when on a declining market, it decreased its deliveries and orders. Later the armistice was agreed upon and the Chemical company ordered the Supply company to cease manufacturing on Jan. 1, 1919. The court found that this contingency was provided for in the contract, although the contract had yet 6 months to run and a large amount of unfinished supplies remained in the hands of the Supply company.

The Supply company construed the contract as imposing an obligation on the Chemical company to give orders and deliver raw materials in an amount sufficient to enable it to make a certain minimum monthly profit throughout the term of the contract; and therefore it brought this suit. Wholly different interpretations of the contract were advanced by both parties, resting on one particular paragraph. The correct construction was held to be that the Chemical company "asked for" and thereby promised to take "the products of the enlarged plant which shall be" the monthly tonnage named. The Chemical company was required "to take a specified amount," but the Supply company promised, quite indefinitely, "to use its best efforts so to increase the plant as to produce the quantity asked for." Here the Chemical company urged a lack of mutuality in the contract. The trial court, confining itself to this paragraph, held that as the Supply company had not promised to produce chemicals in any given amount, the promise of the Chemical company to take chemicals in a named amount was without consideration and therefore not enforceable.

Interpretation of Trial Court Found in Error

The Court of Appeals found the trial court in error in restricting its interpretation to this one paragraph. Looking at the whole contract, it says, a consideration for the Chemical company's agreement to take the monthly tonnage named may be found elsewhere in the contract in the Supply company's surrender of its plant and the devotion of its energies exclusively to production for the Chemical company. Therefore it held the contract was not void but enforceable.

Defendant Had Right to Terminate Contract

Yet while this contract partook of a business venture in which the common object of both parties was enlarged production to meet an abnormal market due to war, it was apparent to both that the war would end and with it the market. Therefore the Chemical company in promising to take the increased production of the enlarged plant in the amount of 7 tons plus 4 tons plus 4 tons of different chemicals monthly undertook to do so only "for the present and until further notice." And it gave that notice by ordering production to cease Jan. 1, 1919. The court thought this was not unreasonable and the real intention of the parties, and held that it gave the Chemical company the right to terminate the contract on reasonable notice. Therefore the court held that the Supply company was entitled to receive the total of the monthly differences between profits it would have earned under the contract had the Chemical company supplied it with materials and orders, and the profits it actually received, reckoned from the date of the contract to its termination by notice on Jan. 1, 1919. But it was not entitled to recover profits from this date down to the date named in the contract for its termination, which was about 6 months more. The judgment was reversed and the case sent back for retrial.

Heat Losses of Stored Coal

Calorimeter tests to determine the losses in calories of coal heated in the air for various lengths of time are being made at the Pittsburgh experiment station of the Bureau of Mines. At 125 deg. C. the following heat losses were obtained:

Time of Heating	Per Cent Loss	Time of Heating	Per Cent Loss
30 min.	0.30	3 hr.	1.01
1 hr.	0.26	20 hr.	3.3
2 hr.	0.311	46 hr.	5.7

Samples were heated for various periods of time ranging from ½ hour to 100 hours, and the calorific value determined by the coal laboratory. The results show no regularly increasing loss in heating value as the time of heating increases. The coal samples show a change of weight on heating. First a decrease in weight due to the loss of moisture is observed. The decrease is generally less up to 24 hours, when there is an increase in weight of 0.64 per cent. After heating 100 hours at 125 deg. C. there is an increase in weight of 1.35 per cent and a loss in heating value of 3.02 per cent.

Iron Ore Smelting by Electricity

ALFRED STANSFIELD, Birks professor of metallurgy at McGill University, Montreal, Canada, outlined some of the difficulties in the electric smelting of Canadian iron ores, in an address given Oct. 9, 1922, before the Cleveland Section of the Association of Iron and Steel Electrical Engineers. After tracing the history of the experiments at Sault Ste. Marie, Heroult (Calif.), and those in Sweden financed by the Jernkontoret, it became evident that the design of a successful furnace was no simple matter.

The "elektrometall" furnace, developed by the Swedes, was with some small exceptions the only one in successful commercial operation, but iron ores can be smelted successfully in the "Noble" furnace developed at Heroult and even in a plain, open-top, pit furnace, and these latter furnaces are preferable to the Swedish furnace for the production of gray foundry iron.

Gray Iron for Foundries

Whereas the Swedish furnace operates much like an ordinary iron blast furnace, in that ore reduction and even carbonization of the spongy iron is done by hot CO gas rushing up the stack, low furnaces, of course, must rely almost entirely upon direct contact with solid carbon for reduction and carburization. Doubt has been expressed that the latter will produce the gray iron required for ordinary foundry work in view of two facts: (1) The normal output of the Swedish "electrometal" furnace is white iron, despite its approach to conventional blast-furnace principles; (2) that it was found exceedingly difficult to make "synthetic iron" containing more than 2½ per cent carbon, when remelting steel scrap with granular carbon in an electric furnace. Professor Stansfield was quite positive that these two facts had been stressed unduly. The Swedes make low-carbon white iron, because that metal is more desirable for conversion into steel and wrought iron, and this is the use to which their production is put. Furthermore, synthetic pig iron carburizes so very slowly because the reaction takes place only at the surface of the bath, covered with floating carbon. Keller,[1] in France, showed how to get high carbon by charging the carbon and steel scrap in layers. Therefore a pit furnace would produce high-carbon iron if there remained a slight excess of carbon in the ore column when it finally reached the bottom. This residue of coke or charcoal would rest on the hearth, supporting the granular charge above, and submerged in the molten metal, dissolving therein. Then if conditions were correct—the furnace operating with a "free-burning" arc at high voltage—silicon would also be reduced and the furnace would produce the soft graphitic iron required for ordinary machinable castings.

Excess of Carbon in Charge Is Fatal

An electric furnace is quite sensitive to correct proportioning of the charge. An excess of carbon arriving at the hearth will remain there, and even accumulate if some lean charges are not forthcoming, gradually plugging up the furnace and stopping the operations. It cannot be burned out with more air at the tuyeres, for there are no tuyeres. It simply remains until some solid oxide reacts with it or the metal dissolves it away. On the other hand, a cumulative slight deficiency in carbon (in an electric furnace) means poor reduction, large slag loss and a hard semi-steel, low in carbon and silicon. Even the best of electric smelting furnaces are subject to these troubles—a low pit furnace has something the better of the Swedish shaft furnace, in that a much shorter time is required for a corrective charge to work its way to the seat of the trouble.

Experience with several furnace designs indicates that iron is smelted best when the arc is free burning—i.e., immersed in the charge but slightly—and surrounded by an incandescent crater of flame and gas. Deep immersion diffuses the heat because many more paths through the ore charge are offered by which the current can leak from electrode to electrode. Short circuits are then frequent and the voltage must be reduced; partial fusion and reduction occurs at many points, and the charge has a tendency to "hang up." Even worse conditions result if the electrodes are forced still lower into the molten slag or metal, when the furnace becomes completely short circuited.

Economic Considerations

Professor Stansfield pointed out that inherently electric smelting demanded cheap power. Two-thirds of a ton of fuel per ton of pig iron may be saved, but in general the electric energy required (½ hp.-yr.) costs more than that much coke, although it may cost less than the amount of charcoal that would be saved. It follows that the electric furnace is unlikely to replace the coke blast furnace, though it has successfully replaced the charcoal blast furnace in Sweden. It was his opinion, also, that electrical energy was far too valuable a commodity to be used permanently in such a crude operation as ore smelting. It could be done only on the "outposts of civilization," where the power might easily be developed long before the demands of culture and industry could absorb it. As population increased, their multifarious needs would warrant them paying a far higher price for electricity, and ore smelting would be discontinued. This is not a particularly bright outlook for the method, however. The speaker said the reason, in his opinion, why electric pig iron was not now being produced in Canada was on account of their high labor and material costs and a lack of a special market which could be filled by that special quality of iron. But is it not true that labor and materials are always high in the outposts of civilization and there is never a local market for special irons and steels?

Professor Stansfield considered that there was a field for the application of electric smelting of iron ores on a limited scale at points where conditions were especially favorable, but that any large-scale development of electric smelting must form part of a process in which the ore would be reduced to the metallic state in fuel-fired furnaces at a low temperature before entering the electric melting furnace for the production of steel.

[1] *Chem. & Met.*, vol. 22, p. 83, Jan. 14, 1920.

The Grignard Reaction and Organomagnesium Compounds

Dr. C. J. West of the National Research Council some time ago compiled a very complete bibliography of articles relating to the Grignard reaction. This bibliography and a discussion of the reaction are now available as No. 24 of the reprint and circular series of the National Research Council. The report is exceptionally complete and splendidly indexed by compounds and by authors. The report is for sale by the Council at $1.50.

New Invention Eliminates Accidental Explosion in Gas Mixtures

By Dr. H. C. P. Weber
Research Laboratory, Westinghouse Electric & Manufacturing Co.

THE accumulation of explosive gas mixtures in inclosed spaces is of frequent occurrence, and accidental ignition of these explosive mixtures in public places has led to disastrous results.

Thus the explosion of sewer gases in city sewer systems is not at all infrequent. So also occasional explosions are reported from public service tunnels and underground systems. The same problem presents itself as a result of gas mixtures which accumulate from various causes in closed vaults containing control apparatus, electrical or otherwise, in transformers and in similar apparatus.

Nature of Explosive Gases

The gases accumulating under these conditions may arise from a variety of causes. In general, however, they are essentially hydrocarbons (principally CH_4 and related compounds), with occasional admixtures of hydrogen and carbon monoxide. Thus the accumulation in sewers may be CH_4 from fermentation or, at times, gasoline vapors. In the case of other underground systems in streets, there is some possibility of the accumulation of gasoline vapors or of illuminating gas from adjoining mains or, in unusual cases, gases arising from the accidental destruction of the organic insulating materials commonly used. In systems where considerable quantities of lubricating or insulating oil are used, a slight accumulation of explosive vapors may arise from these materials themselves.

A similar problem presents itself in the gases accumulating in mines which resulted in authoritative and exhaustive research by the Bureau of Mines on this subject. Here the quantities of gas are so enormous and the spaces to be controlled are so vast that little can be done beyond obtaining the best possible ventilation. In more limited spaces, however, some preventive measures have been taken, such as the use of fire-snuffing vapors, chloroform and carbon tetrachloride; but these measures have been rewarded with only a limited amount of success. The use of CO_2 to dilute the explosive mixture below the explosion point has been suggested, but this requires an entirely impracticable amount of CO_2. Moreover, one of the essential requirements to obtain safety is occasional attention only; and under these conditions the use of CO_2 becomes unsatisfactory.

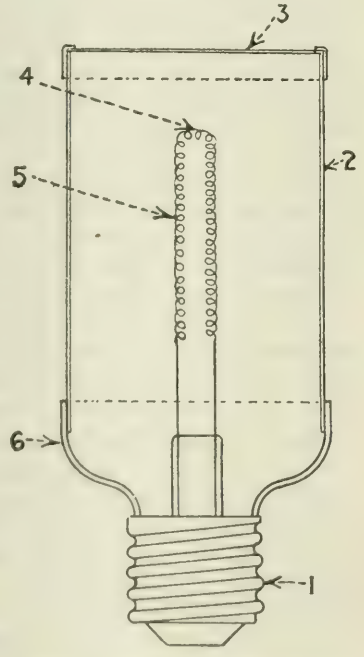


FIG. 1—OUTLINE DIAGRAM OF LAMP

The method to be described here eliminates the danger of explosion by continuously removing the explosive mixture itself—that is, by burning it up more rapidly than it can accumulate. In order to do this the gas must be oxidized at a temperature considerably below that at which the explosive wave is propagated—that is, below the explosion point. It has been possible to do this by the use of an oxidative catalyst finely distributed over a porous surface. A description of the principle of this operation, and some of the results attained, follows:

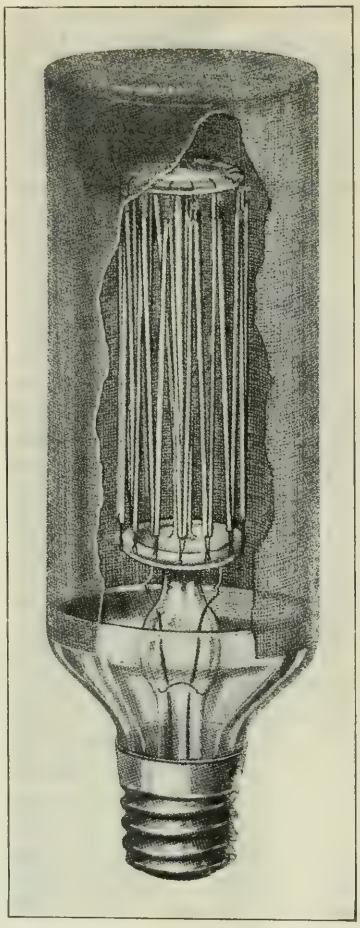


FIG. 2—LAMP WITH SECTION OF WIRE SCREEN CUT AWAY TO SHOW FILAMENT

In the diagram, 1 is a lamp base of the ordinary type which may be screwed into any ordinary lamp socket for the purpose of making connection with a 110-volt circuit. The leads are brought in from the base in the standard fashion through a glass insulating member; 6 is a glass member supporting 2 and 3; 2 and 3 consist of a fine mesh wire screen which is intended to prevent any flame which may form in the interior from striking through to the outside, according to the well-known Davy principle. As a matter of fact, the device is so designed that the possibility of formation of a flame in the interior may be neglected. The bulk of the results described in the succeeding were obtained with the bare and unprotected filament, and the wire gauze is in the nature of additional security. The filament itself, 4 and 5, is shown in the diagram in the simplest form of a coil. In practice there are a number of variations more suitable for special purposes, either consisting of a solid porous cylinder internally heated or of wires sheathed in porous tubes and arranged to form a hollow cylinder.

The essential feature in the whole device is the application of a catalyst to a considerable porous surface, and the control of the resistance of the whole system so that it normally takes on a safe and effective operating temperature. The temperature we have found most satisfactory to use has been between 600 and 800 deg. C. using a platinum catalyst. The best temperature of operation depends somewhat on the catalyst used and the results have varied with various compositions used as catalysts. For this discussion the results with platinum may be taken as typical.

Results Obtained With Platinum Catalyst

The following results give the temperatures (measured by the optical pyrometer) necessary to explode a mixture of 10 parts of air to 1 of natural gas.

Time	Amperes Through Lamp	Deg. C.	
10 min.	1.00	925	No explosion
5 min.	1.05	955	No explosion
20 sec.	1.10	995	Exploded
.....	1.15	1,080	Immediate explosion

These tests were repeated with the natural gas in various mixtures, and the results uniformly showed that under these conditions, filament bare and unprotected, a temperature of nearly 1,000 deg. C. was necessary to produce explosion.[1]

With these preliminary results at hand, the next set of determinations had to do with the operating efficiency of the device as a gas consumer.

RATE OF GAS CONSUMPTION. BARE WIRE, NO CATALYST
2,500 c.c. Air. 250 c.c. Natural Gas

Time	Filament Temp., Deg. C.	CH_4 Burned Per ½ Hr., Per Cent
2½ hr.	780	4
½ hr.	850	11
½ hr.	940	26
2 min.	940	.....
2 min.	960	62 (no explosion)
½ min.	1,000	.....

Results With Other Catalysts

A further series of experiments was carried on to determine the effect of a number of well-known oxidation catalysts. These were carried out by running up the temperature for each catalyst and determining the rate of gas consumption at successive steps 400, 500, 600 and 700 deg. C. Detailed discussion of these results is reserved for some future date. It may be said, however, that while the order of effectiveness did not change essentially for the various catalysts, certain catalysts were relatively more effective than others at low temperatures—that is, change in temperature did not affect all catalysts to the same degree. Further work is needed to discuss this phase satisfactorily.

As examples of the final results obtained, the following values are given:

RATE OF GAS CONSUMPTION. COVERED WIRE + CATALYST
2,500 c.c. Air. 250 c.c. Natural Gas

Catalyst	Time	Filament Temp., Deg. C.	CH_4 Burned Per ½ Hr., Per Cent
Ca-Cr	½ hr.	700	80.4
Pt (A)	½ hr.	700	93.0
Ba-Mn	½ hr.	700	78.0
Pt (B)	½ hr.	700	97.0

The best of these results shows that with the volumes as given, 97 per cent of the combustible constituent, methane, of a mixture in the proportions for complete combustion and highly explosive, can be burned out in ½ hour. The temperature at which this is possible is about 300 deg. C. below the ignition point.

Of course a similar result could be attained at the expenditure of greater time and at a lower temperature. However, throughout an extended series of tests with numerous gases and a variety of lamps, we have never obtained ignition of the most highly explosive vapors and we consider 700 deg. a safe temperature for the device as constructed.

Results With Various Gas Mixtures

Some of the results obtained[2] at various times, based on 5 cu.ft. of gas, or 136 liters, and using the lamp of the most effective type have been as follows:

Pittsburgh natural gas	.6%	91.4 air	43% in 24 min.
Rich coal gas	8.6%	91.4 air	40% in 24 min.
Lean coal gas	10.0%	90.0 air	57% in 24 min.
Hydrogen	10.0%	90.0 air	56% in 10 min.
Hydrogen	15.0%	85.0 air	76% in 10 min.

The astonishing result is that the device functions even in a 10 or 15 hydrogen air mixture. This is probably the most severe test that could be made. The rate of consumption is enormously increased in this mixture, as may be noted. For mixtures of air and hydrogen (submarines and the like) we recommend a type specially designed for this purpose.

In conclusion it may also be stated that when actively functioning in an explosive mixture, the temperature of the filament is somewhat higher due to the heat of reaction. This is readily discernible and the temperature drops again when the combustible gas is exhausted, giving a qualitative indication of the presence of explosive vapors. By the use of a thermocouple junction this indication may be made to be self-recording and capable of accurate measurement.

Use of Oxygen in Metallurgical Operations

Use of oxygen in connection with the enrichment of the blast in the blast furnace and in practically all phases of pyrometallurgical work will furnish the key to success in the further development of such metallurgical operations, according to Dr. F. G. Cottrell, formerly director and now consulting metallurgist of the United States Bureau of Mines, who first directed the bureau's attention to this subject. Through this enrichment process, it is hoped to increase the efficiency of metallurgical operation with a resultant production of metals at lower cost and possibly the use of lower grade ores.

The Bureau of Mines now has outlined plans for two studies which will be carried on simultaneously. The first will cover the present-day processes for the production of oxygen, in order to determine the feasibility of attempting to produce oxygen, or oxygenated air, in such amounts and at such a cost as to permit of its use in metallurgical operations. The second study will be devoted to the feasibility of using oxygen, or oxygenated air, in metallurgical operations.

Because of his interest in this investigation, M. H. Roberts, vice-president of the Franklin Railway Supply Co., was asked to select an advisory committee to work with the Bureau of Mines, and to act as chairman of this committee. The committee will consist of Dr. F. G. Cottrell, director of the Fixed Nitrogen Research Laboratory; Prof. W. L. DeBaufre, chairman of the mechanical engineering department of the University of Nebraska; Dr. D. A. Lyon, chief metallurgist of the Bureau of Mines; Dr. R. B. Moore, chief chemist of the Bureau of Mines; Dr. R. C. Tolman, professor of physical chemistry and mathematical physics, California Institute of Technology; J. W. Davis, mechanical engineer of the Bureau of Mines; F. W. Davis, metallurgist of the Bureau of Mines; Frank Hodson, president of the Electric Furnace Construction Co., and P. H. Royster, assistant metallurgist of the Bureau of Mines.

Previous to the war, some work was done in Belgium on the enrichment of the blast with oxygen in connection with the smelting of iron ores in the blast furnace.

[1] An exhaustive study on the temperatures of glowing wires necessary to explode various gas mixtures is found in Bureau of Mines Bulletins 52 and 131, Tech. Papers 23, 28 and 75.

[2] For a number of the determinations on various gas mixtures we are indebted to the courtesy of the Pittsburgh Station of the U. S. Bureau of Mines.

Synopsis of Recent Chemical & Metallurgical Literature

Nitrogen in Iron and Steel

A review of methods for determining nitrogen in steel and cast iron and a comparison of the amounts of nitrogen found by previous investigators in the several classes of irons and steels are given by F. Wüst and J. Duhr.[1] Further on in their report they give a modification of the usual method of analysis for nitrogen, describe the preparation of a number of nitrides, and give the results of an investigation of the amount and the behavior of nitrogen in iron during the puddling process and in open-hearth, electric and bessemer steels.

All reliable methods for determining nitrogen in steel yet found depend on the conversion of the nitrogen to ammonia by the action of a suitable solvent. This ammonia, recovered from the solution by distillation with an alkali, is determined by a colorimetric (Nessler) or a titrimetric (alkalimetric or iodometric) method. The Nessler method was condemned by Wüst and Duhr because the color of the Nesslerized distillate is modified by the amines during the solution of cast irons. In the analysis of cast irons it was also impossible to determine satisfactorily the end point in the iodine titration. A very sharp end point and satisfactory results were obtained by titrating the ammoniacal distillate with 0.01 normal sulphuric acid using an ether solution of iodeosin as the indicator. Thirty c.c. of this indicator solution is shaken in a 250-c.c. flask with the ammoniacal distillate. Two layers separate, the lower one colored a deep rose. This color fades on titrating with sulphuric acid and is completely lost with the slightest excess. Results for nitrogen in cast irons were from 50 to 100 per cent higher by the iodometric titration than by the iodeosin method. Hydrocarbons which interfere in the iodine titration are shaken out in the ether layer in the new method and thus do not influence the results.

Nitrides of several metals and ferroalloys were prepared by heating the finely powdered materials in N at 900 to 1,025 deg. C. for a number of hours and the product analyzed by the iodeosin method. Results are given in Table I.

TABLE I—ABSORPTION OF N_2 AT 900 TO 1,025 DEG. C.

Metal	N_2 by iodeosin method
Pure Fe	0.02 per cent
Pure Cr	9.81 per cent
Mn (97 per cent)	6.60 and 7.36
Ni	none after 3 hr.
Mo	none after 6 hr.
47 per cent ferrochromium	0.92
86 per cent ferromanganese	0.78
25 per cent ferrotitanium	1.52
10 per cent ferro-aluminum	more than 3
25 per cent ferrovanadium	more than 1
83 per cent ferrotungsten	0.0118
22 per cent ferrophosphorus	0.0179

Wüst and Duhr conclude with an investigation of the amount and behavior of nitrogen in wrought iron, and open-hearth, electric and bessemer steels. Nitrogen in puddled iron increased in proportion to the duration of the heat. The pig iron charge of the heat for which complete data are given contained 0.0009 to 0.0013 per cent nitrogen, while the finished material held from 0.003 to 0.004 per cent.

The changes in nitrogen content during the progress of open-hearth and electric induction furnace heats are traced for one heat of ingot iron, five heats of carbon steel and three heats of chromium steel. Each of these steels was made by a duplex process—a preliminary refining in an open-hearth furnace by the Talbot process, followed by the final refining in a Röchling-Rodenhauser induction furnace. The nitrogen content of the metal of the bath at the start of the open-hearth refining period was about 0.002 to 0.003 per cent in all heats. At the close of the open-hearth refining the nitrogen content was approximately the same as at the beginning, although in some of the carbon steel and chromium steel heats the nitrogen value had passed through a maximum during the progress of the heat and then fallen off to its original value.

During the electric furnace refining the nitrogen in the ingot-iron heat increased slightly to a final value of 0.004 per cent. The nitrogen content of the carbon and the chromium steels increased very considerably during the electric furnace refining; the plain carbon steels finished with 0.009 to 0.012 per cent and the chromium steels with 0.005 to 0.008 per cent N. In heats selected as typical by the authors, plotting the nitrogen content of the bath against the duration of the heat shows very strikingly the influence on the nitrogen content of the various additions to the bath. Recarburization with coke at once increased the nitrogen content of the bath five or six fold—for example, from 0.002 to 0.010 or 0.012 per cent. Additions of a lime-clay-fluorspar slag mixture decreased the nitrogen content, but the subsequent addition of ferrosilicon near the close of the heat again raised the nitrogen content to nearly or quite its maximum value for that heat.

The behavior of nitrogen in basic bessemer practice was determined in about ten heats from each of six different works. From each heat were taken samples of the charge, of the steel before deoxidation, after deoxidation, and after the casting of the last ingot. The nitrogen in the pig iron charge was from 0.0007 to 0.0013 per cent. The steel before deoxidation contained from 0.0109 to 0.0210 per cent nitrogen, and this value was not changed by deoxidation by either solid or liquid deoxidizers.

Qualitative tests for nitrogen in iron as cyanide were negative. The theory that silicon may be a nitrogen carrier in iron does not seem to be correct, or there would be higher nitrogen in acid than in basic bessemer metal, a condition which is not in accordance with fact. From their success in introducing nitrogen into pure iron by heating in nitrogen gas at 900 to 1,100 deg. C., as well as from further successful attempts at nitrogenizing charcoal iron and basic bessemer pig iron by leading dry nitrogen through the molten metal, Wüst and Duhr conclude that in the bessemer blow, nitrogen from the air blast unites directly with the iron.

[1] *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung*, vol. 2, pp. 29-57; reviewed at length in *Stahl und Eisen*, Aug. 17, 1922, pp. 1295-6.

A Novel Salvaging Operation

The *Hercules Mixer* for September, 1922, describes the novel method used for wrecking four of the sulphuric acid-concentrating units. The building contained five lead pan concentrating units which were used during the war for the concentration of denitrated sulphuric acid. It was decided to tear down four of the units and the building which housed them. Accordingly, the structure was cut away between the fourth and fifth units and a ⅞-in. steel cable approximately 200 ft. long was attached to a roof truss. The other end of the cable was attached to a steam locomotive, and after two or three attempts the building gave way and collapsed.

The lumber was used as fuel under the nitric acid retorts. The nitric acid plant happened to be located near to the old sulphuric acid recovery building, so a portable saw was set up near the wreckage and the lumber sawed up into suitable lengths for use in the nitric acid furnaces.

Feldspar Production in New Hampshire

A recent report of investigations of the Bureau of Mines by Raymond B. Ladoo describes one of the important recent developments in the feldspar industry—namely, the rapid rise of New Hampshire as a feldspar-producing state. The unusual size and purity of the deposit now being worked in Keene and the improved methods of mining and milling used have been responsible for this situation. In the spring of 1921 the Keene Mica Products Co., of Keene, N. H., began the production of feldspar from its property in Gilsum, N. H., which had long been operated as a mica mine. The purity of the feldspar at once attracted favorable attention and the production of crude ore rapidly increased. The feldspar is pure and

shows little or no evidence of alteration. It occurs in large crystals and masses with relatively small quantities of crystallized quartz. There is little or no graphic granite or intergrowth of feldspar and quartz. The quality of the feldspar is altogether unusually good.

Milling Operations

The crude ore is unloaded on the floor of the mill and shoveled into a 9x6-in. manganese steel jaw crusher of a special type, which in one operation will crush large lumps to about ⅜-in. size. The ground material is raised by means of a bucket elevator to a 35- to 40-ton bin, and delivered to a disk feeder to a Hardinge mill. The finely ground material is conveyed by a bucket elevator and a short belt conveyor to a 14-ft. Emerick air separator. The fine material is conveyed to a railway car or to storage while the oversize material is returned by a belt conveyor to the disk feeder. The estimated capacity of the plant is 1½ to 2 tons per hour. The success of this method of milling following the general method outlined by the Bureau of Mines offers definite proof that feldspar can be ground continuously and sized by air separation, at the same time making a better product, at a lower cost than is common in batch grinding in "dump cylinders."

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Tanning Extract From Quebracho and Waste Sulphite Liquor—Quebracho extract is completely soluble in waste sulphite liquor yielding a liquor which has a tanning value somewhat in excess of the sum of the tanning values of the components. This liquor differs materially from sulphited quebracho extract prepared with the aid of sodium sulphites, as the fresh waste liquor contains only a trace of free sulphurous acid or sulphites. The waste liquor is used just as discharged from the digestor—that is, in the form which is usually called light liquor to distinguish it from evaporated preparations. Various efficient tanning agents can be made from the light liquor by concentration and by other treatment, but the light liquor as it comes from the digestor and without treatment has but little tanning value. If further acidulation of the light liquor is desirable, commercial sulphonic acids containing an aromatic group appear to function better than most other acids. As an example of the preparation of extracts according to this specification, 5 per cent of a sulphonic acid is added to a mixture of equal parts by weight of commercial quebracho extract and light liquor. Upon warming, a clear extract is obtained which can be diluted as desired with water without precipitation of tans. (1,430,477. John K. Tullis, of New York, N. Y., assignor to Fulcra Tan Co., of Irvington, N. J. Sept. 26, 1922.)

Chlorination of Gaseous Hydrocarbons — An essential feature of the invention consists in effecting the chlorination of the hydrocarbons in the gaseous phase and under anhydrous conditions, and thereafter isolating from the reaction mixture the unchanged hydrocarbon, the chlorine derivatives thereof, and the halogen acid, or some of them, by liquefaction methods comparable to those applicable for the separation and recovery of the components of air or other mixtures of so-called fixed gases. (1,422,838. George O. Curme, Jr., assignor to Carbide & Carbon Chemicals Corporation. July 18, 1922.)

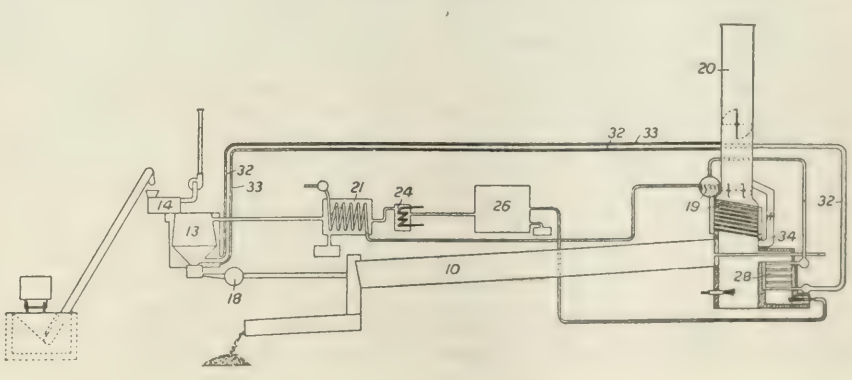
Tanning With Pyrophosphates and Alum—In tanning with solutions containing sodium pyrophosphate, alum and salt, as described in U. S. Pats. 1,039,150 and 1,191,527, it has been found that successful commercial operation requires careful regulation of the temperature, preferably between 95 and 105 deg. F. Exposure for any length of time to temperatures above 107 deg. F. causes deterioration, the leather lacking tensile strength and becoming more or less brittle or "grain-cracky." (1,427,221. Ernest Wyndham Merry, of Sheffield, England, assignor by mesne assignments to Pyrotan Leather Corporation, of Wilmington, Del. Aug. 29, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Building, Chancery Lane, London, England.

Cement—The apparatus described comprises a kiln plant and a process for operating it, in which the firing of the kiln is effected by the coke residue from a carbonization plant working in conjunction therewith. In one form of apparatus, the waste gases from the rotary kiln 10 are utilized in a low-pressure boiler 19, the steam from which is passed to an independently fired superheater 28, and thence to a continuously operating low-temperature distillation retort 13 having a fuel preheater 14. The gas from the retort is passed through a condenser 21, acting as a feedwater heater for the boiler, a cooler 24, and byproduct recovery plant 26, and may then be used for firing the superheater 28 and supplying additional heat to the boiler 19 when required. The solid residue from the retort is pulverized while still hot, and is fed to the kiln by the fan 18. When additional fuel is required for the kiln, the powdered residue, with or without other powdered raw fuel, is mixed with the residual oils from the gas and fed to the kiln in colloid form. The waste gases from the kiln may be bypassed round the boiler through the flue 34. The steam pipe 32 leading from the superheater to the retort is jacketed by a flue 33, through which waste gases from the chimney 20 are passed to a jacket round the retort and thence to the preheater 14. In a modified form of apparatus the boiler and superheater are independently fired and the waste gases of the kiln are utilized for heating the feedwater only. The hot gas from the retort is passed through three heat interchangers in series which act respectively as a feedwater heater, a vaporizer and a superheater, and the steam from the last is passed to the superheater in connection with the main boiler. (Br. Pat. 181,811. E. G. Weeks, Northumberland. Aug. 16, 1922.)

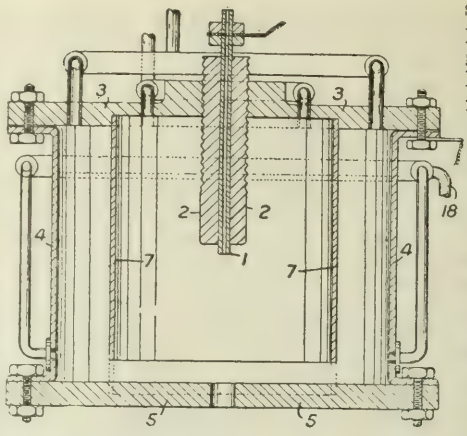
Metallic Powders—Metallic powders for industrial and decorative purposes are obtained by electrolysis using an anode of the required metal, the current density being chosen so that the metal is deposited on the cathode in a finely divided, non-coherent and non-adherent crystalline form; the electrolyte is passed rapidly between the electrodes so as to carry away the powder, and then passes through a separator and, if necessary, a regenerating vat, from which it is returned to the cell or cells by a pump. The current density may be 20 amp. per sq.ft., and the electrolyte velocity 10 ft. per sec. The electrodes may be $\frac{3}{32}$ in. apart. The cathode may be of aluminum or copper and may be stationary or may revolve or reciprocate. The powder may be separated from the electrolyte centrifugally or by levigation or filtration, and is washed, dried and, if necessary, polished. In obtaining bronze powder from scrap metal, the electrolyte may be a saturated solution of copper sulphate together with sulphuric acid. Thirty-six cells in series are used, with a current of 1,000 amp. and a pressure of 36 volts. A 50-volt generator is used, driven by a motor which also drives the pump



and the washer, polisher and drier. (Br. Pat. 181,831. W. M. Gillespie and P. Buckley, London. Aug. 16, 1922.)

Bleaching Powder — Compounds of calcium hypochlorite and calcium hydrate are stabilized by washing to remove calcium chloride and by subsequent drying at temperatures up to 110 deg. C. either *in vacuo* or at ordinary pressure. The products thus prepared, which comprise compounds containing 1 to 4 molecules of calcium hydrate in combination with one molecule of calcium hypochlorite, are stated to possess various advantages over ordinary bleaching powder, in that they remain almost unaffected at elevated temperatures at which bleaching powder would be decomposed, have a higher percentage of available chlorine and possess only a faint smell. In an example, 1 cu.m. of chlorinated milk of lime containing 145 grams of available chlorine per liter is stirred with 60 kg. of calcium hydrate, after which 128 kg. of moist salts is separated from the mother liquor. The product, after drying at an elevated temperature, weighs 100 kg. and contains 42 per cent of available chlorine. In another example, a lime sludge containing 100 parts of quicklime and 250 parts of water is chlorinated by stirring in a closed vessel until 85 parts of chlorine have been taken up. The product is freed from the calcium chloride mother liquor and the pressed cake dried in a steam drying oven. The product contains 50 per cent of available chlorine and in this case contains the compound comprising one molecule of calcium hydrate in combination with one molecule of hypochlorite, in addition to that containing twice this quantity of hydrate. The proportions of calcium hydrate and chlorine may be varied so that other products of higher basicity or, on the other hand, mixtures of basic hypochlorite with neutral hypochlorite may be produced, as desired. The compounds are suitable for use in bleaching and disinfecting. (Br. Pat. 182,921. Chemische Fabrik Griesheim Elektron, Frankfurt-on-Main. Sept. 6, 1922.)

Electrolysis—Various products are obtained by the action of nascent oxygen or its equivalent, such as a halogen, produced at an anode having a very small active area compared with that of the cathode, current being supplied at such a pressure that the anode becomes hot, preferably incandescent. Substances to be treated are supplied to the electrolyte or introduced at the anode in dissolved or gaseous form. The substances may be fed through the tubular anode, of which only the end is exposed to the electrolyte. As shown, the anode 1 is surrounded, except at the ends, by a porcelain sheath 2. Instead of a single aperture, the anode may be provided with a number of small holes for the passage of the gas, etc., or may have a porous surface—for example, a coating of silver, platinum, osmium, iridium, carbon or graphite. Alternatively, the anode may be a solid rod, other means for introducing the reagents being provided. Platinum, graphite, lead, silicon and silicon alloys are suitable anode materials. The cathode may consist of the cell wall 4, of compressed carbon or other material and provided with flanges to which are bolted a base 5 and cover-plate 3, which may be of vulcanite, glass, asbestos, etc. A cylindrical diaphragm 7 of earthenware, fireclay, cement, asbestos, etc., extends from the cover nearly to the base, or in some cases into a groove in the base. An overflow 18 leads to a pump, which may return the electrolyte to the anode. Separate circulation of anode and cathode liquids may be provided for. Gases escape at atmospheric or reduced pressure. Under some circumstances intermittent heating of the anode may result from the alternate generation and absorption of gas. Oils from lignite, etc., may be oxidized to fatty acids by introduction through the anode, say in the form of an emulsion in concentrated solution of sodium bisulphate or bichromate, the electrolyte containing bisulphate with or without persulphates. Oil from Caucasian petroleum, emulsified with dilute sulphuric acid, may be treated in the presence of an electrolyte containing sulphuric and hydrochloric acids and sodium bisulphate or perchromates. Naphthene sulphuric acids and carboxylic acids are obtained. Oxygen may be supplied to the anode with the emulsion. If nitric acid is used instead of sulphuric acid, adipic acid is obtained. Substances resembling montan wax can be got by heating lignite under pressure with caustic alkali solution, mixing the product with sodium perchlorate solution and introducing the mixture into the electrolytic apparatus, which may be kept hot so that the wax can be run off in liquid form. Nitrates may be obtained by passing nitrogen-oxygen mixtures through multiple perforations of the anode into the electrolyte, containing a chloride or other salt of aluminum, magnesium, calcium or barium, with or without a salt of chromium, tungsten, or vanadium. Resin oils may be converted into resin acids. Methane may be oxidized to methyl alcohol, formaldehyde or formic acid, the electrolyte in this case, according to the provisional specification, being a concentrated solution of potassium permanganate containing 10 to 20 per cent of chloride of iron. Acetylene gives acetaldehyde and acetic acid. Hydrocarbons can be chlorinated, or nitro compounds obtained. (Br. Pat. 181,848. G. Plauson, Hamburg. Aug. 16, 1922.)



Tungsten Electrolysis—Tungsten or molybdenum trioxide or the corresponding hydrated oxide is reduced to a lower oxide in an electrolytic cell the cathode of which is immersed in a paste of the powdered oxide and an electrolyte such as dilute sulphuric acid in which the oxide is insoluble. A suitable composition for the paste is 900 grams of tungsten trioxide to 150 c.c. of dilute sulphuric acid of specific gravity 1.2. The paste may be contained in a porous pot, and may be agitated by a metal ring connected by spokes to a central rod. The cathode consists of about thirty thin rods of nickel-chromium alloy connected at the top to a metal plate through which the agitator rod passes. The anode may be of lead and may be inclosed in a porous pot containing scrap molybdenum which is oxidized during the process. The cathode paste may contain zinc sulphate or other soluble salt of a metal more oxidizable than tungsten or molybdenum. A current of 30 amp. at 6 volts, rising to 7 volts during the process, may be used, the current density being 0.10 amp. per sq.cm. at the cathode and 0.28 amp. per sq.cm. at the anode. The temperature is maintained between 40 and 60 deg. C. The reduced paste is washed to recover the acid and to remove impurities and then dried on a vacuum filter. The powder obtained may be reduced to metal by heating in a current of hydrogen, the product being obtained in a finely divided state; it may then be pressed into rods or bars and sintered. (Br. Pat. 181,837. R. E. Pearson and E. N. Craig, Hanwell. Aug. 16, 1922.)

Casein—Casein is prepared for use as a plastic material by dissolving it in a solution of sodium or potassium carbonate, sodium silicate, borax or ammonia, adding coloring matter to the solution if desired, and precipitating the casein with the reagent described below. The precipitate is worked up by heat into the desired forms and hardened with formaldehyde. The precipitating agent is made by dissolving zinc sulphite, potassium or sodium meta-bisulphite, glacial acetic acid and alcohol in water, adding zinc cuttings, decanting the clear liquor, treating this with milk of lime and filtering. (Br. Pat. 183,972. R. H. Abrey, London. Sept. 27, 1922.)

Benzanthrone Derivatives — An hydroxybenzanthrone is obtained by heating benzanthrone under pressure with caustic alkali solution in the presence of anthraquinone, with or without addition of a chlorate or nitrate. An aminobenzanthrone is obtained by heating the hydroxy compound with strong ammonia under pressure. (Br. Pat. 183,351. British Dyestuffs Corp., Ltd. Sept. 13, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Coal Commission Faces Broad Problems

Lack of Coal Specialists Delays Completion of Staff

As the President's Coal Commission draws nearer to the mountain of work which it has been assigned to do, the commissioners are receiving a new impression of the enormity of the task and the very short time at their disposal. At a time when every hour is precious, they are experiencing exasperating delay in obtaining the technicians for their staff. It has become very evident during the past week that there is no surplus of coal specialists in the country. As a result, the commission is being forced to attempt to draft some of the trained men in the employ of the interests concerned. Due to the limited time and the large amount of work to be done a comparatively large staff of trained men must be put to work. There is a feeling that mine operators, the United Mine Workers, the exporters and the large consumers of coal should be willing to contribute to the success of the commission's work by being willing to make some sacrifice in the way of releasing specially qualified members of their own staffs.

Scope of Investigation

An idea of the task that is facing the members of the commission may be obtained from some of the alternatives between which they must choose. One of the most important questions the commissioners will have to consider is whether or not they will recommend amendments to the anti-trust statute which will authorize consolidations and permit of a scheme of collective marketing.

While it is possible that the commissioners may avoid a flat recommendation as to the rates of wage which they may regard as fair, it is certain that they must go deeply into the wage and living cost questions. In their report they will be expected to discuss and express opinions on such questions as a minimum wage, a guarantee of employment, and unemployment insurance.

It is not unreasonable to suppose that they will consider the place of trade unions in the business of coal production, especially when the organization of coal miners exerts such an important influence on the production of two-thirds of all the coal produced in the United States, which is incidentally nearly half the world's output. The commission is called upon to probe deeply into the affairs of the strongest labor union in the world.

While nationalization is specified as one of the points on which the commission must report, it is regarded as probable that it will be dismissed without extended discussion, although it is probable that the commission will see in the cry for nationalization a reflection of the course which the public instinctively pursues when called upon to pay unusual prices as a result of manipulations for which it is in nowise responsible.

Another big question with which the commission must wrestle is that of regulation. The commission will be expected to express its opinion as to whether or not coal falls into a public utility category.

Need of Feldspar Association Recognized

As the result of a preliminary conference and sounding of sentiment, a meeting of feldspar producers and grinders will be called to be held at the same time and place as the annual convention of the United States Potters' Association to form an organization for general handling of mutual problems and advancement of the industry. It is probable that the meeting will be held in Washington in December.

Standardization is an outstanding problem in the feldspar industry, it is pointed out, as at present there are wide variations of grades nominally identical. It is believed that an agreement on this point can be worked out satisfactorily only through an association, co-operating as a unit with the consumers.

Those interested in the organization of a feldspar association also declare that proper co-operation would bring about a wider market by a close study of the amount of quartz which may be left in the prepared product without injury and by means of interchanging soda feldspar and potash feldspar. It also is felt that by organized effort a wider field of usefulness for the product, which now is consumed principally in pottery and enameled ware, could be found.

The more important producers and grinders of feldspar in the United States number at least seventy. The principal production is along the Atlantic coastline, from Maine to Georgia, with some production in California and a little in Colorado.

Bureau of Mines and A.E.S. Co-operate on Research

At the recent meeting of the American Electrochemical Society in Montreal an advisory committee was appointed to consult with the Bureau of Mines on its electrometallurgical research work and to recommend to the bureau lines of research and investigation. The membership of the committee is made up of the following, who are also members of the Electrothermic Division of the American Electrochemical Society: Robert Turnbull, chairman; J. A. Seede, Dorsey A. Lyon, F. W. Brooke, E. L. Crosby, Acheson Smith, Colin G. Fink and C. A. Schluederberg.

The bureau will send monthly progress reports of its electrometallurgical work to the members of this committee. Among the suggestions for research work which the committee has already made to Dorsey A. Lyon, chief metallurgist of the Bureau of Mines, are: Specific heats at different temperatures; refractories; expanding of refractories; and spalling of refractories.

Joint Meeting of Ceramic Societies Scheduled for December

The New Jersey Clay Workers' Association and Eastern Section of the American Ceramic Society will hold an annual convention in the assembly room of the new Ceramics Building, Rutgers College, New Brunswick, on Dec. 12, with morning and afternoon sessions. An interesting program of technical and practical papers is being arranged. A committee has been appointed to perfect details of the gathering, composed of Prof. George H. Brown, director of the department of ceramics at Rutgers College; Abel Hansen, Fords Porcelain Works; LeRoy H. Minton, General Ceramics Co.; Leslie Brown, Lenox, Inc.; Frank R. Valentine, M. D. Valentine & Brother Co.; and George Simcoe, Perth Amboy Tile Works.

American Electrochemical Society Plans Spring Meeting in New York

For the first time in several years the American Electrochemical Society will hold its annual spring meeting in New York City, on May 3, 4 and 5, 1923. Very promising progress is being made on two symposiums: one on the production and application of the rare metals, under the direction of Dr. F. M. Becket, and the other on electrode potentials, under the direction of Dr. William G. Horsch. Headquarters will be at the Hotel Commodore.

More Tariff Jokers Come to Light

Customs Officials Straightening Tangles in Duties on Coal-Tar Products, Molasses and Paper Pulp

Some difficulty has been experienced in working out the provisions of the McCumber-Fordney tariff act dealing with the application of the United States value to coal-tar dyes and chemicals, which are given treatment different to that accorded to other classes of merchandise.

A joint conference among representatives of the Tariff Commission, the United States Bureau of Standards and the Customs Division of the Treasury Department was held in New York, Nov. 2 and 3. Plans were discussed for determining the standard strength of coal-tar dyes in commercial use prior to July 1, 1914, and gathering samples of domestic dyestuffs for comparative purposes for proper administration of the new tariff act.

Chemicals Cause Heavy Work

The conferees also discussed the needs of the laboratory at the appraiser's stores in New York, which is to be enlarged both in equipment and in personnel so as to be able to make the tests which will be required in assessing duties on coal-tar products. Announcement of the appointment of the chief of this dye-testing laboratory is expected to come from the Customs Division within a few weeks. It is planned to give him three assistant chemists and the necessary clerical force.

The chemical work thrown upon the Customs Division because of the two coal-tar products paragraphs of the new tariff bill is heavy. Domestic products must be determined, because the act provides that where there is a comparable domestic coal-tar product, the imported product shall be assessed for duty on the basis of the wholesale selling price of the American product. Non-competitive imports are to be assessed on the basis of United States value.

The basis of assessment also is to be upon the strength in commercial use prior to July 1, 1914. Prior to that date many dyes were imported in single strength which now come in in double, treble or even greater strength. The change in form of imports is particularly true of vat dyes. In the case of dyes coming in with higher strength than in the first half of 1914, the specific duty of 7 cents per pound will be increased proportionately. This will give a "concealed protection" to some domestic dyes not shared by others and is one of the inequalities of the new tariff act.

Molasses Practically Embargoed

An almost prohibitive duty will be assessed against imports of molasses if an interpretation said to have been made by the Treasury Department of the wording of the molasses provisions of the McCumber-Fordney tariff law holds. The intent of Congress apparently is not carried into the language of the provisions, and it is understood that the Treasury Department takes the stand that it has no alternative than to interpret literally Paragraph 502.

9½ Cents per Gallon on Blackstrap

The same situation is found to be present with respect to the latter part of this paragraph dealing with blackstrap molasses. Congress provided a rate of one-sixth of one cent per gallon when testing not above 52 per cent total sugars; testing above 52 and not more than 56 per cent total sugars, one-sixth of one cent additional for each per cent of total sugars and fractions of a per cent in proportion.

On this basis sugars totaling 56 per cent in molasses would take a rate of one-sixth cent per gallon up to 52 per cent, and then along will come the excess rate—56 times one-sixth cent per gallon plus one-sixth cent per gallon; so that the assessment will be 9½ cents per gallon.

Logs for Paper Pulp Erroneously Taxed

Another oddity of the McCumber-Fordney tariff act came to light following complaints to Washington from importers of logs that Collectors of Customs are seeking erroneously to collect duties when the logs are free of duty as pulp wood. Paragraph 1700 provides for the free entry of "wood: logs, timber, round, unmanufactured, hewn, sided or squared otherwise than by sawing; pulp woods. . . ."

The conflicting paragraph is Paragraph 401, "logs of fir, spruce, cedar, or Western hemlock, $1 per thousand feet board measure."

The importers protested to the customs officials at ports involved that this lumber is strictly for pulp wood production uses, and the Collectors are said to have held up the entries awaiting action in Washington as to the methods to be pursued in handling log imports. There is no doubt as to the intent of Congress to place pulp wood on the free list, so that construction is not involved.

Perkin Medal Awarded to M. C. Whitaker

The committee in charge of the annual award of the Perkin medal met last week at the Chemists' Club and selected Dr. M. C. Whitaker, vice-president and general manager of the U. S. Industrial Alcohol Co., as the recipient for 1923. The presentation will be made at a meeting of the American section of the Society of Chemical Industry, Jan. 12, 1923. The medal is awarded annually under the auspices of this organization, having been established in 1906 on the occasion of the visit to this country of Dr. William Henry Perkin of England. He was the first recipient of the medal, which has been awarded annually since that time for conspicuous contributions to the science and industry of chemistry.

Helium Legislation to Be Pushed

Federated American Engineering Societies Emphazises Importance of Early Hearings on Pending Bill

The desirability of conducting hearings at the earliest possible time on the bill providing for the conservation and production of helium has been emphasized in representations made by the Federated American Engineering Societies to the chairman of the Public Lands Committee of the House of Representatives. The legislation has the indorsement of the President and the members of the Cabinet concerned with helium production. The request of the Federated Engineering Societies was to the effect that these hearings begin during the extra session of Congress, should one be called, or if not, that they be undertaken immediately on the reassembling of Congress in December.

Kahn Bill Pending

It is well known that large quantities of helium are daily going to waste. Representative Julius Kahn, of California, has introduced a bill in Congress to support a definite program of helium recovery. This bill is in the hands of the Public Lands Committee. It has the indorsements of the President and Secretaries Denby, Weeks and Fall, and its purpose is to develop the best methods of recovering helium and to collect and store supplies for military and commercial uses. The recent disaster which met the attempted flight of the hydrogen-inflated dirigible C-2 at San Antonio, Tex., again emphasized the necessity for using a non-flammable gas in balloons.

Progress in Technology

Satisfactory operation on a laboratory scale of a simplified and much cheaper method of recovering helium is reported by the Bureau of Mines. In a test run made within the last month at the cryogenic laboratory in the Interior Department Building, helium was recovered from natural gas in one operation in sufficient purity for use in dirigibles or balloons.

Helium recovery as carried on at government plants in Texas results in a gas of about 64 per cent purity and necessitates a second operation to remove impurities. By the old method the flow from the natural gas wells is directed through a series of compressors which reduce the various gases in the mixture to liquid form. Methane becoming liquid at a higher temperature is taken off first. The remaining gases are then, one by one, liquefied, leaving helium, which has an exceedingly low liquefying point. The difficulty with the old method is to liquefy all the nitrogen.

It is planned to erect a semi-commercial plant and apply the new method to quantity production. The workers have hopes of being able to do in large scale operation nearly as well as they have done in the laboratory.

A.S.M.E. Plans Big Meeting in New York

Joint Sessions With Other Societies Will Attract Many Engineers

The annual meeting of the American Society of Mechanical Engineers, the biggest of the national engineering gatherings of 1922, will be held in the Engineering Societies Building, New York City, Dec. 4 to 7. At that time John L. Harrington of Kansas City will succeed Dean Dexter S. Kimball of Cornell as president of the society.

A feature of the meeting, which will attract engineers, manufacturers, economists, educators and industrialists from all over the country, will be joint sessions with the American Economic Association, the American Society of Safety Engineers, the American Society of Refrigerating Engineers and the American Engineering Standards Committee.

H. F. Loree, president of the Delaware & Hudson R.R. Co., and E. M. Herr, president of the Westinghouse Electric & Manufacturing Co., will be among the speakers at the economic forum, at which addresses also will be delivered by Dr. W. C. Mitchell of the National Bureau of Economic Research, professor of economics at Columbia University; Prof. H. R. Seager of Columbia, president of the American Economic Association, and Dean Kimball. Mr. Herr's topic will be "The Human Problem in Industry." Professor Mitchell will discuss "Making Money and Making Good."

Subjects for Discussion

The sessions of the professional divisions of the society will cover a wide range of industrial and technical progress, including development in aëronautics. Orville H. Wright is a member of the aëronautics division. Other professional divisions to meet include those devoted to fuel, management, forest products, ordnance, railroads, textiles, gas power, machine shop practice and materials handling. The ordnance division is working with the army authorities to produce better ordnance and eliminate the evils revealed by the war.

Education, described as a question of increasing interest in the engineering profession, will be one of the big features of the meeting, to which representatives from practically all the leading universities and technical schools will come. Notable among the reports to be presented will be that by the committee on training for the industries, covering recent advances in correspondence work in extension schools, industrial training schools, and training in the works.

Student Sections Meet

The American Society of Mechanical Engineers maintains student branches in sixty-two colleges and technical schools, and in connection with the meeting a session planned and directed by students themselves will be held. Research will be a principal topic and several papers telling of its progress will be read. Local sections and branches of the society from fifty-four industrial centers will send delegates to the meeting. Activities of the professional divisions represent 8,970 members. A special program in which women are taking an active part is being arranged.

Other features of the meeting will be public hearings on the society's boiler code, which has formed the basis for laws in eighteen states, and on the power test code; local sections conferences, presidential address and reception, and a business meeting. The opening event will be a meeting of the society's council on Monday, Dec. 4.

New Committee Chairmen

Elections of executive committees to direct the work of the professional divisions during the coming year are announced at the national headquarters of the society in New York. The new chairmen are:

Aëronautic Division, Major Thurman H. Bane, U. S. Air Service, Dayton, Ohio; Forest Products Division, Thomas D. Perry, Grand Rapids, Mich.; Fuels Division, Prof. L. P. Breckenridge, Yale University; Gas Power Division, Van H. Manning, director of technical research, American Petroleum Institute, New York; Machine Shop Division, F. O. Hoagland, Worcester, Mass.; Management Division, R. A. Wentworth, Long Island City, N. Y., Materials Handling, H. V. Coes, Philadelphia, Pa.; Ordnance, Waldo H. Marshall, New York City; Power, John H. Lawrence, New York City; Railroad Division, James Partington, New York City, and Textile Division, Charles T. Plunkett, Adams, Mass.

Delegates to the American Engineering Council have been elected by the society as follows: L. P. Alford, New York City; E. R. Fish, St. Louis; Dean Arthur M. Greene, Princeton; John L. Harrington, Kansas City; Edwin B. Katts, New York City; Fred R. Low, New York City; Fred J. Miller, New York City; S. W. Stratton, new president of the Massachusetts Institute of Technology; and Max Toltz of St. Paul.

Government to Study Recovery of Byproducts From Wool Scouring

With legislation in prospect dealing with the pollution of streams, a more active interest is being manifested in utilizing the byproducts of wool cleaning. The problem is being worked on actively at the Bureau of Chemistry in the hope that means may be found which will make it possible to recover the grease and potash in cheaper and more effective methods than have been tried heretofore.

The Bureau of Chemistry recently made an exhaustive survey of the subject and finds that the average grease content of wool is 15 per cent and that the average potash (K_2O) content is 4 per cent. In some instances the grease content ran as high as 35 per cent and the potash content as high as 6 per cent.

Phosphate Rock Prospects Are Good

Fertilizer Companies Expect Big Year—Hydro-Electric Power Needeed

Development of the potential hydro-electric power of the Duck River, which runs through the northern portion of the phosphate rock fields of middle Tennessee, or the Buffalo, which runs a few miles to the west of the deposits, has been suggested by men in the phosphate rock business in that section. It is thought that the greatest need of these fields at the present time is cheap hydro-electric power. It had been hoped by these interests that the work at Muscle Shoals would be rushed to such an extent that they could get power from that source. They are now looking around, however, for another source for this power.

The phosphate rock mining, crushing and washing in this section have grown to large proportions during the past 2 years, in spite of the small comparative sale of fertilizer during that period. At present 600,000 tons per year are mined and employment is given to 2,000 men.

Most of the rock being mined at present is being shipped to the Northwest for the wheat crops. As soon as these shipments are completed the rock will be diverted to the plants of the various fertilizer companies in the South, to be used in the production of complete fertilizer for next year's crops. It is predicted that fertilizer sales will take a big lead over those of the past 2 or 3 years. This is accredited to the fact that very little fertilizer has been used in the past 2 or 3 years by the Southern cotton farmer, and with the demand for cotton being ahead of this year's crop, the farmers will be encouraged to try to produce larger crops next year.

Recent announcement has been made that the American Agricultural Chemical Co. will erect a large crushing and washing plant in connection with a large tract of proved, high-content rock which it holds near Cleburne, Tenn. Work on this plant is progressing and it is thought that it will be started into operation in time to produce rock for next spring's fertilizer business.

Complaint Lodged Against Varnish Company

The Federal Trade Commission alleges methods of unfair competition in a complaint issued against the Don-O-Lac Co., Inc., of Rochester, N. Y.

The concern is a manufacturer and distributor of paints, varnishes, shellacs and kindred products, and is charged in the complaint with advertising and selling under the name of "American Shellac" a substitute for shellac which is inferior to shellac as commercially known. The trade and the general purchasing public, the complaint avers, is thereby deceived into the belief that the product is composed of shellac gum and alcohol, when such is not the case.

Water-Power Act to Be Defended

Committee Formed to Support Its Provisions, Which Would be Violated by Ford Muscle Shoals Proposal

Declaring that the principles of the federal water-power act passed in 1920 after 15 years of discussion in Congress and of effort by the friends of conservation are under attack from divers quarters and that the law itself is in danger, Philip P. Wells, formerly chief law officer of the U. S. Forest Service and later of the U. S. Reclamation Service, has announced that a national committee for the defense of the act has been formed.

The State of New York has brought suit in the Supreme Court of the United States to have the water-power act annulled. The Federal Power Commission, administrator of the act, is, by a decision of the Comptroller of the Treasury, forbidden to spend the money appropriated by Congress for the employment of experts urgently needed for the proper administration of the act. Congress does not take up the very simple legislation necessary to cure this defect, but has given a vast amount of time to Henry Ford's proposal at Muscle Shoals, which violates every one of the principles of the act and gives to Mr. Ford, in addition, a vast subsidy from the federal Treasury.

Ford Terms a Bad Precedent

If this proposal were accepted by Congress, every corporation which has or desires a water-power privilege would demand a lease on Mr. Ford's terms. And how could they be denied? The acceptance of his offer would be a deadly blow to the application of the principles of conservation to the use of water power.

The water-power act of 1920 embodies those principles, and thereby protects the public interest in obtaining full development without having to pay monopoly profits. It does this by requiring:

(1) That every water-power lease shall be limited to a maximum of 50 years.

(2) That the lessee shall pay the government a small rental for the power privilege when he builds his own dam and other works, and a larger and fair rental when he uses works constructed by the government.

(3) That the lessee must submit to regulation by state authority, or, if there is no state authority, by the Federal Power Commission, of the services he renders and the prices he charges for light and power.

(4) That any excess profits over a fair liberal return on the actual investment shall be made over to the public in the form of a reduced price for the lessee's works at the end of his 50-year term.

(5) That states and cities have first call on power sites.

None of these requirements would be imposed under the Ford offer, acceptance of which by Congress would therefore be practically tantamount to a repudiation of the federal water-power act. That act is at once progressive and practical. It safeguards for all time public rights in the greatest of natural resources, but it is acceptable to investors in and to managers and promoters of water-power enterprises today. It was framed with great care and embodies, perhaps beyond any other law on the statute books, the conclusions of experts in engineering, economics, legislative drafting and constitutional law.

Committee Members

Among the members of the committee which will stand for the support of the act are James R. Garfield of Cleveland, Walter L. Fisher of Chicago and John Barton Payne of Chicago, former Secretaries of the Interior; Henry L. Stimson of New York, Lindley M. Garrison of New York and Newton D. Baker of Cleveland, former Secretaries of War; David F. Houston of New York and Edwin T. Meredith of Des Moines, former Secretaries of Agriculture; Governors Henry J. Allen of Kansas, Joseph M. Dixon of Montana and John M. Parker of Louisiana; Gifford Pinchot, Republican candidate for Governor of Pennsylvania; Henry S. Graves, head of the Yale Forestry School, until recently chief of the U. S. Forest Service; Herbert Knox Smith of Connecticut, former Commissioner of Corporations; William Kent of California, former Congressman, and other prominent conservationists.

Ferro-Alloy Duty to Be Based on Buyers' Analysis

Explaining that commercial sampling of ores and alloys used in the manufacture of steel is an elaborate and expensive process for which the Customs Division has no facilities, the Treasury Department has notified Collectors of Customs to use the determinations made for settlements between buyers and sellers as the basis for collecting final duties on such imports. Collectors are instructed to preserve samples for a checking analysis against the figures of buyer and seller.

The instructions further assert that inasmuch as most of the imported manganese ores contain from 45 to 55 per cent metallic manganese, Collectors are authorized to accept estimated duties on the basis of an average of 50 per cent metallic content.

This ruling disposes of one of the features of the new tariff act which has caused administrative officials much study. The duties on ores and alloys used in steel manufacture are based on the metallic content. Investigation disclosed that accurate sampling would be too expensive for the Customs Division to undertake independently and the decision to accept the settlements between buyer and seller as the basis for assessing duties followed.

German Beet Sugar Industry Fatally Crippled

Germany will never again be able to export 1,000,000 tons of sugar, as it did before the war, according to Alfred P. Dennis, special representative of the Department of Commerce in Europe. Perhaps 10 years from now it may have a surplus of 500,000 tons, but for the immediate future it will have all it can do to supply domestic needs.

Germany for years has been the leading beet-sugar producer of the world. Second place in world production, formerly occupied by Russia, has now been taken by the United States. With production cut approximately in half by the war, the recovery of the German sugar industry is a matter of practical concern to American beet growers and sugar refiners.

For the past seven years Germany has been entirely out of the sugar export trade, and during the last season was under the necessity of importing 150,000 tons or more to cover absolute domestic requirements.

Loss of Beet Lands

Within the territory turned over to Poland by Germany under the terms of the peace settlement were 296,400 acres of beet-sugar land. Indeed, some of the best beet-sugar soil of the old empire was in the Posen region and the so-called Danzig corridor. With the territory there passed also to Polish control two sugar refineries and upward of 30 sugar factories. Experts estimate that 450,000 tons of sugar production has been lost to Germany by territorial cession out of the 2,700,000 tons of pre-war sugar capacity.

Aside from territorial losses, beet growing has been further curtailed in the area now included in Germany, the acreage having fallen in the post-war period about 21 per cent, while yields per acre have fallen off approximately 30 per cent. The two main factors that check rising production are labor difficulties and soil deteriorations.

The deterioration of the German beet-growing soil is connected with reduced imports of oil-cake and phosphatic fertilizers. Experts agree that it will take at least 10 years for the German sugar industry to get back to its pre-war position.

Cuban Sugar Mill Breaks Production Record

Establishing a world record, a Cuban sugar mill has already ground over 350,000,000 pounds of sugar this year to August 31, according to a report received by the Department of Commerce. Indications are that the crop which will soon be finished will amount close to 4,000,000 long tons. During the first eight months of 1922, 1,473,064,829 pounds of sugar valued at $35,059,803 were shipped from Cuba to the United States—about twice the quantity shipped during the same period of 1920 when sugar prices were excessively high. The 1920 sugar was valued at $88,374,248.

Manufacturers to Standardize Fertilizers

Confer With Experiment Station Officials in Chicago on Methods of Reducing Varieties of Product

Reduction of the number of mixed fertilizer analyses for use in Ohio, Indiana, Michigan, Missouri and Wisconsin from the fifty or sixty now marketed to fifteen, involving elimination of low grades, fractional analyses and poorly balanced mixtures, was agreed upon at a conference among agronomists of the five states and representatives of nineteen fertilizer manufacturers doing business in the Middle West, together with representatives of the soil improvement committee of the National Fertilizer Association.

It is expected that this agreement will prove the forerunner of similar action for other groups of states, with resultant benefit to the farmers, by simplifying selection of the proper analyses for certain soil and crop conditions and to the manufacturers by reducing the number of analyses manufactured.

For several years meetings have been held in various states where manufacturers of fertilizer were brought into touch with officials of the experiment stations. These are to be continued.

MANUFACTURERS APPRECIATE RESEARCH

Manufacturers' representatives at the Chicago conference adopted resolutions to direct their sales policy to encourage the sale of the mixed fertilizer analyses recommended by the agronomists above others. The manufacturers also favor state meetings of their traveling salesmen, when they may receive information of experimental work with fertilizers. Another resolution approved the desire expressed by certain state experiment station and control officials to have determined and published the availability of the nitrogen in fertilizers and recommended that reports of availability be expressed as percentages of the total nitrogen present.

State agronomists at the conference were Prof. Firman E. Bear, Ohio State University; Prof. A. T. Wianoko, Purdue University; Prof. M. F. Miller, University of Missouri; Prof. A. R. Whitson, University of Wisconsin, and Prof. M. M. McCool, Michigan Agricultural College.

The fertilizer manufacturers represented were: Alliance Fertilizer Co., American Agricultural Chemical Co., Armour Fertilizer Works, Calumet Fertilizer Co., Darling & Co., Diamond Fertilizer Co., Farmers Fertilizer Co., Federal Fertilizer Co., Groves Fertilizer Works, Hopkins Fertilizer Co., International Agricultural Corporation, Jarecki Chemical Co., Morris & Co., F. S. Roster Guano Co., Smith Agricultural Chemical Co., Swift & Co., Virginia-Carolina Chemical Co., Welch Chemical Co. and Wuichet Fertilizer Co.

SEE MUTUAL ADVANTAGE

Returning from Chicago, where the conference was held, Prof. William D. Hurd, director of the soil improvement committee, predicted mutually beneficial results from the agreement. "The conference was marked by a splendid spirit on the part of both the state officials and representatives of the industry," said Professor Hurd. "The subjects involved were approached with an appreciation of one another's viewpoint and there was much frank and wholesome discussion.

"The state agronomists will now formulate their recommendations for various soils and for best crop conditions, based on the selected analyses. Instead of a multiplicity of recommendations, which are confusing and irritating to the farmer, there will be an unanimity which cannot but increase fertilizer usage, to the benefit of farmer and manufacturer alike."

Fish Oil Factory for British Columbia

The Ferphos Fish Products, Ltd., has been organized at Victoria, B. C., for the purpose of taking over the patents of E. G. Henshall and of building and operating a factory at Skidegate Inlet, Queen Charlotte Island, for the manufacture of oil and fishmeal from dogfish, which abound in the Northern Pacific waters.

For some time past Mr. Henshall has been operating a small experimental plant at Sooke, 20 miles from Victoria, and claims to have demonstrated that, by his process, the whole of the fish can be used and 100 per cent more oil be extracted than by methods hitherto used, and that a better grade of oil is obtained. By the old method oil was extracted only from the liver of the fish and, except in a few instances where the fish was used for fertilizing nearby land, the rest of the fish was wasted. By the old method 50 tons of fish yielded 100 gal. of oil, which sold on an average at 40 cents per gallon, whereas by the Henshall process the same quantity of fish is said to yield 200 gal. of oil and 2,000 lb. of fishmeal, the total value of which is more than $150. Local paint manufacturers have taken all the oil produced at the experimental plant and have pronounced it high grade. The Provincial poultry inspector has indorsed the fishmeal as a suitable food for poultry. The plant at Skidegate Inlet will have a capacity of 50 tons of dogfish per day, and will be thoroughly up to date in every way. The dogfish found in the waters near the inlet range from 10 to 40 lb. in weight.

Propose Fertilizer Payment to German Grain Farmers

According to the official Prussian press service the Prussian Government has proposed to the Reichsrat to pay the farmers the increase in the price of grain quotas in the form of Chilean saltpeter. According to the proposal the 1923 harvest would show an increase of 3 to 4 million tons of grain. Only in this way, says the preamble of the Prussian proposal, can a cheapening of the price of bread in the near future be effected.

Personnel Association to Meet in Pittsburgh

Industrialists, educators and personnel experts representing the country's largest business and manufacturing enterprises will engage in a 3-day national forum, beginning Nov. 8, at Pittsburgh under the auspices of the National Personnel Association. Centering around the numerous discussions, addresses and committee reports, covering a wide range of administrative effort, will be the problem of "the human factor," now of outstanding importance in this and other countries.

The Pittsburgh gathering will mark the first annual convention of the National Personnel Association, which has taken over the activities of the National Association of Corporation Training and the Industrial Relations Association of America. Immigration, psychological tests, motion pictures, pension plans for workers, employment and labor turnover, shop training and the relation of industry to both the engineering and the public schools will be discussed as questions pressing for solution.

The announced purpose of the convention is "to advance the understanding of the principles, policies and methods of creating and maintaining satisfactory human relations within commerce and industry."

NOTED SPEAKERS

Michael Pupin, professor of electromechanics at Columbia University and famous as an inventor for his contributions to the wireless art, will deliver an address on "The Immigrant's Point of View." Professor Pupin, born in Serbia, began life as a shepherd boy, coming to America with a nickel and an apple as his sole possessions. Magnus W. Alexander, managing director of the National Industrial Conference Board, will speak on "Our Immigration Policy and Its Social and Economic Effects." George F. Quimby, industrial service secretary of the Associate Industries of Massachusetts, will discuss "Training Immigrant Workers."

Other speakers will be H. M. Jefferson, Rowland Rogers and Dr. Lee Galloway of New York, Oscar M. Miller, Bayonne, N. J.; Cator Woolford, Atlanta, Ga.; J. W. Dietz, New York; Martin W. Dodge, New York; Harry A. Hopf, New York. Major W. A. Magee of Pittsburgh will address the delegates, for whom social events have been arranged by the Pittsburgh Personnel Association.

Chamber Sulphuric Acid Plant to Be Built for City of Buenos Aires

Considerable interest in heavy chemical circles has been focused on developments in South America during the past year. It is now announced that a contract for a large chamber sulphuric acid plant to be erected by the City of Buenos Aires, Argentina, has been awarded to the Chemical Construction Co., of Charlotte, N. C.

Manufactured Gas Sales Increase Greatly

Growing Use in Industry and New Domestic Appliances Explain Growth

Sales of manufactured gas for 1921 touched a new high figure of 326 billion cubic feet, an increase of 7 billion cubic feet over 1920 and 20 billion cubic feet over 1919, according to the third annual survey of the gas utilities of the United States just completed by the American Gas Association.

Coincident with the compilation of its 1921 figures, the association has also made an analysis of the per capita consumption of gas for the last twenty years. This shows that the per capita increase for the ten-year period 1901 to 1911 was 30 per cent, while for the period 1911 to 1921 it was 80 per cent, showing that the American people during the last ten years consumed nearly three times as much gas per capita as they did during the preceding decade.

One of the principal factors in this increase is said by the association to be due to the growing use of gas in industrial plants during the last ten years. At the present time, the survey shows, about 22 per cent of the total amount of gas sold is used by industry.

Figures showing the domestic use of gas also reveal a remarkable increase. At the end of 1921, according to the association, 46,700,000 persons in the United States were served with gas through 69,500 miles of mains and 9,291,000 meters, the gas being used in 7,040,000 cooking appliances, 1,573,000 water heaters, 1,268,000 space heaters and 8,800,000 incandescent burners. This is an increase over 1920 of 363,000 customers, 314,000 meters, 1,000 miles of gas mains, 370,000 cooking appliances, 150,000 water heaters, and 144,000 space heaters.

Of the total amount of gas sold for the year 1921, 18.50 per cent was for illumination, 56.71 per cent for domestic uses other than illumination, 21.62 for industrial uses and 3.17 for other uses not classified.

Miniature Working Models Will Feature Power Exposition

Among the interesting features which will be displayed at the National Exposition of Power and Mechanical Engineering, at the Grand Central Palace, New York, during the week Dec. 7 to 13, are several elaborate models of modern installations.

As an excellent example of the manner of preparing anthracite coal for the market, the model of the famous Loree breaker of the Hudson Coal Co. will be exhibited. This model, requiring an entire express car for shipment to the exposition, is a replica of the largest breaker in the world, which was erected and put in operation in 130 days and in 1921 handled 591,000,000 tons of coal. This model will show the breaker in operation, crushing the large lumps of coal, sizing it through screens and passing the sized coal through jigs, where the refuse material is separated.

The development of the power station will be illustrated by the exhibition of a series of models of the important central stations in New York City. The original station erected by Thomas Edison in Pearl Street will appear beside the more modern Waterside stations and the recent Hell Gate station. The representation of this latter station is a faithful reproduction built to a scale of one-quarter of an inch to the foot. It shows the steam and electric apparatus in the plant and the various boiler room and turbine room auxiliaries as well as the elaborate machinery for handling the enormous tonnage of coal and ashes.

Rubber Paving Block Is Developed in England

Composition Core With Vulcanized Cover May Be Commercially Practical

A new type of rubber composition paving block has been produced by Wingate & Sutton, 5 Victoria St., Westminster, London, according to a report to the Department of Commerce by Consul Coulter, London, which, it is claimed by the manufacturers, can be placed on the market at a price to compete with the ordinary creosoted wooden block, when the advantages of absence from noise and long life, estimated at 15 years, are taken into consideration.

Two types of blocks have been produced, a No. 1 block, made of the "core" surfaced with a half-inch hard vulcanized rubber, and a No. 2 block, which consists of the "core" only. The principal ingredients of the core, which has been patented, are rubber, jute and china clay. These ingredients enable the whole block to be vulcanized in one piece, and it has been found by experiment that the block should be a solid mass and not made up of separate superimposed portions.

In an experiment of a wooden block upon which a steel plate was placed as a seat for a rubber surface, it was found that the heavy traffic turned up the steel plates at the edges. At St. Pancras Railway station the covered way under the hotel is covered with a sheet of rubber of about ½ in. thickness. It has been found, it is claimed, that there is a tendency for the rubber sheet to "lick up" so that it must be pegged down from time to time. As a result of various experiments, Wingate & Sutton have decided that the separate solid block gives the best results. The block proposed is similar to the wooden block used ordinarily for street paving, and measures 9x4½x3 inches.

Up to the present time it has not been possible to manufacture rubber blocks at under three times the cost of wood paving which is about $5.40 per square yard. The Gould block core it is claimed can be made at about 4 cents per pound and it is hoped that the price of paving will not be more than $13.35 per superficial square yard.

Personal

FREDERICK FRANZ, who for the past 4 years was chief engineer of the Terminal Engineering Co., has opened an engineering office at 27 Warren St., New York City. He will devote attention particularly to labor-saving machinery for industrial plants.

H. A. GARDNER, of Washington, D. C., gave an address on the technology of paints before the members of the Lehigh Valley Section of the American Chemical Society, Allentown, Pa., on Oct. 20.

ALEXANDER LEGGAT, formerly a consulting engineer at Butte, Mont., and previously connected with the engineering department of the Anaconda Copper Mining Co., has been appointed manager at the plant of the Richmond Mining, Milling & Reduction Co., Wallace, Idaho. Mr. Leggat is a graduate of the Houghton, Mich., School of Mines.

Prof. W. A. NOYES of the University of Illinois has been granted a year's leave of absence for study and research in Europe.

Dr. WALTER ROSENHAIN, of the National Physical Laboratory of Great Britain, will deliver the second annual lecture of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers. The subject will be some theoretical phase of non-ferrous metallurgy. During his visit in this country Dr. Rosenhain will deliver lectures at Massachusetts Institute of Technology, Yale, Columbia, Case School of Applied Science and Franklin Institute.

Dr. C. G. SCHLUEDERBERG, of the Westinghouse Electric & Manufacturing Co., expects to sail for the Orient late in November and will be away several months. He is president of the American Electrochemical Society.

C. E. SKINNER, assistant director of engineering of the Westinghouse Electric & Manufacturing Co., has sailed to attend the meeting of the rating committee of the International Electro-Technical Commission to be held in Geneva, Switzerland, beginning Nov. 18. Mr. Skinner organized and directed the research work of the Westinghouse company until his recent promotion to the position of assistant director of engineering. The chief work to be taken up by the committee at Geneva will be to obtain final agreement on the basis of rating of all classes of electrical machinery.

Dr. M. C. WHITAKER, vice-president and general manager of the U. S. Industrial Alcohol Co., New York, has been selected as the recipient of the Perkin medal to be presented Jan. 12, 1923.

WALTER G. WILLARD, field secretary of the Western Petroleum Refiners' Association, resigned Nov. 1.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities Prevailing Prices and Market Letters From Principal Industrial Centers

Inflation!

What Is It? Is It Coming? How Shall We Know When It's Here?

"How's business?" we asked a chemical manufacturer.

"Good," he replied, "I'd say fine, if I dared, but 1920 isn't so many years ago, and I said fine then."

"I suppose you're afraid of overproducing again?" we queried.

"Man, I'm more than afraid of it. I have cold shivers every time I think of 1920. We are buying from hand to mouth and it will be some time before we change."

That's the principal reason why we don't need to worry about inflation for a while. Very few manufacturers will forget 1920 and 1921 for a while and conservative business policy will probably rule for some time. So we have answered the second question before we have answered the first. Calamity howlers and rising prices in a few lines do not indicate inflation any more than a gray cloud in July indicates snow.

Modifying Conditions to Evaluate in Studying Inflation

Increasing prices, advancing wages and increasing loans by banks are all indications of an inflation. But these must be studied in the light of modifying conditions. At the present time we have all of these things, but increasing prices are due to the shortage and high price of coal as a result of the strike and to higher wages. Higher wages are largely attributable to more emigration and less immigration. The increase in bank loans is due to a resumption of business activity and the fact that banks are beginning to look for commercial loans. During the past year over one and a half billion dollars worth of securities have been acquired by banks. Quite an appreciable part of these securities has been due to the floating of bond issues by corporations which came out of the boom and depression cycle with heavy bank indebtedness. Although the banks have largely absorbed these securities, they are now ready to market them to customers, and this they could not do with loans. So we have a condition wherein Barkis is willing (meaning the banks) to make commercial loans and they are able to do so to a greater extent than ever before, since the reserve requirements under the federal reserve act are less and the confidence in the reserve system is established.

But don't forget that Barkis himself had pretty hard sledding and he isn't going to dash into commercial loans with the old 1920 abandon—not for some years, even if it is tempting and a customer or two may be lost by more liberal credit grants by competitive banks.

Inflation Signals—How to Recognize Them

Where inflation begins is an uncertain point. There will undoubtedly be an inflation-deflation cycle in many industries before a period of general inflation lures us again to believe that "permanent" prosperity is ours. It therefore behooves us to learn the inflation symptoms in individual industries as well as in the country in general. Such symptoms are not easily discernible and not always reliable. One danger signal is when material sold exceeds normal consumption without apparent reason. That often means larger stocks laid in, anticipating larger demand, but if the normal consumption is exceeded, inevitably there will follow a reaction. A rise in price eliminating, if possible, speculative causes may be another danger signal. Wage increases within an industry and large increases in productive capacity are other signposts. But none of them are certain.

A Word of Caution

A word of caution to the technical man is not out of order. Everyone knows how much easier it is to operate with large stocks of raw materials available and with a stockroom crammed with every conceivable item which might be needed. Therefore the pressure of the operating man is always to increase stocks of all kinds. They should remember that there is another side to the question and that perhaps there is valid reason for scaling down orders — a thing which invariably arouses ire in the plant. The reason is a desire to avoid inflation.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	157.01
Last week	157.77
November, 1921	146.82
November, 1920	240
April, 1918 (high)	286
April, 1921 (low)	140

An error in the weighted index number for last week necessitate the publishing of the correct index number and for sake of clearness we are also publishing the figures for the two weeks previous.

October 18, 1922	153.77
October 25, 1922	157.71
November 1, 1922	157.77

Department of Commerce Items

Two rather striking items received attention in the recent *Commerce Reports*. One was newsprint paper and the other was steel.

Export Steel Trade Declines

The absence of expected purchases by Japanese interests has caused a loss in the August export figure for iron and steel. The monthly export figure showed steady improvement through the winter and reached a maximum in May. June showed a slight decline, but was still slightly in excess of 200,000 tons. The July and August figures represent only about 75 per cent of this figure, however, and unless an improvement takes place the yearly total will hardly equal the estimated figure of 2,200,000 tons.

While we are on steel and iron the situation in Germany is interesting. The exports are still slightly ahead of imports, but only slightly, and the expectation is that the year will show an unfavorable balance. The following figures are of considerable interest indicating the nature of the exports and imports in the iron and steel industry in Germany. The figures are for the first 7 months of 1922 and are recorded in tons:

GERMAN EXPORTS AND IMPORTS OF IRON AND STEEL FOR THE FIRST 7 MONTHS OF 1922

	Exports	Imports
Pig iron, scrap and ferro-alloys	116,806	507,437
Ingots, blooms, slabs, billets and sheet bars	27,541	144,821
Rails and accessories	206,266	61,412
Bar iron, hoop and girders	290,856	351,217
Rolls	4,779	108
Plates and sheets	137,969	33,003
Tin plate, galvanized sheets (plain and corrugated) and other sheets	16,900	7,473
Cast-iron pipe	26,935	25,871
Tubes and fittings	81,607	5,730
Bridge and other structural work	33,759	1,061
Railway axles and wheels, tires and springs	33,015	70
Carriage and cart axles	1,950	126
Wire, rolled and drawn	89,160	27,923
Wire rope and cord, barbed wire, wire gauze and cloth	36,116	261
Wire and cut nails and tacks	35,003	114
Screws and rivets	17,374	3,679
Ships' anchors	138	1
Horseshoes, calks, horseshoe nails and nails n.e.s.	2,914	21
Chains	4,390	38
Cask buoys, tanks, containers	6,613	220
Wagon springs	876	266
Iron and malleable castings and forgings, including machine parts	24,047	7,990
Total	1,195,014	1,178,842

Newsprint Paper

A table is given herewith of the estimated annual producing capacity and consumption of newsprint.

Perhaps the most interesting single

ANNUAL PRODUCING CAPACITY AND CONSUMPTION OF NEWSPRINT

Countries	Producing Capacity, Short Tons	Consumption, Short Tons
Germany	530,000	300,000
[illegible]	300,000	450,000
[illegible]	150,000	210,000
Sweden	185,000	30,000
Finland	150,000	10,000
[illegible]	110,000	10,000
Other European countries	200,000	110,000
Total (Europe)	1,625,000	1,120,000
[illegible]	1,500,000	2,000,000
[illegible]	1,000,000	130,000
[illegible]	150,000	[illegible]
All other countries	40,000	[illegible]
Total (world)	4,315,000	[illegible]

item is the size of the Canadian production figure—from 150,000 tons in 1909 to about 1,000,000 in 1922. This arises principally from the Canadian provincial pulpwood embargoes, which make Canadian Crownland pulpwood unavailable for American mills. It is estimated that over half of the capital invested in Canadian mills is of American origin.

Still another table is of interest. It shows exports from the principal newsprint countries in 1913, 1920 and 1921.

EXPORTS OF NEWSPRINT IN 1913, 1920, AND 1921, METRIC TONS

Countries	1913	1920	1921
Germany	69,000	45,000	109,000
Finland	70,000	90,000	94,000
Sweden	62,000	116,000	112,000
Norway	98,000	77,000	46,000
Canada	70,000	79,000	47,000
United States	46,000	42,000	15,000

It shows the signal advance of Germany and Finland as production centers. Finland, it is stated, is likely to be a significant factor because of low production costs and the complete absence of labor troubles. These two countries, together with the Scandinavian countries, are bound to be factors in the American market. An interesting indication of this is the formation of selling organizations for groups of mills in this country. This closer relation plus the fact that newsprint is on the free list makes foreign competition here a certainty.

Centralized Export Facilities for Flour

Successful culmination of a project whereby tidewater terminal facilities are provided for export shipments of flour, is noted in the Oct. 25 issue of the *Northwestern Miller*.

On Oct. 21 the huge pier which constituted the Oregon Ave. Army Base in Philadelphia was dedicated to the use of the millers of the United States. The ceremonies which marked the formal opening of the pier were attended by millers from central states and the Middle West, officials of the Millers' National Federation, Eastern seaboard members of the flour trade, and representatives of transportation, banking and other financial interests.

The pier is 1,500 ft. long by nearly 200 ft. wide, accommodating two factory fireproof warehouses approximately 1,480 ft. long by 100 ft. wide, with a total flour storage capacity of 750,000 to 1,000,000 bbl. Fire walls divide each warehouse into five sections and each of the ten sections is served by double trackage full length. Each warehouse loads direct to boats on the full length of 1,500 ft. The pier is leased by the United States Shipping Board to an operating company, the Tidewater Terminal Co., headed by Harvey C. Miller. These facilities will enable export shipments of flour to be handled more nearly on the same basis as export wheat. The storage and handling facilities will also be available for making reshipments to domestic points so that the terminal need not be idle during periods of slack export trade.

The New York Market

NEW YORK, Nov. 6, 1922.

The alkali export market has again shown signs of buying interest, and leading dealers have marked up quotations. Italy and Japan have been the largest purchasers, but the demand is fairly widespread over various foreign countries. This is the first time that caustic soda has braced up during the past 4 months and the fact that this product is in some quarters regarded as the barometer of the chemical list has led large factors to believe that the industry will continue on its upward trend. Another important feature uncovered during the week was the announcement of bichromate prices by some producers over 1923. Manufacturers of chloroform advanced prices 10c. per lb., due to "increased costs of production." Producers of chlorate of soda increased prices ¼c. per lb. at the works. Formaldehyde was again advanced by makers and the condition of the spot and nearby shipment market is exceedingly firm. White arsenic still continues in excellent demand and prices are firmly maintained. Permanganate of potash was materially higher on spot and importers stated that inquiries were more numerous than at any other time during the previous month. Barium chloride showed an easier tendency on spot. The market, in general, has continued to show complete signs of strength and steadiness. Declines were few and of only minor importance and sellers were quite satisfied with the volume of passing business.

GENERAL AND SPECIAL CHEMICALS

Arsenic—The demand was very active and the general tone remained firm. Sales of spot goods were reported at 10¾@11c. per lb., with shipments held at 10½c. Stocks in warehouses are very scarce.

Barium Chloride—There has been much stronger competition in this product and prices are somewhat easier. Material on spot was quoted around $95@$100 per ton.

Bichromate of Soda—Sales of spot goods were recorded at 7½@7¾c. per lb. Leading factors quoted shipments over next year at 7½@7¾c. per lb. There were several rumors that other producers were offering contracts as low as 7@7¼c. per lb. The demand was moderate during the interval.

Caustic Soda—The condition of the export market has shown considerable improvement and prices were advanced to $3.60 per 100 lb. Domestic prices remain at $3.75@$4 per 100 lb. ex-store.

Chlorate of Potash—Most dealers were somewhat higher at 7¾@8c. per lb. for the powdered. Domestic producers are quite firm in their views at 8½@9c. per lb., f.o.b. works.

Chlorate of Soda—Leading producers have advanced quotations to 6½c. per lb., f.o.b. works, and report a strong market at this level. Imported spot goods are bringing 6¾@7c. per lb. for round lots. Demand is quite active.

Chloroform—Producers of U.S.P. material have announced a new advance of 10c. per lb. Spot material is now quoted at 35c. per lb. The advance is due to the increased cost of manufacturing.

Formaldehyde—Spot and shipment material has again been advanced and leading factors are quoting 14c. per lb. f.o.b. works, carload lots. The tone of the market is exceptionally firm.

Permanganate of Potash—Prime U.S.P. spot goods were quoted higher and the best figure was 16½c. per lb. The range was from 16½@17c. per lb. Demand continues quite steady.

Prussiate of Soda—Several odd lot sales were reported at 22¾@23c. per lb. The tone of the market was somewhat irregular during the week. Imported goods for shipment held around 23c. per pound.

COAL-TAR PRODUCTS

The coal-tar products industry has shown a steady improvement and producers state that business has increased considerably during the entire month of October. The crude products have shown the most noteworthy gains and products in several instances were heavily sold ahead. Phenol, cresylic acid and benzene were the leaders of this group. Among the intermediates, beta naphthol prices were advanced and spot offerings were relatively light. Dimethylaniline was advanced owing to added costs of manufacture and a much improved demand. Ortho-amidophenol was also quoted higher under the same conditions. Salicylic acid showed material gains during the interval, with U.S.P. goods in very light supply on spot.

Aniline Oil—Dealers were asking 16½@17c. per lb. for spot material, although producers still quoted 16c. per lb., f.o.b. works. Offerings were somewhat lighter with improved demand.

Beta Naphthol—Spot goods are very scarce and as high as 26c. per lb. has been paid. The general range was around 25@26c. per lb. Recent heavy buying has diminished surplus stocks.

Dimethylaniline—There has been a moderate inquiry noted at 34@35c. per lb. The new advance is due to higher costs of production.

The St. Louis Market

ST. LOUIS, Oct. 31, 1922.

The market in this locality remains very active, with orders continuing to increase in volume. Furthermore, the market has maintained a very steady tone since our last report. Transportation facilities are still very poor and no relief is in sight for some time.

ALKALIS

The *caustic soda* market is, and has been for some time, very quiet. Apparently no large volume of business is being done, practically all purchases being confined to 5- and 10-drum lots. Prices are as of our last report, with no tendency to weaken. Perhaps the steadiness in value is due to the fact that rock bottom has been reached and lower prices could come only by way of sacrifice on the part of manufacturers. What has just been said for caustic can be repeated with emphasis for *soda ash* and *bicarbonate of soda*. Prices hang around the same level and business moves with the same momentum. *Sal soda*, while still maintaining its price of 2 weeks ago, is moving better recently. One jobber reports heavy sales of both package goods and barrels, apparently quite a volume of this item having changed hands recently.

GENERAL AND SPECIAL CHEMICALS

Heavy mineral acids continue to improve and there has been a steady hardening of prices. The *phenol* situation remains firm and inquiry continues to be very heavy. The *citric acid* situation remains unchanged, the demand being only routine and sales confined to small quantities. *Acid tartaric* is in better demand since our last report. The *white arsenic* market is exceedingly strong and supplies are becoming scarcer, the market ranging from 10½@12½c. f.o.b. New York in carload lots. Manufacturers of *chloroform* advanced their prices 10c. on Saturday of last week. A fairly good call is noted for *cream of tartar*. The demand for *copperas* is still very heavy; producers are unable to meet it owing to the curtailment of production. The demand for *epsom salts* is very light and supplies are readily obtainable, prices ranging from $2.50@$2.60 per 100 lb. *Glycerine* is still maintaining the same firmness of 2 weeks ago—18½c. in drums—and is moving in good volume. Apparently there is no letdown in sight and 20c. glycerine before the end of the year is to be expected. *Sulphur*, while still selling at the abnormally low price of 2 weeks ago, is moving in large volume through the natural channels. *Zinc dust* is now being quoted at from 10@10½c. f.o.b. New York in carload lots and a strong market is reported. There has been no change in quotations for *zinc sulphate* since our last report.

VEGETABLE OILS AND NAVAL STORES

Turpentine continues to advance and reached $1.72 this week. No one seems to know or even be willing to venture a guess as to where this item will stop. *Castor oil* has finally had a relapse and has started downward. A reduction of ½c. per pound was recently made by the manufacturers, but we do not expect any further decline, since the demand is very active. *Linseed oil* has not changed in price. A good volume of business is being done through the natural channels, and the market seems to be safely in the producers' hands.

PAINT MATERIALS

Nothing of note has happened in this market since our last report. Prices have not changed and business at this time is somewhat slow.

The Iron and Steel Market

PITTSBURGH, Nov. 3, 1922.

Steel mill operations are at approximately the same rate as a week ago, and indeed there has been little variation since late in September, production being about 70 per cent of capacity.

Car supplies for shipping mill products have improved a trifle farther. Current production is being shipped without much difficulty, and there is a gradual diminution of the piles of steel accumulated when car shortages were serious. There are still many embargoes, making proper distribution difficult, but embargoes are not as numerous or widespread as a few weeks ago.

The chief point about the transportation situation is the danger of movement being greatly slowed down by the appearance of inclement weather. Most of the roads, if not all, are in precarious position and cannot stand any weather handicaps.

FINISHED STEEL MARKETS QUIET

The finished steel markets are extremely quiet. They have been quiet for several weeks, indeed, and the present state is really one of decided dullness. The strongest lines are sheets and tubular goods. In sheets the independents are booking nearly as much as they are shipping, but their order books are gradually decreasing and some have considerably less than a month's production ahead. In tubular goods there is not a great deal of new buying, but there is pressure upon mills for better deliveries against old orders, particularly for butt weld black and galvanized merchant pipe, demand for which has been extremely heavy on account of the boom in garage and dwelling house construction.

Delivery premiums on bars, shapes, plates and sheets are still less important than a week ago, their almost complete disappearance reflecting the early deliveries many mills are now able to offer on new orders, by reason of their having had heavy shipments of late, with little booking of new business.

FINISHED STEEL PRICES

Regular prices on finished steel products are as follows: Bars, shapes and plates, 2c.; hoops, 2.90@3c.; wire, 2.45c.; nails, $2.70; tin plate, $4.75; merchant steel pipe, 66 per cent basing discount; black sheets, 3.35@3.50c.; galvanized sheets, 4.35@4.50c.

The American Sheet & Tin Plate Co. will probably name prices next week for sheets for first quarter and tin plate for first half of the new year. Recently prospects were plain that advances would be announced in most cases, but the prospect is now considerably less certain, because other products are now likely to decline rather than advance when they again move.

A few weeks ago it was difficult to buy sheet bars at $40. This week there are a half dozen or more sellers offering tonnages. Definite prices are not quoted, but it is considered certain that purchases could be made at not above $38. There is no regular inquiry. Predictions are that the sheet bar market for first quarter delivery, when developed eventually, will be at not above $35.

COAL AND COKE

Coal prices in the Pittsburgh and Connellsville markets are a shade firmer than a week ago, steam being quotable at $3.25@$3.50 rather than at $3@$3.50. Good Youghiogheny gas coal is stronger, at $4.50 for mine-run and $5@$5.50 for screened. At the insistence of Fuel Director Spens operators of the Pittsburgh district have agreed to limit their price on domestic 1¼-in. lump to $4.50 and assume that for metallurgical coal they may feel free to get all the market will give them. The reduction in domestic coal may have had something to do with the stiffening in other grades.

Connellsville coke is a shade firmer than a week ago. Odd lots on track awaiting shipping instructions and commonly known as "distress coke" continue to go at about $7.50, while a regular supply over a week or two may possibly command $8.50 rather than the $8 quotable a week ago. The market has an undertone of strength that cannot be attributed to increasing demand and is in face of increasing production. The condition probably arises from a number of consumers having decided, on the recent break from $12 to $8, that they would do better to close to the end of the year than await any further decline.

PIG IRON

Pig iron continues to present a stagnant market. Prices are in a general process of readjustment, which may require several months for completion. Meanwhile consumers, whose requirements appear smaller than formerly, are disposed to buy only for immediate requirements, and in the absence of large inquiry little competition occurs between sellers. Bessemer continues to sell in small lots at $33 valley, and foundry in small lots at $30 valley. Basic, which was at $30 for several weeks, has sold at $29 valley in a lot of about a thousand tons. There is no basic inquiry now and the chances are that the next inquiry will develop a lower price.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0.19 – $0.20	.20½– .22
Acid, acetic, 28 per cent	100 lb.	2.92½– 3.00	3.05 – 3.20
Acetic, 56 per cent	100 lb.	5.85 – 5.90	5.95 – 6.25
Acetic, glacial, 99½ per cent, carboys,	100 lb.	11.16 – 11.20	11.25 – 11.50
Boric, crystals	lb.	.11 – .11½	.11¾– .12
Boric, powder	lb.	.11 – .11½	.11¾– .12½
Citric	lb.	..... –	.51 – .52
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11¾– .12
Lactic, 44 per cent tech	lb.	.09½– .10	.10½– .12
Lactic, 22 per cent tech	lb.	.04½– .04¾	.05 – .05¾
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg	lb.	.05½– .05¾	.06 – .06½
Nitric, 42 deg	lb.	.06 – .06½	.06½– .07
Oxalic, crystals	lb.	.15 – .15½	.15¾– .16
Phosphoric, 50 per cent solution	lb.	.07½– .08	.08¼– .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.31 – .31¼
Tartaric acid, imported, powdered	lb.	..... –	.31½– .32
Tartaric acid, domestic	lb.	..... –	..... – .32
Tungstic, per lb. of WO	lb.	..... –	1.00 – .110c
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.36 – .38
Alum, ammonia, lump	lb.	.03½– .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03½– .03¾	.04 – .04½
Alum, chrome lump	lb.	.05 – .05¼	.05½– .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½– .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums(750 lb.)	lb.	.06¾– .07¼	.07½– .08
Ammonia, anhydrous, cyl.(100-150 lb.)	lb.	.30 – .30½	.30½– .31
Ammonium carbonate, powder	lb.	.08¼– .08½	.09 – .09½
Ammonium nitrate	½ lb.	.06 – .06½	.06¾– .07½
Amylacetate tech	gal.	..... –	2.35 – 2.50
Arsenic, white, powdered	lb.	.10 – .11	.11½– .11½
Arsenic, red, powdered	lb.	.12½– .12¾	.13 – .13½
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	95.00 –100.00	102.00 –105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼– .22
Barium nitrate		.09 – .09¼	.09½– .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04¾– .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05½– .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .38	.28½– .35
Calcium acetate	100 lb.	3.00 – 3.15	3.20 – 3.50
Calcium carbide	lb.	.04½– .04¾	.05 – .05¼
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½– .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.88 – .90
Carbon bisulphide	lb.	.07 – .07¼	.07½– .07¾
Carbon tetrachloride, drums	lb.	.10 – .10¼	.10½– .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04¼– .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½– .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½– .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾– .06
Chloroform	lb.	..... –	.35 – .38
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	21.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.21 – .21½	.22 – .22½
Copper cyanide	lb.	..... –	.58 – .600
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.504
Cream of tartar	lb.	..... –	.25½– .26
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.14 – .14½	.14½– .14¾
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth—imported powdered	net ton	30.00 – 32.00	..... – .....
Fuse oil, ref.	gal.	..... –	2.75 – 2.90
Fusel oil, crude	gal.	..... –	1.65 – 1.85
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c.p. drums extra	lb.	..... –	.18½– .18¾
Iodine, resublimed	lb.	..... –	4.40 – 4.50
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.11½– .12½
Lead arsenate, powd.	lb.	.13 – .13½	.13½– .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½– .08	.08¾– .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½– .07¾
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.90 – .92
Methanol, 97%	gal.	..... –	.92 – .94
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	$0.12 –$0.12½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35¼
Potassium bichromate	lb.	$0.10 – .10½	.10½– .11
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06¼	.06½– .06¾
Potassium chlorate, powdered and crystals	lb.	.07¾– .08	.08¼– .09
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.25 – 6.50	6.60 – 7.00
Potassium iodide	lb.	..... –	3.45 – 3.55
Potassium nitrate	lb.	.06½– .06¾	.07 – .08
Potassium permanganate	lb.	.16½– .16¾	.17 – .17½
Potassium prussiate, red	lb.	..... –	.95 – 1.00
Potassium prussiate, yellow	lb.	.37¾– .38	.38¼– .38½
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06¾– .06¾	.07 – .07¼
Salammoniac, gray, granular	lb.	.08¼– .08½	.08¾– .09
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.08 – .08¼	.08½– .09
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½– .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼– .04¼	.04¾– .05¼
Sodium chlorate	lb.	.06¾– .07	.07¼– .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.19½– .21	.21½– .25
Sodium fluoride	lb.	.09¾– .10	.10¼– .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½– .02¾	.03 – .03½
Sodium nitrite	lb.	.09 – .09¼	.09½– .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½– .04	.04¼– .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.22½– .23	.23¼– .23½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04¼	.04½– .05
Sodium sulphite, crystals	lb.	.03¾– .03⅞	.03¾– .04½
Strontium nitrate, powdered	lb.	.09½– .10	.10¼– .12
Sulphur chloride, yellow	lb.	.04½– .05	.05¼– .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30 00 –40.00	..... – .....
Talc—domestic powdered	ton	18 00 –25.00	..... – .....
Tin bichloride	lb.	.10 – .10¼	.10½– .10½
Tin oxide	lb.	..... –	.39 – .40
Zinc carbonate	lb.	.14 – .14½	.14¾– .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07¾– .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½– .08	.08¼– .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.29 — .31
Aniline oil, drums extra	lb.	.16¼— .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.53 — .55
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.34 — .36
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.85 — .90
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½— .07
Naphthalene, balls	lb.	.07½— .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12

Nitro-naphthalene	lb.	$0.30 —	$0.35
Nitro-toluene	lb.	.15 —	.10
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.80 —	.85
Ortho-nitro-toluene	lb.	.12 —	.15
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.30 —	.32
Pyridine	gal.	1.60 —	1.75
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.33 —	.35
Salicylic acid, U. S. P	lb.	.38 —	.40
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12 —	.14
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.20 —	$0.21
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.36 —	.40
Candellila, wax	lb.	.33 —	.34
Carnauba, No. 1	lb.	.39 —	.40
Carnauba No. 2, North Country	lb.	.24 —	.25
Carnauba, No. 3, North Country	lb.	.17 —	.18
Japan	lb.	.15 —	.16
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04¾
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	.02¾
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¾ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03¼ —	.03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09¾
Stearic acid, double pressed	lb.	.09½ —	.09¾
Stearic acid, triple pressed	lb.	.10½ —	.10

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.90 —	....
Rosin E-I	280 lb.	6.95 —	....
Rosin K-N	280 lb.	7.00 —	$7.10
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.64 —	1.64
Wood turpentine, steam dist	gal.	1.35 —	....
Wood turpentine, dest. dist	gal.	1.25 —	....
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.43 —	....
Rosin oil, second run	gal.	.51 —	....
Rosin oil, third run	gal.	.53 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pine wood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.65
Blood, dried, f.o.b., N. Y	unit	4.60 —	....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.35 —	2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0 24 —	.24¼
Upriver coarse	lb.	.18¾ —	.19
Upriver caucho ball	lb.	.18 —	.18¼
Plantation—First latex crepe	lb.	.22¼ —	.22½
Ribbed smoked sheets	lb.	.22¼ —	.22½
Brown crepe, thin, clean	lb.	.20 —	.20½
Amber crepe No. 1	lb.	.20 —	.20½

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12½ —	.13
Cocoanut oil, Ceylon grade, in bbls	lb.	.08½ —	.08¾
Cocoanut oil, Cochin grade, in bbls	lb.	.08¾ —	.09
Corn oil, crude, in bbls	lb.	.09½ —	.09¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.07½ —	....
Cottonseed oil, summer yellow	lb.	.10½ —	.10¾
Cottonseed oil, winter yellow	lb.	.11¼ —	.11½
Linseed oil, raw, car lots (domestic)	gal.	.89 —	.90
Linseed oil, raw, tank cars (domestic)	gal.	.86 —	.87
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90 —	.92
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07½
Palm, Niger	lb.	.06⅛ —	.06¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¼ —	.09
Peanut oil, refined, in bbls	lb.	.12½ —	.13
Rapeseed oil, refined in bbls	gal.	.77 —	.78
Rapeseed oil, blown, in bbls	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.08¾ —	.09

FISH

Light pressed menhaden	gal.	$0.54 —	....
White bleached menhaden	gal.	.58 —	.59
Blown menhaden	gal.	.64 —	.65
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11 —	.12
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.12 —	.13
Ferromanganese, 78-82% Mn, Atlantic seaboard	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	37.00 —	38.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	68.00 —	70.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.90 —	.95
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19 00 —	20.00
Coke, foundry, f.o.b. ovens	net ton	10.00 —	10 50
Coke, furnace, f.o.b. ovens	net ton	7.50 —	8.00
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	....
Manganese ore, chemical (MnO_2)	net ton	70.00 —	75.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00 —	8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	7.75 —	8 00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13¼

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.75–13.875
Aluminum, 98 to 99 per cent	20.00–21.00
Antimony, wholesale lots, Chinese and Japanese	6.75–7.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35 00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	36.25
Lead, New York, spot	6.75–6.80
Lead, E. St. Louis, spot	6 50
Zinc, spot, New York	7.45–7.50
Zinc, spot, E. St. Louis	7.10–7.15

OTHER METALS

Silver (commercial)	oz.	$0.67
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	52.00@55.00
Mercury	75 lb.	72.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

OILS—Martin & Co., Transportation Bldg., Chicago, Ill., have inaugurated operations at their new oil refinery at Osborne, Ind. Portions of the plant are still to be completed and equipment will be installed at an early date. The refinery will run on crude oil from the Pioneer field, Tex.

The Premier Refining Co., Oatsville, near Princeton, Ind., has placed its new gasoline-refining plant in operation and will develop maximum output at an early date. This is the first such refinery in Gibson County.

The Globe Petroleum Co., Los Angeles, Calif., is increasing production at its different plants, and exclusive of royalty plant leases, an average of 150,000 bbl. of oil per month will be maintained.

About 50 per cent of the independent oil refineries in Oklahoma are closed down or have curtailed operations, due to the general conditions in the mid-continent fields, according to an official statement made at the meeting of the Oklahoma Oil Jobbers' Association, Oklahoma City, Oct. 19.

The New England Refining Co. has advanced production at its Fall River, Mass., plant to a basis of 20,000 to 25,000 bbl. of crude oil through the stills per day.

RUBBER—The Studebaker-Wulff Rubber Co. has adopted a day and night basis of operation at its local plant, giving employment to a full working force. Extensions are planned to double the present capacity.

Negotiations are said to be in progress for the sale of the plant of the Philadelphia Rubber Works, 37th and Reed Sts., Philadelphia, Pa., to new interests, which propose to place the plant in operation at an early date. It has been closed since 1919.

PAPER—The Philadelphia Paper Mfg. Co., Philadelphia, Pa., has developed capacity operations and is now running on the basis of 500 tons per day. A wage advance of 15 per cent was recently made at the mill. About one-fourth of the output is being utilized at the plant of the Fiber Container Co., a subsidiary organization, which is also running full.

The Kieckhefer Container Co., Camden, N. J., is operating at full capacity at its paper and fiber plants, giving employment to regular working force. A new plant is being built at Delair, near Camden, and will be placed in service as soon as completed.

Every newsprint paper mill in Canada, totaling thirteen in all, is running on a full-capacity, full-time basis, with maximum output the highest in a number of years. For the first 7 months of the present year the production totaled 643,858 tons, or more than the total for any year prior to 1917. The Spanish River Paper Co., Ottawa, one of the largest producers, is running full in all departments of its mills.

IRON AND STEEL—The Bourne-Fuller Co., Cleveland, O., has blown in another furnace at its plant.

The American Bridge Co. has placed all furnaces in blast at its Pencoyd Works, Manayunk, Philadelphia, Pa., and will maintain on this basis for an indefinite period.

The Crane Iron Works, Catasauqua, Pa., is making improvements and repairs in its large blast furnace, and expects to have the unit ready for blast some time in December. The date of blowing in will be announced soon.

The American Steel & Wire Co., Cleveland, O., has blown in another furnace at its local mills.

The Eastern Steel Co., Pottsville, Pa., has placed its local plant on a full-production basis, and is said to have orders on hand to keep the six mills at this point for about 12 months to come. The Pottstown, Pa., furnaces of the company are also all on the active list.

The Carnegie Steel Co. has placed its Farrell, Pa., works on a full-capacity schedule, and will maintain on this basis for an indefinite period.

The American Sheet & Tin Plate Co. has started up all of the forty hot mills at its Shenango Works, near New Castle, Pa.; ten of the mills have been idle for about 6 months past.

The Republic Iron & Steel Co., East Chicago, Ind., has closed its local mills for an indefinite period, due, primarily, to the decreased demand for bar iron. About 400 men will be released until further notice.

The Robesonia Iron Co., Reading, Pa., is arranging to blow in its large stack about Nov. 15. The plant has been idle for repairs to the furnace for a number of weeks past.

The American Sheet & Tin Plate Co. has placed the twelve hot mills in operation at its New Philadelphia, Pa., plans, after a short curtailment. About 350 men will be employed. The company has recently booked heavy orders in sheet bars.

Steel plants in all parts of the country are now running on a basis of about 75 to 80 per cent of normal. Increased working forces are being employed.

MISCELLANEOUS—The Barrett Co., Grays Ferry district, Philadelphia, Pa., manufacturer of coal-tar products, has adopted a capacity operating schedule at its plant, and will continue on this basis for an indefinite period. A full working force is employed.

The National Sulphur Co., Bayonne, N. J., has commenced operations at its new plant at North Akron, O., on a full-time production basis. The initial output is expected to be advanced at an early date. The company will remove its New York office to North Akron.

Brick-manufacturing plants in the vicinity of Atlanta, Ga., are making ready for a full-time production schedule immediately, following a shut-down due to the railroad car shortage. It is said that every plant in this district has orders ahead to insure capacity for a number of months to come.

The Henry Bower Chemical Mfg. Co., Manayunk, Philadelphia, Pa., is running on a full-capacity, full-time basis, with employment of normal working force. Less than 6 months ago the plant was practically closed down due to lack of orders. The orders on hand insure maximum operations for some time to come.

The Diamond State Fiber Co. has closed down its plant at West Conshohocken, Pa., temporarily, due to the demand of employees for a wage advance of 10 cents per hour, and the company's refusal to meet the request. More than 200 workers are affected by the shut-down.

The R. M. Hollingshead Co., Camden, N. J., manufacturer of soaps, leather dressings, etc., is increasing production at its plant and is now running at close to capacity.

The Chattanooga Coke & Gas Co., Chattanooga, Tenn., has resumed operations at its coke works, following a suspension for a number of weeks. Byproduct gas is also being furnished again to local consumers.

Construction and Operation

Alabama

TARRANT CITY—The Lehigh Portland Cement Co., Allentown, Pa., has awarded a contract to Dwight P. Robinson & Co., Inc., 125 East 46th St., New York, N. Y., for the erection of its proposed cement-manufacturing plant at Tarrant City, near Birmingham. It will be equipped for an annual production of 1,000,000 bbl., and is estimated to cost close to $1,500,000 with machinery. It is purposed to have the mill ready for operation in about 12 months.

California

ANAHEIM—Charles A. Criss is completing plans for the construction of a new plant at 315 South Vine St., for the manufacture of cement brick and art cement products. It will consist of three buildings.

LOS ANGELES—The W. P. Fuller Paint Co., Los Angeles, has awarded a contract to Lepper & Laisy, O. T. Johnson Bldg., for the erection of its proposed 2-story plant on Ave. 22, 120x125 ft., estimated to cost approximately $45,000.

FRESNO—The United Engine & Machine Co. recently organized with capital of $250,000, to merge the Sulprizio Machine Works, 507 Broadway, and the Fresno Pattern Works, 2137 Cherry St., has plans in progress for the erection of a 1-story foundry and molding shop, 100x150 ft., for iron and steel castings production. G. J. Dolan, Jr., is head.

LONG BEACH — The American Avenue Glas Co. has acquired a site on West 15th St., Inner Harbor district, 80x125 ft., for the erection of a new glass-manufacturing plant. Theodore J. Stein is president.

Connecticut

WEST HAVEN—The Sanderson Fertilizer Co. has filed plans for the erection of a new 1-story building at its plant.

BERLIN—The Stiles & Reynolds Co. plans for the rebuilding of the portion of its brick-manufacturing plant on Christian Lane, destroyed by fire, Oct. 23, with loss estimated at about $18,000.

HARTFORD—The Skat Co., Francis Ave., manufacturer of soap, soap powders, etc., has filed plans for the erection of a 2-story addition, 40x75 ft.

Florida

FORT LAUDERDALE — The International Sugar Co. has tentative plans under consideration for the construction of a new sugar refinery and mill on site near Fort Lauderdale. The proposed plant will have an initial capacity of about 1,500 tons per day, and is estimated to cost in excess of $500,000, with machinery. It is expected to commence work during the coming year. Howard L. Allen is general manager.

WEST PALM BEACH—Carl Riddel, city manager, is developing plans for the purchase of the artificial gas works now furnishing service to the city. When the plant is taken over, extensions and improvements will be made.

Illinois

GRANITE CITY—The Mepham Paint Co., East St. Louis, Ill., has plans in progress for the erection of a new plant on local site, 1-story, 100x100 ft., estimated to cost close to $100,000. It will be used primarily for copperas production.

CHICAGO — The Patterson-Sargent Co., 2025 Lumber St., manufacturer of paints and varnishes, has excavations under way for the erection of a new 4-story building at Lumber and Stewart Sts., 60x125 ft., and expects to have the structure ready for occupancy early in the coming spring. Additional land has been obtained, 75x200 ft., for proposed later extensions.

Indiana

EVANSVILLE—The Evansville Enameling Co., Fulton St., will take bids at once for the erection of its proposed 1-story addition, 50x85 ft., estimated to cost about $55,000, including equipment. Russ & Karges, Furniture Bldg., are architects.

EVANSVILLE — The Globe - Bosse - World Furniture Co. has had plans prepared for the construction of a 1-story plant addition, 45x160 ft., to be equipped for the manufacture of mirrors. Russ & Karges, Furniture Bldg., are architects.

Kansas

AUGUSTA—The White Eagle Oil & Refining Co., Wichita, Kan., has construction nearing completion on a new unit at its local refinery, to increase the capacity of the cracking stills. The extension will be placed in service at an early date.

Kentucky

ASHLAND—The American Rolling Mill Co., Middletown, O., has plans in progress for the erection of an addition to its local plant, to include a new sheet mill, jibbing mill and galvanizing works. Dwight P. Robinson & Co., Inc., 125 East 46th St., New York, N. Y., is engineer.

Louisiana

MONROE—The Louisiana Producing & Carbon Co. has plans under way for the construction of a new carbon and gasoline extraction plant, estimated to cost in excess of $150,000. The carbon works will comprise two individual plant units, the first of which will be ready for service early in 1923, and at which time erection of the second unit will be commenced. The complete plant will have a capacity of 8,000 lb. of carbon black per day. The gasoline plant will be of vertical absorption type, with treating capacity of 10,000,000 cu.ft. of gas per 24 hr. The company has recently increased its capital to $350,000 for the expansion. R. R. Beaman is president.

Maryland

CAMBRIDGE—Fire, Oct. 27, destroyed a portion of the plant of the Dorchester Fertilizer & Lime Co., Trenton St. and Cambridge Creek, with loss estimated at about $65,000. It is planned to rebuild at a later date. Lloyd Webster and John Skinner head the company.

BROOKLYN—The Arundel-Shope Brick Co., Pier 2, Pratt St., Baltimore, is perfecting plans for the erection of its proposed new brick-manufacturing plant on local site, to consist of a number of buildings with power house. Lawson L. Wagner is president and manager.

BALTIMORE — The Holtite Mfg. Co., Warner and Ostend Sts., manufacturer of rubber specialties, has plans in preparation for the erection of a new 1-story plant addition, 50x155 ft., to double, approximately, the present output. Stanislaus Russell, 11 East Lexington St., is architect.

BALTIMORE—Fire, Oct. 23, destroyed a large portion of the plant of the Porcelain Enamel & Mfg. Co., O'Donnell and 8th Sts., with loss estimated at about $400,000, including buildings and equipment. It is planned to rebuild. Heinrich Turk is president.

EASTON—The City Council is arranging plans for the purchase of the local artificial gas plant, and will operate as municipal property. It is proposed to issue bonds for extensions and improvements.

BALTIMORE—The Standard Oil Co. has filed plans for the erection of a 1-story asphalt works, 124x204 ft., at 2nd Ave. and 2nd St., estimated to cost about $40,000.

Massachusetts

BOSTON—The Tileston & Hollingsworth Co., River St., Hyde Park, has awarded a contract to the Aberthaw Construction Co., 7 School St., Boston, for the erection of a 1-story addition to its paper manufacturing plant, to cost about $30,000. George F. Hardy, 309 Broadway, New York, N. Y., is engineer.

SOMERSET—Fire, Oct. 24, destroyed a portion of the plant of the E. S. Parks Shellac Co., including drying department. An official estimate of loss has not been made.

Michigan

BAY CITY—Construction is being rushed on the new local plant of the Wildman Rubber Co., and is expected to have the structure ready for the machinery installation at an early date. It will be 4-story, 165x365 ft., and will be used primarily for automobile tire production.

Minnesota

MINNEAPOLIS—The Carter-Mayhew Mfg. Co., is planning for the construction of a new 1-story foundry at its mechanical works, 19th Ave., N.E., 60x100 ft., estimated to cost close to $30,000.

Missouri

SARCOXIE—The plant of the Sarcoxie Lime Kiln Co. has been acquired by H. T. Oltman and Charles Shull. The new owners will continue the operation of the property for the manufacture of commercial fertilizer products, and plan for extensions and improvements, including the installation of a new crushing plant.

New Jersey

SALEM—Fire, Oct. 27, destroyed a building at the plant of the Gayner Glass Works, with loss estimated at about $100,000, including stock, equipment, etc. The company specializes in the manufacture of bottles, jars, etc.

New York

BINGHAMTON—The American Hide & Leather Co. has disposed of its local tannery to the Endicott-Johnson Corp., manufacturer of footwear, which will continue the operation of the plant.

RICHMOND HILL, L. I.—The Unique Leather Goods Co., Jamaica Ave., has awarded a contract to the Ettinger Contracting Co., 44 Court St., Brooklyn, for the erection of a 2-story addition, 80x400 ft. William Higginson, 15 Park Row, New York, is architect.

BUFFALO—The Bethlehem Steel Co. is arranging an extension and improvement program for its local Lackawanna Steel works, estimated to cost in excess of $10,000,000, including buildings, machinery, etc. The initial work will comprise the modernizing of a number of plant departments.

North Carolina

HERTFORD—Fire, Oct. 22, destroyed a portion of the plant of the Eastern Cotton Oil Co., with loss estimated at about $35,000. It is planned to rebuild.

LEXINGTON—The Rodrain Electro-Metallurgical Co., Salisbury, N. C., has tentative plans under way for the construction of a new 3-story plant for gold refining at its Gold Hill mine, estimated to cost approximately $500,000. J. L. Mittenhuler heads the company.

Ohio

ELYRIA—Negotiations are under way for the purchase and reorganization of the Columbia Steel Co. A new company will be formed under the present name with capital of $1,500,000, and extensions and improvements made in the present plant, including the installation of improved processes of production in a number of departments. It is purposed to issue bonds for $750,000, a portion of the fund to be used for the expansion. C. E. Lozier, vice-president and general manager of the present organization, will head the new company.

Oklahoma

PONCA CITY—The Empire Refineries, Inc., will make additional extensions and improvements in its oil refining plant to cost close to $1,000,000. Work on an initial program calling for an investment of about $2,000,000 is now nearing completion, and new plant units will be placed in service at an early date. The refinery is now running on a basis of 4,000 bbl. per day.

MUSKOGEE—The Oklahoma Fabric & Rubber Co., recently organized with a capital of $2,500,000 by officials of the Allen Tire & Rubber Co., Allentown, Pa., has acquired a local building and site for the establishment of its proposed plant for the manufacture of tires and other rubber products. Extensions and improvements will be made in the present structure to cost in excess of $1,000,000, including machinery installation. The local Chamber of Commerce is interested in the project.

Oregon

GRANTS PASS—The Beaver Portland Cement Co., Portland, is reported to be planning for the construction of a new cement mill in the vicinity of Grants Pass, estimated to cost in excess of $750,000. The entire project will include the development of raw material properties in Josephine County and the construction of a private railroad line, to involve a total expenditure of about $1,200,000.

Pennsylvania

MCKEES ROCKS—The Federal Enameling & Stamping Co., Thompson Ave., is completing plans for the erection of a new 3-story plant addition. A portion of the structure will be equipped as a furnace department. C. E. Christian is in charge.

PITTSBURGH—The Pruett-Schaffer Chemical Co., Tabor St., manufacturer of paint, etc., has acquired a tract of vacant property at Lincoln Ave. and Ohio St., for $15,000, for future expansion.

Tennessee

COLUMBIA—The plant and property of the Ruhm Phosphate Co. have been purchased by J. P. Greenlaw and associates. The new owners plan for extensions and improvements in the grinding plant and other departments.

MEMPHIS—Fire, Oct. 22, destroyed a building at the plant of the Plough Chemical Co., with loss reported at about $125,000. It is expected to rebuild.

Texas

GONZALES—The Gonzales Cement Works, Inc., has plans under way for the erection of a new plant, 50x90 ft., with adjoining structure, 40x50 ft., for the manufacture of cement tile and kindred products. A. O. Neumann heads the company

JACKSONVILLE—The Jacksonville Cotton Oil Co. is reported to be planning for the rebuilding of its plant, totally destroyed by fire, Oct. 16. An official estimate of loss has not been announced.

TEXAS CITY—The Terminal Oil & Refining Co. is planning for extensions in its topping plant to more than double the present capacity. Work will be commenced at an early date. C. E. Robertson is superintendent.

Utah

SALT LAKE CITY—The Salt Lake Insecticide Co. is pushing construction on its new local plant for the treatment of ores from the properties of the Western Utah Copper Co. The plant is designed to recover the arsenic in the form of calcoum arsenate, utilizing lead or zinc oxide in the process. Dr. Frank W. Cameron is general manager.

Washington

VANCOUVER—The United States Molybdenum Metals, Ltd., operating in the St. Helens mining district, near Spirit Lake, has acquired the former shipyard property of the Standifer Shipbuilding Co., as a site for the erection of a new smelting and refining plant. Work will be commenced at an early date. Headquarters of the company are at 16 Natoma St., San Francisco, Calif.

SEATTLE — The Washington Iron Works will commence the immediate erection of a new 1-story foundry, 130x660 ft., for the production of iron and steel castings, estimated to cost about $90,000. Richard Ellis is company engineer.

West Virginia

WHEELING—Plans are being prepared for the construction of a new filtration plant at the municipal waterworks, and bids for equipment are expected to be asked early in December. The plant will have a capacity of 20,000,000 gal. With new power house, tanks and pumping station, the project will cost about $1,000,000. J. N. Chester, Union Bldg., Pittsburgh, Pa., is engineer.

Canada

MONTREAL — The Howard Smith Paper Mills, Ltd., has authorized plans for the construction of a new plant for the production of bleached soda pulp, to have an initial capacity of about 15,000 tons per annum.

New Companies

THE RENSSELAER PAPER CO., New York, N. Y., care of J. L. Holtzman, Woolworth Bldg., representative, has been incorporated with a capital of $50,000, to manufacture paper products. The incorporators are S. Berkman, A. Krissoff and M. Carberry.

THE AMERICAN VAT COLOR MFG. CO., 3223 Western Blvd., Chicago, Ill., has been incorporated with a capital of 4.500 shares of stock, no par value, to manufacture synthetic organic chemical products. Incorporators: William J. Loeffler, E. C. Kohlsaat and H. F. Clark.

THE CLINTON CHEMICAL CORP., Irvington, Newark, N. J., has been incorporated with a capital of $125,000, to manufacture chemical products, gasoline intensifiers, etc. The incorporators are Henry S. DeForest, Francis W. Wilcox and George F. Schmitt, 1045½ Clinton Ave., Irvington. The last noted represents the company.

THE CHEMICAL PRODUCTS CORP., Providence, R. I., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are James B. Littlefield, Fred A. Otis and Gilbreth Brown, 24 Audubon Ave., Providence. The last noted represents the company.

THE CRYSTAL SOAP & CHEMICAL CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $100,000, to manufacture chemical products, soaps and kindred specialties.

THE MORRIS PETROLEUM CO., Somerset, Ky., has been incorporated with a capital of $25,000, to manufacture petroleum products. The incorporators are Jackson Morris and Leslie Combest, Somerset; and Henry J. Stites, Louisville, Ky.

THE CASS CHEMICAL CO., 4405 Cass Ave., Detroit, Mich., has been organized under state laws to manufacture chemical specialties, synthetic products, etc. The incorporators are Edward Hirschfeld and Benjamin Meyers.

THE YOUNGSTOWN HIDE & TALLOW CO., Youngstown, O., has been incorporated with a capital of $25,000, to manufacture tallow, greases, and kindred specialties. The incorporators are George J. Bickler and L. J. Ferbstein, both of Youngstown.

THE RED BALL REFINING CO., 1400 Consumers' Bldg., Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture refined oils, etc. The incorporators are F. G. Howell, B. Groh and L. E. Walther.

THE DRURY MFG. CO., Mineola, L. I., care of T. C. Horton, Rahway, N. J., representative, has been incorporated with a capital of $15,000, to manufacture brick, tile and kindred burned clay products. The incorporators are W. F. Drury and R. C. Hunt.

THE SEMINOLE PRODUCTS CO., Jacksonville, Fla., has been incorporated with a capital of $400,000, to manufacture cement products. J. R. Nordquest is president; and Harry Mills, secretary, both of Jacksonville.

THE DEN-WAL MFG. CO., Newark, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are H. L. Davis, Nathan P. Walton and James A. Dennis, 8 Jefferson St., Newark. The last noted represents the company.

THE LOUISVILLE PETROLEUM REFINING CO., Louisville, Ky., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated with a capital of $500,000, to manufacture refined petroleum products and byproducts.

THE SHO-FORM CO., Buffalo, N. Y., care of Persons & Blair, White Bldg., Buffalo, representatives, has been incorporated with a capital of $25,000, to manufacture soap products. The incorporators are W. F. and E. G. Messing, and L. E. Moschel, all of Buffalo.

THE STENSEL-SPEAR MICA CO., New York, N. Y., care of Oscar Lowenstein, 27 Cedar St., New York, representative, has been incorporated with a capital of $12,000, to manufacture mica products. The incorporators are H. S. Spear, E. and A. Stensel.

THE VAL-O CHEMICAL CO., 823 North Broadway, Decatur, Ill., has been incorporated with a capital of $50,000, to manufacture chemical specialties. The incorporators are Val H. Chronister, H. M. McMillan and N. Stookey.

THE ADANAC-TEXAS OIL CO., San Antonio, Tex., has been incorporated with a capital of $150,000, to manufacture petroleum products. The incorporators are B. W. Somers, C. L. Watson and J. D. Reese, all of San Antonio.

THE EASTERN REFINING CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws with capital of $50,000, to manufacture refined petroleum products.

THE TEXARKANA PAINT CO., Texarkana, Ark., has been incorporated with a capital of $25,000, to manufacture paint, varnish and kindred products. The incorporators are B. H. Kuhl, H. H. and J. H. Harrell, all of Texarkana.

THE ROYAL PAPER PRODUCTS CO., New York, N. Y., care of M. I. Murzin, 233 Broadway, representative, has been incorporated with a capital of $25,000, to manufacture paper specialties. The incorporators are I. Levy, D. and C. Rosenthal, all of New York.

THE MOHAWK OIL CO., San Francisco, Cal., has been incorporated with a capital of $3,000,000, to manufacture petroleum products. The incorporators are C. E. Ward, L. B. Cook, F. R. Stewart and Joseph C. Meyerstein, 57 Post St., San Francisco. The last noted represents the company.

THE NOUN CHEMICAL CO., New York, N. Y., care of J. F. Neuman, Jr., 601 West 144th St., New York, representative, has been incorporated with a capital of $5,000, to manufacture chemical specialties. The incorporators are E. D. Neuman and H. C. Harvey.

THE NATIONAL TILE WORKS, INC., New Brunswick, N. J., has been incorporated with a capital of $25,000, to manufacture ceramic tile products. The incorporators are Samuel and Joseph LiCausi, 146 Neilson St., New Brunswick. The last noted represents the company.

THE MCELMORE COVE OIL CO., Chickamauga, Ga., has been incorporated with a capital of $50,000, to manufacture refined oil products. The incorporators are J. P. Dunaway, Chickamauga; Frank P. Case and D. H. Mitchell, both of Chattancoga, Tenn.

THE PHARAOH PARCHMENT CO., San Francisco, Calif., has been incorporated with a capital of $50,000, to manufacture paper products. The incorporators are E. Hepner, G. E. Lund, J. Politizer and George A. Connolly, Mills Bldg., San Francisco. The last noted represents the company.

THE PALADO OIL CO., Houston, Tex., has been incorporated with a capital of $50,000, to manufacture petroleum products. The incorporators are F. H. Sheffield, Claude Kavanaugh and H. P. Porter, all of Houston.

THE M. A. WELLIN OIL CO., Syracuse, N. Y., care of C. S. Carr, White Memorial Bldg., Syracuse, representative, has been incorporated with a capital of $50,000, to manufacture oil products. The incorporators are M. A., F. and J. Wellin.

THE J. & J. CHEMICAL CO., Buffalo, N. Y., care of Clarence MacGregor, Ellicott Sq., Buffalo, representative, has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are J. Sansone, and J. Barone.

THE VIM OIL CO., 175 West Jackson Blvd., Chicago, Ill., has been incorporated with a capital of $50,000, to manufacture oil products. The incorporators are A. J. Minster and Oscar A. Steffels.

THE STAR SMELTING & REFINING CO., Philadelphia, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., has been incorporated under Delaware laws, with a capital of $10,000, to manufacture refined metal products.

Capital Increases, etc.

THE BAKELITE CORP., 8 West 40th St., New York, N. Y., manufacturer of rubber composition products, has filed notice of increase in capital from $3,100,000 to $5,100,000.

THE REX STEEL STAMPING CO., Joliet, Ill., has filed notice of increase in capital from $40,000 to $100,000.

THE INLAND GLASS CO., Chicago, Ill., has filed notice of increase in capital from $1,500,000 to $2,000,000.

THE HERCULES POWDER CO., Wilmington, Del., has filed notice of increase in capital from $20,000,000 to $40,000,000.

THE MADISON TIRE & RUBBER CO., Buffalo, N. Y., is arranging for a bond issue of $750,000, a portion of the proceeds to be used for general expansion.

THE GENERAL REFRACTORIES CO., Oliver Bldg., Pittsburgh, Pa., has purchased the plants of the Hayes Run Fire Brick Co., Orviston, Pa., and the Pennsylvania Fire Brick Co., Beech Creek, Pa., at the same time increasing its capital to $18,000,000. The acquired properties will be merged with other plants recently secured in this district.

THE JOHN LUCAS CO., 322 Race St., Philadelphia, Pa., manufacturer of paints, varnishes, etc., has arranged for an increase in capital from $1,500,000 to $7,000,000.

Herman Ringel and William C. Ridgway have been appointed receivers for the HOBOKEN PAPER MILL CO., 1 Newark St., Hoboken, N. J. The assets are stated to be $798,000, and liabilities, $759,100.

THE INDEPENDENT OIL & GAS CO., Okmulgee, Okla., is arranging to increase its capital to $10,000,000 for proposed expansion.

Industrial Notes

THE CUTLER-HAMMER MFG. CO., Milwaukee, Wis., in order to give greater attention to business in western New York and the Province of Ontario, has opened a branch office at 358 Ellicott Sq., Buffalo, N. Y. B. A. Hansen, formerly located in the New York office, has been placed in charge.

THE DURIRON CO., INC., Dayton, O., has opened an office at 495 Ellicott Sq., Buffalo, N. Y., to take care of business in that territory. The new office will be in charge of N. E. Philpot, who for the past 2 years has been engineer in charge of the company's Cleveland office.

AUTOMATIC & ELECTRIC FURNACES, LTD., has moved to larger works and offices at 173-175 Farrington Road, London, E C. 1, England. In addition to the Wild-Barfield electric furnaces and laboratory muffles it is introducing new types of muffles for laboratory use, etc.

THE SEMET-SOLVAY CO., Syracuse, N. Y., has been awarded a contract for the construction of a byproduct coke plant of 500 tons daily capacity for the Hoskins Iron & Steel Co., Sydney, New South Wales, Australia. The contract has been awarded as a result of competitive tests on low-grade "zig-zag" Australian coal.

THE WESTON ELECTRICAL INSTRUMENT CO., of Newark, N. J., announces that G. P. Atkinson has opened an office in Atlanta, Ga., for the territory of Georgia, South Carolina and northern Alabama. In addition to Weston instruments, Mr. Atkinson has in charge the sale of other electrical equipment. This company also announces a new line of small portable instruments for use on alternating-current circuits, known as "Weston, Jr." The group comprises wattmeters, voltmeters, ammeters and milliameters.

THE HERCULES POWDER CO., Wilmington, Del., has recently employed the following men at various plants and the research station: Roderick Eskew, Roy S. Hancock, Carl B. Durr, Robert C. Brown, B. I. Stoops, Charles W. Woodrow, H. W. Botts and H. E. Krueger.

Manufacturers' Catalogs

THE BROWN HOISTING MACHINERY CO., Cleveland, O., has issued Catalog L, on Brownhoist drop-forged chain for conveyors and elevators. Copies will be mailed to any reader who is interested.

THE METAL & THERMIT CORP., New York, has issued the fourth edition of its Thermit Locomotive Pamphlet, No. 21, which is of interest to railroad superintendents of motive power, general foremen, blacksmith foremen and Thermit welders. The new pamphlet contains many revisions since the last edition was published, chief among which are instructions for applying important improvements in practice in Thermit welding which have been developed by exhaustive research. The drawings and instructions illustrate and describe the making of Thermit welds in various parts of locomotive frames and other locomotive and railroad equipment, and show improved practice.

THE CENTURY WOOD PRESERVING CO., Pittsburgh, Pa., has issued Bull. 24, on "Treated Ties and Timbers for Industrial Plants."

BALLARD, SPRAGUE & CO., New York, are issuing a new catalog on boiler settings and chimneys. Illustrations of actual installations are given as well as descriptive matter.

THE COLORADO IRON WORKS CO., Denver Colo., in Catalog 32-B discusses the drying of fine materials, with a description of the Lowden patent drier.

THE JEFFREY MFG. CO., Columbus, O., has published three new catalogs: No. 277, "Jeffrey Machinery for Fertilizer Plants," which has 35 pages of illustrations and description and data covering equipments which have a wide range of service in the handling and treatment of materials in the fertilizer and allied industries; No. 258, which illustrates and describes Jeffrey Standard Apron Conveyors in both wood and steel types; and No. 368, which is on Jeffrey Swing Hammer Pulverizers adapted for reducing all kinds of friable materials. This catalog has 42 pages of description, data and other information, together with numerous shop illustrations and installation views showing the wide application of Jeffrey swing hammer pulverizers.

Coming Meetings and Events

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, 52 East 41st St., New York City, Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor

R. S. McBRIDE
SIDNEY D. KIRKPATRICK
A. E. BUCHANAN, JR.
GRAHAM L. MONTGOMERY
CHARLES WADSWORTH, 3D
CHARLES N. HULBURT
Assistant Editors

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An Engineer As Ambassador

IN THE appointment of GELASIO CAETANI as Ambassador from Italy to the United States, engineers generally, but particularly mining and metallurgical engineers of the West, will find a new source of pride and gratification. We are no longer unaccustomed to the appointment of engineers to high places in civic affairs, but occasionally a conspicuous example like this excites our admiration. Our Western readers will recall Mr. CAETANI as a man of charming personality and an engineer of exceptional ability who made his mark in ore dressing. In a fine democratic spirit he began at the bottom, following his graduation from the Columbia School of Mines in 1903, and worked his way to recognition through sheer merit. To only a few of his friends was it known that he was the son of the Duke of Sermoneta, and a descendant of a noble Italian house that has been prominent in the national life of Italy for nearly a thousand years.

During the late war Mr. CAETANI served in the Italian army, rose to the rank of Colonel, and gained fame by destroying an Austrian stronghold, the Col di Lana. Since the armistice he has been a prominent figure in Italian affairs, first being elected Mayor of Rome, and subsequently serving as a member of the Chamber of Deputies. It is with this fine heritage that Mr. CAETANI will return to the United States as the Ambassador of his native country; and without disparagement of his eminent predecessors, we feel that he will bring qualities of mind and personality that will add fresh luster to this diplomatic post.

Specifications for A Government Post

IN THE resignation of Dr. STRATTON as director of the Bureau of Standards, the government finds itself confronted with no mean problem—that of discovering a successor technically fitted for the position and financially able to support it.

The Bureau of Standards is probably the greatest physical institution in the world, and in view of its close relation to science and industry it requires a many-sided director. But like most government posts, the salary is not commensurate with the requirements. And while it is a sad commentary on the unwillingness of the government properly to compensate its technical servants, the fact remains that in most of these positions the incumbent must accept honor as a large part of his remuneration.

Imagine a position in industry with the following requirements: (1) A knowledge of industry, from the practical rather than the academic point of view. (2) A broad and profound knowledge of the science of physics. (3) Ability to command the confidence of Congress in order to obtain appropriations for projects of great importance but not particularly spectacular. (4) Administrative experience and executive ability. (5) A quality of social leadership among scientific men and laymen that will command respect for professional standards and scientific workers in the community. And then imagine the salary that would be offered to the happy possessor of these qualifications. It would certainly be several times that established for the director of the Bureau of Standards. And yet these are practically the specifications for the man to fill Dr. STRATTON'S place. But if these were all the task might not be so difficult. We must still add the requirement of a private income sufficient to eke out the salary that Congress has seen fit to establish for the heads of scientific bureaus in Washington.

During the recent war it was not uncommon for men of exceptional ability to abandon their regular vocations and give their services to their country at nominal salaries. Such evidence of patriotism is not unexpected at a time of national crisis, but should not be called for in civil service in times of peace. The dollar-a-year man of war times has returned to his job, but we can almost find his counterpart in the scientific servants of the government today.

Treating Symptoms or Establishing Principles?

IT IS illustrative of our loose habits of thought, or disinclination to think at all, that there was a very favorable popular reaction to the announcement that Congress intended to set up a commission to "get the facts" in the coal industry. Apparently the public had an idea that there was confusion as to the facts. The miners had made various claims as to excessive capacity of coal mines, as to miners being very poorly employed in point of time, and the like. The public was probably assuming that the operators were denying most of the statements. As a matter of fact they were not, and they were making very few statements of their own.

In an industry that employs hundreds of thousands of men and produces hundreds of millions of tons a year there are naturally many facts. The coal commission will probably assemble thousands of facts, perhaps hundreds of thousands if the figures in the tables are counted as facts.

But the whole coal situation may be regarded as an industrial symptom. Here is an industry said to be overdeveloped, overcapitalized and overmanned. The natural laws of trade are expected to correct such conditions. Usually they do; in coal they do not. Surely we all know that this failure is not due to any essential economic quality of coal, differentiating it from iron ore, copper or zinc. If we suspected a difference, we should seek for a great mass of facts not simply in coal

but in all industries to show by comparison how it happens that coal is different.

The great fact in coal is one that requires no commission to find. It is simply that a great labor union has grown up in that industry, one of the results being that the law against restraint of trade is ineffective. For while that law forbids producers to agree with one another to restrict production, it does not forbid coal operators and coal miners from disagreeing with each other, whereby a restriction in production actually occurs.

Herein is involved a definite principle. Is it in accord with public policy to permit workmen to form unions and to permit the unions to restrict production? The tendency of labor unions in the United States is to do this. They do it in the building trades and they have done it with the railroads. These are the most powerful unions in the United States.

What has occurred in coal is merely an industrial symptom resulting from the practice of permitting labor unions to restrict operations. We do not need a great mass of facts about coal in this connection, showing how or to what extent they do it, what their various excuses are and how the money is divided that is thus obtained from the public. We know enough about that already.

What we need is clear thinking as to what principle should be laid down, as a matter of public policy, to govern the relations between employers and employed, whether the work is in coal mining or any other industry. Obviously the coal industry furnishes an excellent opportunity for experimenting in the application of any new principle we may adopt, but if harm is being done by our permitting restraint of trade by employees when we do not permit it by employers, it would be very unfortunate if we should act only when the restraint goes to such outrageous lengths as it has in coal. Public opinion needs to be formed, and for this leadership is usually requisite. Public opinion now holds that workmen will be imposed upon unless they are permitted some latitude. There is only dissatisfaction, and then not a great deal, when the latitude covers arson and murder. Let us adopt the principle, if we find it right, that workmen do need protection and then let us give them the protection freely and properly, instead of letting them commit crimes to protect themselves.

The Chemical Game Of Hide and Seek

A HIGHLY esteemed subscriber writes to ask if we cannot find place for a regular column or department devoted to the results of investigations that are in progress relative to atomic and molecular structures. These problems, he says, "are in a similar position to those of engineers not very long ago. When they desired to build a bridge they first made a model, then loaded it with sandbags, found where it gave way, made these parts stronger, and repeated the process until they finally concluded that the bridge was strong enough. Then, using the model as a criterion, the bridge was built with its stresses and strains computed by a 'cut and try' method. Today they know the characteristics of their materials, and, by simple mathematics, they compute the size of beams and braces when once the load is given." It seems to us he is harking back a considerable time in regard to general engineering methods, but that is not germane to the subject. He wants to see chemists at work, for example, at synthesis, having the facilities of the engineer to compute the units of his structure. So do we.

Our correspondent's appeal for more light is indeed the cry of the chemical world today. We need more study, more definitions and more understanding of chemical forces. Our power, our heat, and water flow, all come from the sun. When we burn coal we are recovering, as the late Professor CIAMICIAN said, the fossil energy of the sun. This is true in that the sun furnished the energy to bring about the endothermic synthesis of cellulose, lignin, gums, etc., in the trees and plants. But chemical energy comes from within the atom.

The Lewis-Langmuir theory is a grand beginning, although progress is slow. Here we have approximately definite geometrical shapes for atoms. The arrangement of protons and electrons is such that there is not complete balance of positive and negative charges on the faces of the atoms, except in those of the inert gases. The pair- and octet-forming drive of electrons in the presence of positive charges accounts for the wandering of electrons from one atom to another to make up or to approximate octets and thus form ions which are held together by electrostatic force, or to cause combined atoms to hold pairs of electrons in common. In this manner molecules are built up. Here is a world of study ahead to enable us to visualize every molecule.

Given this, and we have again a lack of balance on the several faces of the molecule, owing to the preponderance or greater proximity of either positive or negative charges to every face in question. These produce electropositive or electronegative fields of force over the molecular faces, and indicate a reason for the formation of crystals. Granted geometric shapes with definite and similar fields of force on the same face of each, then we can well imagine how the dominant electropositive face will attach itself and cleave to the dominant electronegative face of the molecules of a substance. This would provide for Sir WILLIAM BRAGG'S crystal units made up, as he says, in quartz for instance, of three molecules of SiO_2 arranged in a particular and specific manner. The strongest fields of force would be within the crystal unit with electropositive and electronegative faces joined and held together by electrostatic force. But, so far as we are aware, we have not reached the study and computation of these fields of force as yet.

Within the domain of colloid chemistry the situation is, as usual, rather muddy, foggy, hazy and indefinite. Why is it that some substances form crystals and others do not—so far as we know? Or, granting the above reason for crystal formation, why are some substances amorphous? We are now over in the domain of armchair chemistry, without anything but imagination to help us. We do not know whether amorphous particles are made up of indefinite aggregations of molecules or of crystal units or of both. But suppose the fields of force on the faces of the molecules or crystal units are so evenly balanced that they join "at haphazard," as the saying is; then any electropositive face will join any electronegative face at haphazard, and the resulting aggregates will be irregular. And as soon as the surface of the particle becomes completely electropositive or completely electronegative, then aggregation will cease.

This is mere guessing, and yet it shows how fascinating the field is and how sorely we need additional study and research. Exposition should not be difficult in the end, if we could only get at the facts.

Political Fortunes Of Chemical Industry

ASIDE from its purely political aspects, the recent election has an incidence on chemistry in this country in so far as it determines the attitude of Congress toward our chemical industry. In the Senate we have lost two good friends, T. COLEMAN DU PONT of Delaware and J. S. FRELINGHUYSEN of New Jersey. On the other hand, WILLIAM H. KING of Utah was re-elected and we still have with us Senator MOSES of New Hampshire, both of whom are known to be unsympathetic with the hopes and aspirations of the chemical industry. In the House we have been fortunate in retaining Mr. LONGWORTH, while HERMAN METZ was defeated by OGDEN L. MILLS of New York. The defeat of Mr. VOLSTEAD may have some effect in getting fair treatment for industrial alcohol, because his place as chairman of the Judiciary Committee of the House probably will be taken by Mr. GRAHAM of Pennsylvania, who, we hope, will not be so absorbed in the administration of the prohibition features of the Volstead act that he will fail to recognize the mandate for the encouragement of industrial alcohol.

Intelligent Use of Fire Extinguishers

UNDER the caption "Turning Accident Into Disaster" we commented editorially in our issue of July 19, 1922, on an accident in one of New York's subways in which Pyrene was used to extinguish a fire resulting from an electric short circuit. Current press reports of the accident stated that a large number of passengers had been overcome by fumes of Pyrene and its decomposition products. Knowing something of the chemical properties and physiological effects of carbon tetrachloride, phosgene, chlorine and hydrochloric acid, and accepting as reliable the reports that passengers had been gassed and taken to hospitals for recovery, we drafted an editorial condemning the use of Pyrene in the subway and holding that its use had added to the disastrous consequences of the accident.

Subsequently the official report of investigation by the Transit Commission exonerated Pyrene as a factor in the distress and illness of the passengers. In the light of this report, which was summarized in our issue for Aug. 16, it is obviously incumbent upon us to retract our strictures on the use and effect of Pyrene as far as they pertain to this particular accident. In its investigation the Transit Commission had the benefit of the experience and service of experts from the U. S. Bureau of Mines who are competent authorities on the subject; and if they found that there were no "really serious cases resulting from the effect of possible toxic gases" we are quite willing to accept their verdict.

As a byproduct of the incident we were led to investigate the general use of Pyrene and other forms of carbon tetrachloride fire extinguishers. The results show conclusively that, owing to its poisonous properties, great care should be exercised in its use, since illness and even death may result under some conditions. We are also convinced that, in offering for sale a chemical product of this kind, the manufacturers are in duty bound to protect the public against the consequences of unintelligent use.

We acknowledge error in our interpretation of the subway accident, but feel justified in maintaining the general principles here expressed.

Current Investigations On Fatigue of Metals

ABOUT three years ago a notable investigation into the endurance of metal under rapidly alternating stresses was started by Prof. H. F. MOORE. An enormous amount of work has since been done on a group of steels, some fundamental information of extreme practical value discovered, and at a very low cost—in fact, it amounts to less than one cent on every ton of alloy steel produced during the period. It would be ridiculous to assert that the makers and users of fine steels have not profited to that extent. As a matter of fact, they have gone untaxed, since the cost has been borne by the Engineering Foundation, the General Electric Co. and the University of Illinois.

Within a few weeks the original program will have been completed.

It has established high probability to the belief that metal has a true endurance limit—that is, a unit stress which no matter how often repeated can be successfully resisted. Fortunately for the testing engineer, a slightly higher stress causes failure in less than ten million repetitions, so that these time-consuming tests can then be discontinued.

The investigators have also determined that a very close approximation to the endurance limit may be had by measuring the heat generated in a loaded beam, rapidly rotating, and have devised a simple machine for this purpose. Such a test takes as many hours as formerly required weeks or even months.

An idea of the endurance of a tough steel may even more rapidly be had by assuming it to be 45 per cent of the ultimate tensile strength or 250 times the Brinell hardness.

Designers, manufacturers and users of turbines, high-speed engines, axles or springs will not now have to rely upon factors of safety, or rather factors of ignorance, ranging up to 20. Of course, ripe experience and service records are the ultimate judges of excellence, but such judgments may not be had rapidly. Actual tests are continually needed to pick out the best material from several attractive analyses or heat-treatments. Furthermore, manufacturers of such things as cast steel, drop forgings, wrought aluminum or manganese bronzes and malleable iron are often called upon to make pieces which are subject to alternating stresses. How much do they know about the fitness of the material they furnish for that particular duty? In nearly every case it is less than nothing.

Ultimately, a great many plant laboratories will be equipped with facilities for conducting endurance tests. Purchasers will demand it. But these will require no little money and competent supervision, both of which seem to be rare just now. At the present moment such work can be submitted to Professor MOORE'S department at the University of Illinois and be handled by an experienced test party. It is estimated that reasonably complete data on one lot of metal can be had at a cost of not more than $600—certainly a modest sum compared to the damage resulting from one disastrous failure or, for that matter, to the money already expended by more than one progressive concern in its own laboratory, studying fatigue.

The pioneering work has already been done. American industry doubtless will recognize the economy in making best use of this organization—it can skim the cream, as it were!

Readers' Views and Comments

Impressions Concerning the European Steel Industry

To the Editor of Chemical & Metallurgical Engineering

SIR:—The outstanding impression one receives from a rather extended tour of the north European countries is that business conditions, particularly in iron and steel, are extremely unsettled, and there is a great deal of unemployment.

The output of pig iron in England has increased over 1921 figures, but is still less than half 1919 and 1920 figures. The 1922 output of steel ingots and castings has averaged around 400,000 long tons per month; the average for 1919 was around 700,000, and over 800,000 in 1920. In June, 1922, 115 blast furnaces were operating, against 298 for June, 1920. In June, 1922, 212 open-hearth plants were operating and 497 in June, 1920. Average weekly wages of iron and steel workers are lower now than any time since 1914. The official figure for June, 1922, was £2/16/0 ($12.30) per week, against $22 in June, 1919, and $8.25 in 1913.

Taxes are extremely high in England, many employees and salaried men paying up to 60 per cent of their total income in taxes. This high taxation is blamed for the present stagnation in British industries—the employer will not risk capital or engage in new enterprises and most of them are just waiting for sane business legislation and reasonable taxation.

As is doubtless well known, the British Government has a system of unemployment insurance doles and probably one-quarter of the whole working population is in receipt of these weekly payments. It was stated by the lately deposed government officials that such payments for unemployed were necessary to prevent, possibly, a revolution, but the result has been extremely bad. The worker draws sufficient to keep himself comfortably without working and does not appear anxious to work and earn a somewhat better wage. The employer of labor feels he is unfairly taxed to keep idle these drones and he has no incentive to find more work. He knows the British workmen are too sensible to be gulled by "revolution" talk, but all the same they will take money without working just as long as the government is fool enough to pay. In addition to the unemployed drawing government "doles" there are larger numbers of unemployed not on "dole" who are affected indirectly by the shortage of work in the main industries such as steel, coal and shipbuilding. Co-operative effort by workers and employees, as understood here, is practically unknown and the future looks very dark for many British industries.

The Welsh tin plate mills appear to be the only works running on anything like normal capacity—their output is quite up to previous good years.

From a short visit to France it would appear that there is much less unemployment than in England. A great deal of building and reconstruction work is going on, particularly on the old battle areas. To the writer the one outstanding feature of France was the amount of ground that is being put into cultivation. Contempt and hatred of Germany are still much in evidence but not interfering with their getting down to real work.

Norway appears to be in a transition stage betwee war profits and after-war losses. Their experiment with prohibition were quite farcical. They prohibite wines, so the Spanish and Portuguese prohibite Norwegian dried fish and sardines, practically closin down the Norwegian fishing industry. Then the Nor wegian Government permitted light wines and beer and agreed to take the Spanish and Portuguese win crop in return for the lifting of the embargo on fish.

Just a little example of too much independence!

American products are in considerable demand i Scandinavia, but the unfavorable rate of exchange i preventing much business in American material. Th Fordney tariff has created a very unfavorable impres sion abroad, particularly in those countries which ar large debtors to the United States. The fear is openl expressed that they will be unable to meet these debt until the tariff wall is removed and reasonable trad facilities are given. It is the only way some of thes countries can pay, and if we stop trade we stop pay ments also.

FRANK HODSON.

Electric Furnace Construction Co.,
Philadelphia, Pa.

Galvanic Corrosion on Yacht Sea Call

To the Editor of Chemical & Metallurgical Engineerin

SIR:—In the Oct. 4 number of *Chemical & Metallurgica Engineering*, page 678, and referring to Montreal meet ing of the American Electrochemical Society Henr Howard of Cleveland, Ohio, refers to the disintegratio of the Monel yacht Sea Call. Mr. McKay of the Inter national Nickel Co. explained this by pointing out tha it was a case of electrolytic action—the stem and ster of the yacht and likewise the rivets and bolts were mad of iron.

The general understanding is that the Monel meta showed evidences of depreciation, *and not the iron parts* As Monel metal is quite strongly electronegative to bot cast and wrought iron as well as steel in an electrolyt of sodium chloride solution, the disintegration referre to can scarcely be attributed to electrolytic action.

It will be interesting to hear what Mr. McKay has t say in regard to this.

A. HOUGH.

Summit, N. J.

To the Editor of Chemical & Metallurgical Engineerin

SIR:—If Mr. Hough will refer to the *Engineering New* of Sept. 9, 1915, and to the *Metal Industry* for Novembe 1915, he will find the question of the yacht Sea Call full described by men who made a personal examination o the yacht after she was taken out of the water. Thes reports show clearly that, contrary to Mr. Hough's un derstanding of the situation, the iron and steel showe depreciation, and *not the Monel metal parts.* I agre with Mr. Hough that Monel metal is strongly electro negative to iron in sodium chloride solution. In such cell Monel metal will be the negative pole and the curren in the solution will flow from the iron electrode to tha of Monel metal, disintegrating the iron and protectin the Monel metal, which explains the disintegration re ferred to, contrary to the conclusion drawn by M Hough.

ROBERT J. MCKAY.

New York City.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, Oct. 21, 1922.

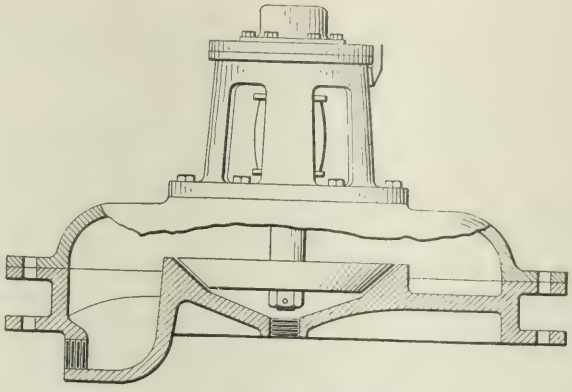
THERE has been a marked improvement in the chemical trade, particularly in heavy chemicals, although there are few changes in price to record. The policy of buying from hand to mouth which has been pursued for so long has probably spent itself and in the near future purchases should be on a larger scale. The recent spectacular rise by which the price of rubber has been doubled is only partly due to the decision to restrict output; similarly, when buyers come forward with more substantial orders, those who have held off too long may also find themselves at a grave disadvantage in regard to certain chemical commodities. The present political upheaval has, if anything, been a bull point, as the policy which a Conservative Government is likely to pursue should benefit British chemical industries at the expense of foreign competitors. This does not necessarily mean that there would be additional tariff legislation and the program would not be influenced materially by the Fordney tariff, the effect of which has already been discounted to some extent, although its precise consequences are not yet clearly realized.

A BRITISH MILL FOR EMULSIFICATION AND DISINTEGRATION

Several articles have recently appeared in the technical press descriptive of the Plauson colloid mill. The Plauson Research Institute has taken out hundreds of patents in connection with the possible application of the principles on which the invention is based, and it would seem that many of the claims formulated are rather in the nature of intelligent anticipation, with actual practical results to follow. Much play has been made with the word colloid, which perhaps may be likened to the diagnosis of "gout" when the routine medico does not quite know what ails his patient. It is therefore refreshing to find a British mill put on the market by the Premier Filterpress Co. working on an entirely different principle, apparently achieving at least equal results and perhaps studiously refraining from the use of the word colloid. The Plauson mill works on the impact principle, while the Premier mill depends on a shearing action in liquid suspension. The object seems of sufficient importance to give a short description in these notes.

DESIGN OF PREMIER MILL AND ITS APPLICATION

Reference to the diagram shows that the mill comprises a conical rotor revolving vertically at 1,000 to 000 r.p.m. in very close proximity to a corresponding achined conical surface in the outer casing, the materials to be treated passing upward between the two urfaces and the whole arrangement bearing a close esemblance to an automobile clutch. The gap between he two surfaces is adjustable by means of a micrometer ead and in practice the clearance may be anything etween 0.003 and 0.025 in., according to the nature of he work being done, without ever permitting the two urfaces to touch. When the mill is working, the material is pumped through in liquid suspension at a suitable ate and, owing to the enormous speed of the rotor, the uspended particles are rapidly torn apart in the passge of the fine film between the conical surfaces. As here are no grinding surfaces, wear and tear are practically eliminated and the power required for the mill itself varies between 2 and 5 hp. when treating 5 to 10 gal. per minute of oils or milk. In practice two liquids normally immiscible become so finely divided that they coalesce and form an emulsion, while solid particles are very minutely disintegrated, the machine being jacketed



THE PREMIER MILL

if necessary, for heating or cooling during operation. As instances of successful application, the regeneration of milk from the dried powder, the manufacture of vanishing cream using about 10 per cent of magnesia, the grinding of ferric oxide and the mixing and incorporation of all kinds of paints, varnishes, enamels, disinfectants, etc., may be mentioned, and the purification of naphthalene, benzene, etc., is also facilitated. Experimental work is continuously being carried out in regard to further new applications, two mills having been installed for that purpose and, as is usual, many initial failures have subsequently developed into real successes by the use of small quantities of additional reagents and by suitable modifications of clearances and other working conditions.

THERE IS LIME AND LIME

Old Buxton lime has held the field for so long that the advent of a serious competitor entailed extensive propaganda. Now that Callow rock lime is making progress we are in the midst of antagonistic advertising by the rival producers on ingenious and even ingenuous lines that remind one of the salesman's comparison between lubricating oils having spherical and triangular molecules respectively. Both firms claim greater chemical reactivity for their product, the Callow interests basing their statements partly on scientific control of the burning operation and on fineness and purity, while the Buxton firms rely largely on reputation and some indefinable "natural properties" possessed by their raw material. Good chemical lime is of considerable importance in the manufacture of bleach and for the alkali, paper, textile, ammonia and other industries, and the booklet issued by the Callow company is instructive in spite of its quite natural bias. Reactivity is presumed to be measured by the rate of reaction with water, and both firms claim that a ton of their lime will go further than a ton of "any other lime." The lesson to be drawn seems that just as for feldspar, standard tests and specifications are needed and also the publication of comparative test results under reliable expert supervision for each particular application in the chemical industry. The fact is that competition has made the producer realize that lime is really a chemical and cannot be placed in the same category as common brick.

European Conditions as I Saw Them*

Comparative Fundamental Conditions in France, Belgium and Germany — Grievances of France as to Her Monetary Status — Analysis of the French Coal Situation, Showing That There Is No Foundation for the German Bitter Complaints Against France's Coal Policy

By J. S. Negru

COMPARING existing conditions in France and Belgium, I am inclined to believe that, taken altogether, France is much better off.

During my trip through these countries I learned of some conditions that are far worse in France than in Belgium, but, in my judgment, these are more than counterbalanced by others which are in her favor. In the unfavorable group of conditions, of course, is the enormous loss in life and devastation of property during the war. But among those things that are of first importance in France's favor are the following:

France is and always will be a self-supporting country, whereas Belgium has always depended and will have to depend on imports for the daily necessities of life and for the raw materials needed to support her old-established industries, such as iron, zinc and glass. France can readily find markets for her products at home, as well as in her extensive colonies, besides being well assured of a large export of goods in the luxury class to practically all the countries of the world. Belgium, on the contrary, can scarcely find markets at home for her products, while her only colony, the Belgian Congo, does not yet absorb appreciable quantities of manufactured goods. As for foreign markets, Belgium has to contend with strong competition from surrounding industrial countries, and this is not lightened by the fact that she must import so much of her raw material.

The great losses of France may be classed as temporary. It may safely be expected that within a very few years she can be reconstructed in population, if I may use such an expression, as well as in devastated property. Her inherent advantages are stable. Belgium, on the contrary, is and will be for a long time to come at the mercy of outside factors that will determine whether she can regain and hold her absolutely necessary foreign market.

These, briefly, are my reasons for saying that, taken altogether, France is much better off than Belgium.

Distinctive Characteristics Between France and Germany

In comparing conditions in France and in Germany, I am led to set down two main points that appeal to me as the fundamental reasons why France is in a far better position than Germany.

First, France has proved in the past that she can be a good loser, and as such, has enjoyed deserved consideration at the hands of the other nations. Everything points to the fact that Germany, too much imbued with a sense of her own importance, was unable to accept the consequences of the war, however hard they may have been, with the result that she is gradually becoming the ward of others.

Second, France is an entity, whereas Germany is merely an artificial aggregation of peoples who have only the language in common. As a result, France was and is one in adversity as well as in prosperity, whereas Germany seems to be on the road to disintegration at the first appearance of adversity.

To the foregoing also may be added the fact that the French demanded revanche (revenge) in all that the word implies, and took it as the best guide of their thoughts and actions. The Germans, on the contrary, are apparently dominated by a spirit of Hass (hatred). Revenge breeds a will to regain superiority by reasoned deeds, however wrong the reasoning may be; hatred breeds bad blood, a kind of animal savagery that prevents clear thinking. "Ich hasse Wilson und mit die Franzosen kein Mitleid" (I hate Wilson and have no pity for the French) was the parting statement given me by Dr. von H. In view of all that is now being written in Germany on the psychology of this and that, it would seem to be timely for them to consider the comparative psychology of revenge and hatred as applied to co-operation among neighboring countries.

Grievances of France as to Her Monetary Status

I had not been long in France before I discovered what one would naturally expect—namely, the grievance of France as to her monetary status. The official figure for reparation expenditures in the devastated regions was put at a little over 80 billion francs in March, 1922. Part of this was advanced by the French Government in monthly installments up to February, 1921, and the remainder was obtained from the sale of shares offered by the devastated industries. Not one pfennig had been paid by Germany for reparation up to March, 1922. Such a statement, coming from many sources and especially from E. Gruner, vice-president of the Comité Central des Houillères de France (Central Committee of French Collieries), was quite evidently a fit subject for conversation with representative Germans. As a consequence, I learned later that although large sums had already been paid by Germany, they had not in the least been used for reparation purposes, but had been expended on the different commissions with their large number of experts and for the maintenance of allied soldiers in Germany.

It is idle for me to pass judgment on the advisability or necessity of having so many allied soldiers in Germany, but with respect to the numerous commissions and their experts I may say that the impression I got of their work is that they are like buckets with screen bottoms, through which huge sums have been poured that might have been used to better advantage.[1]

Another monetary difficulty in France is a consequence of the failure of the Russian Government. Before the war over 20 billion gold francs was invested by the French people in Russian industries, and this sum now looks to be a total loss.

It is not difficult to see, therefore, that the failure

*This is the fourth of a series of articles by Mr. Negru on this subject. The first appeared in the Oct. 18 issue, the second in the Oct. 25 issue, the third in the Nov. 8 issue.

[1]From de C. in France I learned that a very good engineer of "Postes et Télégraphes" was a coal expert in Germany, and on one occasion I dined with a Belgian expert who gave small evidence of fitness for his position.

of both debtors, Germany and Russia, to meet the claims of the French people and the accumulation of huge debts contracted for carrying on the bitter struggle of war are weighing heavily on the French people, and explain somewhat the stand France is taking.[5]

Germany's Bitter Complaint Against the French Coal Policy Unfounded

Germany is making a capital case of her coal situation, and bitter complaints are being made by the intellectuals, as well as the common people, that France is squeezing her out of the much-needed coal which is then used for export purposes. From what I learned I know that this accusation is not warranted but that it is used with great efficacy to keep alive the deep hatred of the German people against the French. I openly expressed this opinion and recorded it in my diary as late as March, 1922, and I shall now endeavor to substantiate it.

According to the stipulations of the peace treaty, it is known that the Saar district is to be worked for a limited number of years by the French as compensation for the devastated French coal mines and that Germany will have to export to France certain tonnages of coal on account of reparations.

Lately Germany has also lost part of the Upper Silesia coal fields. Circumstances did not permit my getting from both sides any impressions about the Upper Silesia coal, so I shall content myself by expressing my personal opinion, gathered in casual conversation, that this loss is more on paper than in reality. Apparently, little of the Upper Silesian coal has been used outside of what is now the lost district. But as this is merely a personal impression, I prefer not to consider it particularly, and I shall dwell only on what I learned from both sides regarding the Saar district and about the export to France.

German Official Coal Figures

Although I am in possession of data and figures gathered during my trip, I shall use instead those presented in an official document of the German Government that came into my possession lately—namely, the "Bericht des Reichskohlenrates über die Kohlenwirtschaft im Jahre 1921," (Situation of the German coal industry in 1921), trusting that conclusions derived from this document will carry more weight.[6]

In 1913, the production of the Saar district was 13,071,000 tons of coal, and that of the Pfalz and Lorraine districts was 4,790,000 tons, respectively 6.8 and 2.5 per cent of the total German coal production for that year. These districts, which in 1913 had a total production of 17,861,000 tons, or 9.3 per cent of the total German coal production, are now in French hands. During the same year the production of coal in what is now the French devastated region was 18,662,000 tons.

In 1921, the Saar, Pfalz and Lorraine districts produced 9,574,000 tons of coal, and the French devastated district 5,365,000 tons, a total of 14,939,000 tons, as against 18,662,000 tons in 1913. Thus, France still has a deficit of 3,723,000 tons with the Saar, Pfalz and Lorraine districts included.

In 1913, the total French production was 40,278,000 tons of coal,[7] of which 21,616,000 was in the non-devastated area. In 1921, the total production was 27,516,000 tons, of which 22,151,000 tons was in the non-devastated area. This gives an excess of 535,000 tons in 1921 over the 1913 production in the non-devastated area.

The French import and export of coal for 1913 and 1921 were as follows:

Year	Import Tons	Export Tons
1913	23,889,000	1,511,000
1921	23,132,000[8]	2,360,000

In 1913, the amount of coal in France was: 40,278,000 tons mined in France plus 23,889,000 tons imported minus 1,511,000 tons exported—i.e., a net total of 62,656,000 tons. In 1921, the amount of coal in France was: 22,151,000 tons mined in the non-devastated area plus 5,365,000 tons mined in the devastated area plus 9,575,000 tons from the Saar, Pfalz and Lorraine districts plus 23,132,000 tons imported minus 2,360,000 tons exported—i.e., a net total of 57,863,000 tons, as compared with the net total of 62,656,000 tons in 1913, a difference of 4,793,000 tons.[9]

These figures show clearly that the 1921 export of 849,000 tons in excess of that of 1913, the decrease in import of 757,000 tons in 1921 as compared with 1913 and the deficiency of 4,793,000 tons between the French total coal in 1913 and 1921 do not warrant in the least the bitter accusation of the Germans that their coal industry is crippled by the French, who, they contend, use all of the coal imported from Germany for export purposes only, while Germany is forced to buy English coal with her depreciated marks.

It might be well to give here additional figures showing German coal production, import and export, for 1913 and 1921:

Year	Production Tons	Import Tons	Export Tons
1913	209,467,000	16,257,000	45,986,000
1921	163,286,000[10]	3,223,000	26,903,000[11]

Nor do these figures show that the German coal industry is thoroughly crippled by the French, for the import in 1921 was less than 20 per cent of that in 1913, and the reduction in the total amount of coal mined was not due solely to the loss of a maximum of 17,861,000 tons from the Saar, Pfalz and Lorraine districts (1913 production), but to the diminished working capacity of the miners. Similarly, the 26,903,000 tons export for 1921, of which less than 70 per cent goes to the Entente for war reparation, is not in the least as discouraging as the Germans make out, when compared with the export of 45,986,000 tons in 1913.

While I was still in Germany I was aware of the existence of these figures, and I used them in conversation with industrial leaders. Some of those with whom I spoke contended that quality as well as quantity of coal had to be taken into consideration. Granting this, I wish to add that, from personal experience, I know

[5] In confirmation of these impressions that I gained in April, I may cite the following enumeration of conditions by Lord Henry Bentinck, published in the London *Times* for Aug. 1, 1922:

"1. Great Britain and America together are claiming from France a far larger sum than France can ever hope to receive from Germany.

"2. While Great Britain has secured, as spoils of victory, large accessions of territory and the removal of the menace of the German navy and the competition of her commercial fleet, France has not yet received any substantial payment for the restoration of her devastated areas.

"3. While France's claim is a just one, Great Britain's claim for payment of pensions and allowances, while being of doubtful justice and questionable morality, has contributed to the present impasse by piling on Germany a burden of debt impossible to discharge."

[6] The document is dated April 1, 1922.

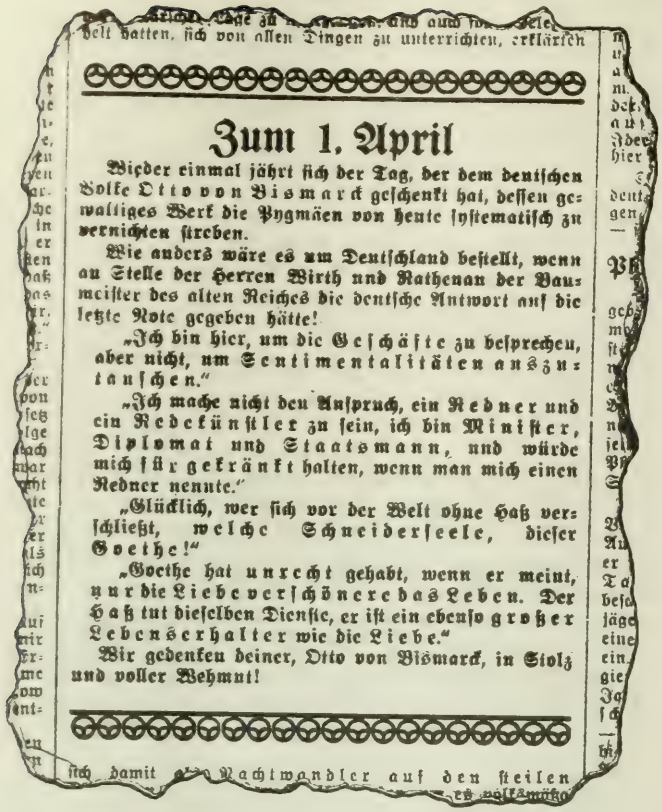
[7] All the figures of coal tonnage refer to the sum of the separate items of coal, coke and lignite, calculated on a coal basis.

[8] This includes also the total amount imported from Germany on account of war reparations.

[9] I have learned from authoritative sources that the present French demand for coal is practically the same as before the war, even with her western industries not yet fully reconstructed.

[10] This does not include the Saar, Pfalz and Lorraine districts.

[11] This includes also the total amount exported to the Entente on account of war reparations.



Zum 1. April

Wieder einmal jährt sich der Tag, der dem deutschen Volke Otto von Bismarck geschenkt hat, dessen gewaltiges Werk die Pygmäen von heute systematisch zu vernichten streben.

Wie anders wäre es um Deutschland bestellt, wenn an Stelle der Herren Wirth und Rathenau der Baumeister des alten Reiches die deutsche Antwort auf die letzte Note gegeben hätte!

„Ich bin hier, um die Geschäfte zu besprechen, aber nicht, um Sentimentalitäten auszutauschen."

„Ich mache nicht den Anspruch, ein Redner und ein Redekünstler zu sein, ich bin Minister, Diplomat und Staatsmann, und würde mich für gekränkt halten, wenn man mich einen Redner nennte."

„Glücklich, wer sich vor der Welt ohne Haß verschließt, welche Schneiderseele, dieser Goethe!"

„Goethe hat unrecht gehabt, wenn er meint, nur die Liebe verschönere das Leben. Der Haß tut dieselben Dienste, er ist ein ebenso großer Lebenserhalter wie die Liebe."

Wir gedenken deiner, Otto von Bismarck, in Stolz und voller Wehmut!

TRANSLATION

For the First of April

Once again has arrived the date when Otto von Bismarck was given to the German people, the man whose gigantic work the pygmies of today try systematically to destroy.

How different it would have been for Germany if the answer to the last note had been framed by the builder of the old empire, and not by Wirth and Rathenau.

"I am here to talk business, and not to discuss sentimentalities."

"I do not pretend to be an orator nor a master of oratory; I am a minister, diplomat and statesman, and I would feel injured were I to be called an orator."

"Happy are those who have lived without hatred. What a simpleton this Goethe!"

"Goethe was wrong when he stated that love alone beautifies life. Hate does the same thing. It stimulates life just as strongly as love does."

We remember you, Otto von Bismarck, with pride and deep sorrow.

that the quality of coal exported from Germany in prewar time was the same as that of 1921.

Only those who have witnessed the exalted spirit of hatred of the Germans against the French on account of their wrong conception of the coal situation can realize how well it would be for the Germans to study the above-mentioned official German report and reason out the actual conditions. This, and similar reports, would do much to counteract and perhaps stop the hate-breeding propaganda carried on through German papers.[12]

Other articles by Mr. Negru on this subject will appear in subsequent issues.

[12] The official coal report is dated April 1. On the same date, which is the anniversary of Bismarck's birth, the Berlin weekly newspaper *Die Gesellschaft* published in heavy black letters the item reproduced herewith, the quotations being selections from Bismarck's utterances.

Russian Chemical Industries

THE FIRST nitric acid factory in Russia has recently been opened in a small town near the Black Sea. The Russian Government has offered important concessions to foreign capital for the establishment of three such factories. In the meantime Russia has gone ahead with this factory, known as the "Yousovsky," which occupies 21½ acres near the Novo-Snolianikev mine, formerly owned by the Novorossiisk company. The liquid ammonia process is used, with a platinum catalyst in the oxidation reaction. The yield is extremely satisfactory, as the following table shows. The yield at the Yousovsky factory is here compared with those of well-known foreign factories:

Process	Percentage Yield	Quality of Ammonia in Kg. Used Per Oz. of Platinum Per Day
Ostwald	85	14.7
Amer. Cyanamid	90.92	22.65
Bureau of Mines	90.91	27.2
Yousovsky Factory	93.97	17.27

PHOSPHATE WORKS IN RUSSIA

Two superphosphate works, one at Kineshma and the other at Nijni, are at present at a standstill owing to lack of capital and the necessity for re-equipment. The Briansk factory, although working, is in a not much better condition. On the other hand, the exploitation of the huge rediscovered phosphate deposits in the Province of Viatka and near Moscow has begun, but the work is still on a small scale. A proposal was made to import phosphates, but it has been decided first to investigate fully the possibility of home production. Large stocks of phosphates exist, but a market cannot be found for them owing to the high cost at which they are produced and to the low purchasing capacity of the peasants. A commission has been appointed to see whether these stocks cannot be sold (*a*) through a company; (*b*) by direct credits to the peasants; (*c*) by lowering the price of phosphate. If these measures are not successful, phosphates will have to be imported from abroad.

Extensive deposits of kaolin, graphite and manganese have been discovered in the Province of Odessa; work on these has already begun. Large quantities of bismuth have been discovered in the Trans-Baikal Province, on the territory of the Far Eastern Republic.

SUGAR AND SOAP INDUSTRIES

For lack of necessary and modern equipment the sugar and soap factories in Russia are operating on very low production. The price of sugar is very high. Soap sells for from two to three times the price in the United States.

SANTONINE IN TASHKENT RUSSIA

The santonine factory in Tchikment, in the Province of Tashkent, was nationalized in 1918 and placed under the control of the Supreme Council of National Economy. The latter body had the factory put into shape and operation in 1920, with the result that now 100,000 poods (3,600,000 lb.) of raw materials is worked annually and 5,000 kg. of pure santonine is produced.

The santonine plants (*Artimisia citæ*) grow in the Tashkent district of Russia. Over 1,000,000 acres are devoted to the growth of this plant. An acre yields about 60 kg. of the plant, which is brought over for processing to the Tchikment factory. Before the war santonine was chiefly purchased from Merck in Germany.

Fireclay Refractories

Outline of Manufacturing Operations at the Laclede-Christy Clay Products Co., St. Louis—Dry Press and Stiff-Mud Process Fireclay Brick—Special Shapes—Glass House Refractories—Washed Pot Clay

By Alan G. Wikoff

IT IS PROBABLE that the fireclay refractory industry in the United States dates from 1812, when a firebrick plant was erected in New Jersey, although he exact location of this first plant is uncertain. With he increasing industrial demand for materials more efractory than common brick, the industry developed apidly, deposits of suitable clay being abundant in any localities. By 1842 the industry had progressed s far west as St. Louis, where 2 years later the Laclede 'ire Brick Manufacturing Co. was established. In 857 the Christy Fire Clay Co. was founded, and the ombination of these two firms in 1907 formed the resent Laclede-Christy Clay Products Co.

Owning 240 acres of clay mines right in the heart f the famous Cheltenham clay district, the company is ssured of a constant supply of this essential raw mate- ial. The two main plants are located within the city mits of St. Louis, the larger of these, known as the aclede plant, being located on Manchester Ave. south f Forest Park. The Christy plant is about 2 miles rther south on Kingshighway Boulevard.

Practically every variety of fireclay article is made these plants. The refractories line is particularly mplete, including six grades of firebrick adapted to eet the different conditions of heat, abrasion and flux- g action encountered in industrial furnaces; chemical ick and acid tower packing rings; special shapes and le for boilers, stokers and furnaces; glass house re- actories. In addition clays are prepared for use in number of other industries, such as the manufacture f glass house pots, lead pencils, crucibles, oilcloth and per filler. Sewer tile, drain tile and related products e also made from fireclay, a considerable portion of e Laclede plant being devoted to their manufacture. he total daily capacity of the plants is 700 tons.

In spite of the great variety of products, the number different manufacturing methods is not large, so that rather brief outline will serve to indicate the opera- ons at these plants.

Laclede Plant

Three plants comprise the Laclede group, numbered follows: 1, brick and tile; 2, sewer pipe; 3, refrac- ries.

Dry Press Process Brick

Two brands are made by the dry press process, the ss refractory having a fusion point of Seger cone 29 us, or about 3,100 deg. F., while the other melts at ne 32 plus, or about 3,200 deg. F. While the clay ixtures differ, the process remains the same for both ades.

Cheltenham plastic clay forms the raw material for the s refractory grade. It is brought from the mines st back of the plant on a narrow-gage high line so at the clay can be dumped through hoppers into orage bins. When ready for use, the clay is shoveled to a measuring car having adjustable vertical parti- ons which determine the proportions of raw and rnt clay, or grog, in the mixture. The mix is dropped rough a chute onto an apron feeder which supplies a conveyor running to the dry pans, where the material is ground. It is then transferred to storage bins on an upper floor by means of a bucket elevator.

Mixtures for the more highly refractory grade contain, in addition to the plastic clay, raw and burnt semi-flint clay from mines owned by the company in northern Missouri.

Chutes from the storage bins deliver into agitators which are simply cylindrical wooden tanks provided with a mechanical stirring device. These serve to maintain a steady flow of material to the three Boyd dry presses on the floor below. The tremendous pressure applied forms brick so firm that they will stand almost any amount of handling, even before drying.

Waste Heat Driers

For drying, the brick are carefully arranged on double deck cars holding about 540 9-in. brick. The driers consist of a series of parallel tunnels through which the cars are pulled by an electric crab. The motion is not continuous, as the cars must remain in the drier for about 2 days. At regular intervals cars of dried brick are drawn, a corresponding number of cars of green brick being run in at the other side of the tunnel so that it is always full.

Heat from kilns which are cooling is supplied to the driers by a powerful blower so as to maintain a temperature of about 210 deg. F. at the exit end. A Bristol recording thermometer gives a permanent record of drier conditions. Every 2 months anemometer readings are taken to make sure that the flues leading from the kilns to the driers are open and free from obstruction.

There is a space in front of the driers so that the brick can cool off before going into the kiln. In case no kiln is ready the cars can still be drawn on schedule and held there. Fig. 1 shows several cars of brick ready for the kiln and also the electric crab which is used to pull the cars. This runs on a track laid at right angles to the drier tracks. Transfer cars also use this track in distributing cars of brick to the tracks in the kiln yard.

At first sight it would seem possible to conserve heat by transferring the brick immediately from the driers to the kilns, but as the brick must be set by hand, they would be too hot to handle. Further, about 2 days is

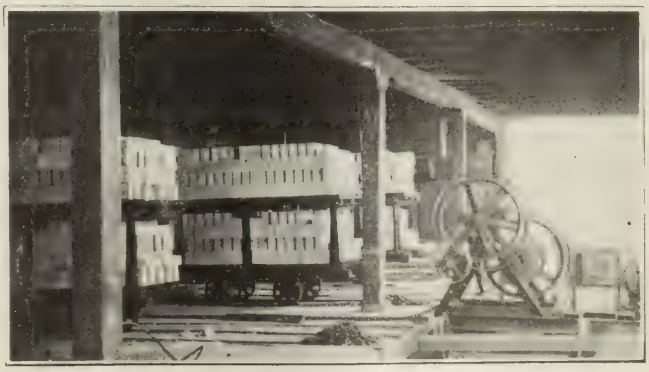


FIG. 1—DISCHARGE END OF DRIERS

FIG. 2—SETTING RECTANGULAR KILN

required to set a kiln, so that most of the heat would be lost anyway before the kiln could be fired.

Burning

Refractories are all burned at this plant in down-draft periodic kilns of either the round or rectangular type, there being seventeen kilns at the brick and tile plant and nine at the refractories plant. The capacity varies from 240 to 350 tons. As a 9-in. brick weighs about 7 lb., the latter figure is equivalent to about 100,000 9-in. brick.

In setting a kiln, unnecessary handling is eliminated by running the cars of dried brick right into the kiln, as shown in Fig. 2, which also illustrates the method of setting a rectangular kiln. Brick in the lower part of the setting are arranged according to a definite plan which will give the most uniform burn throughout the kiln. Tile and special shapes are placed in the upper part.

The burning schedule is followed by the indications of a Price pyrometer. A recording instrument of the same make serves as a check on the burners and also gives a permanent record. Kilns are finished at about 2,350 deg. F., the exact time being determined by drawing trial pieces from the kiln and observing Seger cones.

Kiln turnover is from 14 to 16 days, as follows: Setting, 2; burning, 5 to 6; cooling, 5 to 6; drawing, 2.

Stiff Mud Process Brick

As in the case of the process just described, two brands are made by the stiff mud process. Here again the only difference is in the composition of the mixtures, the more refractory grade containing flint clay as well as plastic clay.

Ground mixtures are fed from the storage bins to a poidometer which controls the delivery of clay and water to a pug mill in the exact proportions necessary to form a mud of the desired consistency. The clay is then worked in a vertical auger machine, discharging in the form of a continuous column from which the brick are formed by a wire cutter. The rough brick are then put through represses to insure true dimensions and a clean-cut finish. The brand is also stamped into the brick during this operation.

Subsequent operations of drying and burning are similar to those for dry press brick.

Special Shapes

Of particular interest is the recent development of machine molding for certain special shapes which have hitherto been molded by hand. Of necessity the designs must be small, fairly simple and in sufficient demand to warrant the expense of preparing special dies. Pourin nozzles for use in steel mills are being made this wa successfully.

Mixtures for special shapes are brought to a worl able consistency with water in an auger machine, th proportions of water and clay being regulated by poidometer. Numerous mixes have been developed t meet the conditions to which a particular shape will b subjected in service. Whenever possible wooden mol are used and the pieces are set on steam-heated woode drying floors until ready to go to the kiln. Their di position in the kiln has already been indicated.

Christy Plant

While brick are also made at the Christy plant, th processes are so similar to those already outlined tha further consideration is unnecessary. Features of pa ticular interest at this plant are the manufacture glass house refractories, preparation of clays for speci uses, and the ceramic laboratory. Fig. 3 is a gener view of this plant.

Glass House Refractories

Owing to the unusually severe service conditions, th manufacture of refractories for use in the glass indu try presents many difficult problems. For exampl modern continuous tanks are operated at about 1,5 deg. C., or 2,750 deg. F., and the refractory bloc which form the bottom and sides of such furnaces mu resist the fluxing and wearing action of molten gla at this temperature. In addition, the blocks must n check or crack with changes in temperature and shou be good non-conductors of heat. The requirements f glass pots are even more exacting. The Cheltenha deposit is one of a very few in the United States whi yields clay suitable for these purposes.

Tank blocks are carried in stock in sizes varyi from 12x12x18 in. to 12x24x36 in., and the care whi must be exercised to obtain uniformity of compositio drying and burning in pieces of such size can readi be appreciated.

Pot clay purified by washing is used in the prepar tion of tank blocks of the flux grade, the grain size a proportion of raw to burnt clay being carefully adjust to give the desired properties to the finished block. T mixture is tempered with water in wet pans to th proper consistency, aged, pugged and worked into th molds by hand. The blocks are permitted to dry the floor very slowly in order to prevent cracking. Aft drying, the blocks are trued by the action of eme wheels in a machine made by the Niles Tool Machine Co. The emery wheels themselves wear very rapid and have to be trued about once a day.

The blocks are burned in round down-draft period

FIG. 3—GENERAL VIEW OF CHRISTY PLANT

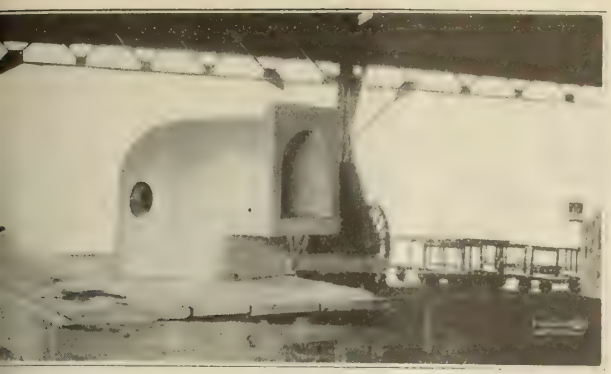


FIG. 4—BOOT FOR GLASS FURNACE

ıs, the blocks being set in the center surrounded by -ft. ring of washed clay blocks.

Many other interesting shapes are made for the glass ustry, such as gathering rings 4 ft. in diameter, ter legs up to 8 ft. in length and boots as shown in . 4. Nor are the products of this plant limited en- ly to glass house materials. Figs. 5 and 6 are ical of the wide range of complicated shapes. The er is particularly interesting because of the core ch in the finished block passes completely around the tral circular opening. The photograph shows only right-hand portion of a complete block split through center.

Washed Pot Clay

he use of washed pot clay in the manufacture of k blocks has already been referred to. This is also pared for sale in various forms. In wooden tanks ided with agitators, a slip is prepared by beating selected pot clay with water. The slip passes ugh a screen into a trough which leads from the agitators to six wooden settling tanks. The trough a chain drag conveyor to prevent settling in transit. r the clay has settled in the tanks, the clean water rawn off and the thick clay soup pumped through a ery of eight Johnson filter presses. These have a city of 15 tons of clay and it is possible to fill them times per day, giving a daily capacity of 60 tons. cakes are dumped to a conveyor which feeds a pug The washed clay emerges from this in the form continuous column which is cut up into blocks hing about 23 lb. when dry. Some of the blocks alcined and ground to form grog. The clay may be as blocks or ground, either dried or calcined accord- o the requirements of the purchaser.

Bagging Clays

ny of the prepared clays are shipped in a finely d state. The material is fed through an automatic weighing hopper into bags which pass on a very short conveyor belt to a stitching machine made by the Union Special Machine Co. The bags proceed on a gravity roller conveyor to another conveyor which delivers them right to the car. One man at the machine and one man at the car can handle 2,000 100-lb. sacks of clay per day in this way.

FIG. 5—TYPICAL SPECIAL SHAPE

Ceramic Laboratory

The laboratory is located at the Christy plant but it serves Laclede plant as well. It is up to date in every respect and is a vital department of this company. Here experiments are conducted for developing new mixtures and products for almost every conceivable refractory use.

In addition to new work, a careful check is kept on the standards of quality of each product. This entails periodical control tests. The various products and mixes have been developed to meet particular requirements and it is to assure the necessary characteristics of each that the control tests are made. The most important of these are: chemical analysis (ratio of silica-alumina content to flux); spalling (action under sudden changes of temperature); fusion or melting point; reheat (linear changes after having been fired at high temperatures); load (compression under load at high temperature); resistance to slagging action.

FIG. 6—COMPLICATED SHAPE WITH CORE

For assistance in obtaining data for this article, the writer is particularly indebted to Richard D. Hatton, vice-president and general manager, W. F. Godejohn, industrial engineer, and John B. Lyons, superintendent of the Christy plant.

The Ural Platinum Mines

The provisioning and financial condition of the Ural platinum mines have considerably improved since the end of July, which in turn favorably affected production. Up to July 1 production was considerably below the program, whereas the July program was exceeded by about 30 per cent. The estimated output of private prospectors was realized only to the extent of 28.45 per cent up to July 1, due to shortage of supplies for paying the prospectors, which was also the cause of thefts of metal. The mines are provided with fuel to the end of the fiscal year.

The output of platinum and the incidental production of gold in all the Ural mines from Jan. 1 to July 15 amounted to 700 lb. of the former and 158 lb. of the latter metal; also 111 grains of iridium were recovered. Apart from this, 87 lb. of platinum was purchased from outsiders.

Use of Bleaching Powder for Sweetening Gasoline

By H. W. Young* and A. W. Peake†

Development of Process at the Midwest Refining Co.'s Plant at Salt Creek, Wyo., for Treating Natural Gas Gasoline or Product From Stills — Description of Plant and Operating Practice

GASOLINE is considered sweet or sour, depending on whether it is negative or positive to the doctor test.[1] A positive doctor test indicates the presence of sulphur compounds which may be objectionable in themselves, or may, in decomposing, impart to the gasoline certain undesirable properties. The principal claim to superiority for sweet gasoline is that it is more stable in storage, showing less tendency toward the development of a yellow color and an objectionable odor.

During, and for some time following, the world war, the demand for gasoline was so great that much was marketed which would not now pass inspection. With the return of conditions more nearly approaching normal, competition among marketing concerns again became a factor. This competition led to a demand for sweet gasoline which increased to such a degree that many marketing companies would not accept sour gasoline from the refiners. In the spring of 1921 the sales department of the Midwest Refining Co. issued instructions that it would be necessary to sweeten the blend produced at the Salt Creek gasoline plant, a natural gas gasoline plant owned by that company and located in the Salt Creek Oil Field, Natrona County, Wyoming.

Usual Methods of Sweetening

In order to bring out more clearly the difficulties involved in meeting this situation, a review of the established methods of sweetening gasoline and of the conditions surrounding the production and shipping of the blend is presented.

The usual methods of sweetening involve the use of sulphuric acid, caustic soda, litharge and sulphur. Local conditions frequently render the use of certain of the reagents unnecessary. The application of doctor solution discolors the gasoline. This discoloration may be removed in part by a water wash, but usually sulphur is added, followed by a water wash. An immense volume of water is ordinarily used.

Natural gas gasoline is produced at the Salt Creek plant by the compression method. This is blended in about a 50:50 ratio with naphtha topped from crude petroleum at the plant. The blend is weathered to the desired vapor pressure then pumped to the refinery at Casper, 42 miles away.

The local supply of water in the Salt Creek field is an uncertain quantity. During times of protracted drought —a not unusual condition in central Wyoming—very little, if any, water can be drawn from the gravels in the creek beds. The supply from wells is inadequate and water pumped from the North Platte River at Casper is too expensive for use in large quantities.

Three conditions made the usual methods of sweeten ing unsuitable for use at Salt Creek:

(1) The water supply was inadequate to permit suffi cient washing of the treated blend.

(2) The high initial cost of such a plant couple with the high cost of attendance and of transportatic of supplies.

(3) Steam stilling the treated blend to remove c color would involve heavy expense for equipment ar would be a serious drain on the already meager wat supply.

It was imperative therefore to develop, if possibl an inexpensive method which would not discolor t blend and which would involve a minimum of washin

Preliminary Tests

In view of the fact that sourness is ordinarily attri uted to the presence of certain easily decomposal sulphur compounds, the problem naturally resolv itself into two lines of investigation:

(1) The precipitation and removal of the sulphur insoluble sulphide.

(2) The oxidation of the sulphur to a more sta form.

A series of tests was made with reagents, which, the presence of soluble sulphides, form insoluble s phides. Ferrous sulphate did not prove of any ben whatever. Copper sulphate sweetened momentarily, It was of no permanent benefit. Soluble salts of sil r sweetened permanently, as did also mercury and m curic oxide. This is strong evidence that the sulpl r is in the form of mercaptans. Additional proof of t s view was developed in later investigations.

While the results recorded above were interest g from a scientific standpoint, they were of no pract l value. The first oxidizing substance used was brom e water, which proved an excellent sweetening ag t. Iodine likewise gave good results. Freshly prepa d chlorine water proved excellent for the purpose. 'e high cost of bromine and iodine prohibited their se on a commercial scale, but it was certain that chlo e could be obtained at a reasonably low cost. The bl d was not discolored during treatment and was practic ly freed from chlorine and chlorides by relatively l le washing. To sum up, the work to this time had s closed the essentials of a process which apparently et all requirements for use under local conditions.

However, since chlorine is an extremely active e ment, there naturally arose a question as to the poss il ity of reactions between it and the liquid hydrocarb during treatment. Such reactions would incr s unduly the consumption of chlorine and might y products deleterious to the blend.

The literature relative to the formation of subs u tion products by reaction of chlorine with liquid pa f fine hydrocarbons is meager and conflicting. In ge a it may be said that these reactions are favored by g temperature, light and catalytic agents. Since h

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[1] Tech. Paper 214, U. S. Bureau of Mines, covers all details of the doctor test.

proposed treatment would take place at low temperature, in the dark and with no catalytic agent present, it was considered unlikely that such reactions would occur.

Hydrocarbons of the olefine and acetylene series react readily with chlorine, forming addition products. The low consumption of chlorine indicated that hydrocarbons of these types were either absent from the blend or present only in very small amounts.

Chlorine contained in steel cylinders could scarcely be considered on account of high transportation costs. It was thought that by electrolyzing a solution of sodium chloride in a suitably designed cell chlorine could be produced rather cheaply. In addition, if desired, the chlorine could be absorbed in the caustic solution produced in the cell, forming sodium hypochlorite. This would make possible the use of an alkaline solution which would considerably reduce the outlay for specially constructed equipment.

Dr. Loy, chief chemist of the Midwest Refinery at Casper, suggested the use of bleaching powder as a substitute for chlorine or sodium hypochlorite. Bottle tests proved this a good sweetening agent.

Small-Scale Plant

A small-scale plant was built to determine as nearly as possible the conditions under which plant operation should be conducted. Two 5-ft. towers made from 6-in. pipe were about half filled with broken sewer tile, which served as baffling. The first tower was filled to about two-thirds capacity with a solution of bleaching powder in water, the second was filled to like capacity with water. The blend, weathered to about 35 lb. vapor pressure, was introduced at the bottom of the treating tower, passed upward through the solution to the top of this tower, then downward through a small pipe to the bottom of the washing tower. It passed upward through the wash water, then to a storage tower, where it was measured. The pressure drop in the treating system was kept as small as possible. In all tests made with this equipment ½ lb. of bleaching powder was used.

Several tests were made with the apparatus as described, in each of which ½ lb. of powder sweetened about 100 gal. of blend. This was considerably below the efficiency which bottle tests had shown should be obtained. It was decided to try the effect of aërating the solution. A small tower was connected with the bottom of the treating tower, with connections so arranged that a portion of the solution could be drawn off and aërated, then returned by air pressure to the tower. Several tests were made in which, by repeated aëration of solution, each half pound of powder sweetened about 166 gal. of blend.

Tests made on the spent solution showed that considerable available chlorine still remained. There seemed to be a minimum strength of solution below which sweetening would not take place in this apparatus. A second half pound was added to the spent solution and the test repeated, the volume sweetened being 225 gal. A third test gave results checking the second. This test was repeated a number of times, and in every case ½ lb. of powder, with an available chlorine content of about 30 per cent, sweetened 225 gal. of blend. This is at the rate of 2.22 lb. per 1,000 gal., or 0.0933 lb. per barrel.

These results were considered sufficiently encouraging to warrant proceeding with the design and construction of a plant capable of treating the entire volume of blend being produced.

Tests made on the spent solution revealed the presence of sulphate. In one bottle test and one test with the small-scale plant, distilled water was used in making up the solution and the sulphate determined by precipitation with barium chloride. The weight of sulphur oxidized to the sulphate condition per 1,000 gal. of blend treated was found in each test to be 2 grams.

Frequent mention is made in the patent literature of the use of chlorine and hypochlorites for decolorizing and "purifying" petroleum products. The only specific mention so far encountered of the use of bleaching powder for sweetening gasoline is contained in the U. S. Patent 723,368. This patent was issued March 24, 1903, and expired 17 years later. Excerpts appear in "Gasoline and Other Motor Fuels," by Ellis and Meigs, p. 106 *et seq.* This book appeared several weeks after the plant at Salt Creek was placed in commission. The process described in the above-mentioned patent is unnecessarily complicated, and, so far as known, was never employed on a commercial scale.

Large-Scale Plant

Some modifications were made in the plant as originally constructed, during the first few weeks of operation. The following description applies to the plant which has been in service for about 14 months.

The building housing the treating plant is steam heated and thoroughly ventilated. This building is divided into two rooms, the pump and control room, and the treating room proper. In the treating room are five towers, placed in a row. An open top tower of 500-gal. capacity, in which the solution is aërated, is placed next to the pump room. The remaining four are, in order, for weathering, treating, washing and settling. These towers are 6½ ft. in diameter and 20 ft. in height, with dished heads, designed to operate at 50 lb. pressure. These were not especially designed for the purpose, being "daily run" towers which were no longer needed. Standard wrought-iron pipe couplings were welded on for gage glass fittings, intake, discharge and such other connections as were desired.

In the pump room are located two steam-driven duplex pumps, each 5¼x3½x5 in., one for circulating solution, the other for circulating wash water. There is also a box in which fresh charges of bleaching powder are dissolved; a cabinet contains all chemicals and apparatus necessary for determining the available chlorine in the solution and for making doctor tests on the treated product.

The four large towers are provided with one set of relief valves connected to a common header which carries the weathered gas from the building. As an additional precaution each tower is provided with an independent relief valve, which is set to operate at slightly higher pressure. A pressure gage board is located in the pump room and a separate pressure gage is placed on the side of each tower. Each tower is provided with a complete set of gage glasses.

The blend, received from the plant accumulators, passes through a valve into the weathering tower, where the vapor pressure is reduced to about 42 lb., which is sufficient to force the blend through the system and to storage. From the bottom of this tower the blend passes through a knothole mixer (Fig. 1) and enters the treating tower near the bottom.[2] The treating solution is pumped into the mixer. During the brief interval of

[2]This knothole mixer is extensively employed at the Midwest Refinery at Casper.

intimate contact practically all the treating takes place. The blend entering the treating tower rises through about 5 ft. of solution, then continues slowly upward to the outlet, which is about 18 in. from the top of the tower. It then passes downward through a 4-in. pipe to near the bottom of the washing tower, in which it rises through about 8 ft. of glazed tile baffling submerged in water. It continues upward to the outlet about 18 in. from the top of this tower, then downward to near the bottom of the settling tower, in which it rises to the outlet about 8 ft. from the bottom, thence to storage. Any water or emulsion which collects in this tower is drawn off.

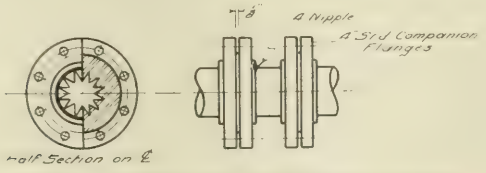

FIG. 1—DETAIL OF KNOTHOLE MIXER

The solution returning from the treating tower may be run into the 500-gal. tower, where it is aërated by splashing over a baffle, or it may be drawn directly into the pump. The latter is called the "closed circuit" plan. The average volume of solution maintained in the system is about 2,000 gal. The weight of bleaching powder in solution varies from 50 to 75 lb.

The wash water is drawn from a tank outside the building and introduced into the washing tower through two pipes which discharge it about 5 ft. below the top of the tower. The water returns to the flow tank through a pipe connected near the bottom of the tower. As the plant was originally designed the purpose of the outside tank was to provide a collecting place for emulsion and to furnish additional storage capacity for wash water. Experience has shown that little emulsion ever collects there. In cold weather it has been found more convenient to discontinue the use of this tank, the wash water being circulated on the "closed circuit" plan. Where conditions are such that it is possible to change the wash water frequently, an outside tank is quite unnecessary.

The use of baffling in the washing tower would be unnecessary if a knothole mixer were provided similar to that in the solution system. This would be cheaper, and, on the whole, more satisfactory, provided the water pump could be adjusted to handle any desired volume. If an excessive amount of water were introduced with the blend into a knothole mixer, a considerable volume would probably be carried over into the settling tower.

Solution is frequently carried over into the washing tower. The available chlorine of this solution is of course lost. If a settling tower were provided between the treating tower and washing tower this solution could be recovered.

Plant Operation

When once the valves are adjusted and the speed of the pumps regulated, very little attention is required. The regular duties occupy less than one-fourth the time of one man on each shift. These duties consist of determining the strength of solution, adding fresh charges of bleaching powder, making doctor tests on the treated product and making such adjustments of valves and pumps as may be needed to care for changes in the volume treated. Repairs requiring more than a few minutes are made by the regular repair gang in the plan In making up fresh batches of solution the powder i drawn into the box through a chute from a dru located on a platform outside the building. The chut delivers the powder into a screen-bottomed box sus pended in the upper portion of the larger box. B spraying the powder with water delivered through hose and breaking the lumps with a shovel or hoe, i is possible to work the charge through the scree with a moderate dusting loss. The enriched solutio is transferred from the mixing box to the aëratin tower. The supply pipe to the mixing box is so cor nected that the box may be filled with fresh wate circulating wash water, or solution.

A more convenient method of putting the bleachin powder into solution is being devised. While all detail have not been agreed upon, a small tube mill will prob ably be provided into which the powder may be drawn water added, and the powder reduced to a fine stat of subdivision. This will increase the recovery c hypochlorite somewhat, but the chief gain will be i reduced dusting loss and increased comfort to th attendant.

When the blend is excessively cold, trouble is exper enced with the formation of "mush" ice in the knothol mixer and the treating tower. This trouble may b obviated by warming the solution between the pum and the knothole mixer.

Experience has shown that it is well to hold th level of the blend in the weathering tower quite lov Storage capacity to care for the accumulating blend i thus always at hand, should it be necessary to shu down the plant for a short time for repairs.

Corrosive Action of Bleach

It is well known that a solution of calcium hypo chlorite is corrosive to iron and brass, especially th latter. A word in regard to the effect of this solutio on pumps, pipes and the interior of towers is c interest.

Until very recently the solution pump has been use to draw the enriched solution from the mixing bo A considerable amount of undissolved lumps and gritt residue was always drawn out and passed through th pump. The natural result was a rapid impairment c wearing parts, necessitating frequent replacements an repairs. The effect of corrosion was thus masked an could not be accurately estimated, but it was certai that it was small in comparison with mechanical wea

At present the enriched solution is drawn from th mixing box into a submerged tank and elevated by ga pressure into the aërating tower. This should greatl prolong the life of the wearing parts of the solutio pump. Also, tests are being made with several pater alloys with promising results to date. It is probabl that the use of one or more of these for all wearin parts, in connection with relieving the pump fro handling gritty residue, will solve the difficulty.

After more than 8 months of service three sho lengths of pipe were removed from the solution lin for inspection. One, which was in contact with a bra valve at the discharge end of the pump, was found t be badly corroded. In the others an impervious linin about one-sixteenth of an inch thick had formed, whic had protected the pipe perfectly from corrosion. Thi lining was found to be largely calcium sulphate, wit some lime.

After the plant had been in operation more tha

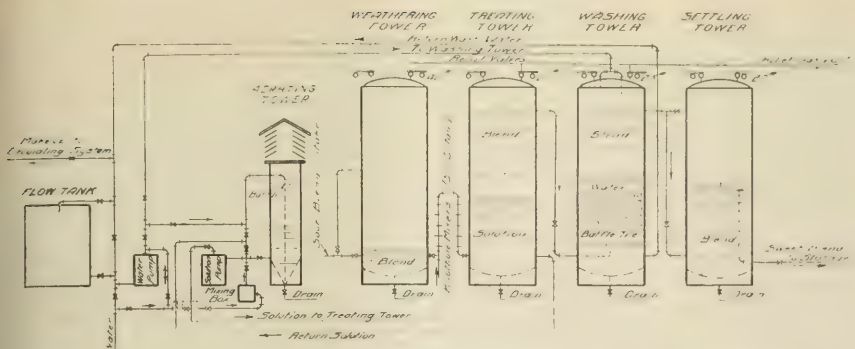

FIG. 2—DIAGRAMMATIC SKETCH OF GASOLINE SWEETENING PLANT USING BLEACHING POWDER

a year the manholes near the bottom of the treating tower and washing tower were opened and the interior of these towers inspected. The interior of the treating tower was found to be covered almost completely with a coating, which, however, was not as dense nor as adherent as the coating found in the solution line. Some corrosion had occurred, but when the accumulated oxide was scraped off, the metal beneath was found to be practically free from pitting. It is impossible to state whether the oxide was formed shortly after the plant was started and that corrosion had ceased, or whether it was the result of continuous action. Even if the second assumption were correct, it would require many years for corrosion to proceed so far that the tower would be in danger of failing.

Several feet of sediment, largely lime, was found in the treating tower. This was sluiced out with a hose. A tank with a cone-shaped bottom would permit the complete removal of this sediment at intervals while the plant is in operation.

Little corrosion had taken place in the washing tower. In spots the interior was somewhat roughened but for the most part it was smooth and bright. Some consideration has been given to the selection of a material suitable for lining the towers, should a more extended experience prove this necessary.

Resistant Materials

Tests are now in progress to determine whether acid-proof paint will withstand the corroding action of the solution. Test-pieces, thoroughly cleaned, were painted and immersed in the aërating tank. These tests have not proceeded far enough to warrant a decision as to the suitability of such paint for the purpose. A lead lining such as is used in acid-treating plants would undoubtedly give satisfactory service, but a zinc lining would be still more durable. This metal is practically inert when exposed to hypochlorite solution[3] and possesses the added advantage of being electropositive to iron.[4] Should it be decided to employ this metal, serious consideration should be given to the method of application.

The use of galvanized iron plates in the construction of those tanks which are exposed to the solution is not altogether satisfactory since the film of zinc would be broken in many places during the construction of the tanks, thus exposing the iron. Also the film of zinc deposited in the galvanizing process is not as thick as seems desirable for this purpose. A method which seems applicable was described by Henry Hess in *Chemical & Metallurgical Engineering* several years ago.[5] Finely powdered zinc, to which finely powdered lead and tin have been added, is mixed to a paste with a suitable flux and applied with a brush. By heating with a blast torch the metals are melted and form a tough, adherent coating. By adding the proper amounts of tin and lead it is claimed that greater toughness is obtained without losing the electropositive property of the coating.

Experience to date indicates that the oxide formed by contact with the hypochlorite solution furnishes quite efficient protection to the metal beneath. If the treating and washing towers were constructed from extra heavy steel there is little doubt that a long life could be obtained at moderate cost. For both solution and water lines the use of pipe galvanized inside is recommended.

Operating Practice

The consumption of bleaching powder is about 2.75 lb. per 1,000 gal., or 0.1155 lb. per barrel. This is somewhat higher than the consumption indicated by the preliminary tests. Probably the greatest contributing factor is the carrying over of solution into the washing tower. Other sources of loss are leakage of solution through the pump, exposure of solution in the aërating tower to diffused light and occasional overflows of the aërating tower.

As both the naphtha and the compression product are sour, it is necessary to sweeten the entire volume of blend. At present the plant is producing about 75,000 to 85,000 gal. of blend daily, which the treating plant is handling very satisfactorily. Construction is now in progress for doubling the output of the gasoline plant, and it is the opinion of the authors that the present treating plant, with possibly some minor changes, will handle the increased production.

Tests on Refinery Products

A series of experiments were made during the months of July and August, 1921, at the Midwest Refinery at Casper to test the adaptability of the process to refinery products. These tests proved that some heavy naphthas could be treated economically, while others could not be treated at all. Lighter naphthas could be treated, but with a somewhat higher consumption of bleaching powder than that experienced in handling the blend at Salt Creek. Gasoline which had passed the steam stills could be treated easily and economically. A large amount of such gasoline was in storage which the management was particularly anxious to prepare for market. It was decided to connect up four towers of a plant formerly used for treating pressure still distillate to form a plant for treating this product.

This improvised plant differed in some respects from the plant at Salt Creek. Since the gasoline was not "wild," the weathering tower was omitted. The towers were, in order, for treating, settling, washing and settling. All the towers were about about 20 ft. in height; the diameters were, in order, 5 ft., 5 ft., 6 ft. and 7 ft. Three pumps were used, one for gasoline,

[3] "A Comprehensive Treatise on Inorganic and Theoretical Chemistry," by J. W. Mellor, vol. 2, p. 253.

[4] "The Protection of Iron by Electroplating," by Oliver P. Watts and Paul L. DeVerter, *Trans. Am. Electrochem. Soc.*, vol. 30, p. 145.

[5] *Chem. & Met. Eng.*, vol. 16, p. 13, Jan. 1, 1917.

one for solution and one for wash water. The bleaching powder was mixed in a tank from which the solution would gravitate into the aërating tank. The pump drew the solution from this tank and forced it through the mixer into the treating tower, from which it was returned by pressure to the aërating tank or to the mixing tank, as desired. Due to the limited capacity for both aërating and treating, only about 4,200 gal. of solution could be handled advantageously. During the first continuous run, lasting over 20 hours, gasoline was treated at the rate of about 6,500 bbl. per 24 hours. This plant was operated until the entire volume of sour gasoline in storage was treated.

Very little solution was carried over into the first settling tower, but a considerable volume of emulsion was drawn from this tower. There was a decided tendency for the gasoline to be carried into the aërating tank with the returning solution. The treating tower was so small and the circulation of the solution so rapid that there was no opportunity for the mixture to "break," thus allowing the gasoline to rise and the solution to settle.

Chemical Tests

The details of preparing doctor solution and the procedure in making the test are described in detail in several publications.[6]

A standard solution of either sodium arsenite or sodium thiosulphate may be used in the determination of the available chlorine present in solutions and in samples of bleaching powder. A solution approximately tenth normal is convenient.[7]

In calculating the pounds of bleaching powder in solution the following formula may be used:

$$\frac{0.003546 \times (X) \times \frac{3785}{25} \times (Y) \times \frac{100}{Z}}{453.6} = \text{pounds of bleaching powder in solution.}$$

In this formula,

X = c.c. of $N/10$ sodium arsenite or sodium thiosulphate to titrate 25 c.c. of solution.

Y = gallons of solution in circulation.

Z = per cent of available chlorine in the bleaching powder.

For example, should $X = 15$, $Y = 3{,}000$ and $Z = 35$,

$$\frac{0.003546 \times 15 \times 151.5 \times 3000 \times 2.855}{453.6} = 152.6 \text{ pounds of bleaching powder in solution.}$$

Treatment of Emulsion

If any considerable volume of emulsion forms during treatment, provision for the recovery of the gasoline which it contains would probably be a paying investment. This emulsion should be collected in a lead-lined tank, permitted to settle, and the clear solution returned to the system. Some acid, either muriatic or dilute sulphuric, should be added and the contents of the tank thoroughly stirred. After being permitted to settle, the gasoline may be recovered and the sludge run to waste.

[6]Tech. Paper 214, U. S. Bureau of Mines, pp. 24-25; "Gasoline and Other Motor Fuels," Ellis and Meigs, pp. 59-60; "The Examination of Petroleum," Hamor and Padgett, pp. 59-60.

[7]Descriptions of methods of preparing standard solutions of sodium thiosulphate and sodium arsenite and for the determination of available chlorine in bleaching powder are contained in practically all books on quantitative analys's. Good descriptions may be found in "Analytical Chemistry," vol. 11, by Treadwell-Hall, "Quantitative Chemical Analysis," by Olsen, and "Quantitative Analysis," by Mahin.

Precautions for Economical Use of Bleach[8]

When dissolving bleaching powder all lumps must be broken up. This may be done in a box fitted with a screened bottom, suspended in water. To avoid dusting loss, the transfer of the powder from drum to mixing box should take place where there is no wind.

The powder should not be exposed to the air unnecessarily, especially where it can absorb moisture continuously.

The drums should be stored in a cool, dry, place.

The solution should be protected from diffused light as much as possible and never exposed to direct sunlight.

The solution should be maintained at the lowest strength compatible with safety of operation. This minimizes losses from both mechanical and chemical sources.

Provision should be made for aërating the solution, either by the splash method or by bubbling air through the body of the solution.

Careful attention should be given to the packing of valves and pumps. A seemingly small loss occurring frequently as in case of an improperly packed pump will soon amount to a considerable volume.

As little weathering as possible should be allowed to take place in the treating tower. Ebullition in this tower carries solution over into the washing tower. Loss from this source will greatly increase the consumption of bleaching powder.

Conclusions

The process described is not suitable for sweetening heavy naphthas, but is suitable for sweetening gasoline from the steam still or direct from the fire still, and is especially suitable for treating natural gas gasoline.

With a well-designed and well-constructed plant a large volume of gasoline can be sweetened with low cost for supplies, attendance and upkeep of plant.

Acknowledgments

The design and construction of the plant was under the supervision of W. R. Finney, superintendent of gas department; A. C. Andrews, superintendent of the Salt Creek gas plant, was in direct charge of construction. Both offered many suggestions which were incorporated in the plant, and have since helped in many ways in improving the operation of the plant.

E. Buddrus, laboratory foreman at the time the preliminary tests were being made, exercised painstaking care in making these tests.

A. J. L. Hutchinson, who joined the staff after the plant was in operation, has aided in clearing up some of the chemical problems which were not fully investigated when the details of the process were being worked out, and has also offered valuable suggestions in the preparation of this article.

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Sensitiveness of Gasoline Vapors to Ignition

Tests have been conducted at Pittsburgh, Pa., by the United States Bureau of Mines to obtain data as to the comparative sensitiveness of gasoline vapors and methane with respect to their ignition from electric flashes

[8]The properties of bleaching powder are covered in great detail in "A Comprehensive Treatise on Inorganic and Theoretical Chemistry," by J. W. Mellor, vol. 2, p. 258 *et seq.* Information of value is also contained in "Outlines of Industrial Chemistry," by Thorp, 3rd ed., pp. 132-135.

A New Induction Furnace*

By J. Murray Weed

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IT IS the object of this paper to describe a new induction furnace for melting non-ferrous metals, possessing some features which differ radically from those found in any previous furnace and affording great flexibility of design and a broad scope of application.

In this furnace, as in other induction furnaces, the heat is produced by an electric current induced by transformer action in a looped portion of the molten charge, which we will call the secondary. This secondary is distinct from the melting chamber pot, in which the cold charge is received, melted and held for refining and pouring. The success of the furnace depends upon a continuous, automatic circulation of the molten metal between the secondary and the melting pot, to prevent overheating in the former and to deliver the heat to the cold metal in the latter. It is in the form of the secondary, and in the character of the circulation and the method of producing it, that the new fundamental features of this furnace are found.

The secondary loop in this furnace closes upon itself without passing through the melting chamber, as illustrated by sectional views in Fig. 1. It is in the form of a hollow cylinder, of considerable length, which communicates with the melting chamber through two distinct ports or passages, from opposite ends of the cylinder. The current flows around the cylinder in a circumferential direction without entering the chamber or communicating passages, while the circulating charge flows through it in an axial direction, transverse to the current. The movement of the molten metal is unidirectional, from the secondary cylinder to the melting chamber by one passage and from that chamber back to the secondary by the other.

Mechanism of Circulation in Secondary

The circulation in this furnace is effected by the force of electromagnetic repulsion, set up through the medium of the magnetic leakage field, which exists between primary and secondary in any transformer. This force is proportional to the square of the current flowing, and is familiar to all transformer engineers as having caused much trouble in the wrecking of transformers when the windings were not held with sufficient rigidity to withstand the enormous forces of this nature which are set up when short circuits occur.

The induction furnace is, in fact, a special case of a short-circuited transformer, in which the internal impedance is comparable with the total full load impedance of the secondary circuit of the ordinary transformer. The repulsive force in this furnace, therefore, is not excessive, as in ordinary transformers when short-circuited, but only such as exists in ordinary transformers when normally loaded.

Some explanation may assist in understanding how this repulsive force becomes effective in producing circulation of the molten material through the secondary, while the secondary itself is fixed in position.

In the case of an ordinary transformer, with solid secondary, relative motion between primary and secondary occurs only when the strength of the structure supporting the windings is not sufficient to withstand the force corresponding to the current flowing, and when such motion does occur, the current and its conducting medium, the solid metal of the coil, necessarily move together. In this furnace the case is quite different. The repulsive force will always be small, relative to the physical strength of the structure as a whole, and while the secondary current and the position of the secondary do not shift, yet the secondary conducting medium can and does flow. This difference is understood after considering the nature of the magnetic leakage field, which is the same in both cases, and the natural effect of the modified conditions upon its action.

The physical characteristics by which any magnetic field makes itself apparent are those of mechanical attraction and repulsion, and of inducing voltages in conducting media when relative motion not parallel to the field occurs between it and the conducting medium. A force of attraction exists between unlike magnetic poles, while a force of repulsion exists between like poles. The former force is due to a tractive effort or tensile stress exerted by the field in directions parallel to itself, while the latter is due to a pushing effort or compressive stress in a direction at right angles to the field. These stresses are true mechanical stresses, measurable in grams per sq.cm. or pounds per sq.in., which exist simultaneously in any magnetic field and which produce the results which such stresses would be expected to produce.

The stress involved here is that of pressure at right angles to the field, this field being the leakage field between primary and secondary. In the case of the solid secondary of the ordinary transformer, if it is free to move, bodily motion will be produced. If it is properly supported, although mechanical pressure is produced, no movement occurs. In the case of the fluid secondary of the furnace, the mechanical pressure appears as a fluid pressure and even though the secondary as a whole is not free to move, this fluid pressure, if not uniform and if permitted to do so, will cause the metal to flow from points of higher pressure to points

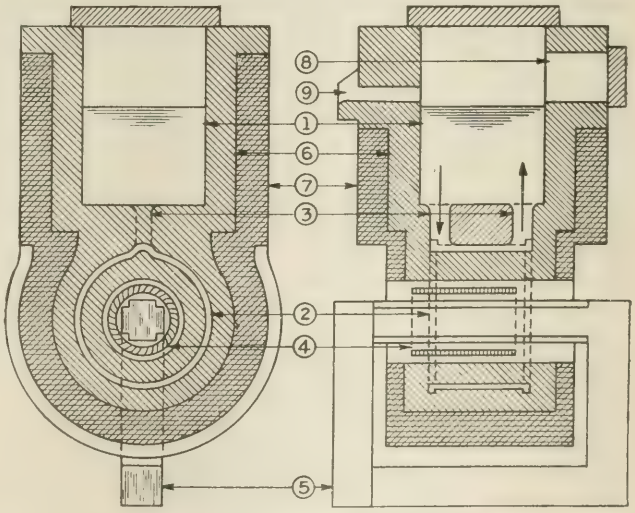


FIG. 1—TWO VERTICAL SECTIONS OF THE FURNACE AT RIGHT ANGLES TO EACH OTHER

1. Molten metal bath in melting chamber; 2. Molten metal secondary cylinder in which heat is generated by induced currents; 3. Ducts for unidirectional circulation of the metal; 4. Primary winding; 5. Laminated iron core; 6. Refractory lining; 7. Thermal insulation; 8. Charging door; 9. Pouring spout.

Note the thickened sections at the ends of the secondary cylinder, one serving as a channel for distributing the metal around the perimeter of the cylinder and the other for collecting it. The flow within the main body of the cylinder is in an axial direction.

Note the axial displacement of the primary winding with respect to the secondary. The velocity of the circulation of the metal may be varied by shifting the position of this winding.

*Paper presented at the forty-second general meeting of the American Electrochemical Society in Montreal, Sept. 21, 22 and 23, 1922.

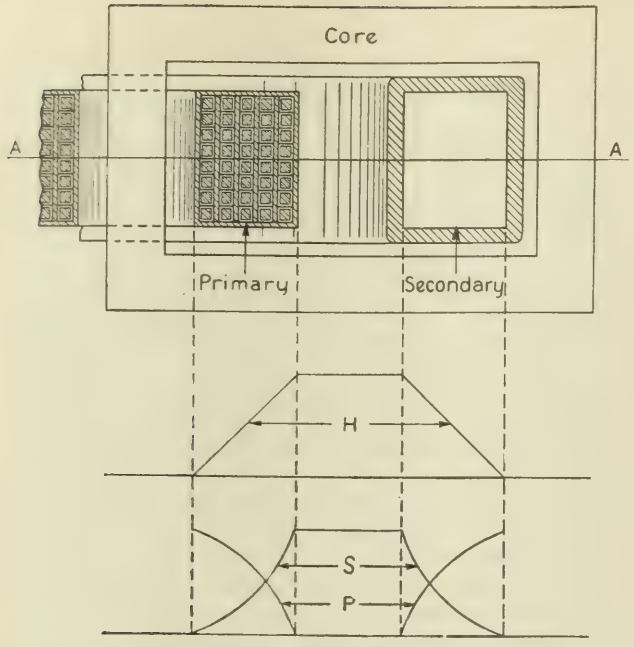


FIG. 2—TRANSVERSE SECTION THROUGH PRIMARY AND SECONDARY OF A HYPOTHETICAL FURNACE, WITH CURVES

H shows the variation of the density of the magnetic leakage field between primary and secondary along lines parallel to *A-A*.
S shows the variation of the stress in the field which is proportional at every point to the square of the density.
P shows the variation of the fluid pressure in the molten metal. The difference between the fluid pressures at two points is equal to the difference between the corresponding stresses of the field. The maximum fluid pressure occurs in the part of the secondary most distant from the primary where the minimum stress is found.

of lower pressure. It remains now to show that the pressure is greater at certain points in the secondary than at certain others, and to show how this pressure difference is utilized to produce the desired circulation.

The leakage flux between primary and secondary is not all confined between their adjacent boundaries. This matter has been carefully investigated for transformers, and for an arrangement with transverse cross-section, such as is illustrated in Fig. 2, for instance, the distribution of the leakage field is shown by the curve *H*, the ordinates representing the magnetic densities at points along lines parallel to *A-A*. In both primary and secondary, the density falls away gradually, from its maximum value at adjacent boundaries, and disappears at the further boundaries. As the stress in the field at any point is proportional to the square of the density, the variation of the stress along the line *A-A* is in accordance with the curve *S*. This, however, does not signify that the mechanical or fluid pressure imparted to the secondary (or primary) is represented at each point by the ordinate of curve *S*.

Were the density of the field uniform throughout, the magnetic stress at any point would be counterbalanced by equal stresses at all other points, and no mechanical pressure would be imparted to the material medium. It is only the difference between the magnetic stresses at given points in the secondary that appears between those points as mechanical pressure.

If the differentials of pressure be added along the line *A-A*, from the side of the secondary nearest to the primary to the side farthest from it, the integrated or effective pressure will be represented by curve *P*, such that the ordinate of *P* at any point added to the ordinate of *S* equals the maximum value of *S*. The ordinate of curve *P* at any point represents a pressure difference between that point and a point at the side of the secondary nearest to the primary.

In the case of the fluid secondary found in the furnace, this pressure difference constitutes a difference of fluid pressure. It cannot equalize itself within the secondary, since it is opposed by the stresses of the field which sets it up. If, however, a passage or passages be provided external to the secondary, from the point of maximum pressure (farthest from the primary) to the point of minimum pressure (closest to the primary), as illustrated in Fig. 3, the pressure difference will cause the fluid to flow, as indicated by the arrows.

The pressure causing this flow will be maintained by the field, with a corresponding internal flow from the point of minimum pressure to the point of maximum pressure. The strength of flow will be such that the sum of the internal and external pressure drops due to friction will be equal to the total pressure imparted or generated by the field.

Figs. 2 and 3 have been used here for the purpose of illustrating, in the simplest manner, the principle involved. The arrangement of primary and secondary in the furnace, as actually developed and represented in Fig. 1, differs from that in Figs. 2 and 3 for practical reasons, but the principle is the same. Maximum and minimum fluid pressures are found at the ends of the secondary cylinder which are respectively farthest from and nearest to the primary winding as a whole, or to use a form of expression common with transformer designing engineers but somewhat lacking in definition, at the ends which are farthest from and nearest to the magnetic center of the primary winding. This pressure distribution results from the diagonal arrangement of the leakage field, due to the axial displacement between the primary and secondary. It is the radial component of this field which generates the pressure difference between the two ends of the cylinder.

That the axial forces set up in such an arrangement are substantial realities has been demonstrated by experience in transformers with windings of the concentric cylindrical type. Comparatively small axial displacements of these windings have, upon numerous occasions, resulted in crushing the mechanical supports of the coils and deforming the coils themselves, the primary being driven in one direction against the yoke

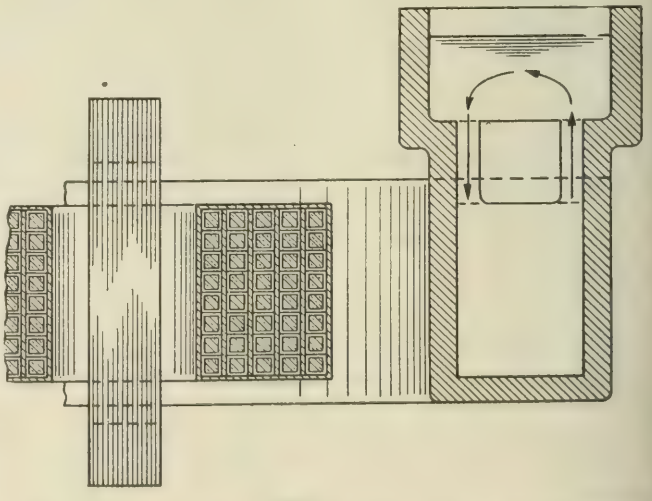


FIG. 3

Section of hypothetical furnace shown in Fig. 2, perpendicular to the section in that figure. The arrows show the way molten metal would flow through the external channel and reservoir, from the point of higher fluid pressure in the secondary to the point of lower fluid pressure.

of the core, and the secondary in the other. The differences in fluid pressure between the two ends of the secondary cylinder in the furnace are demonstrated by the flow of the molten metal in the furnace. Any reasonable velocity of the circulation can be easily obtained, by merely adjusting the axial position of the primary winding with respect to the secondary, for which provision is made in the mechanical design of the furnace.

As intimated at the beginning of this paper, the chief significance of the new physical features which have been described above lies in their effects upon flexibility of design and scope of application. The free unidirectional circulation, set up by a force which can be controlled within desirable limits, not only restricts the temperature variation of the metal to a small value but also avoids the danger of magnetic choking.

This makes it practicable to force the furnace to any extent which is feasible for the primary winding and core, and particularly adapts it for the melting of high conductivity metals, such as copper, as well as of metals of lower conductivity. The form of the secondary is favorable to flexibility of design as regards size and capacity. The only limiting feature in this direction consists in the refractory lining, due to considerations of mechanical strength and general reliability. Such limits are probably capable of indefinite expansion. Increased size and capacity will have no necessary effect upon the power factor, which is inherently high with the long thin section of the secondary.

Notes on the Swedish Paper Industry

IN *Commerce Reports* for Aug. 21, 1922, there is an interesting summary of the history and present status of the paper industry in Sweden. The establishment of the Swedish paper industry dates back to the sixteenth century, but it was not until recent years that it came to occupy a place of prominence in Swedish economic life, and the firm establishment of Swedish paper as an article of export is of still more recent date.

The Swedish mills are thoroughly modern, employing electrical power to a great extent, and produce a great variety of paper, such as newsprint, wrapping, parchments, smooth foolscap, writing, thin printing, colored tissue, crêpe and waxed tissue, affiche, catalog, envelope, sealings and toilet. Production of cardboards includes leather board, duplex and triplex boards.

There are at present 74 mills in Sweden, with a total yearly capacity of 400,000 tons of paper and 75,000 tons of cardboard. Of this amount, approximately 45 per cent is exported. While most of the mills are comparatively small, some are quite large, the three most important (Karan, papyrus, and Holmen) having yearly capacities of from 30,000 to 50,000 tons. The chief grades produced for export are newsprint and wrapping paper, both of which enjoy an excellent reputation in foreign markets.

Great Britain has always been the chief market for Swedish paper products and remained so during and after the war, with France, Brazil, Australia, Denmark, Hungary, Argentina and Rumania following in the order named. Exports to the United States, especially newsprint, have increased steadily. The total exports of newsprint from Sweden to the United States in 1912 amounted to only about 300 tons, while the estimated figure for 1921 reached 30,000 tons. The growing importance of the American market to Swedish paper manufacturers can best be appreciated when it is noted that, of the 12,345 tons of newsprint exported during May, 1922, 7,000 tons were shipped to the United States.

Exports of Swedish Papers

The following table shows exports of Swedish newsprint and other paper and cardboard during 1913, 1920, 1921 and the first 5 months of 1922:

SWEDISH EXPORTS OF PAPER AND CARDBOARD

Years	Newsprint, Tons	Other Paper, Tons	Total, Tons
1913	61,650	151,020	212,670
1920	116,430	169,760	286,190
1921	111,530	71,570	183,100
1922:			
January	10,360	7,980	18,340
February	3,560	4,950	8,510
March	6,600	12,250	18,850
April	5,070	7,730	12,800
May*	.....	.....	26,000

* Estimated.

The preceding table illustrates the extreme depression which the Swedish paper industry suffered during 1921 and from which it is now very slowly recovering. The crisis is by far the most serious experienced since the industry's establishment. The competition from the countries with low-value exchanges, such as Finland and Germany, has been keenly felt, because both of these countries possess large and highly developed paper industries.

Furthermore, the cost of production for the Swedish mills was for a long time kept above a point permitting successful competition, because of the extraordinarily high wages which were being upheld by strongly organized labor.

Recovery of Industry Expected in 1922

Developments which have so far taken place during 1922 promise a return to normal conditions. Production costs have been cut considerably through wage reductions averaging from 25 to 40 per cent. Furthermore, the competition from Finland, while still felt, is not so severe and that from Germany is rapidly disappearing, owing to the steady rise of German prices toward world market levels and the difficulties experienced by German manufacturers in effecting prompt deliveries. On June 15 all mills except those producing boards were running at full capacity and were reported as having advance orders assuring steady occupation for some time to come.

Organization of Paper Manufacturers

Practically all Swedish paper and cardboard manufacturers are organized in what is known as the Sveriges Papperbruksforening (Swedish Paper Manufacturers' Association), which is a general trade organization serving the industry much in the same way as other trade organizations do their industries, without having any price regulations or control features.

During the last week of June an export association has been formed by Norwegian, Swedish and Finnish paper manufacturers of newsprint. The scope of this association is not yet known, but it is understood that it is organized for the sole purpose of promoting sales of Scandinavian and Finnish newsprint in the United States. It is reported that German exporters are to be affiliated with the new export organization.

Non-Metallic Inclusions and Ferrite Segregation in Steel*

Traces of Manganese and Sulphides Are Present in the Steel Surrounding a Sulphide Inclusion, and Cause Precipitation of Ferrite Shells—Such Tiny Inclusions Have Much to Do With the Locus of Excess Ferrite

By E. G. Mahin and H. W. Botts
Department of Chemistry, Purdue University

In THREE earlier papers[1] experimental evidence has been submitted indicating that the effect of non-metallic inclusions upon carbon segregation in steel is due to the fact that in a narrow surrounding zone the steel is saturated with the material of the inclusion itself and with equilibrium products of reactions between the inclusion material and other constituents of the steel. In this zone the ideal equilibrium between austenite and ferrite at the upper transformation point is upset by the dissolved impurities so derived, this resulting in premature ferrite separation. As soon as such separation begins, the supersaturation of austenite with ferrite, as it ordinarily exists at Ar_3, is relieved by continued separation about these localities.

Reference was made to Stead's theory[2] that iron phosphide is alone responsible for ferrite segregation, the presence of inclusions in the same localities being regarded by him as a coincidence, rather than a cause. But we called attention to the fact that iron phosphide is probably only one of a considerable number of such impurities, any of which may exert a similar influence. There is reason for believing that many of these may come from non-metallic inclusions, remaining permanently segregated about the latter.

Segregation of ferrite and cementite about non-metallic inclusions is a phenomenon that has long been familiar to metallographists; the only difference of opinion is with regard to the cause. Most of the theories that have been proposed also are familiar. Ziegler's theory[3] that inclusions act as crystallization nuclei for ferrite has never been generally accepted. Howe supposed[4] that inclusions are rejected from crystallizing austenite to the grain boundaries, where ferrite also is expelled during passage through the temperature range Ar_3 to Ar_1. It was shown by one of us[1] that neither Stead's nor Howe's theory accounted satisfactorily for all of the observed cases. The form and relative positions of inclusions remain practically unaltered by protracted and repeated heat-treatment that totally changes pre-existing grain sizes and forms. Such treatment results also in complete elimination of ghosts of phosphorus and ferrite in rolled steel, but it does not eliminate, in any degree, ferrite segregation about inclusions.

Oxidized Inclusions

Giolitti has vigorously supported[5] his conclusion that it is only "oxidized" inclusions that show any effect upon ferrite segregation and that if the steel is cooled during or immediately after carburization, inclusions do not surround themselves with ferrite. He has argued that the well-known fact that all steels contain certain quantities of dissolved gases is responsible for the reversible reaction within the body of the steel:

$$3Fe + 2CO \rightleftarrows Fe_3C + CO_2$$

the equilibrium of which is shifted in either direction, according to whether the piece is bathed in oxidizing or in reducing gases. The "oxidized" inclusion would be supposed to suppress this reaction to some extent, thus producing a thin sheath of ferrite about the inclusion, which would naturally act as a nucleus for further ferrite crystallization. On the other hand, if the piece of steel were heated in a reducing atmosphere, the resulting carburization and excess of carbon monoxide would be expected to prevent the "free iron" formation. In the last paper just cited Giolitti stated that if a piece of steel[6] containing ferrite segregated about inclusions be heated to a temperature of 1,000 deg. C. for 24 hours in carbon monoxide, ferrite segregation is eliminated, only to reappear if the piece is reheated in carbon dioxide.

In none of the available papers by Giolitti nor in his book "Heat-Treatment of Soft and Medium Steel" is there given any clear definition as to what are to be considered as "oxidized" inclusions. It is difficult to see how such inclusions as sulphide of manganese (the most common and abundant of all inclusions in even the "cleanest" steel) or sulphide of iron could be oxidizing in any sense of the word, and we are quite certain that the ubiquitous manganese sulphide is one of the most active of all inclusions in connection with ferrite segregation. If the "oxidized" inclusions are to be understood as being, for the most part, of the general nature of silicates (the ordinary slag inclusions of iron and steel), it is worth our while to examine the thermochem-

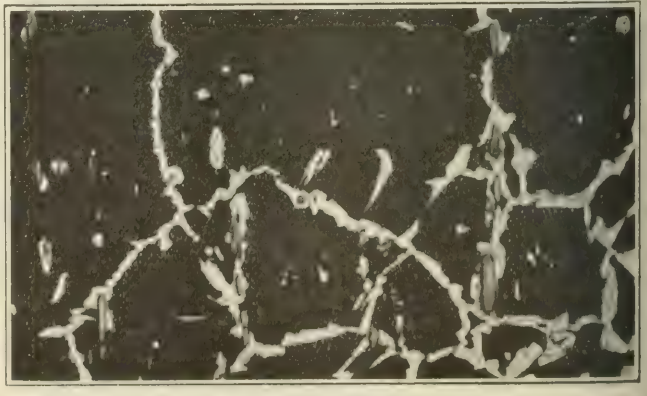


FIG. 1.—INCLUSION IN STEEL CARBURIZED BY CONTACT WITH GRAY IRON CRUCIBLE. × 100

*A paper presented before the Division of Industrial and Engineering Chemistry of the American Chemical Society at the Pittsburgh meeting, September, 1922.

[1] *J. Ind. Eng. Chem.*, vol. 11, p. 739 (1919); vol. 12, pp. 1090, 1095 (1920). Abstracted in this issue, page 990.

[2] *J. Iron & Steel Inst.*, vol. 58, p. 60 (1900); vol. 91, p. 140 (1915); vol. 97, pp. 287, 389 (1918).

[3] *Revue de Métall.*, vol. 8, p. 655 (1911).

[4] *Proc.*, Am. Soc. Test. Mat., vol. 11, p. 271 (1911); "The Metallography of Steel and Cast Iron," p. 280.

[5] *Ann. chim. applicata*, vol. 2, p. 218 (1914); *Intern. Z. Metallog.*, vol. 7, p. 35 (1914); *Chem. & Met.*, vol. 20, p. 271 (1919).

[6] [Dr. Giolitti's experiments were made on medium carbon-chromium and nickel steels made in an acid open-hearth furnace.—Editor.]

istry and the general physical conceptions involved in Giolitti's assumptions.

If this is the true mechanism of ferrite segregation about inclusions, any influence of the material of the inclusion upon the shifting of equilibrium conditions of the reaction expressed above would mean, as a *net* result, that carbon would be oxidized at the expense of silicon dioxide of silicates. The relatively large positive heat of oxidation of silicon ($Si + O_2 = SiO_2 + 180{,}000$ cal.) and the heat of formation of iron carbide ($3Fe + C = Fe_3C + 8{,}460$ cal.) makes it appear improbable that more than a very minute amount of carbon could be oxidized at the expense of silicon dioxide, even at high temperatures. Without regard to intermediate steps, the following changes are to be considered as representing final conditions:

$$SiO_2 + 2Fe_3C \rightarrow 6Fe + 2CO + Si$$

$$[2(29{,}160 - 180{,}000 - 2(8{,}460) = -138{,}600] \text{ cal.}$$

Naturally such a reduction of a silicate would involve the simultaneous formation of some sort of silicide. We have no thermochemical data regarding this reaction, but it does not seem likely that its consideration would materially change the conclusion that equilibrium would be established by a very slight reduction of the silicate, even at 1,000 deg. C. Of course there is to be considered also the possibility that the action of the inclusion may be of a catalytic nature.

If the inclusions that are considered to be responsible for ferrite segregation are understood to be oxides (of nickel or chromium?) only, we still have to account for the fact that plain carbon steels show the same effects.

The second objection to this conception lies in the difficulty in understanding how the preponderance of carbon dioxide or of carbon monoxide in the atmosphere surrounding the piece as a whole could have any such effect as Giolitti outlines at the surface of contact between metal and inclusion. A change in outside environment would, of course, alter the relative concentrations of the respective gases dissolved in the metal, but these gases would have to diffuse through the body of the steel in order to reach the inclusion and there seems no good reason why their action upon carbides should be delayed until contact with inclusions is established, unless the latter act as adsorption or catalytic centers—a hypothesis in support of which there appears to be no experimental evidence. In other words, if an inclusion acts at all in the sense of surrounding itself with an envelope of carbonless iron, this action should be noticed, no matter what might be the nature of the surrounding gases and, furthermore, the effect should be more striking in the case where the average carbon content is being *increased*, rather than decreased—that is, in the case where the piece is heated in a reducing atmosphere. This is because in such a case there would be the greatest possible difference between carbon content near the surface of the inclusion and that at a distance from it. This is the opposite of the conclusion as stated by Giolitti.

Ferrite Separation a Physical Process

In the attempt to understand the mechanism of the separation of ferrite in a cooling steel it is well to recall that this is a physical separation from a true solution and not simply a chemical oxidation of a compound. In order to act as a nucleus for continued crystallization of ferrite, any oxidation of carbon would have to *precede* the normal separation at the point that would otherwise be Ar_3. Whether austenite be regarded as a solution of elementary carbon or of iron carbide in iron (and this point appears to be more or less of a quibble, in the light of X-ray evidence as to the probable crystal lattice of the solution), the only sense in which "free" iron has any meaning is with reference to iron actually thrown out of solution as ferrite. Considering the system above Ar_3, if there is a certain amount of oxidation of carbon at the surface of the inclusion, the excess iron so produced is not essentially different from iron already present as a solvent for carbon and the only obviously possible effect would be a slight local increase in the per cent of iron in the solution. This, it is true, would promote a slightly greater ferrite supersaturation of the cooling solid solution, with consequent breaking down of austenite at these points slightly earlier than at others. The inclusions, then, if active as oxidizing agents (catalytic or direct as Giolitti supposes), should be regarded as surrounding themselves, when above the transformation range, with a zone of austenite slightly poorer in carbon than the average of the steel, rather than with a film of "free" iron. This action should be more or less independent of the nature of surrounding atmosphere. Considering the extreme narrowness of the zone of influence of the inclusion and the very appreciable speed of diffusion of carbon in austenite, one can scarcely suppose that this sort of action can be very important unless oxidation, with consequent gas production, is a continuous process. This is extremely unlikely. It may be remarked also that oxidizing inclusions should exert the opposite effect in hypereutectoid steel, being then found in pearlite grains—a supposition that is contrary to observed facts.

Ferrite May Segregate After Carburization

The foregoing paragraphs contain a brief discussion of some of the theoretical objections to the hypothesis that ferrite segregation about non-metallic inclusions is due only to the oxidizing properties of the latter. We may now mention an even more important objection in the fact that our own experimental results lead in the opposite direction. In Giolitti's paper on flaky and woody structures[7] the statement is made that if a piece of hypoeutectoid steel showing co-segregation of ferrite and inclusions is heated for 24 hours at 1,000 deg. C. in carbon monoxide, it no longer shows ferrite segregation, while if it be reheated in carbon dioxide the ferrite grains again surround the inclusions. We have heated a piece of 55-point carbon steel at 1,100 deg. C. for 72 hours in a cast-iron crucible and covered with fusible glass[8]. The environment here was certainly not oxidizing in nature. On the contrary, the portions of the piece that were in contact with the gray iron crucible were highly carburized, the effect being similar to that of ordinary case-carburizing. Fig. 1 shows a section, longitudinal to the direction of rolling, taken where the carbon had approached eutectic proportions and where, presumably, it was still increasing when the piece was furnace-cooled. Ferrite segregation is as pronounced as before. Transverse sections at higher magnification, taken at points in the interior of the piece, where the carbon had not increased to any notable degree but where the conditions were necessarily slightly reducing, show inclusions surrounded by much thicker shells of

[7] *Chem. & Met.*, vol. 20, p. 271 (1919).
[8] *J. Ind. Eng. Chem.*, vol. 11, p. 739 (1919).

ferrite. Fig. 2 illustrates a similar state of affairs in another piece. A ½-in. rod (0.07 per cent carbon) was packed in a carburizing mixture and heated at 1,000 deg. C. for 6 hours. A deep case was thus produced and Fig. 2 represents a portion near the inner border of the eutectoid zone.

The results of these experiments would not seem to indicate any necessary connection between the existence of an oxidizing atmosphere and co-segregation of ferrite and inclusions.

Inclusions as Centers of Contamination

Manganese sulphide is usually regarded as being formed by the reaction of manganese which has been added to liquid steel containing ferrous sulphide, the latter probably being largely in solution at this temperature. The formation of MnS inclusions would then be the result of precipitation from solution, analogous to precipitation by ordinary reactions in ordinary solutions. The reaction

$$Mn + FeS \rightleftarrows MnS + Fe$$

supersaturates the solution with MnS before precipitation begins. Under conditions otherwise static, equilibrium would finally result with the mother liquor saturated with MnS and containing a certain definite concentration of FeS. McCance[9] does not regard this reaction as being a "balanced" one, but his view can be correct only in a relative sense, for, even though the concentrations of Mn, MnS and FeS in the liquid immediately surrounding the precipitated globule may necessarily be very small, we are not justified in regarding either the formation or the precipitation of MnS as being absolutely complete. As the steel further cools through the region between the liquidus and solidus, these particles are usually caught between large austenite grains, and here they remain in the finally cooled solid steel.

We may assume also that metal in contact with each particle of true slag or of any other suspended material is saturated with the material of the inclusion and with products of any possible reaction between this material and iron. This statement does not imply that inclusion material is soluble to any large degree, but our ideas of physical equilibria make us reluctant to conclude that these particles could have zero solubility.

This conception leads to the conclusion that nonmetallic inclusions in iron and steel (and alloys as well) must always be surrounded by zones of segregation in which the metal is contaminated by soluble impurities or by eutectoids of these with the material of the body metal, and that no amount of heating can serve to eliminate this, because the supply is practically inexhaustible. No doubt these zones are extremely narrow in some cases, and the concentration of the contaminating elements or compounds is probably nearly always very low. But only a trace of such material is needed to upset the stressed condition which obtains as the solution cools past the ideal transformation point, and only a trace of ferrite, separated as a result of the influence of this material, is required to "seed" the solid solution and thus to start the breakdown of austenite.

[9] *J. Iron & Steel Inst.*, vol. 97, p. 239 (1918).

FIG. 2.—CORE OF 0.07 C STEEL, CARBURIZED AT 1,000 DEG. C. × 250

Fig. 3—Carbon steel heated after being plugged with aluminum bronze. × 100.

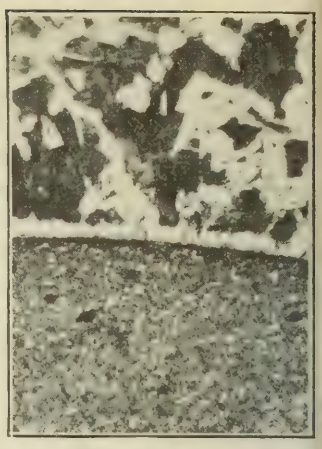


Fig. 4—Carbon steel heated after being plugged with high-speed steel. × 100.

Inclusions are occasionally found touching grains of pearlite or even entirely imbedded in them. We should expect certain exceptions of this kind, in view of the fact that constantly shifting temperature gradients involve corresponding shifts of dissolved impurities, including the contaminations associated with the inclusions as well as the carbon itself. This movement of dissolved matter may occasionally leave a given side of an inclusion unprotected, with the result that on this side there will be no premature ferrite separation.

We should note also that the most obvious cases of inclusions lying in pearlite grains are usually to be found in steels that are of nearly eutectoid composition. In such steels there is a very short temperature range between Ar_3 and Ar_1, the entire breakdown of austenite occurring in such a short space of time and from a system containing so little excess of ferrite that the latter could not possess any very great migratory power. Inclusions can then show little or no effect upon ferrite separation.

Experimental evidence has already been presented[10] to show that, in many cases, segregated impurities in hypoeutectoid steel cause decided segregation of ferrite and that phosphorus segregation is only one of many similar causes of this phenomenon. Specimens of the steel, into which had been driven small rods of dissimilar materials, were heated. These rods were of non-ferrous alloys and also of steels similar in composition to the body steel, except that each insert contained an abnormal per cent of some one element. After holding such composite specimens at temperatures above the transformation range for varying periods of time and then cooling in the furnace, the insert was often found to be surrounded by a well-defined ferrite ring. (Figs. 3 and 4.)

Oxidation Rings

Probably every metallographist has noticed that at times a polished specimen persistently develops minute

[10] *J. Ind. Eng. Chem.*, vol. 12, p. 1090 (1920).

dark spots which prove to be colored rings or halos with non-metallic inclusions at their centers. These rings usually form while drying the polished and washed specimen, either before or after etching, although they may appear also if the specimen is permitted to heat slightly during the final polishing or if it is heat-tinted. Colored rings are merely one example of selective oxidation. They indicate potential differences existing between the zones immediately surrounding the central inclusions and the main portions of the metal, and these potential differences are undoubtedly due to slight differences in the chemical composition of the metal at various distances from the inclusion. It seems obvious either that the inclusion is a source of contamination for the metal or that the metal retains a trace of the substance which was not expelled during the process of precipitation at high temperatures or upon cooling.

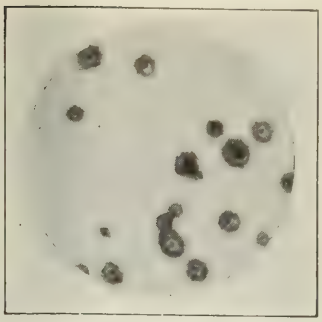


Fig. 5—Oxidation halos on Thermit iron; developed during drying of polished section. × 100.

We have examined a large number of oxidation rings in wrought iron and steel; some are shown in Fig. 5.

Whiteley's antimony solution[11] (5 grams of gelatin, 5 c.c. of glycerine, 0.05 gram of tartar emetic and 1 c.c. of dilute sulphuric acid in 20 c.c. of water) and McCance's silver nitrate modification[9] (substituting 0.1 gram of silver nitrate for tartar emetic) were applied to some of these materials to determine whether sulphide inclusions were centers of segregation. The evolution of minute gas bubbles, which were caught in the overlying gelatin, made it necessary to strip off the gelatin films before microscopic examination, and we finally omitted the gelatin entirely, simply dipping the specimen in the solution for a short time, then gently washing and drying.

Silver nitrate is not satisfactory for this purpose. Well-defined dark rings were produced, but the silver sulphide in thin layers is so nearly the color of the oxide rings that it was often impossible to decide whether the rings finally remaining were silver sulphide or iron oxide, the latter developed during drying. Antimony nitrate solution with the gelatin omitted is excellent for the purpose. Antimony sulphide is so distinctly yellow that it is easily distinguished (Fig. 6).

The alternating concentric rings, often constituting the halos of sulphide inclusions, are zones of higher concentrations of soluble sulphides. Their periodic recurrence is possibly due to different rates at which the various soluble impurities diffuse. With manganese sulphide inclusions we have to consider MnS, FeS and Mn, since all are presumed to be present at equilibrium.

From the results of these experiments it is possible also to confirm the assumption often made, that many of the small slate-gray inclusions found so abundantly in even high-grade steel and iron are sulphides, the natural assumption being that they are principally manganese sulphide. Even when the inclusion is so small as to make identification from its own appearance very difficult, the yellow antimony sulphide halo leaves no doubt as to its general nature. The application of the modified McCance's solution to the mottled "slag" inclusions of wrought iron and low-grade steel confirms the usual supposition that the lighter parts of these bodied are sulphides (Figs. 7 and 8).

[11] *J. West of Scotland Iron & Steel Inst.*, vol. 24, p. 79 (1917).

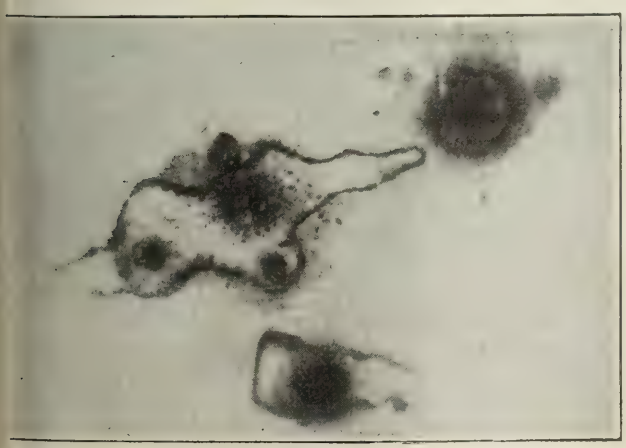
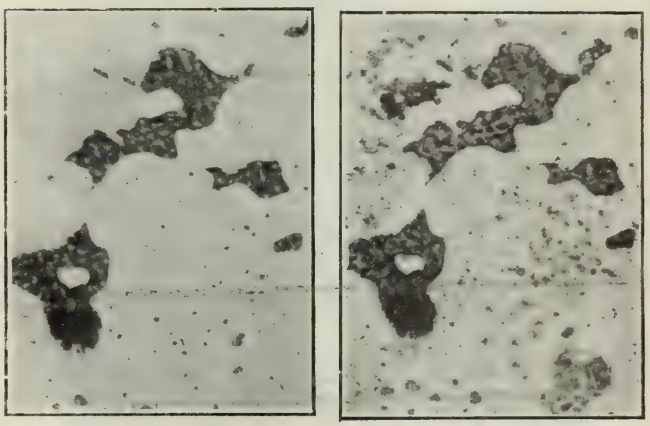


FIG. 6—ANTIMONY SULPHIDE HALOS ON POLISHED SPECIMEN. × 250

Genesis of Ferrite

In his paper dealing with this subject[12] Giolitti reasoned that ferrite is not expelled to the peripheries of



FIGS. 7 AND 8—TWO VIEWS OF SAME AREA ON WROUGHT IRON. × 100

Fig. 7—Unetched. Fig. 8—Etched with McCance's silver solution.

cooling austenite grains, as maintained by Howe[4] and others, but that it first separates at austenite grain centers as small β-grains, which coalesce as they grow, finally forming a semblance of a network. This assumption seems logical if we are to consider only hypoeutectoid steels, *cooling from the liquid state*. The mechanism of the crystallization of austenite between the liquidus and the solidus leads necessarily to the formation of grains in which the carbon content is lowest at the nuclei and highest in the outer portions. The natural tendency of grains of the solid solution to reject their excess ferrite to their boundaries at Ar_3 is then counteracted by the fact that the grain centers reach their transformation temperature first. We should then expect a preliminary formation of either (*a*) isolated ferrite dots alone, near pearlite grain centers, or (*b*) ferrite dots and ferrite network, according to the rate of cooling between the solidus and Ar_3, slower cooling favoring an approach to equalization of carbon content in the grains.

[12] *Chem. & Met.*, vol. 22, p. 737 (1920).

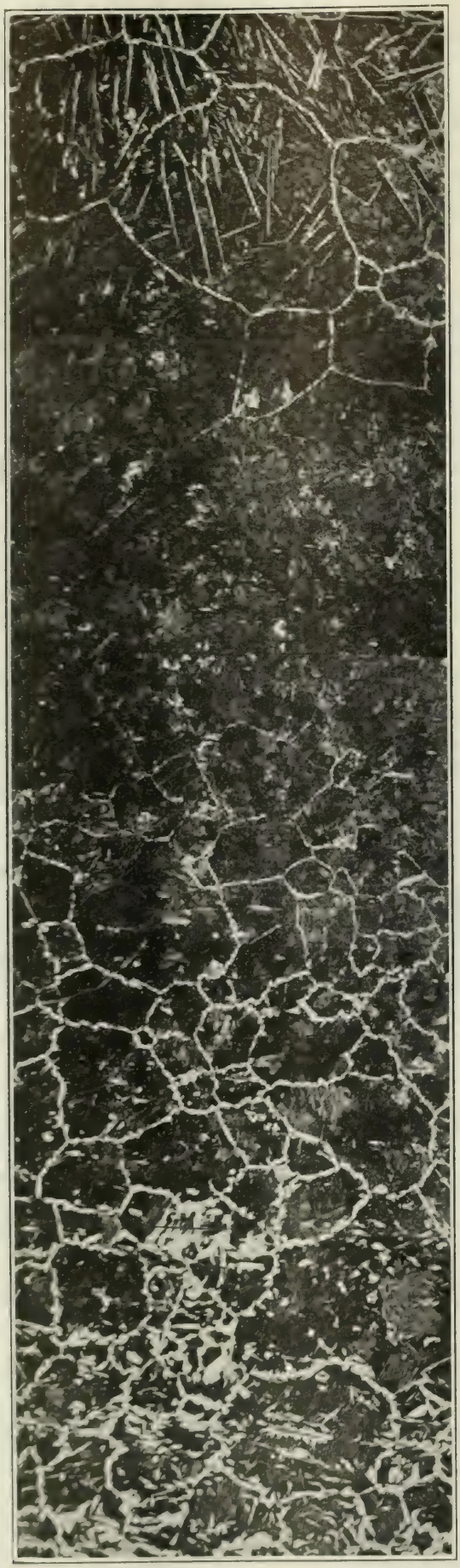


FIG. 9—SECTION ACROSS THE CARBURIZED CASE OF STEEL SHOWN IN FIG. 1. × 50

But if this conception is correct for steel castings cooled not too slowly from the liquid state, the case must be quite different for the reheated steel, which is far more common and important in practice. No matter by what mechanism the ferrite network was first formed when the piece is reheated this network will define a new system of austenite grains whose carbon content will be *highest* at centers. Absorption of the network begins at Ac_1 and is completed at Ac_3. It seems obvious that this reverses the situation. The new system is now in the most favorable condition for ferrite network formation upon cooling. Fig. 9 shows a section across the carburized case of the steel described in Fig. 1. It is easy to see here that the very distinct ferrite network thins out to disappearance in practically the same man-

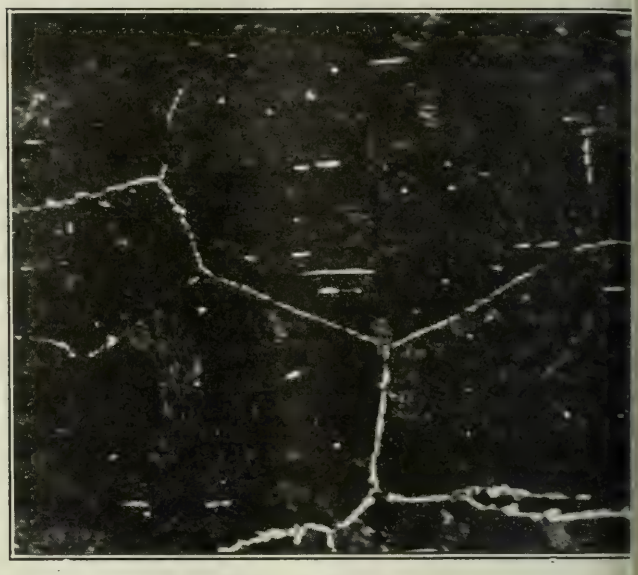


FIG. 10—DISAPPEARING FERRITE NETWORK OF STEEL SHOWN IN FIG. 9. × 100

ner as does the cementite network on the hypereutectoid side. There is no suggestion of random dots at isolated points. Fig. 10 illustrates this still more distinctly.

Fig. 11 shows the typical structure of a coarse-grained hypoeutectoid steel which has been held above the transformation range for some time and then air-cooled. Evidently the process has resulted in the formation of a primary network of ferrite, but, because of the fairly rapid cooling, migration from the interior of the grain was hindered so that excessive supersaturation finally expelled ferrite to cleavage planes between crystals to some extent, and this produced the characteristic fringes on the network. Ferrite separation is never complete in a steel cooled in this manner.

It seems reasonable to conclude that Giolitti's dot ferrite formation is largely the result of the influence of scattered non-metallic inclusions in a nearly normalized steel. His steel is stated to be "a well-made, clean steel and to be free from non-metallic inclusions, but it is well known that even the best grades of open-hearth iron or steel that can be produced contain multitudes of these minute bodies, scattered throughout the mass. Inclusions in good steel are minute and easily obscured by etching, but their influence upon segregation depends upon chemical characteristics rather than upon size, as already stated. It seems a fairly safe conclusion that the majority of ferrite "islands" found in pearlite grains in any steel are due to segregation of this character

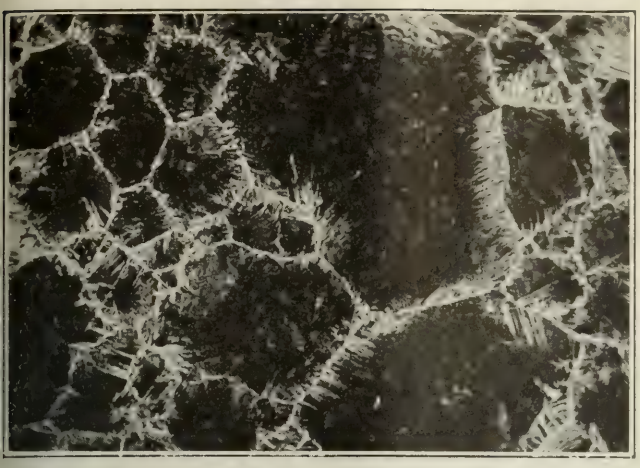


FIG. 11—AIR-COOLED HYPOEUTECTOID STEEL AFTER LONG ANNEALING. × 50

That the inclusion is not always seen in the specimen prepared for the microscope is not to be taken as proof of its absence. Of course the converse is not necessarily true, but since the inclusion is frequently a very small fraction of the ferrite grain surrounding it, the chance that a random section of the grain will contain the inclusion is relatively small.

Giolitti's steel had been heated at 900 deg. C. for 1 hour. Considering the rate of migration of carbon, as evidenced by such a process as case-carburizing or by carbon shift during decomposition of austenite, it is doubtful whether, after such heating, austenite grains a few hundredths of a millimeter in diameter in a 0.62 C steel could retain a carbon content in the grain centers low enough to precipitate β-ferrite granules. This would require that just before reaching Ar_3 these grain centers should contain less than 0.45 per cent of carbon, but in any ordinary hypoeutectoid steel carbon will migrate one-half the average diameter of the ferrite grains while cooling between Ar_3 and Ar_1.

Howe's assumption that ferrite is rejected to austenite grain boundaries in cooling steel, so vigorously attacked by Giolitti, does not involve any assumption of permanency of grain sizes and forms. On the contrary, such influences as coalescence of small austenite grains above A_3, constantly shifting temperature gradients and disturbances caused by non-metallic inclusions produce a state of unrest and continual shifting of high- and low-carbon areas, so that new grain systems are produced upon each reheating. But when this state is finally interrupted by cooling past Ar_3, ferrite will be rejected first where its concentration is highest and where disturbances produced by soluble impurities are first felt. This should give rise to a network structure, bounding austenite grains in general, but with its location modified by inclusions, whose influence can never be eliminated entirely. In addition to this network, certain ferrite grains will nearly always appear within pearlite, where zones of segregation due to inclusions or to other causes are too far from the low-carbon borders to cause a shift of the ferrite network.

Anomalous Behavior of Nickel and Manganese

In the second paper upon the subject of inclusions (to which reference has already been made) it was shown that nickel and manganese, migrating into carbon steel, resemble many of the other elements in inducing ferrite segregation in the regions thus invaded. This is an effect that at first appears to be inconsistent with the property usually attributed to these metals of lowering the transformation points of steel. If the temperature represented by Ar_3, for a steel of given carbon content, is thus lowered, one would ordinarily interpret the action as that of increasing the ferrite solubility in austenite. In a steel containing segregated nickel or manganese it would then appear reasonable to expect that ferrite would separate in these centers of contamination last, instead of first, as the steel cools, which would then leave them in pearlite grains. This is directly contrary to the observed facts.

We are unable to explain this apparent anomaly upon the basis of any direct experimental evidence, but we offer the suggestion that the localized ternary alloy produced by the invading metal, existing in direct contact with the binary solution, produces a system analogous to that of two dissimilar and immiscible solvents containing a common solute, in which the distribution ratio is not unity. Considered as the solvents in question, of course neither the iron-nickel nor the iron-manganese alloy is immiscible with iron above A_3, but the comparatively low mobility of manganese and nickel has the same effect as immiscibility, except in the case of protracted heat-treatments. If we may suppose that the distribution ratio for carbon in the two solvents (iron and iron-nickel or iron-manganese) is such as to cause a recession of carbon from the region invaded by the added (or segregated) metal, the transformation point of the system in this region will be the resultant of two opposing effects: (*a*) Lowering, primarily due to the formation of the ternary alloy, and (*b*) raising, due to the diminished carbon content. It is conceivable that the latter effect may be more pronounced than the former, the net result in a cooling steel then being that the system existing at centers of contamination will be the first to reach Ac_3 and that ferrite will be generated first in these regions.

This hypothesis is offered with some degree of hesitancy and it is to be regarded at present as merely suggestive and as subject to possible revision in the light of data yet to be obtained. The first part of the assumptions involved, having to do with the distribution ratio of carbon, is substantially the same as that offered by Stead to explain the effect of segregated phophorus. In his paper on the effect of phosphorus upon ferrite crystallization (*loc. cit.*) Stead reasoned that the "solid solution pressure" of carbon is lowered by the presence of phosphorus, with the result that carbon recedes from the regions of phosphorus segregation, the low-carbon austenite breaking down upon cooling, before the main body of the steel has reached its own transformation point.

Conclusions

It is believed that the influence of non-metallic inclusions upon ferrite segregation in slowly cooled hypoeutectoid steel is principally due to the fact that the inclusions are centers of contamination for the steel mass rather than to any connection between dissolved gases and the state of oxidation of the inclusion. The development of colored halos surrounding many of the inclusions of a polished steel or iron section, and of similar rings when such a section is treated with antimony tartrate solution, indicates the correctness of this assumption. Howe's hypothesis with respect to ferrite genesis is regarded as being correct, except for steels during their first cooling from the liquid state.

Dry Lime-Sulphur and Sulphur Dust Explosions

By Paul W. Edwards
Assistant Development Engineer, U. S. Bureau of Chemistry

PRACTICALLY any combustible dust will explode with violence, under favorable conditions, when mixed with the proper proportion of air and ignited by a flame or spark.[1] Investigations have been made by the Bureau of Chemistry of several recent explosions during the manufacture of dry lime-sulphur, an insecticide, and the grinding and collecting of powdered sulphur. Six men were seriously injured in one explosion in a plant grinding and collecting powdered sulphur.

Dry Lime-Sulphur

The following spray-drying process is used in an insecticide plant: The lime-sulphur solution is pumped from an adjoining plant to a large steel storage tank and it is then sprayed into the drier house. This drying chamber is approximately 18 ft. wide by 12 ft. deep by 12 ft. high, and below it are three hoppers equipped with a screw conveyor for collecting and discharging a large part of the dried product. Hot air, heated by means of a direct oil-fired furnace, is used as the drying medium. The products of combustion and the air used for drying are mixed and passed through a cyclone separator for the purpose of separating from the hot-air current incompletely burned particles of oil or carbon before they reach the drying chamber. Laden with dust, the air leaves the drying chamber through the sheet-metal ducts connected with the inlet of the suction-filter type collector, from the outlet of which the connection is made to the fan which induces the flow of air.

The dust collector consists of several vertical cylindrical compartments arranged side by side, each containing twelve bags for the collection of the dust. These bags are suspended at their closed ends at the same height in the compartment and are so spaced as to provide ample air channels between the individual bags and between the outer bags and the wall of the compartment. Metal rings are attached to the bags at intervals throughout their length, to keep the bags from collapsing during operation.

The dust-laden air entering near the bottom of the collector is compelled to make a turn in coming into the open lower ends of the bags. This has a tendency to make the heavier particles of dust drop into the hopper at the bottom of the collector. The bags are made of a special porous cloth suitable for holding the dust and permitting the purified air to pass through into the surrounding compartment. While the dust is being collected, the air enters the lower end of the bags, passes through the cloth and out to the fan. During the process of cleaning, a valve on the top of the collector opens, permitting a counter-current of air from the fan exhaust duct to pass from the outside to the inside of the bags and thence into the adjoining compartments. At the same time the bags are shaken violently several times. This cleaning process takes place in each compartment successively about every 2½ minutes.

Fires and Explosions

The first fire is thought to have started in the drying chamber, after the plant had been in operation for about 6 hours. The second fire occurred in the drying chamber after the plant had been in operation for 6 hours. The third fire, accompanied by an explosion, or explosion accompanied by fire, occurred after the plant had been in operation and seemed to start in the upper effluent duct. This fire occurred after a continuous run of 78 hours, during which period a large quantity of product had accumulated in the drying chamber and in the upper and lower effluent ducts, where the air velocity was not sufficient to keep the dry product in suspension. After the plant had been in operation for 61 hours, then idle for 28 hours, during which period the accumulation of the dry powder was permitted to remain in the drying chamber, and had again been put in operation for a short time, the fourth fire occurred.

The fifth fire or explosion evidently started in the dust collector, as it was confined entirely to the dust collector and the duct work connecting the dust collector and the fan, the return air duct from the fan to the dust collector, and the discharge duct from the fan through the ventilator on the roof of the building.

Cause and Prevention

It is reasonably certain that the first and second fires were caused by particles of burning oil or carbon from the combustion chamber. The combustion chamber was elevated and placed in a direct line with the main air intake trunk of the drier and it was known that particles of burning oil or carbon from the combustion chamber were entering the drier. The color of the product at that time was changed to a greenish hue, owing to the carbon which it contained. After these fires occurred a cyclone dust collector was installed between the combustion furnace and the drying chamber to remove the fine granular particles of carbon, and the finished product no longer has the greenish hue which it had before the cyclone collector was installed.

The causes of the third and fourth fires and of the first and second explosions have not been definitely determined. They may have originated from any one of the three possible sources: First, discharge of static electricity; second, sparks from oil-burning furnace; third, friction sparks due to presence of steel, wire nails, bolts, etc., in the conveyors. The presence of hydrogen sulphide and a chemical reaction generating enough heat to ignite the gas was considered a probable cause. It proved, however, to be an improbable rather than a probable cause.

This dry lime-sulphur has the following approximate chemical composition:

	Per Cent
Calcium polysulphide	75
Calcium thiosulphate	5
Free sulphur	8
"Inert" ingredients	12

L. J. Trostel, in the dust explosion laboratory of the Bureau of Chemistry, found that a 75 mg. sample of this dry lime-sulphur generated a pressure of 5.7 lb. per sq.in. when ignited in a 1,500-c.c. flask, as compared with 12.7 lb. per sq.in. for cornstarch, 11.2 lb. per sq.in. for wheat flour, and 10.1 lb. per sq.in. for Pittsburg standard coal dust. The ignition point of dry lime-sulphur was found to be between 275 and 300 deg. C. The ignition point of sulphur is 261 deg. C.,[2] and of hydrogen sulphide 364 deg. C.[3]

This would seem to eliminate the theory that the explosion was caused by the ignition of hydrogen sulphid

[1] "Dust Explosions," Price and Brown, Nat. Fire Prot. Assoc., Boston, July 1922.

[2] Dictionary of Applied Chemistry, Thorpe, Vol. V, p. 297.

[3] Dixon and Coward, *Trans.*, The Chem. Soc., vol. 95, p. 517.

TABLE I—STATIC VOLTAGES NOTED ON DUST COLLECTORS IN STARCH FACTORY

	A Stocking Not Grounded	B Stocking Grounded With Wire To Rings Only	C Stocking Grounded By Wire Sewed to Seam of Bag	Remarks
	0	0	0	Before starting
	10,000+max. 1,000 ave.	1,000	0	No starch, cold air blown through collector
2	2,000	1,000	0	No starch, hot air blown through collector
3	0–500	0–200	0	50 per cent full load starch
4	4,000 ave. 3,500–4,500 limits	2,300 2,300	0	75 per cent full load leaving. Temp. 165 deg.
5	4,500 ave. 1,500–5,000 limits	2,300	0	Full load leaving. Temp. 165 deg.
6	10,000+ Average*	4,500 ave. 5,000 max.	0	Later reading same as (5)

A—Wire to electrometer connected to stocking at a point midway between rings.
B—Wire to electrometer connected to stocking at a point midway between rings and on opposite side of bag from ground wire.
C—Wire to electrometer connected to stocking at a point midway between rings and on opposite side of bag from ground wire.
* Wire to electrometer connected to ring of stocking.

he ignition temperature of which is higher than that f either dry lime-sulphur or pure sulphur. The gen-ral opinion is that the fifth fire was caused by a static park. Everyone concerned was particularly interested n the cause of this fire, because it occurred in the dust ollector, a number of which are already installed in he starch, milling and other industries. It is of vital mportance that the hazard of explosions and fires be educed to a minimum in this equipment.

Dr. W. A. D. Rudge[4] has shown that any dust blown n a cloud imparts a charge of static electricity on each ust particle, the polarity and size of the charge depend-ng upon the chemical composition and fineness of the aterial. Sulphur and the sulphides when blown in a loud carry very strong charges of positive static elec-ricity. Since this particular grade of dry lime-sulphur ontained about 75 per cent of calcium polysulphide and per cent of free sulphur, it was concluded that a static harge of high potential must be accumulating on the ags of the filter type dust collector, owing to the fact hat large quantities of dry lime-sulphur were being lown from the drying chamber to the dust collectors.

Some preliminary readings were made with an elec-rometer to determine the difference of potential be-ween the filter bag and the shell of the collector which ad been thoroughly grounded. In some readings the tatic voltage exceeded 20,000 volts. It was found that y grounding one of the rings of the filter bag through copper wire, the static voltage would be decreased o 3,300 volts. The manufacturer had placed steel chains rom one end of the filter bags to the other, and ad attached both ends to the shell of the collector as means of grounding the filter bags. As a grounding edium the chain was very inefficient, owing to the igh resistance between links of the chain and to inade-uate contact with the bags. Under the circumstances would appear that the high electrical resistance of the ain was a fortunate condition; otherwise, static arks would have passed from the filter bag to the chain a very dusty atmosphere, causing explosion or fire.

Tests for Static Electricity

To obtain additional information on static electricity rmation and to devise definite methods of control, a mplete test was made on a similar equipment used in the manufacture of starch (See Table I). In compartment *A* the filter bag was not grounded and the wire to the electrometer was connected to the bag at a point midway between rings. In compartment *B* the bag was grounded with braided copper wire attached to all rings and to the top and bottom of the shell of the collector. In compartment *C* the bag was grounded with braided copper wire, sewed to the seam of the filter bag and both ends of the wire were thoroughly grounded to the shell of the collector.

The results of these tests showed conclusively that bags not properly grounded carried a high-voltage static charge while in operation, this voltage in some cases evidently exceeding 25,000 volts. In compartment *B*, where the grounding wire was attached to the rings of the filter bag, the charge was not completely carried off, a maximum of 5,000 volts being recorded in the last test. In compartment *C*, where the grounding wire was sewed to the seam of the bag, however, the bag was completely grounded. The electrometer in each of the six tests did not register any voltage.

A very interesting phenomenon was observed in the two cases where the filter bags were not thoroughly grounded. The instant the counter-current of air stopped flowing, the static charge would increase gradually until the bag started to shake, then drop to approximately 2,000 volts and remain there until the counter air current came on, at which time it would immediately drop to zero. This would seem to indicate that the charge which each particle of dust carried was not deposited on the bag, but was retained by the starch. In the sixth test, the wire to the electrometer was attached to one of the rings of the bag which was not grounded in compartment *A*. In this case the average reading was over 10,000 volts, showing that a high difference in potential existed between the ring and shell of the collector.

TABLE II—STATIC VOLTAGES NOTED ON DUST COLLECTORS IN DRY LIME-SULPHUR FACTORY

	A Chain in Stocking	B Chain in Stocking	C Wire Sewed On Bag	D Wire Sewed On Bag	E Chain in Stocking	Remarks
1	0	0	0	0	0	Not in operation
2	0	0	0	0	0	Cold air only
3	0	0	0	0	0	Temp. 122 deg. F
4	0	0	0	0	0	Temp. 173 deg. F.
5	1,300	400	0	0	0	Spraying started Collectors not shaking
6	0–5,000	0–2,000	0–200 (?)	0	0	Collectors shaking
7	10,000+	10,000+	200	0	3,500	Collector door open
8	4,500	0–1,500	0	0	200	Collectors shaking. Temp. 196 deg. F.
9	10,000+	10,000+	0	0	2,000–3,000	Collector door open. Temp. 196 deg. F.
10					0	Collector shaking
11					0	Open door

A—Steel chain through center of bag grounded to shell of collector. Wire to electrometer connected to first ring at bottom of bag.
B—Steel chain through center of bag grounded to shell of collector wire to electrometer connected to two copper wires placed around bag at first and second rings, copper wires connected electrically.
C—Braided copper wire sewed to bag along lengthwise seam. Wire to electrometer connected directly to bag at a point midway between bottom of bag and first ring and on side opposite to seam.
D—Braided copper wire sewed to bag along seam. Wire to electrometer connected to bag at a point midway between first and second rings and on side opposite to seam.
E—Steel chain through center of bag grounded to shell of collector. Wire to electrometer connected to steel chain.

[4] *Phil. Mag.*, vol. 23, p. 852 (1912), and vol. 25, p. 481 (1913).

A complete test was then made on the equipment used in the manufacture of dry lime-sulphur (Table II). These tests were made on one bag in each of five different compartments and under nine different conditions or phases of operation. In compartments *A*, *B* and *E* the test was made with a steel chain through the center of the bag. This was the method that had been used to ground the bags. In compartment *C* the braided copper grounding wire was sewed to the bag along the lengthwise seam, and both ends of the wire were grounded to the shell of the collector. It was known that the shells of all the collectors were thoroughly grounded. The wire to the electrometer was connected to the bag at a point midway between bottom of bag and the lower ring, and on the opposite side of bag from ground wire. In compartment *D* braided copper grounding wire was sewed to the seam of the bag and the wire to the electrometer was connected to the bag at a point midway between the first and second rings and on the opposite side of the bag from the ground wire. The wire to the electrometer in compartment *E* was connected to the steel chain.

No static charges were observed under the first four conditions of test—namely, when the plant was not in operation, when cold air was blown through the whole system, when air at 120 deg. F. was passed through the system and when air at 173 deg. F. was passed through the system. In test 5, where spraying had begun but the collectors were not shaking, static charges were observed on bags inadequately grounded by means of steel chains. In test 6, when the collectors were shaking, the static voltage increased almost instantly to a maximum of 5,000 volts on a bag which was inadequately grounded. It will be noted, however, that no static charge was registered on bags which were grounded with braided copper wire sewed to bag. In the seventh test, as soon as the door at the bottom of collector was opened, the electrometer registered a violent deflection over the graduated scale of the electrometer. This voltage was estimated at between 20,000 and 30,000 volts. In compartments *C* and *D* the ground wire carried off all charges. The remaining tests were repetitions of the preceding tests, for which they served as a check.

These results proved conclusively that under certain conditions extremely high static charges were generated and that these charges can be entirely eliminated by properly grounding the filter bags in the dust collectors.

SULPHUR DUST EXPLOSION IN EXPERIMENTAL GALLERY

Probably the most interesting phenomenon observed while making the tests was the fact that dry lime-sulphur builds up its static charge in a manner directly opposite to that of starch. In collecting dry lime-sulphur, a very small charge was observed when the bags were not shaking, but as soon as the shaking started it immediately built up to 5,000 volts in the bags which were insufficiently grounded with chains. When the door at the bottom of the collector was open, the voltage on these bags built up instantly to probably 20,000 or 30,000 volts, which is the reverse of the action of static charges on bags which were collecting starch dust.

Some tests were made to determine why the static charges on the filter bags collecting dry lime-sulphur did not build up gradually in the same manner that the static charges built up when collecting starch. A small installation similar to the dust collectors described was made. The filter bags were made from the same material as those used for collecting dry lime-sulphur and starch. The bags were insulated from the duct. The powdered lime-sulphur was passed through this collector at a constant rate and it was found that a static charge built up gradually to a maximum of 4,800 volts. The same condition was noted when a starch was used instead of dry lime-sulphur. It will be noted that the building up of the static charge when using dry sulphur in this test was similar to the way the charge built up in the starch collectors, and the reverse of the conditions observed in the dry lime-sulphur collectors. Since it was impossible to duplicate the static conditions as found in the dry lime-sulphur plant, it seems very probable that the difference in conditions was caused by the grounding chain used in the collectors at that plant. It was also discovered that dry lime-sulphur readily attacked the braided copper grounding wire. It is recommended that aluminum, brass, lead or steel grounding wires be used instead of braided copper wire.

Sulphur Dust Explosion

A disastrous explosion occurred recently during the collecting of powdered sulphur in the grinding section of a chemical plant. In this explosion six men were seriously injured. The equipment for grinding and the separation of the different sized particles of sulphur had been designed to operate continuously. Owing to the fact that several fires had occurred in the grinder, the grinder was operated only part of the time and the ground sulphur was bagged. The grinder was then stopped and the ground sulphur was dumped into the suction type pneumatic separating system. The sulphur was passed through a cyclone dust collector, where all particles less than 200 mesh were removed. The rest of the sulphur was carried to a filter type dust collector, where it was removed.

According to a number of workmen, the explosion occurred at the bottom of the filter type dust collector. The explosion propagated through one section of the filter type dust collector, then through the main trunk into the cyclone collector, which was completely destroyed. The explosion propagated from the cyclone collector through the trunking system to the point where the sulphur was being fed into the main trunk, at which point several feet of trunking were destroyed. An investigation showed that one end of the screw conveyor under the filter bag dust collector had become loosened. The probable cause of this explosion was the rubbing of the loose end of the conveyor on the metal jacket which produced sparks that caused the initial explosion. The explosion may have been caused by

static sparks discharged from the bag of the dust collector to the shell or hopper of the collector, and this initial explosion may have also loosened one end of the screw conveyor.

The photograph shows a sulphur dust explosion in the experimental gallery of the Bureau of Mines at Pittsburgh, Pa.

To prevent dust explosions caused by static electricity, it is essential to ground thoroughly all equipment on which charges of static electricity may be generated or accumulated. There are on the market several very efficient static detectors which can detect a difference of potential as low as 300 volts. These are valuable not only to detect static charges but also to make certain that the charges are being carried off after the equipment has been grounded.

Leaching Copper Ore With SO_2

A FEW years ago members af the Bureau of Mines experiment station at Tucson, Ariz., under the direction of C. E. van Barnevelt, made some tests on carload shipments of mill tailings and crude ores from that vicinity, having in mind the possibility that leaching by SO_2 might be utilized to increase the copper recoveries. So much success attended their efforts that the Miami Copper Co. built a 100-ton SO_2-leaching plant which was operated intermittently during 1919 and the early portion of 1920 under the personal direction of a member of the Tucson station staff. The feasibility of SO_2-leaching on copper oxides, carbonates and finely disseminated metallic copper was fully demonstrated. Certain silicates of copper occurring in the Miami ore in the form of a dilute solution of copper silicate in quartz proved quite refractory. Sulphuric acid appeared to dissolve these silicates much more readily. The SO_2-leaching plant at Miami was closed at the end of February, 1920.

When the Bureau of Mines entered the copper-leaching field the New Cornelia leaching plant at Ajo was in operation. The designers of this plant took advantage of all the accumulated knowledge on the subject of sulphuric acid-leaching and copper-refining practice and utilized the best available engineering ideas to design and build a 5,000-ton leaching plant for the treatment of their oxidized ore. Difficulties developed in the operation of the plant, attributable to soluble impurities in the ore, principally iron. An intermediate reduction process was installed to reduce the ferric iron to the ferrous condition. This alleviated but did not cure the trouble, and there is still a considerable loss of electric current. However, the New Cornelia plant was considered not only a commercial success but a decided advance on former practice. The recovery of copper ranges between 80 and 85 per cent. Three-quarters of the copper recovered is electrolytic copper and the remainder cement copper.

Coincident with the experimental work at the Miami Copper Co.'s mill, the Inspiration Copper Co. erected a 30-ton experimental sulphuric acid-leaching plant. The two mines adjoin and the ores are very similar. The Inspiration ores have the advantage over New Cornelia ores in that the amount of soluble iron is negligible. The Inspiration research staff did not venture afield outside of known practice. They did, however, take full advantage of available knowledge on the subject, with the result that they greatly simplified procedure and worked out what appears to be a highly efficient and economical sulphuric acid-leaching process. Decided advance was made in electrolysis. The absence of impurities in the ore permits the use of a very low electrolyte containing around 1 per cent copper, as against 3 per cent copper at New Cornelia. Furthermore, it was found possible to strip the discard solutions by electrolysis, thus avoiding the necessity of precipitation on iron, the entire product being electrolytic copper.

The great improvement of Inspiration results over New Cornelia results interested the Miami Copper Co. to the point of deciding to undertake similar experiments on its ores, with this modification: It was proposed to leach finely ground ore (48 mesh) as against coarse ore ($\frac{1}{4}$ in.) at Inspiration. This involved investigating the possibilities of filtration of acid pulp, and it was decided to close down experimental work on SO_2 leaching. The Miami sulphuric acid experimental leaching work has not been brought to a conclusion, though the experimental plant is temporarily closed.

In the meantime a small-scale pilot drum has been constructed at Tucson which has been developed to the point where it permits very nice control of all the variable factors. The apparatus not only gives qualitative results but gives a very dependable quantitative index. Recently, a decided advance has been made in the dissolution of the hitherto refractory silicates so that the SO_2-leaching process compares favorably with the best sulphuric-acid leaching results reported on these ores.

In 1920 the Arizona Copper Co. erected a 25-ton plant at Cliffton for leaching copper ores with SO_2. This plant began operations on June 1, 1920, and was closed down on April 15, 1921, in conformity with a rigid policy of retrenchment which resulted in closing all the Clifton operations. The Clifton work to date has fully demonstrated the applicability of SO_2 leaching to these ores. The average extraction by SO_2 about equals extractions obtained on parallel sulphuric acid work. On ores having high acid-soluble gangue content, SO_2-leaching results are particularly favorable. Former sulphuric acid-leaching tests on this material indicate a consumption of 8 lb. of acid per pound of copper recovered, equivalent to an acid cost of 4c. per pound of copper. It is estimated that the ratio of sulphurous acid (H_2SO_3) to sulphuric acid (H_2SO_4) required is 1.5 to 1 and that sulphurous acid can be made by roasting local concentrates, at about 0.06c. per pound, which is practically one-tenth the cost of sulphuric acid figured at $10 a ton. The reagent cost in SO_2 leaching would therefore be only 15 per cent of the reagent cost in sulphuric-acid leaching.

Manufacture of Salt in 1921

Census reports show a decrease in the activities of the establishments engaged in the manufacture of salt during 1921 as compared with 1919. The total value of products reported for 1921 amounted to $32,539,107, and for 1919 to $37,513,821, a decrease of 13.3 per cent. There were corresponding decreases in the number of persons employed and in the amount paid during the year for salaries and wages, but there was a slight increase in the cost of materials. Michigan, the leading state in the industry in 1921, produced 31.3 per cent of the total value of products in that year.

The combined output of all establishments was approximately 66 per cent of the maximum capacity, based upon a demand requiring full running time.

Synopsis of Recent Chemical & Metallurgical Literature

Inclusions and Ferrite Crystallization in Steel

Experiments with an open-hearth rail (analysis: C 0.55, Si 0.06, P 0.014, S 0.13, Mn 0.85 per cent) are recorded by E. G. Mahin.[1] Microscopic examination showed a banded ferrite structure, with many inclusions thought to be manganese sulphide. A cupric reagent also shows excessive phosphorus banding. This steel, when quenched from above the transformation range, showed uniform martensite—evidently slow cooling is necessary for the accumulation of ferrite, a conclusion verified by quenching samples which were furnace-cooled to various temperatures in the transformation range. The first ferrite to appear borders inclusions. However, inclusions and their ferrite shells are located indiscriminately within and without phosphorus bands.

Another sample heated for 3 days at 1,100 deg. C. under fusible glass revealed neither ferrite nor phosphorus banding in transverse or longitudinal directions. The heat-treatment coarsened the grain enormously, but did not affect the location and shape of the inclusions, nor the fact that they were still surrounded by ferrite.

Mahin concludes that while phosphorus is largely responsible for the existence of ferrite bands after ordinary heat-treatment, as held by Stead in several papers before the British Iron and Steel Institute, this is certainly not the reason for the persistence of ferrite shells about the inclusions, remaining even after long heating under carbonizing conditions.

To substantiate his hypothesis that this persistent structure was due to traces of the inclusions (or the products of the reaction which formed it) existing in a small volume of the surrounding steel, Mahin and Hartwig conducted further experiments.[2] A bar of rolled carbon steel containing 0.53 per cent of carbon was cut into disks 1 in. thick. These were drilled with ⅛-in. holes, using no lubricant. Clean rods, slightly oversize, of various metals, were then driven into these holes, and the plugged disk heated in a closed muffle at 850 deg. C. for 7 hours, cooling in the furnace. Alloys such as aluminum bronze, white metal, die-casting alloy, stellite, high-speed steel, manganese steel, chromium steel and nickel steel were used for plugs. Heat-treatment always produced a band of ferrite of greater or lesser thickness in the carbon steel at the junction. The conclusion is set forth that certain chemical elements of the high-alloy insert diffuse across the junction, enriching the carbon steel in that immediate neighborhood and so disturbing the solubility of carbon in austenite that ferrite precipitates in those impure portions somewhat above the normal recalescent temperature. This first ferrite to appear acts as a nucleus of crystallization and attracts a considerable mass of ferrite, forming subsequently.

Oxidation is held to have no influence on this decarbonized ring for several reasons. Ferrite production seems to be a minimum where contact between plug and carbon steel is poorest. The insert is never decarbonized. Furthermore, the action is too extensive to be referred to the minute amount of oxygen which could be retained. (In fact, pearlite grains reach the borders of actual cavities found at the junction, any carbon removed by gas being apparently replaced by diffusion.) Likewise, a high-phosphorus steel plug will produce a high concentration of phosphorus in the carbon steel, as can be shown by Stead's reagent. Finally, some inserts have given no ferrite bands.

That diffusion is easily possible across the junction is shown by the fact that a plug of Armco ingot iron shows a ferrite band on the sheath and pearlite at the plug.

Finally, in another paper,[3] Mahin and Brewer show that the electrode potential of the ferrite shell is 0.471 volt, while a corresponding value for ferrite in the unaffected body of the carbon steel is 0.522 volt. This is further evidence that the shell is more impure than the main body.

[1] *J. Ind. Eng. Chem.*, vol. 11, p. 739 (1919).

[2] *J. Ind. Eng. Chem.*, vol. 12, p. 1019, (1920).

[3] *J. Ind. Eng. Chem.*, vol. 12, p. 1095 (1920).

Doherty Washer-Cooler as a Water-Gas Condenser

In a paper presented at the 1922 convention of the American Gas Association at Atlantic City, F. W. Steere, of Detroit, Mich., described the use of the Doherty Washer-Cooler as a water-gas condenser. The Doherty Washer-Cooler method of direct condensation he defined as the process of cooling gas by bringing it in direct contact with its own recirculated condensate, the heat from the condensate being removed before recirculation. The apparatus required is a gas-tight tower with nozzles and connections, a spray-header for distributing the recirculated liquor, grids for bringing about contact between the gas and the liquor, a continuous tar and liquor overflow, a pump for recirculating the liquor, and cooling coils, or other means, for removing the heat from the recirculated liquor.

The gas to be cooled enters the washer-cooler tower at the hot gas inlet and passes upward through the grids in direct contact with the recirculated liquor. This recirculated liquor, after cooling, is sprayed over the grids at the top of the tower and runs by gravity over the surface of the grids to the bottom of the tower, where it is collected in the reservoir in the base.

In the theoretical ideal machine, the recirculated liquor in the base of the tower would be raised to the temperature of the incoming gas, and the gas at the outlet of the tower would be cooled to the temperature of the recirculated liquor at the top of the tower. Local conditions determine how close to these figures it is practical to go.

Data Required for Washer-Cooler Design

The success of the washer-cooler depends on the accuracy with which every part is designed and proportioned for the particular problem in hand. There is no such thing as a standard plant. This is obvious from the varying nature of the conditions encountered in every locality. The tendency in designing gas-works equipment is usually to "play safe." This invariably results in an unbalanced plant and an excessive charge for power and maintenance. Gas saturated with water vapor contains a known quantity of heat at all temperatures and the removal of this heat from the gas and its subsequent dissipation is all susceptible to very accurate figuring.

To determine the maximum demand on the washer-cooler, it is essential to have the data on two conditions—

First, The demand on the plant during the period of highest cooling water temperatures.

Second, The maximum hourly demand on the plant.

With these points determined, it is possible to design a condensing plant which will reduce the temperature of the gas to the lowest temperature possible under prevailing conditions.

Saturation Temperature

The real problem in cooling gas is not in cooling the gas itself, but in removing the heat carried by the water vapor. It is of the greatest importance that fairly accurate information be available on the water vapor saturation temperature of the gas to be cooled. Observations indicate that the saturation temperature of water-gas rarely exceeds 185 deg. F.

In water-gas plants it is found more suitable to locate the washer-cooler tower after the relief holder and get the benefit of the atmospheric cooling resulting from the high temperature in the relief holder. The importance of this is evident because 22,400 B.t.u. must be removed per 1,000 cu.ft. of gas in reducing a saturated gas from 19[illegible] to 185 deg. F. This is almost as much heat as must be removed in cooling

1,000 cu.ft. of gas from 160 deg. down to 90 deg. F.

Another advantage of placing the washer-cooler tower after the relief holder is obtaining a uniform flow through the condensing system without the variations resulting from the intermittent nature of the water-gas process.

Washer-Cooler Tower

The diameter, or cross-sectional area, of the washer-cooler tower cannot be figured until the design of the grids is determined. The space in the tower which is occupied by the grids reduces the gas capacity or the available cross-section of the tower to the extent of their volume. The grids, for this reason, should have the lowest possible volume in proportion to their surface.

Properly designed board grids have been found most effective for use in the washer-cooler tower. The grids must be constructed to have sufficient mechanical strength to support their weight after becoming waterlogged and to eliminate the possibility of their squashing over and closing off the gas passages. The bottom edges of the grids should be serrated to insure a uniform distribution of the cooling liquor throughout the entire height of the machine. The importance of keeping the entire surface of the grids uniformly wetted cannot be overemphasized, as dry surfaces will tend to accumulate solid matter.

With ¼-in. grids spaced ½ in. apart, the washer-cooler tower should have a minimum cross-sectional area of 1 sq.ft. for each 8,300 cu.ft. of gas passed per hour. A vertical height of 30 ft. of grids is about the minimum that can be used to bring about a complete heat transfer between the cooling liquor and the gas and at the same time thoroughly scrub the gas. These figures do not apply to volumes less than one-half million cubic feet per 24 hours, nor for handling gas through extreme temperature ranges.

Distributing Liquor Over the Grids

Since the gas outlet is at the top of the washer-cooler tower and the cooling liquor is introduced at the top, any tendency to fog the liquor as it enters the tower will result in an excessive carrying over of the liquor with the gas. The best design of spray header distributes the liquor over the entire cross-section of the machine as nearly as possible in the form of a rain, the larger the drops the better. The nozzles delivering the liquor should be placed below the level of the gas exit.

Cooling Coils

The first factor to be determined in cooling coil design is the rate at which heat is transferred through the walls. This, of course, depends somewhat on the design; but in any design the laboratory figure for the rate of heat transfer is higher than the figure which should be used for commercial operation. Experiments lead us to believe that a heat transfer of 1 B.t.u. per minute per square foot per degree of mean temperature difference is a safe figure for commercial operation. It must be noted that this figure is based on the mean temperature difference and not on the average temperature difference.

Cooling coil stacks may be either single-pipe or double-pipe. The liquor usually passes through the coils in single-pipe stacks and the cooling water over the outside. Double-pipe stacks are made by putting one pipe inside the other, with the liquor to be cooled passing through the annular space between the pipes. The cooling water flows through the inner pipes and over the outer pipes. The double-pipe stack is not recommended for water-gas cooling, as it is more liable to stoppage and not as accessible as the single-pipe stack.

In the ideal stack, using the countercurrent principle of heat transfer, the cooling water is raised to the temperature of the liquor to be cooled as it leaves the bottom tube, and the liquor is cooled to the temperature of the cooling water. If the stack is too high, the lower pipes of the stack are inoperative, as this temperature equilibrium has been attained before the cooling water reaches the bottom of the stack. If the stack is not high enough, the cooling water leaves the stack before it has been raised to the temperature of the incoming liquor.

The heat can also be taken from the recirculated liquor by passing it over the cooling coils instead of through the cooling coils. This requires an extra pump unless the cooling coils can be placed at a sufficiently low elevation so that the hot liquor can run over the coils by gravity. The cooling water is then run through the coils and this heated water, under pressure, can be utilized for other purposes without repumping.

When the cooling water passes over the coils, there is also a cooling of the cooling water resulting from evaporation. Under conditions of low humidity, this atmospheric cooling may amount to as much as 25 per cent of the total cooling. It should not, however, be taken into account in the calculations for those parts of the world where high humidity and high atmospheric temperatures may occur simultaneously.

Atmospheric Cooling

The heat may be extracted from the cooling liquor by atmospheric cooling. This may be done either in an atmospheric type of cooling tower, in a forced draft type of cooling tower, in a cooling pond or in a combination of these schemes which may fit in with local conditions.

With cooling coils, a washer-cooler tower with the smallest possible cross-sectional area should be always used. This means a lower first cost, and at the same time insures the highest possible heat transfer efficiency. With atmospheric cooling, a larger and more expensive washer-cooler tower is desirable and in many cases necessary. The reason for this is obvious when we recall that a given quantity of liquor is required to wet the grids irrespective of the quantity which may be required to take up the heat in the gas. If the cross-section of the washer-cooler tower is increased, thereby increasing the quantity of liquor required to wet the additional grids, the liquor at the bottom of the tower will be at a proportionately lower temperature, because there is more of it to absorb the same quantity of heat. The mean temperature difference, therefore, between the liquor to be cooled and the cooling medium is correspondingly lower. When cooling coils are used, this condition is serious, as there is a direct relation between the cooling surface required and the mean temperature difference. With atmospheric cooling of the recirculated liquor, the lower temperature of the liquor to be cooled is an advantage. This follows from the fact that as the temperature range through which the liquor must be cooled increases, the expense of the equipment and cost of power rapidly increases.

With atmospheric cooling, there is no cooling water required from any outside source. From this standpoint, atmospheric cooling has a distinct advantage. On the other hand, the mist, saturated with tar and oil vapors, which is given off during the process of atmospheric cooling, carries about the plant and the surrounding district. In spite of the most careful baffling, this at times is very disagreeable. If the plant is located in a settled district, this may result in serious complaints from the neighborhood.

On plants where cooling water is not available in sufficient quantities and where direct atmospheric cooling of the recirculated liquor is objectionable, a very satisfactory combination can be effected by using an atmospheric cooling tower for removing the heat from the water used over the coils. The only cooling water required with this arrangement is the make up to replace that lost by evaporation and windage.

One very interesting fact becomes apparent from a study of any condensing and cooling problem—that is, the key of the design of the entire condensing system is the design of the grids in the washer-cooler tower. This is obvious when we recall that the cross-sectional area of any tower is determined by the proportion between the area occupied by the grids and the free gas passages. The size of the tower, in turn, determines the quantity of recirculated liquor required to wet the grids. The quantity of recirculated liquor determines the temperature to which this recirculated liquor will be raised after passing through the tower. The temperature of the recirculated liquor directly determines the mean temperature difference available for cooling. The mean temperature difference is the factor which determines the number of stacks of cooling coils required. If atmospheric cooling is used, the same argument applies to the range through which the liquor must be cooled.

In conclusion, I might add that pos-

sibly the best proof of the fundamental soundness of this method of cooling and condensing gas is the fact that a great many plants have replaced their tubular condensers with washer-coolers, but I have yet to hear of a washer-cooler being replaced by a tubular condenser.

Rapid Sorting of Alloy Steels

M. Gallibourg presented a note before the French Academy of Sciences (Feb. 6, 1922) in which he proposed to distinguish between steels of equal hardness by measuring their contact e.m.f. against iron. A small pot of mercury, preferably kept at 120 deg. C., is needed. An ordinary galvanometer, potentiometer or delicate millivoltmeter is also required. Electrolytic iron wire is used for leads, the end of one being immersed in the mercury bath, and the end of the other welded to a water-cooled clamp.

Each piece of steel is first tested by the Brinell method and sorted into groups of approximately equal hardness. Every piece of steel of hardness 190-210, for instance, is then tested for contact e.m.f. by clamping each individually in the fixture and immersing the other end into the mercury bath. The latter acts as a heating medium and also establishes a perfect electrical connection. Within a few seconds the electrical indicator reaches equilibrium and a reading is taken. Steels having equal hardness and equal e.m.f. are quite certain to be of the same chemical composition; as a matter of fact, heat-treatment, which affects the hardness greatly, makes little or no change in the electrical characteristics. Only in rare instances would it be necessary to retest a group of steels having the same hardness and contact e.m.f. Such retesting should be done after normalization.

The Influence of Iron on Copper and Copper Alloys

In delivering his address as the chairman to the members of the Birmingham local section of the British Institute of Metals, of Oct. 10, Dr. F. Johnson took as his subject "The Influence of Iron on Copper and Copper Alloys." The following is a summary of the address:[1]

Copper—Iron up to 0.5 per cent deoxidizes, toughens and strengthens copper, even in the presence of arsenic. It is very detrimental to electrical conductivity and a very small quantity makes the metal paramagnetic and unsuitable for using in galvanometers. Copper is capable of holding about 3 per cent iron in solid solution.

Alpha Brass—There appears to be an overwhelming weight of opinion in favor of keeping the iron content low—say, 0.1 per cent—for the reasons that it increases (*a*) the casting difficulties, (*b*) the power required for mechanical operations, (*c*) the annealing costs, (*d*) the corrodibility. For special purposes—e. g., articles required to be stiff and springy—the addition of iron is advantageous, but it need not exceed 1.0 per cent for these purposes. Advantage might be taken of the influence of iron in raising the annealing temperature of cold-worked alpha brass to increase the convenience of the low-temperature annealing processes for the removal of internal stresses of cold-worked material. A slightly higher temperature of annealing would mean a shortening of the annealing period—an advantage in works practice.

Alpha + Beta Brass—Iron appears to serve a very useful purpose indeed in large castings of this type, particularly in reducing the grain size and improving the strength and toughness. The indications appear to be that the beneficial action is greater in the case of brasses in which the beta phase is in excess, and that 1 per cent need not be exceeded.

Beta Brass — The grain size is reduced, but no improvement in mechanical properties appears to accrue to castings. An improvement, especially in ductility, has been found to occur in the case of hot-forged and rolled bars. This may be due to retardation of recrystallization during the hot-working process.

Nickel Brass (Nickel Silver) — The addition of iron has been specially recommended for cutlery stock and extra hard springs.

Copper - Aluminum (Aluminum Bronze)—Iron up to 4 per cent has been found to be very beneficial in reducing grain size, retarding crystal growth and facilitating the production of die castings.

Admiralty Gunmetal—Iron up to 1 per cent does not appear to be detrimental if correctly alloyed. The mechanical properties are enhanced under such conditions, in the case of small chill castings.

In most of the alloys examined, the limit of solid solubility occurs at less than 1 per cent iron. In brass there are two forms in which the iron exists in excess of that entering into solid solution—viz., (1) As free iron-rich crystallites, globular or cruciform in shape. These are pale blue, but turn black when etched. (2) As very minute uniformly distributed dark-etching particles. As a rule, the beneficial influence of iron ceases at the degree of concentration at which the free crystallites appear.

[1] Reported in *The Engineer*, Oct. 20, 1922, p. 412.

Heat-Treatment of Gray Cast Iron

It has often been proposed to anneal gray iron castings in order to relieve internal strains and to machine more easily. Aging 2 months or more in the weather is also resorted to—corrosion will eat through hard spots on the skin at the same time.

J. E. Hurst has presented an article in *The Engineer* (July 4, 1919) in which he concluded that Fe_3C in cast iron containing more than 1 per cent Si gradually decomposed at 550 to 600 deg. C., regardless of the amount of cementite originally contained. Lower silicon irons were found to be very stable.

E. Piwowarsky, in *Stahl und Eisen* (Sept. 28, 1922), took a gray cast iron (combined carbon 2.68, graphite 0.5, silicon 0.07), remelted part with steel scrap (resulting in combined carbon 1.0, graphite 1.5) and another part with 1 per cent Ni. To soften these irons they had to be quickly heated a little above Ac_1 (800 to 825 deg. C.) and cooled at 2 deg. per minute through the transformation—i.e., down to 735 deg. C. Annealing below Ar_1 did not graphitize the carbon.

A second paper in the same issue was written by E. Schütz. He used castings containing (after reheating) 3.1 per cent of graphite, 0.5 per cent combined carbon and 2.3 per cent Si. Such castings varied in Brinell hardness from 126 to 155, surface to center. Cementite in the eutectoid pearlite started to decompose in these castings after 24 hours at 500 deg. C., and the reaction was completed and hardness uniformly reduced to 130 after 3 hours at 650 deg. C., or 24 hours at 600 deg. C.

Importance of Alloy Steels

A striking illustration of the present importance of alloy steels is given in production statistics recently issued by the American Iron and Steel Institute. Despite an extremely low tonnage for the whole industry in 1921, the relative amount of alloy steel remained very close to its record 1919 figure.

TABLE OF PRODUCTION OF STEEL INGOTS AND CASTINGS AND OF ALLOY STEEL INGOTS AND CASTINGS IN THE UNITED STATES. (000 omitted)

	Total Steel, Gross Tons	Alloy Steel, Gross Tons	Alloy Steel of the Total, Per Cent
1909.....	23,955	181	0.75
1910.....	26,094	567	2.17
1911.....	23,676	481	2.03
1912.....	31,251	792	2.53
1913.....	31,300	714	2.28
1914.....	23,513	646	2.75
1915.....	32,151	1,021	3.17
1916.....	42,773	1,362	3.18
1917.....	45,060	1,644	3.65
1918.....	44,462	1,787	4.02
1919.....	34,671	1,481	4.27
1920.....	42,132	1,660	3.94
1921.....	19,743	809	4.10

Spontaneous Hardening During Brinell Test

In a letter to the editor of *The Engineer* (Oct. 20, 1922, p. 408), P. V. Vernon gives some results on various commercial steels. After making the usual test with a 10-mm. ball, he made a second test at the center of the indentation, using a 1-mm. ball. His results follow:

	10-mm. Ball Hardness	Hardness at Center of Impression
Mild steel.....	128	170
0.40 per cent carbon steel...	302	341
0.80 per cent carbon steel...	223	228
Chromium-vanadium steel.	183	192
Nickel-chromium air hardening steel annealed.....	228	228
Nickel-chromium air hardening steel annealed.....	212	212
Ditto, hardened, 800 deg. C.	512	512
Ditto, hardened and tempered, 600 deg. C.....	269	269
High-speed steel annealed....	255	285
Ditto, hardened.....	627(±10)	683
Gunmetal.....	80	115
Copper.....	75	80

Book Reviews

THE MINERAL INDUSTRY DURING 1921. VOL. XXX. Edited by *G. A. Roush* and *Allison Butts*. Cloth, 6¼ x 9½ in. 895 pp. McGraw-Hill Book Co., New York, 1921. Price, $10.

It is a favor to the reading public not familiar with it to be informed regarding the "Mineral Industry." It is the only publication of its kind. Its object is the compilation annually of reviews of the progress during the preceding year in the different fields of mining and metallurgy. Authorities in various lines, after the calendar year has been completed and the statistics and data in the various geological and governmental reports are authentic, contribute articles on the general and economic phases of the industry, thus bringing together under about fifty headings, arranged alphabetically, accurate data on the different subjects, which include Abrasives, Fuels, Metals, Jewels, Precious Stones, and covering these both from the production and economic standpoint. The volume is international in its scope.

Engineers, economists and statisticians accept the publication as a matter of course and regularly add it to their library; but because of the fact that it is issued annually and the first cost seems high, its circulation is relatively limited. It is most probable that there are a large number of people interested in metallurgical products who would greatly appreciate such a book if its merits were brought to their attention; in fact, the writer showed this volume to one of the principal purchasers of one of our precious metals who had never seen it and his criticism was most favorable.

The 43 contributors to the volume include professors, statisticians, consulting engineers, government employees and authorities along various lines, the most of them contributing regularly.

The volume is necessarily published somewhat late after completion of the calendar year, as the governmental statistics must be complete and authentic and also because of the time required by the contributors to arrange the subject matter.

The value of a reference book containing accurate statistics and the possible errors that might occur from using figures containing preliminary reports as to data is illustrated by the fact that the writer has on his desk an annual publication of metal statistics published early in the year and for which a supplementary report was issued in July, correcting certain annual production figures to the extent of about 6 per cent.

The last volume of the "Mineral Industry" is of great interest at a time when industrial conditions are becoming more normal; it shows the lessening of production of metals and materials which were produced in more than normal quantities during the war and also shows the increased production of industrial materials used in times of peace. We look forward with interest to the publication of the volume covering the year 1922.

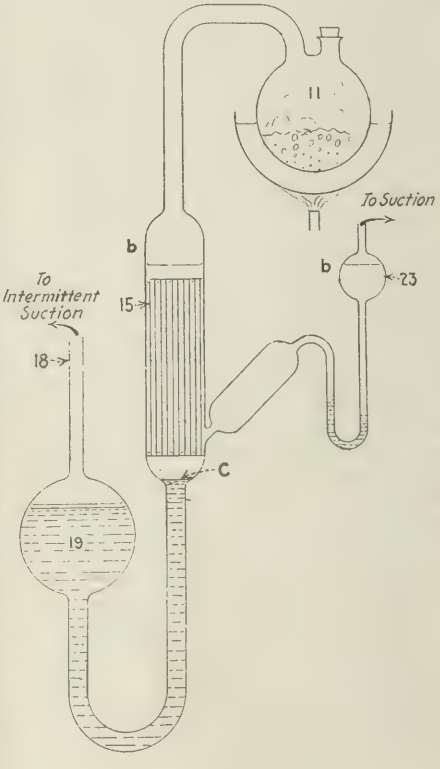
MARSHALL S. WALKER.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Separating Aqueous and Other Vapors From Solids and Fluids — In this patent Dr. Otto Maass, of Montreal, points out that the absorption of water by dehydrators, particularly sulphuric acid, is relatively slow under normal conditions, but if the dehydrators are spread out in thin films, the absorption is extremely rapid. An illustration is given herewith of the laboratory apparatus which was used in this work. The liquid to be evaporated is placed in vessel 11, and vessel 19 contains the dehydrator, in this case sulphuric acid. The principle of operation consists of applying suction at both 18 and 23. First, this causes a diminution in the pressure inside the vessel, then atmospheric pressure is let in at 18, and the liquid rises to a point approximately equivalent to *b* in the diagram. Suction is then applied again at 18, and this draws the liquor down to a point approximately *C*. This acts simply to evacuate the system completely and to saturate the walls and surfaces in vessel 15 with the sulphuric acid. Pressure then becomes sufficiently low so that evaporation takes place at a very low temperature. This is facilitated by the absorption of the vapor evolved in vessel 15 by the sulphuric acid. The process is repeated as long as desired. The application in industry would consist in the evaporation of substances which require low temperature of evaporation due to their easy decomposition in atmosphere—for example, H_2O_2. (U. S. Pat. 1,417,618.)



Method of Conducting the Ammonia-Soda Process—Edward E. Arnold and Palmer St. Clair have conceived the scheme of using liquid ammonia and liquid carbon dioxide as cooling media instead of water in ammoniating and carbonating towers. They object to the complicated water piping systems necessary to effect cooling of the ammonia and carbon dioxide absorption processes in the ammonia-soda process for sodium carbonate. A great deal of water has to be used, and in summer, in many localities, this is unsatisfactory, as the water supply is apt to be fairly warm. By introducing liquid ammonia and liquid carbon dioxide, they would materially cut down the quantity of cooling liquor necessary, because the latent heat of vaporization of the two substances would be equivalent to a relatively large quantity of water in producing equivalent quantities of available heat.

An advantage lies in the fact that leaks in the cooling system would have no harmful effect. Take, for example, the cooling of the carbonating towers with liquid carbon dioxide. Suppose there were a small leak in the cooling system. It would mean the escape of small quantities of carbon dioxide gas into a tower in which carbon dioxide gas was being absorbed. The patent has been assigned by the authors to the Nitrogen Corporation of Providence, R. I. (U. S. Pat. 1,423,510. July 25, 1922.)

Making Low-Boiling Hydrocarbons—Benzol, toluol and other low-boiling hydrocarbon oils are the products obtained from various permanent gases in the process patented by Clive M. Alexander and assigned to the Gulf Refining Co. Natural gas, still gases and various other gases made by heating oil, etc., are submitted to a high temperature, specified as 500 to 100 deg. C. and under a pressure of 50 to 100 lb. A molecular rearrangement takes place to form vapors of the low-boiling or liquefiable hydrocarbons. The patentee states that catalysts may or may not be used in his process. Their presence, however, is often useful, since they lower the necessary heat and pressure. Most of the common metals have the power of catalyzing the operation. Copper, nickel, cobalt, iron, etc., or their oxides may be used. In order to present a larger surface for action and to distribute the heat more uniformly, the heating zone may be provided with some inert carrier material, such as diatomaceous earth, saturated with a solution of one of the catalysts. (1,411,255; April 4, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, Eng.and.

Synthetic Tanning Agents—Soluble tanning agents are produced by condensing at least two molecules of an aromatic hydroxy compound with one molecule of formaldehyde, using an alkaline condensing agent, sulphonating the product with one to two molecules of sulphuric acid and then partly neutralizing. Crude cresol is given as an example of the aromatic hydroxy body; oxides, hydroxides, carbonates or bicarbonates of alkali and alkaline earth metals, ammonia or alkaline salts such as sodium acetate are referred to as condensing agents; while as neutralizing agents, oxides, hydroxides or carbonates of alkali and alkaline earth metals, or ammonium hydroxide or carbonate, may be employed. Instead of formaldehyde, its polymers or compounds giving rise to it may be used; also the condensation may take place at ordinary or increased pressure.

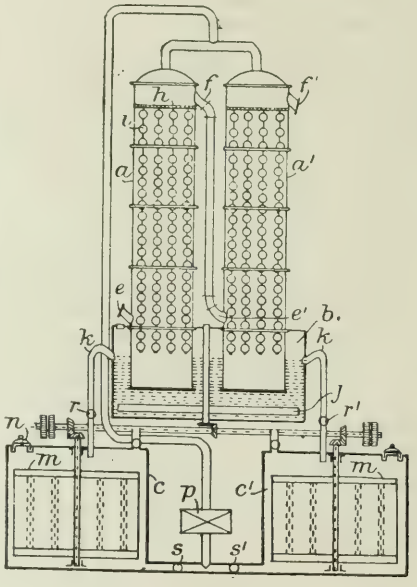
A separate specification covers a modification of the process, in which the sulphonation is followed by condensing the sulphonated resin with an aldehyde and an aromatic compound containing one or more sulphonic acid groups alone or in combination with hydroxyl or halogen groups before neutralizing.

The sulphonated aromatic compound used in the second condensation may comprise the sulphonated resin of the first condensation; and the aldehyde in the second condensation may be formaldehyde or its polymers, acetaldehyde or its polymers, trithioacetaldehyde, aldol or crotonaldehyde. For the partial neutralization, oxides, hydroxides and carbonates of alkali and alkaline earth metals, zinc and magnesium, and ammonium hydroxide and carbonate may be used. Crude cresol is given as the example of the aromatic hydroxy body employed in the first condensation; and crude cresol sulphonic acids and crude α- and β-naphthalene sulphonic acids are given as examples of the sulphonated aromatic body of the second condensation.

Both patents are assigned to McArthur & Co., Ltd., of Liverpool. (Br. Pats. 182,823 and 182,824. R. B. Croad, G. E. Knowles. Aug. 30, 1922.)

Artificial Silk—In the manufacture of artificial silk from solutions of cellulose acetate, nitrocellulose or other ester, ether or derivative of cellulose by a dry-spinning process, the spinning solution is composed of the cellulose ester and a mixture of one or more low boiling point solvents or liquids and a solvent or solvents of high boiling point, and the filaments or threads are drawn out during the spinning, the high boiling point solvent retarding the solidification of the filaments and facilitating the drawing out. Larger jet orifices can be employed for the production of a given denier. The use as high boiling point solvents of tetrachlorethane and like toxic chlorine derivatives is excluded. Suitable high boiling point solvents are acetone alcohol, acetylacetone, diacetone alcohol and cyclobutanone; such solvents are used in an amount not greater than 50 to 100 per cent of the weight of the cellulose ester. Acetone and methyl acetate are suitable low boiling point solvents, but the latter may be in whole or in part replaced by organic diluents of similar volatility. (Br. Pat. 182,166. H. Dreyfus, London. Aug. 23, 1922.)

Chlorates and Hypochlorites—Relates to the manufacture of chlorates and hypochlorites, more particularly the former, of calcium or magnesium by chlorination of the corresponding hydroxide, and to the preparation of potassium chlorate therefrom. A dilute suspension of calcium or magnesium hydroxide is chlorinated, to which fresh material is added from time to time, until a solution of chlorinated products of 60 to 64 deg. Tw. is obtained. For



example, milk of lime containing about 50 grams $Ca(OH)_2$ in suspension is prepared in the mixer *c*, agitated by the stirrers *m*, and, the valves r^1, s^1 being closed, is pumped by pump *p* to the top of the towers *a*, a^1, through which it descends into the vessel *b*. A distributing plate *h*, together with ebonite-coated glass balls *i*, serves to distribute the liquor and expose a very large surface to the action of the chlorine, while at the same time preventing the deposition of solid matter in the towers. Chlorine, of a suitable concentration, passes through the towers, entering at *e*, e^1 and leaving at *f*, f^1, as shown. The liquid in the vessel *b* is agitated by the stirrer *j* and returns by the siphon *k* into the mixer *c*. Thence it is again circulated through the towers. As the chlorination proceeds, fresh lime is periodically introduced into the mixer *c* through the inlet *n*. The temperature during chlorination is kept below 70 deg. C. by using diluted chlorine, and, if necessary, by adding water to the liquor in the mixer *c*. The product of the process, a solution of calcium chlorate and chloride, and possibly hypochlorite, of 60 to 64 deg. Tw., is pumped from the mixer and filtered. If it is desired to prepare potassium chlorate, potassium chloride, in an excess of 2 per cent over the theoretical amount, is added, and the bulk of the chlorate permitted to crystallize at atmospheric temperature. The mother liquor is diluted, if necessary, until there is present preferably 45 to 50 grams calcium chloride in 100 grams of water, when the liquid may be cooled to —20 deg. C. to separate further quantities of potassium chlorate, without simultaneous separation of ice or of calcium chloride. It is convenient to connect the outlet f^1 of the apparatus to a similar apparatus in which comparatively fresh milk of lime is being treated. Then when the liquor circulating in the first unit has been completely chlorinated, the valves *r*, *s* are closed, and the partly chlorinated lime in the second unit is pumped into the mixer c^1 for treatment as described above. Preferably, however, the conveyance of liquor is avoided by reversing the order of the units, and conducting the chlorine first to the second unit and then to the first unit, the mixer c^1 of which contains fresh milk of lime. The chlorine mains are provided with connections which permit this procedure, the connections not being shown in the diagram.

The process may be applied to the production of concentrated hypochlorite solutions. (Br. Pat. 183, 671. M. Wilderman, London. Sept. 20, 1922.)

Urea—In the manufacture of urea by forcing a mixture of ammonia and carbon dioxide into an autoclave, the gases are brought to the necessary pressure by expelling either or both of them from solutions capable of giving them off, by means of heat. By way of example, a concentrated solu- of ammonium carbonate or carbamate is forced into a heated column, the gas mixture produced passed through a cooler at about 110 to 150 deg. C., and the condensate run into an autoclave, where it is heated at 130 to 150 deg. C. until the conversion into urea no longer proceeds. The autoclave may be filled and discharged either at intervals or continuously, or the process can be carried out with single charges when the column is replaced by a pressure-resisting vessel. The unconverted gases are expelled from the urea solution and used, together with fresh gases, to saturate the exhausted liquid from the column for further use. The gaseous ammonia and carbon dioxide may be generated in separate columns —for example, from aqueous ammonia and sodium or ammonium bicarbonate solution respectively—or one of the gases may be forced into the autoclave by means of a compressor. (Br. Pat. 182,331. Badische Anilin und Soda Fabrik, Ludwigshafen-on-Rhine. Aug. 23, 1922.)

Tantalum—The use of tantalum for vessels used in the preparation, distillation or concentration of hydrogen peroxide is covered. (Br. Pat. 184,153 not yet accepted. Chemische Fabrik Weissenstein Ges., Carinthia, Austria Sept. 27, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Few Changes Likely Under Elastic Tariff—Blackstrap Error Adjusted

THE TARIFF COMMISSION began active operation of the flexible tariff section of the new act Nov. 9 when it received preliminary reports from its advisory board on fourteen applications for changes which had been filed with it and acted upon five of them. No rates of major interest are involved in the first fourteen preliminary reports, it was announced.

Thus far, seventy-two applications for changes in the new tariff act have been filed with the commission. Of these, twenty seek changes in classifications, which naturally would affect duties. Fifty-two applications seek direct changes in figures in paragraphs of the act, twenty-nine asking decreases and twenty-three asking increases.

Chemical Schedule Protested

The chemical schedule is affected by the second largest number of applications, ranking next to the agricultural schedule, with the sundries third. Five of the applications in the chemical schedule ask that the basis of valuation for assessing duties be transferred from foreign value to American value. This cannot be done under the act unless the Tariff Commission should find and report to the President that a change of 50 per cent upward on the basis of foreign valuation would not equalize the cost of production.

None of the chemical applications was included in the reports of the advisory board first submitted. Definite announcement of the commodities or products affected by the applications has not been made and will not be until the commission decides whether to proceed with an investigation or to dismiss the application.

It is expected that the commission will start an investigation before Dec. 1 of some commodity among the applications in order to get the full machinery of the act under way and to determine the value of the section and its workability.

Blackstrap Muddle Adjusted

The Treasury Department has issued instructions to customs collectors to collect an additional duty of one-sixth of a cent per gallon on blackstrap molasses testing above 52 per cent total sugars only on the percentage above 52. This order clarifies the situation created by a previous interpretation of the molasses paragraph of the new tariff.

An order along the lines originally proposed by the department would have created a prohibitive rate on blackstrap testing between 52 and 56 per cent total sugars and would have meant that before such molasses could be imported for use in stock feed it would have to be diluted to bring it below 52 per cent, which would have meant heavier tonnage in this class of imports and consequent heavier expense to the importers. The situation arose through failure of the tariff conferees to make an insertion of three words in the molasses paragraph, which was reframed by special resolution after the tariff bill had been adopted by both houses of Congress.

The Treasury's decision is to interpret the paragraph in accordance with the obvious intent of Congress and to keep the clause in question in harmony with the remainder of the paragraph.

Perplexing Problems

Several perplexing questions with regard to the imposition of the so-called flexible provisions of the new tariff act remain to be decided by the commission. One of the most important is whether the tariff body is authorized to change rates in the case of imports which have no counterpart in American production. The guide laid down by Congress for rate adjustment is the difference in the costs of production at home and abroad, but manifestly in such cases such differences cannot form the basis for a decision.

Potash From Kelp Established as Commercial Enterprise

Not only is there every indication that the kelp-potash plant established by the Bureau of Soils for experimental purposes at Summerland, Calif., will be a permanent commercial enterprise, but plans already are being made for its enlargement. The plant was purchased by the United States Kelp Products Co. after it had been operated for experimental purposes by the Bureau of Soils since 1917. Potash is now being produced at the plant at the rate of 5 tons a day. The principal product, however, is kelp char, which is in much demand as a substitute for bone-black as a bleaching agent.

J. W. Turrentine, who was in charge of the plant for the Department of Agriculture and who has been in charge of its operations since their inception, has returned to Washington to take up anew his research work on potash.

Deterioration Tests on Calcium Arsenate

Quality Not Affected by Age, According to Bureau of Chemistry

No practical possibility exists of change in the chemical composition of calcium arsenate during storage. This conclusion has been reached by the Bureau of Chemistry after exhaustive studies on the keeping qualities of calcium arsenate. The detailed description of the tests and the analyses on which the conclusions are based are being printed and will be available in December.

Commercially Important

The question of whether or not calcium arsenate deteriorates during storage has been a controversial one. This point is of special importance to the Federal Insecticide and Fungicide Board, not only because the material must be carried over from year to year by farmers and dealers but because the information is necessary in the enforcement of the insecticide act. If material which analyzes improperly is found in the possession of a cotton farmer, it must be known whether or not there is any possibility of this material having been of correct composition when it left the factory and having deteriorated since that time. Under the insecticide act, prosecutions can be made only when the material is shown to be of improper composition when it entered interstate commerce.

Test Conditions

In making these tests certain lots of material were held in storage at the laboratory of the insecticide board for 6 years and have been analyzed at intervals throughout that period. Other special tests were made of material which had been exposed to extreme conditions during storage. In one series of tests barrels were left standing partly open, totally exposed to the weather, for 11 months. During that time the physical character of the material was altered by rain, but the chemical analysis remained practically the same.

Stocks of calcium arsenate were purchased from eight of the principal manufacturers, selected as representing the principal methods of production. In each case one barrel of the material was left intact in the original package, while the remaining stock of each manufacturer was divided among ten different types of containers, representing all the types used commercially for shipping calcium arsenate.

Midgley Addresses New York A.C.S. Section

Describes Development of Anti-Knock Compound for Gas Engine and Theory of Gaseous Detonation

Before a large and enthusiastic audience in Rumford Hall, on Friday, Nov. 10, Thomas Midgley, Jr., described the now well-known work of the General Motors Research Corporation on "Gaseous Detonation and Its Control." It was substantially the same address which he delivered before the Pittsburgh meeting of the American Chemical Society. The apparatus for the demonstration of the efficacy of anti-knock compound which was used at Pittsburgh was lacking, but the deficiency was more than made up by the delightfully informal and extemporaneous delivery.

Improving Fuel Economy

Mr. Midgley began at the beginning and described the efforts made by different departments to increase the efficiency of internal combustion engines as applied to the automobile. The mechanical engineer would improve the mileage per gallon of fuel by decreasing the gear ratio, but would cut down the potential acceleration of the car and decrease its power on hills. The expert in thermodynamics would increase the compression ratio, but this causes knocking. It looks as if a practical solution of this problem must come from the chemist.

With the aid of his ingenuous revolving chart, the speaker described his conception of the mechanism of internal combustion and gaseous detonation. He derived mathematical expressions showing the relation between the pressures on both sides of the explosion face. The equation contains a constant term. If this constant term could be increased or decreased by the use of a catalyst or, in other words, the reaction velocity changed, it would be possible to use a high pressure in the cylinder without causing knocking. "Wouldn't it be a beautiful scientific achievement," he asked, "if, having derived these equations and shown how a catalyst might change the constant term, we should then simply find the proper catalyst? As a matter of fact, that was not how it was done. We found the substance first, and made up the mathematics afterward."

Story of Development

Early in the investigation of motor fuels there was a theory, which, although it proved short lived, was a good theory—not because it was true, but because it led to results. The theory was that fuels which gave gaseous detonation did so because they were not completely volatilized in the explosion chamber. It was believed that as the gas was compressed, the boiling point of the suspended globules of fuel rose, and although the temperature was continually rising at the same time, it never got high enough for the liquid globules to ignite. Acting on this theory, it was decided to add some coloring matter to the fuel so that it would absorb radiant energy and upset the thermal equilibrium. "We went to the stockroom," said Mr. Midgley, "and asked for an oil-soluble dye." "They did not have any, so they handed out the first thing that came to hand. It happened to be iodine. We made up some brown, some purple and some black gasoline, tried it out, and found that it did not knock. The theory was proved. The same day we got some oil-soluble dye and made up gasoline of the same color with it. It had absolutely no effect on the gaseous detonation. The theory was shot to pieces.

Cut and Try Research

This, however, was the beginning of a series of tests using every element and compound which was available in the laboratory stockroom. Aniline proved to be much better than iodine. Later, tellurium proved to be better than aniline. Up to this time, however, none of the anti-knock compounds tried were commercially practical on account of their high cost and their relative scarcity. Sufficient evidence, however, had been collected by this time to enable the investigators to present the efficacy of various compounds by reference to the periodic table and it was as a result of this line of investigation that lead tetra ethyl was tried out and found to be superior to anything that had been tried before as well as being a commercial possibility."

The talk aroused a great deal of discussion in which Wilder D. Bancroft and J. C. Olsen took part. The ready wit of the speaker made the discussion most interesting and amusing, and on the whole, it was the most human and entertaining meeting that has been held in Rumford Hall for many a day.

Chicago Ceramic Society Plans Annual Meeting

Program Covers Enamel Defects, Smelting Furnaces, Production Planning, Proposed Ceramic Engineering Course

Anticipating a record attendance for its sixth annual meeting, which will be held on Saturday, Dec. 2, at the Morrison Hotel, Chicago, the Chicago section of the American Ceramic Society is planning a meeting with numerous discussions on subjects of live interest to those who will attend.

Briefly, the program now scheduled is to include a discussion on defective enamels by B. T. Sweely, Cribben-Sexton Stove Co. Mr. Sweely spent several months in Washington recently on enamel research work and is well qualified to give a very instructive talk on sheet steel or cast-iron enameling. H. E. Davis, ceramic engineer of Northwestern Terra Cotta Co., will describe a new type of smelting furnace of interest to both enamel and terra cotta manufacturers. A representative from a firm of industrial engineers which has done work in the ceramic industries on glass, enamel, pottery and brick plants will speak on some phase of production. A representative of the Chicago Board of Education will tell of the efforts being made to establish a course in ceramic engineering in the new Crane Junior College just completed. The establishment of such a course would be of great value to the ceramic industries in the vicinity of Chicago, and manufacturers of that section ought to be vitally interested in the discussion that will take place at this meeting.

The event will open with a luncheon at the Morrison Hotel at 12:30 Saturday, Dec. 2, the program following immediately after luncheon. All persons interested in ceramics are cordially invited to attend this meeting.

New Italian Ambassador An Accomplished Engineer

Caetani Studied and Practiced in America—Distinguished Service in War Won Him Decorations

The appointment of Gelasio Caetani a member of the Chamber of Deputies of Italy, as Italian Ambassador at Washington has been received with interest by American engineers, among whom Prince Caetani has many friends.

He was graduated from the School of Mines of Columbia University in 1903 and went West, working as a miner, trammer, timberman and mill-hand at Stratton's Independence mine in Colorado, at the Treadwell in Alaska and at the Bunker Hill in Idaho. He carried through some important projects for the Bunker Hill & Sullivan Co. and later opened offices in San Francisco as a consultant. As a member of the firm of Burch, Caetani & Hershey, Mr. Caetani was engaged in important jobs, mostly in Montana.

Brilliant War Record

At the outbreak of the war Don Gelasio returned to Italy, and was made a Captain in the First Regiment, Royal Engineers. Before the end of the war he was a Colonel. The feat which won world-wide fame as an engineering exploit was the blowing up of the top of the Col di Lana, which destroyed an Austrian fort and opened the way for the Italian army through the Cordevole Pass in the upper Trentino.

After the war he combined business with politics and was elected to the present Chamber as a Nationalist. According to letters received by his American friends, the new Ambassador was one of the first of the Roman nobles to embrace the Fascismo—in fact, he is said to have enrolled himself among the original ninety Fascisti organized as a Roman cohort in 1920.

The choice of Prince Caetani as Ambassador is considered an admirable one, because of his familiarity with American affairs. The date of his departure for the United States has not been fixed.

Coal Commission Gets Down to Business

Dr. Smith Resigns as Director of Geological Survey to Serve on President's Committee

The fact-finding machinery being set up by the President's coal commission is now taking definite form. While the commissioners expect to get much of their information from the broad conclusions from outstanding men engaged in coal production, distribution, wholesaling and retailing, a vast amount of data must be collected by a technical staff. That portion of the work which deals with costs of production will be under the immediate direction of David L. Wing, whose title is to be expert investigator. As the work progresses, Mr. Wing will gather other statistical facts.

C. E. Lesher, editor of *Coal Age*, has been drafted to direct the engineering investigations which the commission will conduct. Coal specialists from various bureaus will be transferred to the commission.

Associations Will Co-operate

Assurances of co-operation have been given by each national association connected with the coal business. A statistical program is being worked out which it is believed will cause very little dissension. It is being arranged so that those engaged in the business can furnish the information in the way it is carried on their books. President Stephens of the Retail Coal Merchants' Association has conferred at length with members of the commission, and so has a committee representing the public utilities. More formal conferences are in contemplation. The one with the retailers is to be held the latter part of November. There is every evidence that the commission will have the whole-hearted co-operation of the whole coal business.

Where statistical and other information is furnished by one branch of the industry, arrangements are being made whereby the other branches concerned and the commission itself can check the figures as they are being compiled. In this way it is hoped to compile statistical data the correctness of which will be admitted by each branch of the industry.

Smith Resigns From Survey

Since the government's law officers decided that Dr. George Otis Smith may not lead a double official life, it became necessary for him to resign his position as director of the United States Geological Survey. After having discussed the matter personally with the President, Dr. Smith presented a formal resignation in which he, among other things, said: "Some plans I have had in mind for the betterment of the Geological Survey's contributions to the public are unfinished, even after my 5¾ years as director. I therefore regret this break in my work, yet while I hope I may have an opportunity for further service with the Geological Survey, I appreciate so keenly the importance to the nation of the task you have intrusted to the coal commission that I am willing to make any sacrifice needed to enable me to devote all my energies to that work for the next 11 months."

In his reply and in a statement issued at the White House, the President explained that Dr. Smith's resignation is of a temporary character and that he will be reappointed as director of the Survey when his duties with the coal commission will have been concluded.

Personnel Generally Approved

The same provision of law bars Judge Alschuler from serving in two official positions. The President will ask Congress to make an exception in this case, but until such a law is passed Judge Alschuler will not qualify as a member of the commission. He will work with the commission, however, in an informal capacity.

The Geological Survey comes in for praiseworthy mention in the recent editorial in the Philadelphia *Public Ledger*. In discussing the coal commission, the editorial says: "The appointment of George Otis Smith was an act for which Mr. Harding cannot be commended too highly. The Geological Survey is purely scientific, non-political, magnificently efficient and brilliantly administered."

The coal commission has been endeavoring since its organization to arrange for the appearance before it of both Secretary Hoover and Secretary Davis. Other duties of these Secretaries, however, have made this impossible.

American Foundrymen's Directors Organize—Accept French Invitation

The board of directors of the American Foundrymen's Association met in Chicago Oct. 3 and completed its organization by electing C. E. Hoyt secretary-treasurer, R. E. Kennedy assistant secretary. R. A. Bull, S. T. Johnston, L. W. Olson and Fred Erb, together with the president, vice-president and secretary, will constitute the executive committee of the board of directors for the coming year. S. Griswold Flagg, 3d, of Stanley G. Flagg & Co., Philadelphia, Pa., was elected a director to fill the vacancy caused by the death of J. P. Pero.

The directors provided for a permanent board of awards, consisting of the seven last living past presidents of the American Foundrymen's Association, Inc., with the junior past president as chairman of the board.

An invitation was received from the Association Technique de Fonderie, of France, inviting the A.F.A. to join with the foundrymen's associations of France, England and Belgium in an international convention and exhibit in Paris in September, 1923. The invitation was accepted and referred to a committee to be appointed by the president, who will represent the A.F.A. and determine to what extent the association will take active part in the proposed international convention.

Discusses Human Factor in Engineering

Personnel Association Urges Active Support of Technical Colleges by Industries

Co-operation with the engineering colleges, the public schools and industries of the nation in enlarged educational effort was urged by committees of the National Personnel Association in reports presented at the closing sessions of the first annual convention of the association in Pittsburgh last week.

"The present state of engineering education is one of active flux," said the report of the committee on relations with engineering colleges, consisting of W. E. Wickenden, American Telephone & Telegraph Co., New York; F. L. Bishop, dean of engineering, University of Pittsburgh; and G. H. Pfeif, secretary, educational committee, General Electric Co., Schenectady, N. Y.

"Educators and officers of industry are agreed that the demands of civilization on the engineer are becoming broader and call for a more fundamental and less specialized form of education. Engineers have achieved brilliant success in creating the machines and structures which make modern industry possible. They are now being called upon to give equal concern to the agencies of society which utilize this material equipment."

Human Element in Engineering

The committee stressed the importance of the "human factor" in engineering, saying:

"As engineers constitute an increasingly influential group in modern industry and government, all member companies are concerned that the schools shall ground them in sound principles and equip them with sound methods in their relations to social and economic questions. There is a need that engineers shall attack these questions with the same unprejudiced, fact-finding, analytical methods that they have used with such marked success on material problems. As a balance to these dispassionate, scientific methods there is an equal need among engineers for sympathetic insight into human motives and aspirations and an understanding of the principles which underlie governmental, business and industrial organization."

Industry Owes Support

"The engineering colleges have a strong claim on the assistance of the industries in return for services rendered," continued the report. "The schools have made inestimable contributions to scientific knowledge from which the industries have profited without cost. Education has increased earning power and so has made possible the markets on which many industries depend for existence. The colleges have expended on each engineering graduate from $800 to $2,000 above all fees received. The industries profit by this and would have to provide costly substitutes for it if it were not available."

Will Pass on Merit of A.C.S. Papers Before Meeting

Industrial Division Hopes to Improve Quality of Material Submitted

In order that more time can be given to the presentation and discussion of papers delivered before the industrial division of the American Chemical Society, it has been decided to ask all who plan to give papers before this division to submit completed manuscripts not later than March 1 to the secretary of the division. The manuscripts will then be sent to reviewers. Upon favorable recommendation of the reviewers and the officers of the division, the papers will be included in the final program of the division.

It has been felt for some time that something must be done to raise the standard of some of the papers which have been given before the division. In some cases old material has been redescribed under a new heading, which often was misleading. No doubt the new method will reduce the number of papers to be presented at any one meeting, but it is felt that a few genuinely good papers followed by a sufficient time for discussion will be what most chemists desire. At the Pittsburgh meeting there were so many papers on the program that a time limit of 7 minutes was allotted, with 3 minutes for discussion. This time proved to be so short that a speaker could not present the paper in the best manner possible, and the period for discussion was so short that there was practically no attempt on the part of members to discuss the subject.

Since the spring meeting occurs at New Haven April 5 to 7 inclusive, it is necessary for members of the American Chemical Society who are planning to present papers before the industrial division to send their papers on or before March 1 to Erle M. Billings, Kodak Park, Rochester, N. Y., secretary of the division.

Belgians and Germans Dominate European Cement Market

Belgian and German cement makers have succeeded through the policy of price cutting in almost completely arresting exportation of French cement in the last 3 months, according to reports received by the Iron and Steel Division of the Department of Commerce. The factories at Boulogne-sur-Mer, the largest cement-manufacturing center in France, are capable of producing 600,000 tons annually, or about three-fifths of the total French production. Conditions in this region are typical of the situation throughout the entire industry. It is estimated that the cement industry during the last week of July was working at about 80 per cent of normal, whereas the first weeks of the month it was only working at 70 per cent.

French exporters are still shipping a small quantity of cement which they are content to sell at the cost of production.

Efforts Needed to Improve Salary Standards of Government Chemists

A determined effort is being made to convince the Navy Wage Board that chemists in the naval service should be better paid and should be differently classified. The Wage Board is now in session considering revisions in the wage scale. Under the law, wages of the employees in the naval establishments must conform with those paid by comparable private establishments. In the case of chemists, it is particularly difficult to find chemists in private industry doing work of the same character. For that reason it is particularly hard to bring before the board convincing evidence as to pay in private industry. The situation of chemists in the navy is so bad that frequently their title is changed to "master mechanic" or "powder expert" so as to make it possible to pay them enough money to retain them in the service.

Revised Gasoline Specifications Approved

The Interdepartmental Petroleum Specifications Committee announces that its latest revision of the federal specifications for petroleum products was approved by the Federal Specifications Board on Oct. 31.

The one outstanding change in the specifications is in motor gasoline, the initial boiling point being lowered to 55 deg. C. and the 90 per cent point raised to 200 deg. When the specification for motor gasoline was last amended in 1919 it was hoped that the specification would be satisfactory for at least 2 years. It has actually been in effect 3 years and improvements in the refinery practice in this period have indicated that the specification could be modified to advantage. This has accordingly been done. The specification for domestic aviation gasoline has been modified to permit the use of cracked gasoline in cases where the material is to be used within 3 months. A corrosion test has been substituted for the doctor test in the specification for mineral spirits. Grade 2 of Liberty aëro and motorcycle oil has been dropped, as this oil is not being purchased at the present time. A few minor changes have been made in some of the other specifications.

The specifications in force previous to Oct. 31 are given in Technical Paper 305 of the Bureau of Mines, and the methods adopted by the committee for testing petroleum products in Technical Paper 298. It is planned to publish the revised specifications, together with the testing methods, as Technical Paper 323, which will be issued by the Bureau of Mines as soon as possible.

The Interdepartmental Committee held an open meeting on July 3, and comments and criticisms on the specifications and testing methods were considered, and such changes as were adopted are incorporated in the revised set of specifications.

Patent Office Still Swamped

Flood of Applications and Heavy Turnover in Personnel Pile Up Work

Despite enactment by Congress last spring of a bill readjusting salaries upward in the Patent Office and authorizing twenty-nine additional examiners and twenty-two clerks for the personnel, the work of the office is no more advanced in overtaking the number of pending applications than it was a year ago. This is attributed to a steady increase in applications for patents and extensions and to increase in applications for the registration of trademarks.

With the revival of industry, the Patent Office also is having difficulty in holding experienced technical men as examiners against the inducements of private employment. While 362 examiners are authorized, approximately a dozen vacancies exist because of inability of the Civil Service Commission to supply qualified men at the salaries offered.

It was stated at the Commissioner's office that within 49 working days twenty-two examiners submitted resignations. It is figured that it requires 6 months for a new employee to become accustomed to an examiner's work, so that resignations are especially serious when they affect this staff. Also, if two resignations come in a single division, two divisions are disturbed, as one new man is put in and an experienced examiner is transferred from some other division to fill the second place. In one division the examining staff now consists of two who have been with the Patent Office 3 years, two who have been there 2 years and three who have been there less than a year.

In several weeks this year the Patent Office has cleared more patents than it has received applications. The flood of applications which set in during and after the war, however, has made it difficult to speed the work as had been hoped for. Up until Nov. 1, 32,582 first patents had been issued for the calendar year, compared with 37,885 during the 12 months of 1921, which shows a higher rate of issuance this year. On Jan. 3, however, there were 60,244 cases up for action in the office and on Oct. 31 these had increased to 70,313. The greatest activity among applicants has been along chemical and electrical lines.

Large Industrial Alcohol Distillery Incorporated

The Canadian Industrial Alcohol Co., Ltd., was incorporated under Dominion Government charter on Oct. 27. The capital of the company is $10,000,000, and the main office is at Montreal. The provisional directors are: James Shaughnessy, a son of Baron Shaughnessy, former president of the Canadian Pacific Ry.; A. R. Holden, H. J. Hague and Chilton G. Howard. No announcement has been made as to the location of the distilleries or from what the product is to be made.

Fertilizer Association Boosts Soil Improvement

States Will Co-operate With Committee —Prizes for Best Fertility Programs

Of the twenty-six states embraced within the activities of the soil improvement committee of the National Fertilizer Association, twenty-four have completed arrangements to co-operate with the organization's soil fertility program plans and a number of county agents have registered for the work. One other state is expected to join and one has declined.

In order to interest county agents in surveying their fields to formulate a definite soil fertility program, the soil improvement committee has offered to defray the expenses of eight agents who can show the best organized work along soil-fertility lines in their respective counties to attend the 1923 meeting of the American Society of Agronomy. The agents are being reached through the extension work of the state experiment stations and register both with the station and with the committee.

The territory to be covered has been divided into four sections, each of which will have two trip-winners. Agents first will submit their programs to the state station, which will select the three best. The best three from each state will be judged by a committee comprising Director S. B. Haskell, Massachusetts Agricultural Experiment Station; Dr. A. G. McCall, in charge of soil investigations, Maryland Agricultural Experiment Station; Dr. Firman E. Bear, professor of agricultural chemistry and soils, Ohio College of Agriculture, and Prof. M. F. Miller, professor of soils, Missouri College of Agriculture.

The object of the plan is to promote more intelligent use of fertilizer by studying and analyzing the results of soil experiments and interpreting these results for the fertilizer industry and the farmers. The program will be judged according to their application to the needs of the section affected and naturally will not be of uniform character.

Surplus Smokeless Powder Transferred to Department of Agriculture

The director of sales announces the transfer to the Department of Agriculture by the Ordnance Department of 5,995,474 lb. of smokeless powder located at the following points: Woodbury, 6,520,100 lb.; Old Hickory, 25,-57,239 lb.; Curtis Bay, 184,897 lb.; Pinmatol, 428,250½ lb.; Seven Pines, 639,309½ lb.; Tullytown, 4,636,552 lb.; Charleston, 529,126 lb.

This transfer, with 5,000,000 lb. previously transferred to the Bureau of Mines, Department of the Interior, disposes of the entire stock of smokeless powder reported surplus to the director of sales, with the exception of 12,312 lb. which still remains surplus and available for sale.

Tendency Toward Federation in Engineering Growing

L. W. Wallace, executive secretary of the Federated American Engineering Societies, has completed a coast-to-coast tour, during which he set in motion plans for Federation expansion, stressing the great influence exercised by the Federation since its organization about two years ago under the presidency of Herbert Hoover and evidencing this by the report of its committee on the elimination of waste in industry, as well as by the report of the committee on work periods in continuous industry and by other substantial achievements. Mr. Wallace was attentively heard by large engineering gatherings in many cities. Everywhere, he reports, engineers are recognizing the enormous potentialities for technical and public service which reside in the Federation as the instrument of expression and action of the engineering profession in America.

New York Industrial Conference

"Elimination of Waste in Industry" will be the theme for discussion Wednesday, Nov. 22, at the sixth annual New York State Industrial Conference to be held at the Hotel Lafayette, Buffalo, for three days beginning Nov. 21. Mr. Wallace will deliver the opening address at the session, his topic being "Wasteful Industrial Habits." H. F. Simmons of the General Electrical Co., Schenectady, will speak on "How to Prevent Waste of Materials." Other speakers at the conference will include Gov. Nathan L. Miller.

Hoover Reiterates Attitude Toward Metric System

While believing that the metric system can be applied to good purposes in the scientific field, Commerce Secretary Hoover has in no way altered the opinion he has expressed on several occasions since assuming his portfolio. It is his opinion that there is nothing to justify the general application of the metric system at this stage of the country's development. When productivity is important, it would be unwise "to warp the brains of the country's mechanics" in their efforts to acquire the metric system, Mr. Hoover says. He thinks much of the propaganda for the metric system comes from a single indefatigable enthusiast.

First Iron Furnace in Central Pennsylvania 130 Years Old

The first iron-smelting furnace ever operated in central Pennsylvania, located on the outskirts of State College, was marked with a tablet under appropriate dedication ceremonies on Oct. 30. The furnace was constructed 130 years ago, as set forth on the bronze tablet, given by the State Historical Commission and the department of history of the Pennsylvania State College. Former President E. E. Sparks of the institution presided at the dedication ceremony, in which the students and faculty of the college participated.

Patent Board Formulates Policies

Regulations for Handling Patents Evolved by Government Employees

With the idea of drafting regulations establishing a policy to be followed by the federal government in the handling of inventions and patents evolved by government employees and other inventions and patents acquired by the government, regular meetings are being held by the Interdepartmental Patents Board. This board recently was set up by an executive order issued by the President. Any policy proposed by this board is to be presented, through the Secretary of the Interior, to the President for his approval. The regulations also will suggest a plan whereby information concerning patents, applications for patents, licenses and other rights under patents, owned by the government, may be disseminated to all the bureaus concerned.

At the present time the activities of the board are being concentrated on the collection of data which will furnish the basis on which any policy proposed will be founded. In the past little effort has been made to co-ordinate patent policies of the different federal bureaus. As a result there has been confusion and duplication. This, the board believes, can be obviated and plans made which will permit of a more intelligent and effective handling of all departmental patent matters.

Andrew Stewart, of the Bureau of Mines, is chairman of the Interdepartmental Board. Colonel Joseph I. McMullen, of the General Staff, is its secretary. The other members are: F. G. Cottrell, Fixed Nitrogen Research Laboratory; S. W. Stratton, director, Bureau of Standards, and Harry E. Knight, Department of Justice.

Mexico Encourages Development of Naval Stores Resources

American naval stores operators, according to advices reaching Washington, are paying increased attention to the possibilities of development of the industry in Mexico. Scarcity of turpentine timber and rising costs in this country, coupled with special inducements from Mexico, are encouraging experienced American operators to consider the establishment of enterprises there. In fact, American interests already are operating on a small scale in Mexico.

The acreage of turpentine timber in that republic is known to be large. It can be obtained at very low prices. Labor is cheap and some of the Mexican states are prepared to authorize tax exemptions to encourage the industry. On the other hand, there are the drawbacks of unsettled political conditions and the difficulties of transportation. The situation, however, is regarded as being of moment to the domestic industry, the prosperity of which is dependent to a considerable extent on the retention of its foreign markets.

Standardization Efforts of Department of Commerce

While the Simplification Division of the Department of Commerce is pressing lumber, hardware and containers as immediate objectives of a major nature, it is co-operating with trade organizations representing more restricted scope at the same time and plans are being laid for new fields of endeavor in 1923.

William A. Durgin, chief of the Simplification Division, was scheduled to address the National Paint, Oil and Varnish Association on Nov. 14 at its convention in Atlantic City to further the work of standardization which has been started by that organization. The association has under way a survey of colors and of containers which is expected to lead to more economical practices.

The American Salt Producers Association also will be addressed by Mr. Durgin while he is in Chicago. This association is looking toward simplification of containers. Mr. Durgin will also speak before the American Petroleum Institute in St. Louis on Dec. 6 on the subject of the same standards for oil well supplies and materials in the different fields of the country.

STANDARDIZATION OF CONTAINERS

One of the largest subjects taken up by the division is that of containers—metal, wood and pasteboard. This affects such a large number of producers and consumers that the division has assigned a special attaché to this subject. A general conference on containers will be held in Washington under the auspices of the Department of Commerce in January, and probably will occupy a week's time.

Washington Chemists Elect Officers

At the November meeting of the Chemical Society of Washington, W. M. Clark of the Hygienic Laboratory was elected president for the coming year; J. B. Reed and H. W. Houghton were re-elected secretary and treasurer, and councilors of the American Chemical Society were elected as follows: W. W. Skinner, R. B. Sosman, R. C. Wells, W. D. Collins and F. C. Cook.

The Washington chemists will join the Baltimore section on Friday, Nov. 24, for a visit to the new refinery of the American Sugar Refinery Co. in Baltimore. A special joint dinner will be held that evening at the Engineers Club, followed by a brief technical session.

Steel Treaters Organize Classes in Heat-Treating

Under the direction of the Indianapolis Chapter, American Society of Steel Treating, arrangements are being perfected for the establishment of a local class to meet at the Arsenal Technical School for studies in heat-treating of steel. The course has been designed for employees of local manufacturers, who are co-operating in the plan, and will be closely associated with the Purdue University Extension Department. Twenty persons have signified their intentions of entering the class, and it is expected that this number will be increased to fifty.

Civil Service Openings

The United States Civil Service Commission announces open competitive examinations for junior chemist on Dec. 6, 1922. Vacancies in the departmental service, Washington, D. C., at $1,200 to $1,800 a year will be filled from this examination.

Positions in the federal classified service throughout the country and the departmental service in Washington for laboratorians—chemical, physical and engineering—are also open and will be filled from applicants who take examinations on Dec. 6 and 7. Salaries range from $1,200 to $1,500 a year.

Both the above carry the additional $20 a month bonus for satisfactory service.

Agricultural Chemists Meet in Washington

Standardization of Analytical Methods to Be Attempted—Notable Speakers

Federal and state chemists engaged in agricultural and food chemical work throughout the United States will attend the thirty-eighth annual convention of the Association of Official Agricultural Chemists to be held in Washington, D. C., at the Raleigh Hotel, Nov. 15 to 17. Particular consideration will be given at this convention to agricultural chemistry with regard to the control laws affecting food and drugs, stock feed, commercial fertilizers, and insecticides and fungicides.

One of the chief objects which the association will attempt to accomplish at this convention will be a standardization of the methods used by the various analytical chemists engaged in the work at different stations, so that the findings of one station may be comparable to those of another station. The methods devised and recommended by the association have become quite generally used, but it is hoped that there will be a still further coordination of effort effected.

PROMINENT SPEAKERS

Approximately seventy-five subjects will be discussed in the 3 days' meeting by as many different chemists covering a wide range of work. On Nov. 16 the association will be addressed by Secretary of Agriculture Wallace, Dr. H. W. Wiley, honorary president of the association and former chief of the Bureau of Chemistry, and Dr. F. P. Veitch of the Bureau of Chemistry, United States Department of Agriculture, president of the association.

Senator E. F. Ladd of North Dakota, who is a chemist and was at one time head of the chemistry division of that state and president of this association, will also address the convention.

To Close Gap in Byproduct Coke Statistics

The U. S. Geological Survey has recently been getting a monthly report of byproduct coke output corresponding to the reports received during the war. However, figures have not been available for 1919 and 1920 and the Survey is now planning to get these data so that there will be a continuity of record from 1917 on.

The Survey is urging co-operation of the industry in this matter. It is recognized that the data are of very great industrial significance not only in the coke industry itself but also to metallurgical industries and fuel users generally. An early summary of the data is promised if prompt reply is received by the Survey.

Personal

BURTON T. BUSH and M. J. SEELEY of Antoine Chiris Co., New York sailed for Europe Oct. 24 on the Aquitania. They expect to return early in December.

GASTON DUBOIS, president of Monsanto Chemical Works of St. Louis sailed Saturday, Nov. 4, on the Maure tania for a business trip to England France and Germany. He expects t return late in December.

HUGH M. HENTON, consulting engineer, of Cleveland, Ohio, has arrived a Pullman, Wash., to succeed Prof. Chester G. Warfel, who died last summer as assistant professor of mining an metallurgy in Washington State College. Professor Henton has been connected with the Case School of Applie Science and with the South Dakot School of Mines, of which he is a grad uate. At one time he was director o research for the Aluminum Casting Co. of Cleveland.

SAMUEL L. HOYT, formerly metallurgical engineer in the experimenta engineering laboratory at Nela Park Cleveland, is now in the researc laboratory of the General Electric C at Schenectady.

Dr. GEORGE OTIS SMITH has resigned as director of the U. S. Geological Survey in order to qualify logically as member of the President's Coal Commission. The responsibility for th conduct of the Survey during the nex 11 months will be in the hands of Phili S. Smith, who has been the Survey's ad ministrative geologist.

Obituary

WILLIAM D. HOWE, vice-president of the Clark Chemical Co., of Denve Colo., died recently, at the age of 69.

CHARLES J. TAGLIABUE, president an founder of the C. J. Tagliabue Manufacturing Co., of Brooklyn, died r cently.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Distribution

This General Problem Is Being Intensively Studied Now Because of the Enormous Economic Waste Bound Up With It—What Will Be the Outcome?

WE HAVE reached an efficiency in production which has never been equaled before. It is possible for us to flood the country with almost any commodity within a short time. Production is almost too efficient. Small wonder that, in company with Herbert Hoover, business men have been turning their attention to distribution and its obviously wasteful methods.

A short time ago a manufacturer asked us to estimate the per cent which his effective sales effort represented of his total sales activity. We passed. "Less than 1 per cent," he announced. "Yet my salesmen are successful according to ordinary standards and well paid." This estimate may be lower than the average, but it is qualitatively representative.

Here is a real problem! What are we going to do about it? Is it reasonable to expect better results from the better use of the present tools? Let us suppose that we redistribute advertising on a new basis, plan selling effort more effectively, retain only the most efficient salesmen, revise credit terms. Can we raise the ratio of effective selling up to a reasonable figure of efficiency?

The Danger of Generalization

Any such question must be individual and specific. Very few generalizations are possible when it comes to problems of business procedure. Take, for example, the cry which has gained considerable force recently, "Away with the middleman! Let us have direct to consumer sales! It will save millions and reduce high prices!" It must be confessed that it has a logical sound. During a recent railroad strike many freight cars destined for New York City had to be unloaded in the suburbs. We recall a fleet of five or six beautiful Packard trucks which bore an inscription something like this:

Coogan & Mooney,
Commission Merchants,
Onions Exclusively
165 X St., New York City.

It was rather an overwhelming idea. Six beautiful trucks bespeaking great prosperity, all on commission selling of onions. The prosperity of such a company argued ill, it seemed to us, for an efficient distribution machinery in modern society. Were those trucks and the profits behind them a necessary tax on society? We felt not. So we grant, then, that it looks as though there was too much middleman occasionally.

The Other Side of the Picture

A young and enthusiastic executive once said: "Away with dealers! We will market our own products!" This he proceeded to do. A live sales manager and a flock of promising salesmen were procured and a great future was predicted. At the end of the year there were no increased profits. In fact it looked very much like a loss. "Why?" groaned the young executive. The dealers marketed a hundred products. They distributed their selling overhead over all of them. Consequently even assuming that their established clientèle was of no advantage whatever, they could distribute more cheaply than the producer with his fifteen products. The moral is: Do not fall into an easy way of talking about business problems by means of formulas. The middleman is not a menace to be eliminated. In some industries he is undesirable. He is often a very salutary influence. The problem of distribution will not be solved by eliminating him.

Some Methods of Tackling This Problem

Let us consider some possible ways and means of effecting distribution economy. First, there are the conventional methods of increasing efficiency in the sales department which have already been referred to.

Study advertising mediums and redistribute advertising effort.

Co-ordinate work more effectively with advertising.

Estimate individual efficiency of salesmen or dealers.

Consider possible variations in terms of credit.

Study changes in product or packaging to attract consumers.

And many other similar studies which have to do with the structure and policy of the department.

A second and exceedingly important method, as yet little tried, has to do with a study of economic conditions in a given district or trade. At the present time a sales manager hears from his salesmen that St. Louis is dead or that the metal-working business is poor. It is becoming increasingly possible for the sales manager to advise the salesmen from his office that St. Louis will be dead for several months or that the metal-working trade will be poor in a short time. This is not by guesswork or by tips, but by business statistics.

It will remind you a little of the White Queen in "Alice Through the Looking-Glass," who screamed terrifically and nearly fainted because she was going to scratch her finger. When she did prick it on a pin, she said: "See, I told you so!" So with statistics! We shall be able to predict depressions, local and national, and this will help to decrease the inflation and make the reaction less severe.

Changes Are Inevitable

Thus the sales manager will have to be an economist as well if he is to put his department upon the highest plane of efficiency. Distribution is and will be the major problem of industry during the next decade. The prizes for the courageous will be exceedingly great. Important and revolutionary changes are certain. This does not mean that they will be consistent—they may be fundamental in industries or in individual companies and yet the composite picture reveal but slightly the fundamental changes. Advertising is bound to be vastly different, with more science, more statistics and less general chatter about reaching markets and benefits accruing. Sales will probably become in general a producer-to-consumer proposition, but the middleman will still continue serviceable, often invaluable. Sales will have to be more intelligently, more deftly, guided. It is a quantitative era in distribution, and many pet nostrums will die of old age and their propagandists will look for clerical work.

"Chem. & Met." Weighted Index of Chemical Prices

Base 100 for 1913-14

This week	158.70
Last week	157.01
November, 1921	146.82
November, 1920	240
April, 1918 (high)	286
April, 1921 (low)	140

The advance in the index number is due to strengthening in the price of cottonseed oil primarily. It indicates, however, a continued strong healthy market. Reference to the market letters confirms this and reveals a weaker market in very few commodities.

The New York Market

NEW YORK, Nov. 13, 1922.

The general tone of the chemical market remained quite steady during the past week. Actual transactions were not as numerous as in previous weeks. However, spot material remained exceedingly firm, with buyers unable frequently to purchase desired quantities. Formaldehyde continued its upward trend and consumers were forced to pay top prices. Competitive selling has practically disappeared from the market and first hands were in control of any available supplies. The feature of the week's trading was again centered around commercial white arsenic. Manufacturers have announced a new advance and importers were quoting considerably higher for shipment material. All tin commodities have been advanced, due to the higher prices for the metal. Bichromates held quite steady. Prussiate of soda showed signs of weakness and prices were much lower in several important trading quarters. The alkali market recorded very little change and prices were firmly maintained among leading producers. Acetate of lead was again advanced on account of the higher prices for lead.

GENERAL AND SPECIAL CHEMICALS

Acetate of Lead—Makers have advanced all varieties ½c. per lb. The general range is as follows: Brown broken, 10½c. per lb.; white crystals, 12c. per lb. in casks; white granular, 12¼c., and white powdered, 12¾c. per pound.

Arsenic Oxide—Spot goods have been in limited supply and small lots sold as high as 11¼c. per lb., with the range around 11¼@11½c. per lb. Shipments were strongly maintained around 11c. per lb. c.i.f. New York.

Bleaching Powder—The spot market presented a quiet appearance, but large consumers showed an interest in contract deliveries. Several sales were recorded for contract over next year at 2c. per lb. f.o.b. works in large drums. Spot quotations are held at 2c.

Caustic Potash—Imported material showed some firmness and figures were fractionally higher around 6⅝c. per lb. for spot goods.

Caustic Soda—No important change has been noted in the export market and producers are holding prices at $3.60 per 100 lb. f.a.s. The domestic demand is routine at $3.75@$4 per 100 lb., ex-store.

Cobalt Oxide—Spot material was somewhat higher and demand seems to have materially improved. Black oxide is held around $2.10 per lb., with the gray ranging around $2.35@$2.40.

Copperas—The spot market is in an exceedingly tight position. Material at the works is moving at a very slow rate and consuming demand far exceeds the spot supply. Several sales were recorded at $28@$30 per ton for spot goods. Shipment material in bulk was quoted at $21 per ton.

Formaldehyde—The market is reported firmer in all producing quarters and 14c. per lb. seemed to be the general asking figure.

Prussiate of Soda—There has been a pronounced selling pressure in this product and prices were much lower on spot. Sales were reported as low as 21½c. per lb., although the general figure was around 22c. per lb.

VEGETABLE OILS

Linseed Oil—Lower cables for the seed resulted in an easier market for the oil. The general demand was somewhat quiet and distributors showed more desire for new business, the situation being greatly in favor of the buyer. Spot oil sold around 87c. per gal. in carload lots. Foreign oil sold in a small way at 86c. per gallon.

Coconut Oil—The market was a shade higher during the week. Spot Ceylon type oil, in barrels, held around 8¾c. per lb. November-December goods, for shipment from the coast, were quoted at 7⅞c. per lb., sellers' tanks.

Corn Oil—Crude oil on spot was in very limited supply and quotations were heard around 9¾@10c. per lb.

Rapeseed Oil—Although the demand was considerably weaker than in the previous week, prices were firmly held. Spot was 77c. per gal. in barrels.

CRUDE RUBBER

The continued strong demand from leading consuming quarters resulted in a much firmer market on all grades. Sales of smoked sheets were reported at 22¾c. per lb. on spot. Most interest was manifested in deliveries over the remainder of the year. Caucho ball upper, was quoted at 18¼@18½c. per lb. First latex crepe was also higher at 22¾@22⅞c. per pound.

Some Production Statistics for Sulphuric, Nitric and Mixed Acids

Reports made by the Department of Commerce show a considerable decrease in the activities of the establishments engaged chiefly in the manufacture of sulphuric acid, nitric acid and mixed acid during the year 1921 as compared with 1919. The total value of products reported for 1921 amounted to $20,529,000, and for 1919 to $31,470,000, a decrease of 34.8 per cent. Of the thirty-five establishments reported in 1921, five were located in New Jersey; five in Pennsylvania; four in Ohio; three each in California and New York; two each in Maryland and Virginia, and one each in Alabama, Arkansas, Colorado, Connecticut, Illinois, Kansas, Massachusetts, South Carolina, Tennessee, Texas and Utah. New Jersey, the leading state in the industry in 1921, produced 27 per cent of the total value of products in that year.

The decrease in the value of products has been accompanied by decreases in the number of persons employed, in the total amount paid during the year for salaries and wages and in the cost of materials used.

The statistics for 1921 and 1919 are summarized in Table I.

Detailed statistics of production for 1921 and 1919 are given in Table II. These acids are also produced to a very considerable extent by establishments primarily engaged in the manufacture of other products: Sulphuric acid by manufacturers of fertilizers, explosives, chemicals in general, and petroleum refineries; and nitric and mixed acids by manufacturers of explosives and chemicals in general. Hence the production here reported is not to be taken as representing total production. The table shows for 1919 the percentage which the production of establishments primarily engaged in the manufacture of these acids constituted of the aggregate production reported for all industries. Corresponding figures for 1921 are not available.

TABLE I—COMPARATIVE VALUE OF PRODUCTS AND OTHER RELATED DATA IN 1919 AND 1921 FOR SULPHURIC, NITRIC AND MIXED ACIDS

	1921	1919	Per Cent of Decrease*
Number of establishments	35	39	....
Persons engaged	3,139	5,860	46.4
Salaried employees	450	899	49.9
Wage earners (average number)	2,684	4,961	45.9
Salaries and wages	$5,243,000	$10,096,000	48.1
Salaries	1,317,000	2,179,500	39.6
Wages	3,926,000	7,916,500	50.4
Paid for contract work	....	48,000	....
Cost of materials	9,714,000	15,857,000	38.7
Value of products	20,529,000	31,470,000	34.8
Value added by manufacture†	10,815,000	15,613,000	30.7

* Percentage omitted where base is less than 100.
† Value of products less cost of materials.

TABLE II—PRODUCTION OF SULPHURIC, NITRIC AND MIXED ACIDS IN 1921 AND 1919

	1921	1919	Per Cent of Total Production, All Industries	Per Cent of Decrease
Total value of products	$20,528,900	$31,470,500	....	34.8
Sulphuric acid (basis 50° Bé.)—				
Tons (3,000 lb.)	1,457,500	1,685,300	50.6	13.5
Value	$15,332,700	$18,113,000	....	15.3
Average value, ton	$10.50	$10.75		
Nitric acid—				
Tons, (2,000 lb.)	2,110	3,150	16.2	33.0
Value	$363,700	$536,700	....	32.2
Average value, ton	$172	$170		
Mixed acid—				
Tons (2,000 lb.)	16,400	28,200	60.7	41.8
Value	$1,316,000	$2,671,500	....	50.7
Average value, ton	$30	$95		
All other products	$3,516,500	$10,149,300	....	65.4

The Chicago Market

CHICAGO, Nov. 9, 1922.

The industrial chemical market continued firm, with a good volume of business reported from most quarters. The tendency on most items is toward higher prices, but buyers are still somewhat reluctant to purchase very far in advance of their immediate requirements. There are no large stocks of any items on hand and buyers are even experiencing some difficulty in locating supplies of certain materials. Freight from the East is quite slow, and this is a factor which makes spot material bring a greater premium than usual over the New York market.

GENERAL CHEMICALS

Caustic soda was unchanged in price, with the market reported firm and supplies moving in a good volume. The ground 76 per cent was available in most quarters at $4.25 per 100 lb. and the solid at $3.50. *Caustic potash* maintained its firm position and a good movement was reported at 7¼c. per lb., basis 88-92 per cent. A good demand for *soda ash* was noted and the price was firm at $2.25 per 100 lb. for moderate lots in cooperage.

Potash alum was rather scarce and spot material was firmly held. The iron-free lump was available in small lots at 5½c. per lb. and the powdered at 6½c. Barium compounds were slightly easier and fair-sized spot stocks were available. *Barium chloride* was offered in one direction at $105 per ton and the *carbonate* from the same source at $90. There was but little demand for the *barium hydrate crystals* and spot material was available at 6½c. per lb. *Sal ammoniac* was in fair demand and the price was firm at 7¾@8c. per lb. for the white granular. *Ammonium carbonate* was quiet and spot material was quoted at 11c. per lb. in single-cask lots. *Bleaching powder* was in fair demand and the price was firm at $2.60 per 100 lb. for drums. *Copper sulphate* was available in fair lots at 6c. per lb. *Carbon tetrachloride* was reported to be in good demand and the price was firm at 9½@10c. per lb. *Carbon bisulphide* was still scarce on spot and what was available was held at 7½c. per lb. Due to the greatly increased price of methanol the price on formaldehyde was sharply increased 15c. per lb. in single-barrel lots. Only moderate supplies were available and a good movement was reported. *Furfural* was quoted at 25c. per lb. in ton lots. *Glycerine* was a trifle unsteady, although refiners maintained the price at 18½c. per lb. for the c.p. material in drums. *Lead acetate* was in fair demand and the white granular was quoted at 12½c. per lb.

Bichromates maintained their firm position and were reported to be moving in a good volume. *Potassium bichromate* was available at 12@13c. per lb. and the *soda* at 9@9½c. *Potash carbonate*, calcined, 96-98 per cent, was quoted at 8¾c. per lb. *Potash cyanide* was very scarce on spot and small quantities only were available at 55@60c. per lb. *Potassium nitrate* was reported to be moving well and the double refined granular was offered at 7¾c. per lb. delivered. *Permanganate of potash* was in fair request and supplies of the imported U.S.P. crystals were offered at 18@19c. per lb.

LINSEED OIL AND TURPENTINE

The market for linseed oil and turpentine was rather quiet the last 2 weeks and buyers were taking on only enough for their immediate requirements. *Turpentine* was slightly lower at the opening of today's market and single-drum lots were quoted at $1.69 per gal. *Linseed oil* was quoted today at 90c. per gal. for the boiled in single-drum lots and 88c. for similar quantities of the raw.

The Iron and Steel Market

PITTSBURGH, Nov. 10, 1922.

The thirty steel companies which make monthly returns of their ingot production show 2,872,415 tons for October, against 2,373,779 tons for September, representing an increase of 21 per cent, each month having had 26 working days. Allowing for the producers not making monthly returns, the rate of production in October was about 40,000,000 tons a year, 9 per cent higher than the rate in June, hitherto the best month of the year. Last month's rate was, indeed, the highest since October, 1920.

A continuance of the October rate for this month and next would bring out a calendar year production of a trifle under 34,000,000 tons, 75 per cent above the production in 1921 and more than 10 per cent above production in either 1912 or 1913, the two greatest tonnage years before the war.

STEEL SHIPMENTS IN EXCESS OF PRODUCTION

During September the steel companies were recovering from the effects of the coal strike more rapidly than was currently assumed, and during October the estimates as to the production rate were below that now shown by the actual returns. In the circumstances the disappearance of delivery premiums on bars, shapes and plates and the decrease in delivery premiums on sheets, the other commodity that had been showing delivery premiums, is readily understood. Much has been said about shortages of cars at steel mills for shipping finished products, but it is known that the small accumulations that developed in September and the first week or so of October have since been reduced, so that shipments in October were in excess of production.

Taking a long range view of the year, one does not see the appearance of there being as heavy steel consumption, in most lines, as was in evidence in 1912 and 1913. The only conspicuous exception is the automobile industry, but its consumption does not represent much more than 5 per cent of the total steel production. It is well to remember, as a collateral indication, that early in the year there was much disposition on the part of steel buyers to anticipate curtailment in steel production by the coal strike, and later it was fully expected that ending of the coal strike would be followed by such railroad congestion as would greatly interfere with the delivery of steel. In the retrospect it is plain that these influences have been of less amount than was expected.

WILL MILLS WITH LEAN ORDER BOOKS MAKE PRICE CONCESSIONS?

Having been under physical restrictions as to operations for many months, the steel mills are now anxious to operate and those that have relatively lean order books will be disposed to seek business by making price concessions. The advances in finished steel products from the low point early in March have been very divergent. Bars, shapes and plates, the cheapest commodities, have advanced about $13 a ton. Tubular goods, a more finished product, have advanced a trifle less than $10 a ton. Nails, at $2.70, are up only $6 a ton, except for there having been sales for a very short time at $2.25. Tin plate, now $4.75, has not advanced at all, except that early in the year the $4.75 price was being shaded rather generally by independents. Sheets, taking the Steel Corporation price of 3.35c. as a basis, are up $7 a ton from last March and $12 a ton from September of last year.

FINISHED STEEL MARKETS QUIET

The finished steel markets are quiet all along the line, and some products are decidedly dull. All mills are well sold for the time being and some are sold far ahead. Buyers are covered, and thus there is no necessity for market activity at the moment. Buying in September was largely by consumers who were not receiving adequate deliveries on their old purchases.

PIG IRON AND COKE

Production of merchant pig iron is now about one-half greater than it was in August. Deliveries are chiefly on old orders, there being very little current buying. Prices are, of course, in process of liquidation, but they decline slowly both because furnaces have old contracts they wish to protect and because, in the absence of important inquiry, energetic price competition is not promoted. Foundry iron has sagged $1 in the week, being now at $29 valley, while bessemer could probably be bought at $32 valley, $1 decline. Basic has shown no development and remains quotable at $29 valley.

Connellsville coke experienced another sudden weakening in the first 2 days of this week, losing 50c. to 75c. in furnace and about $2 in foundry. Furnace coke for spot shipment is $7.25@$7.50 and for shipment next week $7@$7.25, while foundry is $8@$9 according to brand. Production continues to increase. Furnaces now in blast are largely covered to the end of the year.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	—	$0.38 – $0.40
Acetone	lb.	$0.19 – $0.20	.20 – .22
Acid, acetic, 28 per cent	100 lb.	2.92½ – 3.00	3.05 – 3.20
Acetic, 56 per cent	100 lb.	5.85 – 5.90	5.95 – 6.25
Acetic, glacial, 99½ per cent, carboys,	100 lb.	11.16 – 11.20	11.25 – 11.50
Boric, crystals	lb.	.11 – .11½	.11¾ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	—	.51 – .52
Hydrochloric	100 lb.	.90 – 1.00	1.10 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11¾ – .12
Lactic, 44 per cent tech	lb.	.11 – .11½	.11¾ – .12
Lactic, 22 per cent tech	lb.	.06 – .06¾	.06½ – .07
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg.	lb.	.05 – .05½	.06 – .06½
Nitric, 42 deg.	lb.	.06 – .06½	.06¼ – .07
Oxalic, crystals	lb.	.15 – .15½	.15¾ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	—	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	—
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	—
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	—
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	—	—
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	—
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	—	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	—	.31 – .31¾
Tartaric acid, imported, powdered	lb.	—	.31½ – .32
Tartaric acid, domestic	lb.	—	— .32
Tungstic, per lb. of WO	lb.	—	1.00 – .110c
Alcohol, ethyl (Cologne spirit)	gal.	—	4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	—	.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.	—	.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04½
Alum, potash, lump	lb.	.03½ – .03¾	.04 – .04½
Alum, chrome lump	lb.	.05 – .05¼	.05¾ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¼ – .07¼	.07¾ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30¾ – .31
Ammonium carbonate, powder	lb.	.08¼ – .08¾	.09 – .09¾
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	—	2.35 – 2.50
Arsenic, white, powdered	lb.	.11¼ – .11½	.11¾ – .12
Arsenic, red, powdered	lb.	.12½ – .12¾	.13 – .13½
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	95.00 –100.00	102.00 –105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¾ – .22
Barium nitrate		.09 – .09½	.09¾ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04¼ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	—
Blanc fixe, pulp	ton	45.00 – 55.00	—
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)			
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	.27 – .38	.28½ – .35
Calcium acetate	100 lb.	3.00 – 3.15	3.20 – 3.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	—	1.40 – 1.50
Calcium phosphate, tribasic	lb.	—	.15 – .16
Camphor	lb.	—	.88 – .90
Carbon bisulphide	lb.	.07 – .07½	.07½ – .07¾
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	—	.60 – .75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	.04¼ – .04½	—
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	—
Chalk, precip.—imported, light	lb.	.04½ – .05	—
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05½ – .06	.06¼ – .06½
Chloroform	lb.	—	.35 – .38
Cobalt oxide	lb.	—	2.10 – 2.40
Copperas	ton	27.00 – 28.00	29.00 – 30.00
Copper carbonate, green precipitate	lb.	.21 – .21½	.22 – .22½
Copper cyanide	lb.	—	.58 – .600
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.504
Cream of tartar	lb.	—	.25½ – .26
Epsom salt (see magnesium sulphate)			
Ethyl acetate com. 85%	gal.	—	.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	—	.90 – .95
Formaldehyde, 40 per cent	lb.	.14 – .14¼	.14½ – .14¾
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	—
Fullers earth—imported powdered	net ton	30.00 – 32.00	—
Fuse oil, ref.	gal.	—	2.75 – 2.90
Fuse oil, crude	gal.	—	1.65 – 1.85
Glauber's salt (see sodium sulphate)			
Glycerine, c.p. drums extra	lb.	—	.18½ – .18¾
Iodine, resublimed	lb.	—	4.40 – 4.50
Iron oxide, red	lb.	—	.12 – .18
Lead acetate, white crystals	lb.	—	.12 – .12½
Lead arsenate, powd.	lb.	.13 – .13½	.13¾ – .14½
Lead nitrate	lb.	—	.15 – .20
Litharge	lb.	.07¾ – .08	.08¼ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07½
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.		1.00 – 1.80
Methanol, 95%	gal		.90 – .92
Methanol, 97%	gal		.92 – .94
Nickel salt, double	lb.		.11 – .11½
Nickel salt, single	lb.	—	$0.12 –$0.12½
Phogene (see carbonyl chloride)		—	—
Phosphorus, red	lb.	—	.40 – .45
Phosphorus, yellow	lb.	—	.30 – .35½
Potassium bichromate	lb.	$0.10 – .10½	.10½ – .11
Potassium bromide, granular	lb.	—	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06¼	.06¼ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07¾ – .08	.08¼ – .09
Potassium cyanide	lb	—	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.25 – 6.50	6.60 – 7.00
Potassium iodide	lb.	—	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.16½ – .16¾	.17 – .17¼
Potassium prussiate, red	lb.	—	.90 – .95
Potassium prussiate, yellow	lb.	.38 – .38¼	.38½ – .38¾
Rochelle salts (see sodium potas. tartrate)		—	—
Salammoniac, white, granular	lb.	.06½ – .06¾	.07 – .07¼
Salammoniac, gray, granular	lb.	.08 – .08¼	.08¼ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	—
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07¾ – .08	.08¼ – .08½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06¾ – .07	.07¼ – .07½
Sodium chloride	long ton	12.00 –13.00	—
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09¼ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09 – .09¼	.09½ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03¼ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	—	.18 – .21
Sodium prussiate, yellow	lb.	.21¾ – .22	.22¼ – .22½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lbs.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04¼	.04½ – .05
Sodium sulphite, crystals	lb.	.03¾ – .03⅞	.03⅞ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	—
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	—	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	—
Talc—domestic powdered	ton	18.00 –25.00	—
Tin bichloride	lb.	.10 – .10½	.10½ – .10¾
Tin oxide	lb.	—	.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07¾ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.29 — .31
Aniline oil, drums extra	lb.	.16½ — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.53 — .55
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.34 — .36
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.85 — .90
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12

Nitro-naphthalene	lb.	$0.30 —	$0.35
Nitro-toluene	lb.	.15 —	.10
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.80 —	.85
Ortho-nitro-toluene	lb.	.12 —	.15
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.32 —	.35
Pyridine	gal.	1.60 —	1.75
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.33 —	.35
Salicylic acid, U. S. P	lb.	.38 —	.40
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12 —	.14
Sulphanilic acid, crude	lb.	.24 —	.26
Toluidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices Remain Quotably Unchanged.

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.60 —	....
Rosin E-I	280 lb.	6.65 —	....
Rosin K-N	280 lb.	6.75 —	$7.15
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.60 —	1.61
Wood turpentine, steam dist	gal.	1.35 —	....
Wood turpentine, dest. dist	gal.	1.25 —	....
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.43 —	....
Rosin oil, second run	gal.	.51 —	....
Rosin oil, third run	gal.	.53 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Cardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.60 —	3.70

All Other Quotations Remain Same as Previous Report.

Crude Rubber

Para—Upriver fine	lb.	$0.24 —	.24¼
Upriver coarse	lb.	.18¾ —	.19
Upriver caucho ball	lb.	.18¼ —	.18½
Plantation—First latex crepe	lb.	.22½ —	.23
Ribbed smoked sheets	lb.	.22¼ —	.23
Brown crepe, thin, clean	lb.	.20 —	.20½
Amber crepe No. 1	lb.	.20 —	.20½

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12½ —	.13
Coconut oil, Ceylon grade, in bbls	lb.	.08½ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.08¾ —	.09
Corn oil, crude, in bbls	lb.	.09¾ —	.10
Cottonseed oil, crude (f. o. b. mill)	lb.	.08 —	....
Cottonseed oil, summer yellow	lb.	.11 —	.11½
Cottonseed oil, winter yellow	lb.	.12 —	.12½
Linseed oil, raw, car lots (domestic)	gal.	.87 —	.88
Linseed oil, raw, tank cars (domestic)	gal.	.84 —	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.88 —	.90
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07½
Palm, Niger	lb.	.06¼ —	.06¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¾ —	.09
Peanut oil, refined, in bbls	lb.	.12½ —	.13
Rapeseed oil, refined in bbls	gal.	.77 —	.78
Rapeseed oil, blown, in bbls	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09 —	.09¼

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$600 00	$800.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65.00 —	80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00 —	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24 00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	14.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin)ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	14.00 —	20.00
China clay (kaolin), imported, powdered	net ton	40.00 —	45.00
Feldspar, No. 1 pottery grade	long ton	6.50 —	7.00
Feldspar, No. 2 pottery grade	long ton	4.00 —	5.50
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	20.00 —	21.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	....
Kieselguhr, f.o.b. N. Y	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00 —	15.00
Pumice stone, imported	lb.	.03 —	.05½
Pumice stone, domestic, lump	lb.	.05 —	.05
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.66 —	.68
Shellac, orange superfine	lb.	.68 —	.70
Shellac, A. C. garnet	lb.	.70 —	.72
Shellac, T. N	lb.	.65 —	.66
Silica, glass sand, f.o.b. Indiana	per ton	1.75 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	17.00 —	17.50
Silica, building sand, f.o.b. Pa	per ton	2.00 —	2.75
Soapstone	ton	12.00 —	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00 —	17.00

Refractories

Quotations Remain Same as Previous Report.

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, c.i.f. Atlantic seaboard	ton	19 00 —	20.00
Coke, foundry, f.o.b. ovens	net ton	10.00 —	10 50
Coke, furnace, f.o.b. ovens	net ton	7.50 —	8.00
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	....
Manganese ore, chemical (MnO_2)	net ton	75.00 —	80.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00 —	8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	7.75 —	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.80
Aluminum, 98 to 99 per cent	20.00–21.00
Antimony, wholesale lots, Chinese and Japanese	6.60
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	37.00
Lead, New York, spot	7.00
Lead, E. St. Louis, spot	6.80–6.85
Zinc, spot, New York	7.40–7.45
Zinc, spot, E. St. Louis	7.05

OTHER METALS

Silver (commercial)	oz.	$0.66½
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	52.00@55.00
Mercury	75 lb.	72.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

GLASS—The Wichita Falls Window Glass Co., Wichita Falls, Tex., has resumed operations at its plant after a shut-down for the past 5 months, during which time extensions were made in a number of departments, with considerable repairs to machinery. Employment will be given to about 160 men.

The Pioneer Window Glass Works, Marietta, O., recently acquired by John B. Yates, vice-president of the Premier Glass Co., Pennsboro, W. Va., will resume production early in January. Improvements will be made in plant and equipment.

All glass plants are now in operation at Okmulgee, Okla., with the exception of the Graham Glass Co., specializing in the manufacture of bottles. The active factories include the Southwestern Sheet Glass Co., running at maximum output; the Interstate Window Glass Co., and the Baker Brothers Glass Co.

Plate and bottle glass plants in Belgium are now running full, with sufficient orders on hand to insure continuous production for some months. Crystal plants are operating under considerable curtailed output. Window glass plants are advancing manufacture and 20 furnaces are now producing, the largest number since the close of the war.

PAPER—The Forest Paper Co., Yarmouth, Me., is arranging for the immediate resumption of operations at its local plant, which has been inactive since early in March. Employment will be given to a near-normal working force, with increased wage scale.

The Fort Wayne Corrugated Paper Co., Fort Wayne, Ind., is maintaining full production at its mill at Hartford City, Ind., and has advanced the wage scale 10 per cent.

CERAMIC—The Thomas Maddock's Sons Co., Trenton, N. J., manufacturer of sanitary ware, is maintaining operations at its plant on a reduced working schedule, following a strike of skilled potters, affiliated with the union, due to a refusal to grant the wage increase demand of 20 per cent. Unskilled workers are being added to the force on a basis of 60 cents an hour for a 9-hour day, and guarantee of $40 a week for an 8-hour day in a few months after they become proficient.

A total af about 10,000 operative potters are out at the sanitary ware plants at Trenton, N. J., following the refusal of employers to meet a demand for a wage advance of 20 per cent. A total of 16 potteries in this city is affected.

The Elite Pottery Co. and the Van Pottery Co., Trenton, N. J., have resumed production at their sanitary ware plants, following an agreement with operatives for a 20 per cent wage increase, effective Nov. 1. Other plants that have met the demands of the men are the Ironsides Pottery Co., Bordentown, N. J.; Penn Pottery Co., Philadelphia, Pa.; Potomac Valley Pottery Co., Keyser, W. Va.; Wooster Sanitary Mfg. Co., Fredericksburg, O., and Clarksburg, W. Va.; and the Westcoast Sanitary Mfg. Co., Milbrae, Cal.

IRON AND STEEL—The Gulf States Steel Co., Birmingham, Ala., is maintaining capacity operations at 4 open-hearth mills and all finishing mills, with employment of regular working force.

The Carnegie Steel Co. is arranging for the immediate resumption of operations at its bar mill at Sharon, Pa.

The Pulaski Furnace Co., Pulaski, Va., is preparing to blow in its local blast furnace. The plant will advance production further at an early date.

The Woodward Iron Co., Birmingham, Ala., is now running full at all of its 5 blast furnaces for the first time in a number of years. Four of the stacks are producing foundry pig and the other basic material for Western steel mills.

The American Sheet & Tin Plate Co., Sharon, Pa., is arranging to start up at 10 additional hot mills at its local plant, making a total of 25 out of 30 in service. The working force will be increased by about 700 men.

The wage scale of union puddlers, Youngstown, O., has been increased from $8.93 to $10.12 a ton.

The Bethlehem Steel Co., Bethlehem, Pa., is now operating at about 80 per cent of capacity at its different mills.

All plants of the United States Steel Corp., in the vicinity of Sharon, Pa., are operating at normal production, giving employment to about 6,000 men.

The Crucible Steel Co., Syracuse, N. Y., is maintaining production on a 100 per cent basis. It is said that orders on hand insure continuance for a number of months to come.

METALS—The American Smelting & Refining Co. is making ready for the immediate blowing in of its furnaces at the Monterey, Mexico, plant. Employment will be given to more than 2,000 workers.

The Hercules Mining Co., Burke, Idaho, is planning for an immediate increase in production at its local plant, with important additions in the working force.

The Callahan Zinc-Lead Co., Cœur d'Alene, Idaho, has resumed production at its local plant after a shut down of about 24 months. The working force will be increased gradually until the regular quota of 350 men is obtained.

The Monterey Iron & Steel Co., Monterey, Mexico, is running full in all departments of its local mills.

MISCELLANEOUS—Fiber plants at Newark, Yorklyn, New Castle and Stanton, Del., are advancing production, with an increase of from 5 to 10 per cent in working force. Eight plants at Wilmington, Del., are now giving employment to approximately 2,000 workers.

The H. C. Frick Coke Co., Connellsville, Pa., is developing capacity production at its local plants, and is running higher than at any time since December, 1920.

The Corn Products Refining Co. is arranging to advance production to 85 per cent and higher at its refineries at Edgewater, N. J., Pekin and Argo, Ill., as compared with about 65 per cent of capacity during the past month. Plants are being improved and extended.

The Acme Mfg. Co., Acme, N. C., is arranging for capacity production at its fertilizer-manufacturing plant, following extensive additions and improvements.

All cement mills in the Lehigh Valley district of Pennsylvania are running at full capacity, with practically no reserves on hand. Current orders are absorbing all present production.

The United States Industrial Alcohol Co., Baltimore, Md., is operating at full capacity at all plants. New equipment for the production of high-grade alcohol for motor fuel has recently been placed in service at the Curtis Bay works.

Construction and Operation

Arkansas

EL DORADO—The Lion Oil & Refining Co., Kansas City, Mo., plans for extensions and improvements in its refinery at El Dorado, including the installation of new processing equipment. F. W. Thwing is president, and Victor H. Smith vice-president and general manager.

California

SAN FRANCISCO—The San Francisco Sulphur Co., 624 California St., has completed plans for the construction of a new 1-story sulphur-refining plant, 137x138 ft., on West Grant Ave., to cost approximately $35,000. P. M. Paulson, 624 California St., is architect.

LOS ANGELES—The Buckley Milling Corp., a foreign organization has acquired property at San Pedro Harbor, Los Angeles, as a site for a new metal smelting and refining plant. A rolling mill is also planned, with miscellaneous plant structures. Gordon E. Vance, vice-president, and Edgar T. Carlstorm, consulting engineer, are opening local headquarters for the company, and have commenced preliminary plans. The new plant is estimated to cost in excess of $1,000,000.

SAN FRANCISCO—The Goodrich Rubber Co., 401 Mission St., has completed plans and will soon commence the construction of a new 6-story building, 65x160 ft., estimated to cost about $150,000, including equipment. H. C. Baumann, 251 Kearny St., is architect.

Georgia

SAVANNAH—Preliminary plans are being drawn by the Dunlevi Lumber Co. Inc., for the construction of a new turpentine extraction plant, in connection with extensions in its mills in Liberty and McIntosh counties. The company was recently reorganized, with E. V. Dunlevi as president.

Illinois

EAST ALTON—The Western Cartridge Co. has awarded a contract to the Wimmer Construction Co., Victoria Bldg., St. Louis, Mo., for the construction of its proposed 1-story brass mill addition, 86x240 ft., to cost in excess of $50,000, including equipment. Work will be placed under way at once.

Indiana

HARTFORD CITY—The Fort Wayne Corrugated Paper Co., Murray and Barr Sts., Fort Wayne, has preliminary plans in progress for the construction of a 1- and 2-story addition to its plant at Hartford City. Bids will be called at an early date. Mills, Rhines, Bellman & Nordhoff, 1234 Ohio Bldg., Toledo, O., are architects.

NOBLESVI'LE—The New Process Steel Co. has arranged for immediate operations at the first unit of its new local plant, to be used for the production of steel billets and kindred products. Work is under way on three other plant units, and the structures will be ready for service early in the coming year. Employment will be given to about 200 operatives. J. E. Owen is vice-president, and James Hundley general manager.

EAST CHICAGO—The Jones & Laughlin Steel Co,. Pittsburgh, Pa., has preliminary plans nearing completion for the construction of the initial buildings for its proposed new steel mill on local site, recently acquired. It is estimated to cost in excess of $2,000,000.

EVANSVILLE—A 1-story plant, 45x160 ft., for the manufacture of mirrors and other glass products will be constructed at the works of the Globe-Bosse-World Furniture Co. It is estimated to cost about $25,000. Russ & Karges, Furniture Bldg., are architects.

EDINBURG—The Union Starch & Refining Co., operating a local plant, has acquired the factory of the Temtor Corn & Fruit Products Co. at Granite City, Ill., and will concentrate operations at the latter point. Immediate possession will be taken, and necessary improvements made for a complete refinery, to develop an output more than double that of the Edinburg plant. William G. Irwin is president.

Kansas

PHILLIPSBURG—The City Clerk is taking bids until Nov. 20 for the construction of a new filtration plant at the municipal water works, including the installation of complete equipment. Black & Veatch, Mutual Bldg., Kansas City, Mo., are engineers.

Louisiana

MONROE—The Cosmos Carbon Co., Charleston, W. Va., has acquired the local plant of the Oscar Nelson Co. and will take immediate possession. It is proposed to make extensions and improvements and use the works for the production of carbon black and kindred specialties.

STERLINGTON—The Imperial Oil & Gas Products Corp. has plans in progress for extensions and improvements in its local plant to cost about $150,000, including machinery. A primary feature of the work will include a department for the production of carbon.

Maryland

BALTIMORE—The Locke Insulator Corp., Charles and Cromwell Sts., manufacturer of porcelain insulators, has filed plans for the construction of a new 1-story kiln building, 18x55 ft., to cost about $20,000. Work will be commenced at once.

Massachusetts

MALDEN—Wadsworth, Howland & Co Inc., 139 Federal St., Boston, manufacturer of paint, varnishes, etc., has filed plans for

the construction of a new building at its local plant on Green St., estimated to cost about $95,000.

AMHERST—The State Agricultural College is pushing construction work on its new 3-story chemical laboratory building, 45x111 ft., estimated to cost approximately $300,000, and plans to place the structure in service immediately upon completion. Ritchie, Parsons & Taylor, 15 Ashburton Pl., Boston, are architects.

Michigan

MONROE—The Republic Glass Co. has work under way on the installation of machinery at its new local plant, recently completed, and purposes to place the works in service before the close of the month. It will specialize in the manufacturer of automobile lenses and other kindred glass products. Manuel Llera is president and general manager.

TAYLORVILLE—The Kalamazoo Stationary Co., Kalamazoo, has preliminary plans in progress for enlargements at the former paper mill of the E-Z Bag Co., recently acquired, for a consideration of about $40,000. It is purposed to double the present capacity, providing equipment for the employment of about 500 operatives.

FLAT ROCK—In connection with its proposed local plant for the manufacture of sheet glass products, the Ford Motor Co., Highland Park, will construct a large gas producer plant, for which plans are nearing completion. The entire works will cost approximately $1,500,000. Albert Kahn, 1000 Marquette Bldg., Detroit, is architect.

Minnesota

MINNEAPOLIS—The Lavoris Chemical Co., Western Ave., will break ground at once for the construction of its proposed 3-story plant at 910-22 3rd St., North, for which a general contract recently was awarded. It is expected to have the factory equipped and ready for service early in the spring. It is estimated to cost about $120,000. W. H. Leving is secretary and treasurer.

Nevada

RENO—The local Chamber of Commerce has plans in progress for the construction of a local plant for the manufacture of commercial fertilizer, with initial capacity of approximately 10,000 tons per annum. It is proposed to organize a company to operate the mill.

New Jersey

IRVINGTON—The Clinton Chemical Corp., 1047 Clinton Ave., Irvington, Newark, recently organized, has tentative plans under consideration for the construction of a new plant. The company will operate with a capital of $100,000.

BELLEVILLE—Daniel A. Higgins, manufacturer of dyes, chemical specialties, etc., has acquired the local plant of the Thomson Machine Co., 298 Main St., for a consideration of $28,000. The structure comprises about 19,000 ft. of floor space and will be used by the owner for general manufacture.

New York

LONG ISLAND CITY—The E. Virgil Neal Chemical Works, 11 East 30th St., New York, has acquired the 3-story factory at Borden Ave. and VanDam St., heretofore occupied under lease. Operations will be continued permanently at this location and improvements are contemplated. E. Virgil Neal is president.

LITTLE FALLS—The Barnet Leather Co. is completing an addition to its plant, and plans for the early installation of equipment.

NEW YORK—The Standard Oil Co. of New Jersey, 26 Broadway, has tentative plans under consideration for extensions and improvements in different oil refineries and properties in various parts of the country, to include increased production and storage facilities. An appropriation for the expansion will be made from the recent 400 per cent stock dividend declared by the company.

BROOKLYN—Fire, Oct. 30, destroyed the plant of the Kasebier Chatfield Shellac Co., 126 13th St., with loss reported in excess of $50,000.

Ohio

AKRON—The General Tire & Rubber Co. will soon break ground for the construction of three new additions at its plant, to double approximately the present output of 2,500 tires per day. The structures will be each 1-story, 60x100 ft., 40x180 ft. and 36x100 ft., respectively. William O'Neil is vice-president, in charge.

MARION—The Studebaker-Wulff Rubber Co. has completed plans and will commence the immediate enlargement of its works for considerable increase in output. The new unit, with machinery, is estimated to cost about $50,000.

AKRON—The Miller Rubber Co., manufacturer of automobile tires, has filed plans for the immediate erection of two 1-story additions to its plant on Cole Ave., 70x105 ft. and 40x42 ft., estimated to cost about $30,000. It is expected to have the structures ready for service early in January.

Pennsylvania

MARCUS HOOK—The Union Petroleum Co., Widener Bldg., Philadelphia, has arranged for the immediate construction of a number of additions to its oil-refining plant at Marcus Hook, to cost approximately $500,000, including machinery. A. C. Woodman heads the company.

PHILADELPHIA—The Willden Pottery Co., 711-15 Wharton St., has filed plans for the rebuilding of the portion of its plant, recently destroyed by fire. The work will cost close to $25,000. The company specializes in the manufacture of flower pots and kindred pottery products.

BLANDBURG—The Harbison-Walker Refractories Co., Oliver Bldg., Pittsburgh, has perfected arrangements for additions and improvements in its plants in this vicinity, estimated to cost in excess of $750,000, including equipment.

BOYERTOWN—The Eastern Foundry Co. has commenced the construction of its proposed 1- and 2-story plant addition, 100x150 ft., to be used primarily for cast-iron pipe production. A. S. Keptner, 121 Hanover St., Pottstown, Pa., is architect.

BETULA—The Jaeger Glass Jar Corp. has construction under way for a new plant for the manufacture of heavy glass holloware. It is expected to commence the installation of machinery at an early date.

NEWBERRY—The J. K. Mosser Tanning Co. will make enlargements in its local plant to accommodate a branch of the leather works of the Alexander Brothers Division of the Armour Leather Co., Philadelphia, recently acquired. Equipment will be removed at once from Philadelphia to the local plant. The working force will be increased from 800 to about 950 operatives.

PHILADELPHIA—The M. L. Shoemaker Fertilizer Co., Vernango St., has filed plans for the erection of a new 1-story building at its works to cost about $25,000.

Tennessee

COLUMBIA—The Columbia Oil Co., recently organized by E. E. Williams, McComb, Miss., and associates, has plans under way for the erection of a new local refinery.

MEMPHIS—The Memphis Artesian Water Department is taking bids until Nov. 24 for filtration equipment to be installed at the municipal water works, to include a traveling crane, power apparatus and other operating machinery. Fuller & McClintock, Produce Exchange Bldg., Kansas City, Mo., are engineers.

CHATTANOOGA—The Southern Sheet Steel Co. will take bids at once on equipment for its proposed new local plant for the production of sheet steel and other steel products. It will have a minimum annual output of 55,000 tons and is estimated to cost more than $1,000,000, instead of $400,000, as previously announced. Employment will be given to about 500 men. Bids for the buildings will be asked around the close of the year. W. J. Lynch, vice-president and general manager, is in charge.

MEMPHIS — The Strykre Kot-N-Wood Products Co. is perfecting plans for the early erection of a new plant for the manufacture of composition materials at 1040 Oakland Ave., estimated to cost approximately $65,000.

Texas

TEXAS CITY—The United States Gasoline Corp., has acquired a local site, near the property of the Vacuum Oil Co., totaling about 75 acres of land for the construction of a new four-unit gasoline refining plant, with capacity of 100,000 gal. per day. Work will be commenced at an early date on the initial unit, which is estimated to cost approximately $250,000, including machinery. The erection of the three other units will follow later.

HENRIETTA—The Griswold Oil & Refining Co. is planning for extensions and improvements in the local Beacon refining plant, lately acquired, to include the installation of a new pipe line.

TEXAS CITY—The Swiftsure Petroleum Co. will make extensions in its storage and distributing plant, including the installation of additional tanks with capacity of 110,000 gal. and other equipment.

DALLAS—The Dallas Paper Co., 2211 Law St., is planning for the rebuilding of the portion of its works destroyed by fire, Oct. 22, with loss estimated at close to $60,000.

BURKBURNETT—The Burkburnett Gas Co. is planning for extensions and improvements in its plant, including the installation of additional equipment. Clifford Moore is president.

Virginia

HOPEWELL—The Hopewell China Co. is arranging for immediate extensions in its plant, including the installation of two additional kilns.

RICHMOND—Fire, Oct. 29, destroyed a portion of the plant of the Southern Crockery Co., with loss estimated at about $25,000. It is planned to rebuild. F. F. Socoloff is president.

RICHMOND—The European-American Tobacco Co., Mutual Bldg., recently organized with a capital of $2,000,000, has preliminary plans in progress for the erection of a mechanical drying and redrying plant. A local site will be acquired. C. D. Riggon is president.

West Virginia

BUCKHANNON—The Belgrade Glass Co., manufacturer of flint glass tableware products, is considering the rebuilding of the portion of its plant destroyed by fire, Oct. 29, with loss estimated at $35,000, including equipment.

SHINNSTON—The Alley Glass Co., Bridge St., is reported to be planning for the construction of a new plant to cost approximately $300,000, with machinery. L. E. Alley is president.

New Companies

THE GENERAL ALLOYS CO., Boston, Mass., has been incorporated with a capital of $300,000, to manufacture steel alloys and other metals. Henry H. Harris is president; and Charles Van Stone, 426 First St., South Boston, treasurer. The last noted represents the company.

THE OILLESS PAINT PRODUCTS CO., New York, care of J. J. Finn, Yonkers, N. Y., representative, has been incorporated with a capital of $50,000, to manufacture paint, varnish and kindred products. The incorporators are M. F. Cole, E. Tighe and C. R. Douglas.

THE MID-STATES RUBBER CO., Evansville, Ind., has been incorporated with a capital of $100,000, to manufacture rubber products. The incorporators are John S. Hopkins and George A. Cunningham, both of Evansville.

THE STEVENS PAPER MILLS, INC., Windsor, Conn., has been incorporated with a capital of $200,000, to manufacture paper products. The incorporators are L. T. McManus, C. N. Stevens and George C. Russell, 745 Farmington Ave., Hartford, Conn.

THE NEW CHEMICAL CO., Buffalo, N. Y., care of Gibbons & Pottle, Erie County Bank Bldg., Buffalo, representatives, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are A. Schneider, M. P. Ryley and B. J. Maier, all of Buffalo.

THE BEACH CHEMICAL CO., St. Louis, Mo., has been incorporated with a capital of $125,000, to manufacture chemical products. The incorporators are J. M. and J. A. Frere, and M. A. Alexander, all of St. Louis.

THE FULTON MFG. CO., 14 North Main St., Canton, Ill., has been incorporated with a capital of 150 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are A. Judson and Wilmer A. Allton, and Roy E. Wilhoit.

THE GOVE LEATHER CO., Boston, Mass., has been incorporated with a capital of $10,000, to manufacture leather products. Harold A. Gove, Melrose, Mass., is president and treasurer.

THE NEWTON BELLEEK CO., Trenton, N. J., has been incorporated with a capital of $50,000, to manufacture chinaware and other pottery. The incorporators are Robert Weelans, Arthur B. Harris and William H. Vollmer, 59 Pierce Ave., Trenton. The last noted represents the company.

THE AMBER VARNISH CO., Brooklyn, N. Y., care of W. S. Miller, 837 Manhattan Ave., Brooklyn, representative, has been incorporated with a capital of $20,000, to manu-

facture paints, varnish, etc. The incorporators are L., S. and C. Solomon.

THE KANSAS CITY PLATINUM MINING & SMELTING CO., Kansas City, Mo., care of the United States Corporation Co., 65 Cedar St., New York, N. Y., representative, has been incorporated under Delaware laws with capital of $100,000, to manufacture refined metals. The incorporators are Peter J. Murphy, Byron H. Coon and Joseph R. Lason, all of Kansas City.

THE JACOB W. HOOK CO., 3700 Bank St., Baltimore, Md., has been incorporated with a capital of $50,000, to manufacture tallow, greases and kindred products. The incorporators are C. Howard and H. R. Hook, and E. H. Requardt.

THE VURDEX PRODUCTS CO., Indianapolis, Ind., has been incorporated with a capital of $10,000, to manufacture paints, oils and kindred products. The incorporators are Robert M. Bowes, George G. Rinier and John W. Colley, all of Indianapolis.

THE AUTOCLAVE PORTLAND CEMENT CO., Scranton, Pa., care of the Capitol Trust Co. of Delaware, Dover, Del., representative, has been incorporated with a capital of $100,000, under Delaware laws, to manufacture cement. The incorporators are H. J. Force, Wendel L. Whitehouse and J. H. Schnieder, all of Scranton.

THE GLOBE OIL & SUPPLY CO., Newark, N. J., care of Kanter & Kanter, 747 Broad St., Newark, representatives, has been incorporated with a capital of $50,000, to manufacture oil products. The incorporators are Charles J. and A. G. Ring, and L. Bennes.

THE MIDDLESEX SOAP CO., Boston, Mass., has been incorporated with a capital of $50,000, to manufacture soaps, washing powders, etc. William Perkins is president, and Alfred A. Tutin, 63 Dana St., Cambridge, Mass., treasurer. The last noted represents the company.

THE CHARLES V. WALSH CO., Philadelphia, Pa., care of C. Wilson Roberts, 701-3 Franklin Bldg., 133 South 12th St., Philadelphia, rperesentative, is being organized under state laws to manufacture brick and other burned clay products. The incorporators are Charles V. Walsh, F. E. and W. C. White.

THE EMPIRE PLASTIC & CORK PRODUCTS CO., New York, N. Y., care of J. H. Shetron, 116 Riverside Drive, New York, representative, has been incorporated with a capital of $50,000, to manufacture cork specialties and affiliated products. The incorporators are F. Cutmore and W. E. Smart, Jr.

THE RID-OL CHEMICAL CO., Richmond, Va., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are C. M. Langhorne and John K. Hall, both of Richmond, who will act as president and secretary, respectively.

THE KNOX VARNISH CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture paints, varnishes, etc. Howard P. Knox is president; and Herbert B. Morse, 140 Oliver St., Newton, Mass., treasurer. The last noted represents the company.

THE FOUR KINGS MFG. CO., care of Franklin L. Mettler, 832 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $25,000 to manufacture soaps, washing powders and kindred products.

THE CAPITOL CITY SPECIALTY CO., Trenton, N. J., has been incorporated with a capital of 2,500 shares of stock, no par value, to manufacture polishes and allied products. The incorporators are John and Michael Corse, and Charles Kulov, 19 Gordon St., Trenton. The last noted represents the company.

THE COPPER FLASH OIL CO., Linton, Ind., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are Emery A. Powell, Henry A. Maddox and Nathaniel Hagerman, all of Linton.

THE STARKHOUSE CHEMICAL CORP., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $100,000, to manufacture chemicals and chemical byproducts.

THE FORT PITT GLASS CO., Pittsburgh, Pa., care of Raymond B. Gabler, 1608 Commonwealth Bldg., Pittsburgh, has been organized under state laws to manufacture glass products. The incorporators are S. A. Greenlee, H. F. Gabel and K. A. Maratta.

THE QUIMBY TILE CORP., New York, N. Y., care of H. R. Korey, 119 William St., New York, representative, has been incorporated with a capital of $300,000, to manufacture ceramic tile and kindred products. The incorporators are W. Eveleth and W. H. Quimby.

THE MAGNESITE CEMENT PRODUCTS, INC., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture cement and affiliated products. Herbert P. Page is president; and Harold H. Smith, 41 Townsend Rd., Belmont, Mass., treasurer. The last noted represents the company.

THE CREO CHEMICAL CO., San Antonio, Tex., has been incorporated with a capital of $15,000, to manufacture chemicals and chemical byproducts. The incorporators are G. M. Gallaway, William Morgan and Russel Myrick, all of San Antonio.

THE H. G. MILLER CORP., New York, N. Y., care of A. H. Rosenfeld, 80 Maiden Lane, New York, representative, has been incorporated with a capital of $20,000, to manufacture chemical products. The incorporators are H. G. Miller, I. Tilden, Jr., and G. M. Harris.

THE BEACH CHEMICAL CO., Camden, N. J., care of the Corporation Trust Co. of New Jersey, 328 Market St., Camden, representative, has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts.

THE EASTERN STEEL PRODUCTS CORP., Philadelphia, Pa., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., has been incorporated under Delaware laws with a capital of $500,000, to manufacture steel products. The incorporators are John H. Wilson and Alfred S. Miller, Philadelphia; and H. T. Greenwood, Jr., Merion, Pa.

THE KRO-KO CORP., Smallwood and Eagle Sts., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture insect powders, chemical specialties, etc. The incorporators are Donald N. Gilpin, Albert C. Hinrichs and William G. Greisemer.

THE MILLIKEN BRICK CO., Wilkinsburg, Pa., has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. John F. Baldwin, Edgewood, Pa., is treasurer and representative.

THE REMINGTON CHEMICAL CORP., New York, N. Y., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The company is represented by J. H. Ide, 1400 Broadway, New York. The incorporators are F. W. Bein, L. Arnoff and S. Mendelsohn.

THE BAXTER PAPER CO., 409 North Holliday St., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture and deal in paper products. The incorporators are Wylie M. Baxter, Jr., Stephen S. Mann and Rodney J. Brooks.

THE MIDWEST SUGAR REFINING CO., 326 West Madison St., Chicago, Ill., has been incorporated with a capital of $1,000,000, to construct and operate sugar refining plants. The incorporators are Arthur E. Dike, John W. Davis and Ira H. McKinney.

THE ELKHART ENAMEL & PAINT CORP., Elkhart, Ind., has been incorporated with a capital of $50,000, to manfuacture paint, varnishes, enamels and kindred products. The incorporators are P. C. Kendall, Fred Carpenter and J. W. Mount, all of Elkhart.

Manufacturers' Catalogs

THE CENTRAL STEEL CO., of Massillon, O., has issued a well-printed booklet of 40-odd pages entitled "Agathon Alloy Steels." An introduction recounts the development of alloy steels for high strength, a development which has taken place mostly during the past 15 years. The rest of the booklet contains useful diagrams showing the physical properties (tensile strength, elastic limit, elongation, reduction of area and hardness) of some well-known steels, as these are measured after various approved heat-treatments. Nineteen of these diagrams are given, several S.A.E. specifications being added to the "UMA" steels and a chromium-molybdenum steel, these being special analyses developed by the Central Steel Co. Appended to each diagram is a brief description of the various machine parts for which that analysis is adapted.

THE MEDART CO., St. Louis, Mo., calls attention to Catalog 43, on line shafting equipment. This catalog, which supersedes all previous catalogs and publications, presents facts about the most generally used line shafting equipment, giving dimensions, details of construction and list prices which should enable engineers, designers, mechanics and power users to plan installations of the equipment described. The book comprises 192 pages with illustrations.

PAUL O. ABBE, INC., New York City, announces a new catalog, "H," which deals with the manufacture of paint under its patented process in a pebble mill and also covers its special patented mill for doing this class of work.

THE GRISCOM-RUSSELL CO., New York, in Bulletin 910 treats of multiwhirl and G-R vaneflo coolers, exchangers and condensers for oil refineries.

THE BROWN INSTRUMENT CO., Philadelphia, Pa., calls attention to Catalog 85, on the automatic control of temperatures through Brown indicating and recording instruments.

Capital Increases, etc.

THE GULF OIL CORP., Frick Annex, Pittsburgh, Pa., is disposing of a bond issue of $35,000,000, a portion of the proceeds to be used for expansion, additions to working capital, etc.

THE VITREOUS ENAMELING & STAMPING CO., 1381 Sedgwick Ave., New York, N. Y., has filed notice of decrease in capital from $400,000 to $110,000.

THE SHO-ME PRODUCING & REFINING CO., Sullivan, Ind., manufacturer of petroleum products, has filed notice of increase in capital from $25,000 to $100,000.

THE SCOTT PAPER CO., foot of Market St., Chester, Pa., has arranged for a preferred stock issue of $642,700, a portion of the proceeds to be used for general financing in connection with a new plant addition, now nearing completion.

THE CHICAGO BY-PRODUCT COKE CO., 122 South Michigan Ave., Chicago, Ill., has filed notice of increase in capital from $4,500,000 to $6,000,000.

THE EVANSVILLE ENAMELING CO., Evansville, Ind., has filed notice of increase in capital from $50,000 to $100,000 for general expansion.

THE EMPIRE FLOOR & WALL TILE CO., a Delaware corporation, manufacturer of ceramic tile, has filed notice of organization to operate in New York with an active capital of $1,000,000. The company is represented by E. C. Luther, 137 West 25th St., New York.

THE AMERICAN SMELTING & REFINING CO., 120 Broadway, New York, has disposed of a bond issue of $7,500,000, a portion of the proceeds to be used in connection with property expansion.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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aging Editor

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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SIDNEY D. KIRKPATRICK
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GRAHAM L. MONTGOMERY
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Assistant Editors

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ginning At Home

O MATTER how good a thing is it can be improved! And in the opinion of our resourceful nd G. L. W., whose editorial on "The Roots of the iety" appears in the November number of *The mical Bulletin*, that improvement should begin at ne. His reference is to the local sections of the erican Chemical Society. To many of us the national cies and conduct of that organization have long been arded as fitting subjects for comment and criticism, very often we are inclined to forget the fertile field t lies at our very door. For it is the local section he society that offers the real opportunity for conctive service. It should be built up and strengthl until its influence is recognized in the community. t is not and if the section is loosely organized, ess and ineffective, then the fault is with us and s from within rather than from without that imrement must come.

t traveling about the country we have often reked the difference in character and activity of the groups of chemists. At Pittsburgh, for example, were most favorably impressed by the evidence of closely knit organization, which apparently reis the whole-hearted support of the many chemists hat busy district. On making inquiry, we found this enthusiasm is almost directly traceable to the esting social activities of the section—to the hly smokers and to the annual field day and picnic. t it was at Indianapolis that we discovered the eists as a group playing a leading rôle in local rs. For years it has been the custom of that secto hold weekly luncheons—and contrary to general rience with most weekly luncheons, these are unly well attended. Formerly these meetings were rned almost entirely with subjects of interest only emists, but of late problems of a broader and more al significance have been considered. As a result laymen and the newspapers of Indianapolis have to look to the section for an expression of opinion, lone on matters chemical but on many local issues fessional and public interest.

Its zealous promoters of schemes for obtaining eth from the air" or for solving the nation's motorroblem with Indiana lignite have sometimes sudnl found themselves confronted by a little investiig committee of Indianapolis chemists. Somehow ner these men have a reputation for getting at ottom of things very quickly and usually it is ople of the community who are benefited. Likeot long ago an enterprising department store was viced of the wisdom of abandoning some misleadg dvertising of "radio-active golf balls"—even sales were mounting among enthusiasts who had been led to believe that radio-activity had something to do with longer drives and lower scores.

These are but a few of the ways in which this section of the society is making itself felt in the affairs of Indianapolis. Doubtless similar examples could be found in other parts of the country, but certainly these are sufficient to show that the local section of the American Chemical Society is one of the most logical agencies through which the chemist can be of effective service to his community, to his profession and to himself.

The Science and Art Of Baking

THE art of baking is making its way into chemistry, or perhaps *vice versa*. For years Dr. KOHMAN has been working at Mellon Institute, and in 1919 the American Bakers' Association organized, with the help of the National Research Council, its Research Institute, first at Minneapolis and later at Chicago. In the October number of *The Chemical Bulletin* A. W. LANDSTROM contributes a descriptive article of the Institute's new establishment. The work is divided into two parts: the scientific and technical, and the educational. In the laboratories research is carried on and tests are made for members. Advanced research is also conducted in co-operation with several universities. The laboratories have published findings on control of rope, studies of molds, strength of flour as affected by enzymes in the flour and those added in malt extracts, relation of strength of flour and the viscosity of dough made from it, and a lot of other subjects.

At the same time a school of baking is conducted in which foremen are trained and the incidence of scientific control is made clear to them. In the research laboratory a number of advanced students have already completed work which has led to the degree of Ph.D.

When we consider baking in its chemical and biological aspects, the requirements of temperature and humidity as well as the control of materials having such difficult qualities to master as flour, and the manifest complexities of the phenomena that accompany shortening processes, it soon becomes evident that instead of dealing with a craft to be learned by rule of thumb we are facing a great chemical industry.

Our readers may recall an incident we mentioned last winter when a young graduate chemist asked us if we could help him obtain a position in a chemical works in his home town. The company in question was not seeking additional chemists at the time. So we pointed out a large bakery and suggested that he could surely find plenty to do there. "But they don't want a chemist," he said. "That," we replied, "is what gives you your chance. If they knew they needed one, they would get a man of experience; they wouldn't take you. But if you can get a job of any sort there you can find all

sorts of opportunities to apply chemistry and make yourself a man of great value to them. They need a chemist, but don't know it. You can take almost any job in the bakery and teach them what they need to know—if you have tact. And if you have patience along with tact, they will probably pay you well for your services." Before long these chances will not be available. Bakers are beginning to learn that they are engaged in chemical industry.

Metallurgical Education

ONCE upon a time we were guilty of circulating a "questionnaire"—that was in the days when "drives" and "questionnaires" were more often endured than now. We wished, if possible, to assemble detailed information on metallurgical education, as it then existed, to supplement the impressions gathered by visits to a few of the larger technical schools. Furthermore, it might be possible by that means to discover a course in metallurgical engineering which we could enthusiastically recommend to inquiring high school graduates.

Like most questionnaires, the thing was a failure. One of the schools giving the poorest return on paper looks the best upon inspection, while the opposite also turned out to be true. One thing it did, though, was to collect a large number of curricula. And upon examination they were found to be slight adaptations of conventional courses of study in other branches of engineering.

Apparently it works about like this: A certain institution has a school of mines or is teaching mining engineering. Its attendance drops, or the students who attend ask for more and more information about metal and less about ore. So the dean or somebody in authority says, "We shall offer a degree in Metallurgical Engineering," and the next catalog contains the curriculum. It looks like mining engineering, except that Advanced Metallurgy replaces Economic Geology and a 2-hour lecture course on Non-ferrous Alloys is substituted for Hoisting.

You will say we have used "editorial license"—but the point we wish to make is this: That at the present time American colleges are offering courses which are not metallurgical engineering but are grafts or crude adaptations of older courses such as mining or chemical engineering. (If there are any exceptions we should like to hear about them.) Therefore we find such preposterous subjects as mine surveying, fire assaying, and organic chemistry taking up sadly needed lecture hours and laboratory afternoons. Such are, of course, not "preposterous" in their right place, but are they essential to a metallurgist?

Thoughtful educators and men in industry are coming more and more to agree that the fundamentals of the soundest technical education are a thorough groundwork in the great art of language and the sciences of mathematics, chemistry and physics. Furthermore, to be of greatest value to his country and to himself, the student should also attend a series of studies in history, literature, fine arts, psychology and economics—in fact, if one could find a College of Liberal Arts that would put great emphasis on a thorough understanding of science, that would be the best place for an engineer—any engineer—to prepare for his life work.

But all these things take time. Four years is not enough for these studies, plus the metallurgical specialties, plus mine surveying, fire assaying and organic chemistry. So it is that the 5-year course is bei talked about and experimented with and in some u versities the engineering department has actually b come a branch of the post-graduate school.

Admitting that the more education the better, should still be borne in mind that the large majori of students in American universities will balk at 5- or 6-year course. Even during the fourth year t urge to get out and be doing something is very stron graduation day seems interminably long in comin Of course there are a few who wish to pursue the formal studies further, but the place for the engine to specialize is after he gets his job. If he is prope grounded in science, he can easily learn how to doct a sick blast furnace and will humor its whims wi understanding. The science he can never pick up the works—neither can he be taught the "practic details" on a blackboard. It appears that this ti limitation will never be overcome—at least in met lurgical engineering—until the axe is taken to the pr ent schedules of studies. We look for great things wh some energetic and influential educator goes after o of these hybrids with a big sharp axe, demands th the freshmen be taught how to study, lays out a bro and exacting course in the sciences and humanities, a then puts the onus of co-ordinating these things showing the student what relationship the law of ma action has to open-hearth practice—squarely up to t engineering faculty. Then we shall have a course Metallurgical Engineering.

Wage Rates and National Income

IT IS frequently remarked that the clamor for "t living wage" on the part of certain groups of wo men is improperly based, because it calls for an inco that could not be spent, the goods represented bei more than the whole country produces. It is held th what is really wanted is more goods, and that the w to obtain more goods is to produce more, not to t to pay out more dollars in wages, since by that cou the competition of wage earners would merely incre and market prices of goods would rise.

The reasoning is perfectly sound. It is a case of d tributing the national income. Occasionally it is su gested that if we cannot produce as much as we wa we should import more. There is the 15 billion doll or more that is owing us from abroad, the inter alone on which would amount to a tidy sum and mig be paid in goods, while beyond that we could exp goods such as we can make to better advantage th foreigners and with less labor, and receive in retu goods that require much labor in their production.

This reasoning also seems sound, for the essence foreign trade is that of exporting goods that one make easily and getting in return goods that one h difficulty in making.

In the combination of these two ideas, however, th is a feature that does not seem to have been brou out. That feature is that the three groups of la that are making the most trouble from an econo standpoint, those that appear to want more than th natural share of this country's production by comp son with other classes of workers, are engaged in tivities that cannot be supplemented by importatio No one at all conversant with current conditions have any difficulty in identifying these three grou Everyone knows that they are the coal miners, artisans in the building trades and the railroad wo

s. They are all being paid too highly by comparison ith what the remaining workers in the country receive. It is altogether impossible for us to import coal in antity. Our coal is the most easily mined of any and e should export rather than import. We cannot im- rt garages and dwelling houses, which are being built great numbers this year and at an altogether un- asonable cost. We cannot import transportation.

In the case of manufactured goods we depend upon ports to prevent production costs from going to reasonable levels. We pretend, in theory at least, construct our tariffs to cover the proper and legiti- te differences in cost of production as between the ited States and foreign countries. If the theory re carried out in practice, then any demand for un- asonable wages on the part of workmen or unreason- le profits on the part of manufacturers would induce ports and thus bring to bear a restrictive influence. coal, transportation and building, this principle can- t apply.

Our new tariff has been rather generally criticised d unpleasant economic consequences from it have n predicted. As a wage raiser the tariff cannot be dited for the highest relative wages that are being d in the United States, for they are being paid in es of activity the tariff does not touch. Nor, on other hand, can the tariff be blamed for the eco- nically unsound condition of wages being unduly h in the three lines of activity to which reference been made.

William Bragg And His Crystal Units

DESPATCHES purporting to be special and by cable, lately appearing in various newspapers, tell of the covery of the crystal unit by Sir WILLIAM H. BRAGG l his son, Prof. W. T. BRAGG. Expository information ich follows the announcement has been misleading, l, so far as we have observed, characteristic of wspaper chemistry."

he despatches have their origin in the September eting of the British Association for the Advancement cience held at Hull in September. Here Sir WILLIAM vered an address from which the information was en. In a previous work by these eminent physicists the X-Ray Analysis of Crystals they tell of the gin of their investigations, which followed the work Dr. LAUE of the University of Zurich. Dr. LAUE was bitious to cause and measure the differentiation of Xays, on the hypothesis that they partake of the na- e of light. By means of a spectrometer with a dif- tion grating, the length of so-called light waves etermined. The grating, as is well known, consists n arrangement of equidistant parallel lines, ruled in at numbers on glass or a metal surface. The spac- n must be of the order of the wave lengths measured; s sodium light with a wave length of 0.0000589 can liffracted through 24 degrees by a grating of 7,000 s to the centimeter—that is, a spacing of about 0143 centimeter.

ow the X-ray wave, if there is such a thing, is t 10,000 times as short as the waves of sodium light, to construct an appropriate grating for this pur- is unthinkable. The spacing would be of the order f istances between the molecules of a solid. This very appealed to Dr. LAUE, because in crystals we have lid in which the atoms or molecules must be ar- ged in some definite order. By experiment he demonstrated that, if a pencil of X-rays is made to traverse a crystal, the diffracted pencils show arrangements about a primary beam in regular patterns, and these patterns differ according to the crystals employed. This gave Mr. LAUE his results. In other words, X-rays were diffracted through crystals, as light rays are produced from diffraction gratings.

Then the BRAGGS, father and son, at that time attached to the University of Leeds, became actively interested in Dr. LAUE'S conclusions and in the photographs which he published, because they concluded that this very diffraction of X-rays would give them the basis for the more intimate study of atoms and molecules in crystals. Magnificent work on their part, by HULL, ST. JOHN, BAIN, KAYE and other workers in England and America, has resulted in the invention of the X-ray spectrometer, its application to mixtures of very fine crystals, and the solution of many baffling problems of allotropy, isomerism and solids of colloidal size. Many readers will recollect the contributions to theoretical metallurgy, published by Dr. BAIN at intervals in these columns. Others, more familiar with the work done on the other side on salt crystals, will remember, for instance, that in the crystals of such halides as sodium chloride, potassium chloride, etc., it was concluded that each atom of one element organizes itself between four associated atoms of the other, so that, instead of aggregations of molecules forming the crystals, we have a symmetrical order of opposed atoms which constitute the crystal as a whole.

Now it is evident that the BRAGGS have gone beyond this, and reached a new conclusion in regard to crystal units. We quote from Sir WILLIAM'S address at the Hull meeting of the British Association in September:

"Every crystal is built up of units, and every unit is the counterpart of the crystal. The crystal unit contains every kind of atom or bond; every feature and every property that the crystal possesses as a whole.

"X-ray analysis tells us the number of atoms in the unit, and is throwing more and more light on their arrangement.

"The limitation to our knowledge of the properties of gases and liquids is severe. We remove it when by aid of X-ray analysis we examine the nature of crystal units, because the unit displays all the properties of the solid.

"A crystal has elasticities, thermal expansions, thermal and electrical conductivities, dielectric capacities, optical activities, and these not only as scalars, but as vectors.

"The many properties, for example, of quartz as a crystal, are all displayed by its crystal unit—i.e., by three molecules of SiO_2 arranged in a particular way. They are not characteristic of the separate molecules of SiO_2, still less of the separate atoms of Si and O.

"When we know the exact arrangement of the nine atoms of this unit, we can apply all that we know about quartz to that small group. In this way a wide field of research opens out in which the crystal unit plays a part like that of the molecule in other fields. And the magnitude of the results may be just as great."

It is difficult to grasp the bigness of this work, or to measure its significance. It is almost like a flash of lightning over an undiscovered country, and we await with eagerness the more detailed publication of studies by this gifted father and son on the order and arrangement, and the nature of the organization of atoms and molecules in solids.

Readers' Views and Comments

Why We Are Publishing the Articles on European Conditions

To the Editor of Chemical & Metallurgical Engineering

SIR:—The publication of my first two articles on "European Conditions as I Saw Them" and my letter on "Who Financed the German Economic War" have raised the question of my purpose in expounding a situation that may be regarded by some as being more in the domain of politics. It is true that there is a political aspect in the subject under discussion, but of far greater importance is the fact that in Germany's present plight we have a condition that has such a concrete repercussion on the economic status of the whole world that it is worthy of the attention of engineers. Far be it from me to tackle the subject from its political side. My aim is to bring home to American technical and industrial men the fact that they, more than all the politicians and bankers together, ought to know the real causes of existing industrial conditions in Germany, in the expectation that by this means engineers could be moved to develop a policy that would bring back all of the European industrial countries to a stage of constructive production.

In a conversation on March 13, 1922, with Prof. Edgard Milhaud of the International Labor Office at Geneva, Switzerland, he pointed out that a very great part of the blame for the distress in Europe is traced directly to America, which, he said, financed the war so efficiently but is now taking refuge under a turtle shell when so much assistance is needed to finance peace. Subsequently I learned things that brought me to the conclusion that Germany was really leading an economic war as outlined in my first article; that politicians were lulling their nationals with notes and counter-notes spread broadcast; that bankers were watching hawk-like for opportunities to do business and that unscrupulous middlemen were beating all the others in making sure of the bird in hand rather than laying plans to get two in the bush. Finally, I think now as I did April 24 when I wrote in my diary as follows:

"America, although now the greatest loser from the above unhealthy condition, because her industry and commerce feel acutely the effect, is bound to come out the winner in the end, not only because she has the raw materials and modern machinery, but mainly because her industrials, merchants and workingmen possess, as a rule, the mentality of square dealing to an extent not existing in the above-mentioned countries [France, Belgium and Germany]. But instead of waiting until this turn arrives *per se*, which in itself might also lead to the equally bad, if not worse, condition of only America working while the others were bankrupt, we must do something to stop such disastrous consequences and try to pave the way to a sane return of normal conditions when everyone will have an opportunity to do his share of honest work. And we must hasten the arrival of such conditions by using the least radical means."

The fact is that now, only a little more than 6 months after the above was written, America more than any other industrial country is working and enjoying relative prosperity. But we are gradually approaching the undesirable condition of becoming a mere receptacle of the world's wealth, with little, if any, international interchange, while the stricken European countries are beginning to pour their wrath on the "tentacular United States" (Les Etats Unis Tentaculaires), a very suggestive heading on an article in the *Echo des Mines et de la Métallurgie*. We in the United States know that we are not as guilty as all that, but we do nothing to dispel the rapidly growing misconception of the European technical press.

No, when I wrote the series of articles now being published in *Chem. & Met.*, I did not intend to take politics nor did I aim to play the omniscient accuser. My real aim was to inform the American technical world through the columns of a technical paper what I, as an engineer and one of your staff, saw and learned while traveling through Europe. In so doing I was guided by the sincere expectation that I might open up a hitherto unexpressed line of thought in order that engineers, American engineers included, might initiate a policy that would hasten the arrival by the least radical means of a condition where everybody could have an opportunity to do his share of the world's work. I am confident that the reaction of American as well as foreign engineers and industrials, after they have read the full series of articles, will be in this direction.

New York City. J. S. NEGRU

What Is Steel?

To the Editor of Chemical & Metallurgical Engineering

SIR:—Only a day or so after reading your editorial on "What Is Steel?" (issue of Nov. 8), I clipped the following from the Brooklyn *Daily Eagle:*

Memory Test
Can You Answer These?

1. Who discovered that the blood circulates through the body?
2. Why does the wind whistle?
3. What is steel?
4. When is Indian summer?
5. Where is the Cape of Good Hope?

"Ha! ha!" said I to myself, when I got to No. 3, "there's where I fool the Memory Test." Nevertheless I bought the *Eagle* the next day (possibly to find out Why does the wind whistle?) and read:

"3. Steel is a compound of iron containing 0.25 to 3 per cent of carbon."

There you are! And it took you nearly a page to say it. MARTIN SEYT

Titanium Alloys

Of the titanium alloys, only four are in commercial use, ferrocarbon titanium, ferrotitanium, cuprotitanium and manganotitanium. Information regarding these alloys is contained in Serial 2406, "Titanium," which may be obtained by addressing the Bureau of Mines, Washington, D. C.

European Conditions as I Saw Them*

Impressions Gathered During the Extensive Trip Through the Devastated Coal Districts of Northern France—Proof of Wanton Destruction and Active Reconstruction Are Conspicuous, as Illustrated by the Typical Cases at the Anzin and Béthune Coal Mines

By J. S. Negru

ON MY TRIP from Brussels to Paris I passed over many of the battlefields of the late war, and observed that a large number of the small cities nd towns were still in ruins. The removal of débris nd the reconstruction of homes and factories were nly partly done, being necessarily postponed until at east a part of the needed money could be obtained from eparation funds. The fields, on the contrary, were lready well leveled, and looked as if they had never een covered with numberless shell craters of varying izes. Later, I learned that agriculture, more than ny of the other devastated French industries, was lready practically on a pre-war basis. In the industries other than coal mining, the condition was quite he same, and progress in their reconstruction could e measured only by the amount of money available or actual work.

In the coal industry, however, the conditions are ntirely different. Here it is not sufficient merely to ave the money for reconstruction work, for not only ere surface plants at the mines totally or partly detroyed, but the underground workings were also damged. Anyone who is familiar with the geology of the oal seams of northern France and the complicated nderground workings necessary for mining operations an readily understand why, in addition to large sums f money, a vast amount of arduous work is necessary repair a damaged French coal mine.

Visit to the French Devastated Region

In May I had an opportunity to visit the devastated oal region, including the mines of Anzin, Lens, Béune, Liévin, Noeux and Bruay. All of the physical cts and data regarding these mines have been pubshed in elaborate monographs on the French devasted industries, and consequently I shall not indulge a repetition of this phase of the subject. On the her hand, I should like to mention the relation of the rench coal mines to the bitter animosity existing tween Germany and France.

I visited the coal region after I had been in Germany nd had talked there with intellectuals and common eople. Consequently I thought it well, when I was the ground in France, either to corroborate or refute e German contention that the destruction of the mines as not done wantonly, but that it was an inevitable sult of warfare. I wanted, also, to discover how uch truth there was in the German statement that the construction of the destroyed French coal mines was luntarily held back by the French mining companies.

I know now that both of these contentions are wrong. here was wanton destruction of the coal mines, and fere is, on the part of the French people, a feverish sire to restore the mines to working condition as fast funds can be obtained.

It may suffice to cite in corroboration of these statements two typical cases based on official information obtained during my visit.

Destruction of the Anzin Company Mines

The Anzin company was working twenty shafts in 1913, and produced on an average 11,400 tons of coal per day. On Oct. 8, 1918, all of the mines were in good order on the surface as well as under ground. Ventilation and pumping were going on as usual, and the mine horses were still under ground.[13] On this date the general director of the company received an order from the German military authorities to remove the horses from the mines and to stop ventilating and pumping operations. A few days later the technical staff of the Anzin organization was assembled and carried away to Liége, Belgium, and systematic destruction of the mines was begun.[14] All of the tipples, boilers, hoisting machinery, compressors, ventilators, electrical equipment and power houses were completely destroyed. One washery was totally destroyed and another badly damaged. Three of the briquet plants were totally destroyed. The Thiers shaft was badly damaged, 135 miners' houses completely razed, 15 railway switch and signal stations completely destroyed and about 13 miles of track systematically dislocated. Apparently, there was not time to complete the work of destruction, and so the repair shops, some of the screens, washeries, briquetting plants and coke works escaped. A few days before the armistice, the bombarding of this district added to the destruction, so that at the signing of the armistice all of this important coal district was a heap of ruins, with shafts damaged and the mines flooded.

Reconstruction of the Anzin Company Mines

Immediately after the armistice reconstruction work was begun. At the end of June, 1919, six of the twenty shafts were already in such shape that they could be partly worked, yielding a daily output of 1,270 tons, as compared with about 11,400 tons in 1913. The comparative daily production in these six mines for corresponding periods in 1913, and June, 1919, is shown in the following figures:

1913: 679, 873, 412, 453, 808, 1,268
1919: 87, 612, 120, 80, 295, 76

By the end of 1921 the total daily production of Anzin company was about 7,100 tons, as compared with 11,400 in 1913, and at the present time the daily production has approached the 8,000 ton mark. Only two of the twenty mines cannot be worked yet and some of the repaired mines produce now even more than before the war, as can be seen by the following figures of average daily production in tons of coal, in 1913 and in December, 1921:

Mine	1913	Dec., 1921
Lagrange	873	975
Bleuse Borne	415	442
Ed. Agache	539	708

*This is the fifth of a series of articles by Mr. Negru on this subject. The preceding articles appeared in the issues of Oct. 18, Oct. 25, Nov. 8 and Nov. 15.

[13]Haulage in the coal galleries is done by horses. Once they are in the mines, they are kept there as long as they are alive. This is the invariable rule.

[14]Note the date. On Oct. 8, 1918, revolution was already fomenting in Germany.

These figures show clearly that the company has been working feverishly to repair the destroyed mines and to bring the coal production as fast as possible to the pre-war figure.

Destruction of the Béthune Company Mines

The case of the Béthune company furnishes a more striking example of wanton destruction. Shafts 8 and 8bis were occupied by the Germans on Oct. 11, 1914, and were abandoned by them only in the beginning of October, 1918. As these shafts were only a few hundred yards from the first-line trenches, it is small wonder that the surface works were reduced to a heap of ruins. But it was not to be expected that the shafts would be found in such condition as to give unmistakable evidence of wanton destruction. Official evidence indicates that this was done after September, 1917. When it was possible to inspect these shafts, it was found that the metal linings had been badly damaged, especially at the 50- and 100-ft. levels of shaft 8bis. The accompanying drawing of this shaft in elevation shows better than words can describe the condition of its metal lining.

It is now officially known that, in order to accomplish this result, the Germans drilled a series of holes about 10 in. in diameter and about 100 ft. deep at a distance of 3 ft. from the lining of the shaft. These holes were charged with high explosives at the 50- and 100-ft. levels, and similar charges were placed in the shaft at corresponding positions. The firing of these charges quickly accomplished the work of destruction. In addition to this, the shafts themselves had the appearance of craters, due to the explosion of well-placed charges. At one shaft the crater measured about 70 ft. in diameter, and at the other 50 ft., while the ground was well shattered to a depth of about 50 ft.

Difficulty of Reconstruction Work

The ground in this district is highly water-bearing, and consequently the repair of the shafts has been a gigantic and difficult task. Nevertheless the company has already succeeded in repairing the shafts up to within a few feet of the bottom of the craters. The repair work still to be done will require several years, although the work of destruction took but a short time. How thoroughly and systematically the latter was done can be judged by the time required for the vast amount of reconstruction work already completed, as well as by the work remaining to be done.

These two examples suffice, I think, to show that wanton destruction on a large scale was perpetrated by order of the German military authorities. At whose instigation this work was done, we can judge only by circumstantial evidence. It appears to have been accomplished in the interest of German industrials. But of the actual facts of destruction, the German people are not generally aware, even at this date.[15]

Need of Acquainting the German People With the Conditions in the Devastated Districts

During this visit to the French coal fields I talked with many leading French engineers, and was led to

ELEVATION SHOWING THE DESTROYED METAL LINING OF SHAFT 8BIS, BETHUNE, FRANCE

suggest the merit of having a commission of German engineers visit the devastated coal region. I felt that an honest report by such a commission would aid the German people in getting a fair conception of the wanton destruction of the mines and of the reconstruction work already accomplished, and thus alleviate in some degree the bitter spirit of hatred displayed toward the French. Particularly, I broached the subject to Messrs. Champy, the general director of the Anzin company, and Gruner, vice-president of the Central Committee of French Collieries. They all saw the value and utility of such a plan, and the general response was that such a commission would be welcome. When I returned to Germany after having visited the French coal fields, I discussed the subject with many people, and particularly

[15] At this point permit me to recall a personal incident that occurred a few days after the armistice was signed. I was then in St. Ghislain, about 5 miles from Mons. In visiting a tile plant, which had been transformed into a bath house during the German occupation, I observed the utter destruction of all the machinery. In the repair shop my attention was attracted particularly to an ordinary blacksmith's bellows which was still covered with leather and apparently in good condition. In view of the fact that the Germans were greatly in need of leather during the war, I wondered why they had not taken this. Thereupon Mr. van H., the owner, showed me that it had been sharply cut from top to bottom, thus rendering it useless.

vith Prof. Dr. Matschoss, director of the Verein deutscher Ingenieure (Society of German Engineers), and vith Prof. Dr. Rassow, general secretary of the Verein leutscher Chemiker (Society of German Chemists), and expressed the belief that if the findings of such a commission were made public through the technical press, t would do the German people a world of good. Here, nowever, the suggestion met with passive indifference.

Policy of Miners' Dwelling Rentals

In the reconstructed coal mining towns in France, I understand that there will be practically no private dwellings. The companies are erecting the buildings, and will rent them to their employees at the nominal sum of 10 francs (about 85 cents) per month. This is for a two-story brick house. It will be interesting to see what effect this policy has on the relations between employer and employee. At first sight it may appear to have the advantage of always keeping the miners contented through their low rental, but on the other hand t leaves open the question of whether they may be paying indirectly, through lower wages or otherwise, and ultimately giving the companies a fair return for the money invested in housing. I should expect this policy to work better in Germany, where the workmen have long been accustomed to obedience and paternalism. The French, on the contrary, as I know them, may not prove so docile; and I have wondered what the French miners may think and do when they find themselves in the permanent position of tenants on company-owned property.[16]

War Damage Compensations

I had not been long in Europe before I got the impression that reparation payments in France, particularly the sums awarded as compensation for war damage, are quite often in excess of the value of the actual loss. That this was well founded is proved by the fact that recently the French press has been active in denouncing this harmful practice. In the latter part of July, 1922, I read of a typical case where an industrial had put in a large claim for relatively small damage and his claim was accepted. This case is now being dealt with by the French judicial authorities. Shortly after this I noted in the London *Financial Times* for July 31, 1922, the following item under the caption "Huge Expenditures":

"It is computed that the French Government has spent between 80 and 90 billion francs in reparations which are considered as 'a financial advance to Germany,' but it would be interesting to know what percentage of the amount could have been economized by more practical control over the spending department. An enormous amount has been squandered unnecessarily, not to speak of the amount which, up to a year ago, went into the pockets of dishonest architects and other intermediaries to whom the war-devastated districts have been as a 'land flowing with milk and honey.'"

I may add that in the course of conversation with responsible authorities I have learned that the French Government is actually engaged in correcting these erstwhile abuses.

Other articles on this subject by Mr. Negru will appear in subsequent issues.

[16] In X, a German company-owned town, the barber told me with pride that he is the only independent tenant as far as employment is concerned. The social welfare work for German employees has contributed greatly to developing what is, in reality, a bonded working population.

Cracking Processes for Petroleum

The growing demand for greater gasoline production in order to satisfy the increasing demand for motor fuel has given rise to numerous tried and experimental cracking processes for increasing the yield of gasoline from crude oil. The National Petroleum Association in its Bulletin 134 has recently published the following compilation of the best-known processes which are being used successfully in the refineries of the mid-continent field, classified by inventor, owner and method:

Burton—Standard Oil Co., Indiana; pressure.
Hoover—Hoover Co., Chicago; catalytic.
Cross—Gasoline Products Co., New York; pressure.
Dubbs—Universal Products Co., Chicago; pressure.
Coast—Cosden & Co.; pressure.
Cherry—C. & C. Development Co., Kansas City.
Jenkins—Jenkins Petroleum Process Co.; pressure.
Fleming—Richard Fleming Co., New York.
Ramage—Barnsdall Corporation, New York.
Rittman—United States Government; pressure.
Greenstreet—Pressure.
Ellis—Standard Oil Co. of New Jersey.
Isom—Sinclair Refining Co.; pressure.
Alexander—
Adams—Texas Co.; pressure.
Holmes—Texas Co.; pressure.
Parker—American Gasoline Corporation; pressure.
Blaisdell—Mutual Oil Co.; pressure.
Von Tilberg—Pressure.
Ormonde—Pressure.

The chief refineries of the country using cracking processes successfully are as follows:

Cosden & Co., Tulsa, Okla.—*Coast.*
Barnsdall Refining Co., Barnsdall, Okla.—*Ramage.*
Globe Oil & Refining Co., Blackwell, Okla.—*Cross.*
White Eagle Oil & Refining Co., Augusta, Kan.—*Burton.*
Sterling Oil & Refining Co., Wichita, Kan.—*Fleming.*
American Gasoline Corporation, Kansas City, Mo.—*Jenkins* and *Parker.*
Lakeside Petroleum Co., Augusta, Kan.—*Jenkins.*
Roxana Petroleum Co., Wood River, Ill.—*Dubbs* and *Cross.*
Texas Co., Port Arthur, Tex.—*Holmes.*
Midwest Refining Co., Casper, Wyo.—*Burton.*
Standard Oil Co., Neodesha, Kan.—*Burton.*
Standard Oil Co., Whiting, Ind.—*Burton.*
Sinclair Refining Co., E. Chicago, Ind., and Whiting, Ind.—*Isom.*
Indian Refining Co., Lawrenceville, Ill.—*Cross.*
Atlantic Refining Co., Philadelphia, Pa.—*Burton.*
Pure Oil Co., Heath, Ohio—*Cross.*
Petroleum Refining Co., Latonia, Ky.—*Cross.*
C. & C. Developing Co., Kansas City, Mo.—*Cherry.*
Mutual Oil Co., Chanute, Kan.—*Blaisdell.*
Gulf Refining Co., Port Arthur, Tex.—*Alexander.*
Humble Oil & Refining Co., Houston, Tex.—*Burton.*
Aetna Refining Co., Louisville, Ky.—*Ormonde.*

Nickel Steel for Locomotive Connecting Rods

Connecting rods of 3 per cent nickel steel are installed on about 1,400 locomotives on the North-Western Railway of England. Most of these engines are equipped with Joy's valve gear, which is driven by a link working off the connecting rod. Bending of the rod at this link connection has been frequent—about fifty replacements per year being recorded from this cause. Two recent breakages of such nickel steel connecting rods, occurring while the engines were operating at high speeds, are exciting much comment in the British engineering periodicals. One was doubtless due to a large flaw in the rod; it is suspected that the other was caused by a local heating of the rod in a railroad smithy. This is strictly against regulations, which forbid local shops from doing any work whatever on nickel steel rods. It appears as another instance of the extreme care which must be exercised to prevent abuse of alloy steel, pending the time when mechanics are sufficiently educated to handle it intelligently.

Standardization Of Enameled Apparatus For Chemical Purposes*

By Emerson P. Poste
Director of Laboratories, Elyria Enameled Products Co.

Standardization as Regards Types of Enamels to Withstand Varying Degrees of Corrosive Action—Materials of Construction, Uses, Methods of Temperature Control

ALTHOUGH the manufacture of enameled equipment for the chemical industries is a relatively new development in this country, it has advanced to a stage that warrants consideration from the point of view of standardization. Further experience in its construction and use will secure the well-merited place which it has already gained among the available types of apparatus for the carrying on of the more exacting chemical operations.

Standard Enamels

The enamels which are used in the chemical and allied industries differ in certain respects from those used for ordinary household ware. A piece which is to serve as a domestic culinary utensil or a sanitary fixture need not have a high chemical resistance, but should possess a particularly pleasing appearance by way of color, gloss and opacity. The raw materials which promote these qualities often do so at the expense of chemical resistance. Heavy metal oxides are commonly used. But for chemical work proper resistance without the use of heavy metals is the prime requisite. A pleasing appearance is desirable, but is of secondary importance.

Corrosive Action Classified According to Relative Severity

Commercial experience has caused the manufacturer of enameled apparatus to offer to the trade a series of enamels with chemical properties suited to the several demands of the industry. From a chemical standpoint these enamels may be considered in four classes, thus divided by the demands made for them.

Neutral or Very Slightly Corrosive Materials

The mildest set of conditions which enameled ware may be called upon to meet involves the handling of materials which are not markedly corrosive but do become discolored or contaminated by contact with the ordinary metals of construction. This grouping includes neutral solutions in general, those slightly acid on hydrolysis, a great variety of organic compounds and a group of materials such as chlorine gas which, in the presence of traces of moisture, react with metals. Enamels of this type have given satisfactory service in connection with the following typical substances: oil during deodorization, alcoholic extracts, aniline hydrochloride, ammonium nitrate during evaporation and fusion, bleach liquor, chlorine gas, dry hydrogen chloride gas, hydrogen peroxide, tincture of iodine, phenol, salicylic acid, acetic anhydride, dry sulphur dioxide, tannic acid, bromine.

Weak Acids

In the second classification conditions demand an enamel with a sufficient chemical resistance to serve under more definitely acid conditions with particular reference to the organic acids as a whole, and traces of free mineral acids. The group also includes solutions definitely acid on hydrolysis. As a general case a metal container would be actively attacked, resulting not only in the contamination of the product being handled but in the gradual destruction of the apparatus. Typical cases of satisfactory service in this class are the following: ammonium sulphate, inversion of sugar, citric and tartaric acids, acetic acid, acid brines, moist chlorine, tin chloride with traces of free hydrochloric acid, zinc chloride, mixed acids relatively low in water content.

Resistance to Strong Acids

The third classification involves resistance to all mineral acids with the exception of hydrofluoric. Contact with a metal container would cause a very rapid destruction thereof. Conditions of more severe acid nature not named in connection with the former classes naturally fall here. Typical cases include hot hydrochloric acid, nitric acid, dilute mixed acids.

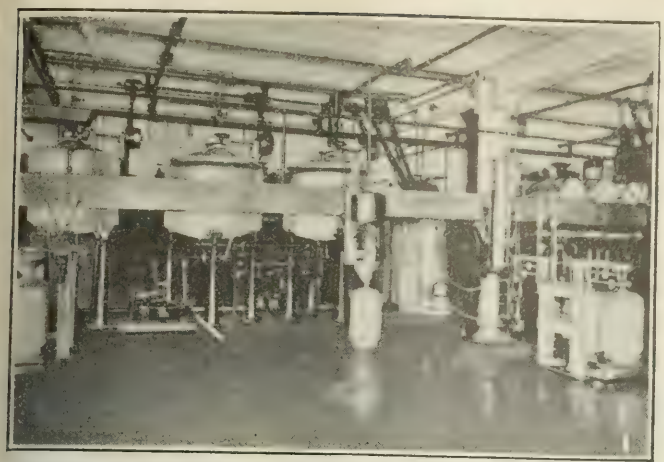
Resistance to Alkalis

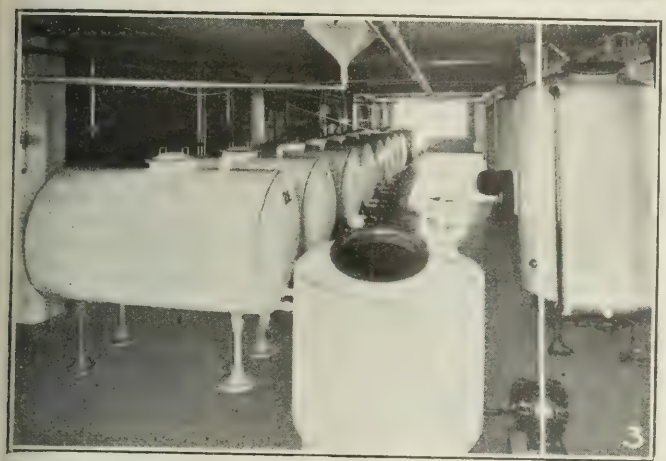
The fourth point as to chemical resistance of enamels is that of the relation to alkalis. As a general statement it may be said that acid resistance of enamels is promoted by the use of materials which are subject to action by alkali. Experience has shown that ammonia has no appreciable effect on enamels. The hydroxides of the alkaline earths are somewhat active. The free hydroxides of sodium and potassium are quite active, excepting at very low concentrations and in the absence of water. Caustic soda solutions under 5 per cent in strength have been successfully stored in enamel-lined units. The carbonates of sodium and potassium can be safely handled over quite a range of concentrations. Sulphides of these bases are quite active. In general enamels are not particularly resistant to alkali.

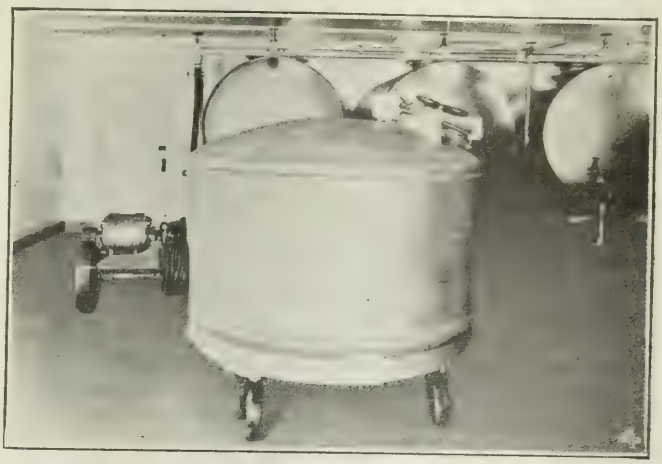
Factors Influencing Choice of Enamel

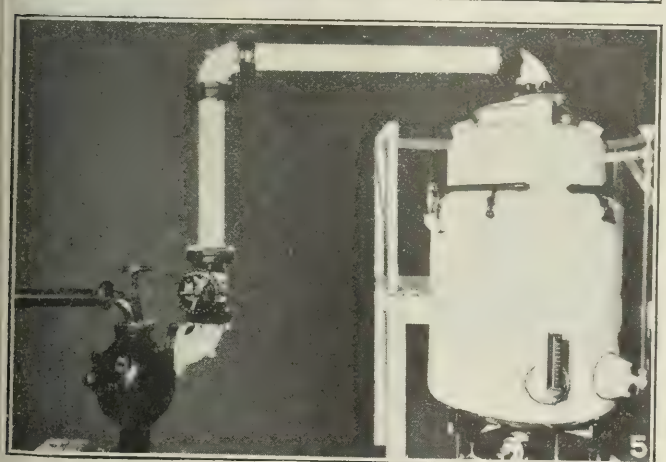
The foregoing consideration has been general. It is difficult to reduce the situation to definite standards. Matters of temperature, type of unit, limitation of size, complication of design and manner of use must be considered in a given case. The more severe the chemical conditions and the more resistant the required enamel the more difficult is the production of a satisfactory unit. Demands of increasing chemical severity, therefore, must be met by smaller units, simpler designs and more careful operation. A condition that may be safe at atmospheric temperature will be far more difficult at higher temperatures. Conditions that are mild at 50 lb. steam pressure may be chemically out of the question at a pressure of 200 lb. A solution successfully handled by one type of enamel in an open unit may give off vapors more active than the liquid itself, necessitating the use of a more resistant enamel in a closed unit. Each case must, therefore, be treated by itself. A statement of the essential chemical conditions by the pro-

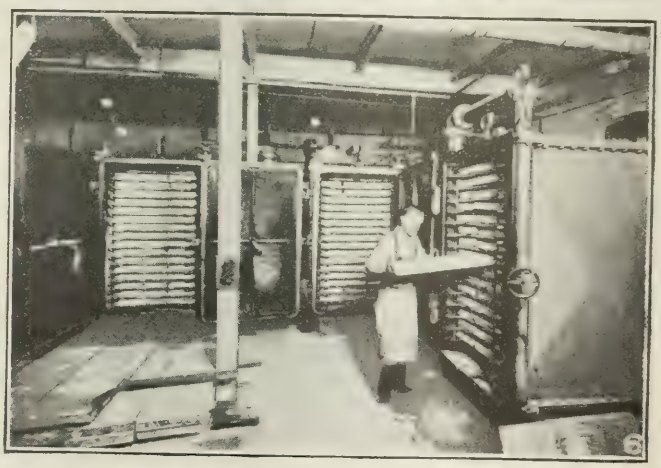
*Paper presented at the Eighth National Exposition of Chemical Industries, Ceramic Day, Sept. 15, 1922.

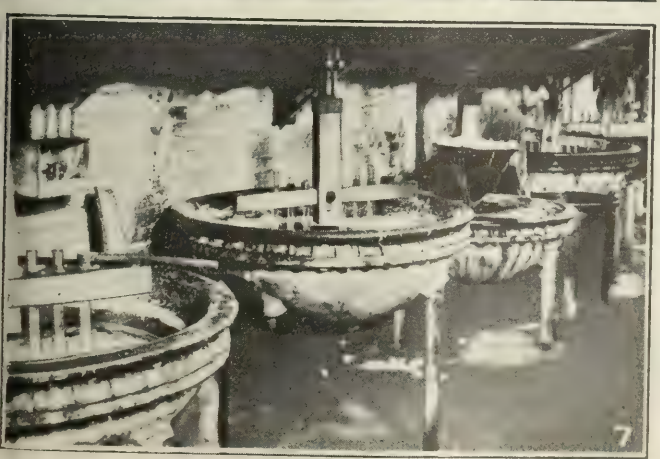












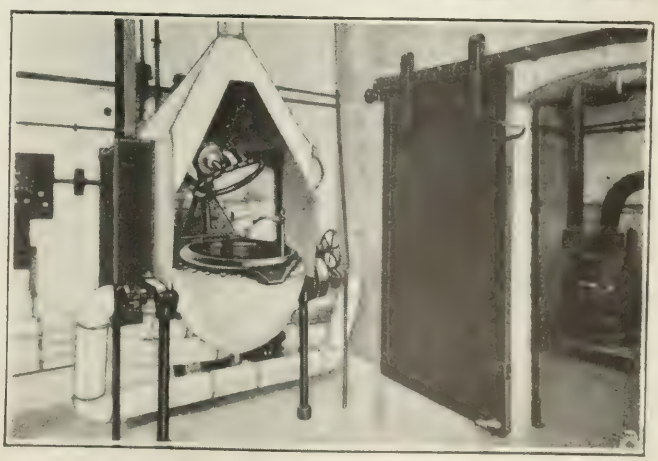


Fig. 1—Standard sirup mixing tanks.
Fig. 3—Storage tanks; mixing tank.
Fig. 5—Standard vacuum pan.
Fig. 7—Jacketed evaporating dishes.

Fig. 2—Vertical mixing and storage tanks.
Fig. 4—Factory transportation unit with agitator.
Fig. 6—Enameled trays in shelf drier.
Fig. 8—Tilting reaction kettle with agitator.

spective user and a careful analysis of the situation by the manufacturer are required if the proper grade of enamel is to be furnished on apparatus of correct design.

One may logically ask why the most resistant enamel is not used on all types of ware. As a general rule the processing temperature of enamel of a given class increases with an increase of chemical resistance. This in turn greatly multiplies the manufacturing difficulties and limits the maximum size and flexibility of design. To use an enamel of more than the required resistance puts an unnecessary burden on the manufacturer and in turn a higher price on the product.

Standard Constructions

As a whole there are two standard types of construction used in the manufacture of enameled apparatus. The one involves the application of a relatively thin coat of enamel to steel, the other a thicker coat of an enamel of a different type to cast iron. Each has its advantages. The steel construction makes possible larger units, but certain manufacturing features limit the larger sizes to mild conditions of use. With smaller pieces more resistant enamels can be used and more severe service met. But the cost per unit volume increases with decreasing size and other features contribute to the relative undesirability of very small units of steel construction for chemical work. On the other hand, there are various points which make the manufacture of smaller cast-iron units very feasible. As a class cast-iron enamels process at lower temperatures than steel enamels of the same resistance. Other details go to make this type of construction desirable on certain lines of work. Some manufacturers furnish steel equipment only, others cast iron only, and still others follow both lines.

Standard Uses

The classification of enameled apparatus from the point of view of the chemical operation to be carried on therein is difficult because chemical manufacturing processes deal with such a variety of substances and treatments. It is more logical to consider the standardization of enameled units from the point of view of the mechanical operations being performed therein.

In classifying enameled apparatus in accordance with the mechanical use, five headings may be considered: mixing, storage, transportation, evaporation, and reaction. These standard operations will be considered with reference to the grades of chemical conditions previously outlined.

Mixing

The mixing problem may range from the rapid dissolving of a solid in a liquid to the formation of a difficult emulsion. The batch may be a few gallons or as large as 7,000 gal. Chemically it may only be required to keep from contact with steel a product which would be discolored thereby; or possibly acids are present which would rapidly eat through the unit at the minutest metallic contact. For mild service large mixers with complicated agitators of wood or special metals are possible. Conditions of intermediate severity call for smaller units and the use of an agitating device coated with enamel, contact with even small areas of the relatively resistant alloys often not being permissible. Such agitators must be of simple design and operated from the top of the unit. With the most corrosive compounds still smaller units of very simple design must be supplied to assure a satisfactory piece of machinery. The mixing unit may be a single-shell tank or it may have a jacket or other device for temperature regulation. It may be of an open or closed top construction.

Typical mixing problems that are successfully met with the proper design of enameled equipment are the following: Mixing of face creams and tooth pastes, preparation of cod liver oil emulsions, mixing of phosphate sirups containing free acid.

Storage

Enamel-lined storage tanks are subject to the same general controlling factors as mixing units. They may be horizontal or vertical as desired. A large variety of accessories are possible for tanks for mild conditions, while severe acids must be met with simpler constructions.

Among typical materials stored are the following: Edible oils, sirups, elixirs, perfumes, extracts, tincture of iodine, phenol, alcohol, c.p. mineral acids.

Transportation

The transportation on a large scale is at present confined to conditions of a mild nature. Liquors containing free organic acids are being transported in enamel-lined tanks on railroad cars. The carrying of smaller batches of liquid from one part of a plant to another is an accomplished fact for all classes of chemical conditions. Open or closed top tanks mounted on trucks or castors find a ready application.

Typical cases of this type include the conveying of chlorinated organic compounds containing free chlorine, the distribution of alcohol to various departments, and the carrying of small amounts of mineral acids about the plant.

Evaporation

In presenting the use of enameled units for the evaporation of liquids it is well to have clearly in mind the fact that the evaporation to dryness of large quantities of material, or the rapid concentration of large volumes of solution, cannot be successfully accomplished in this type of apparatus. These problems fall to the drum drier and other relatively complicated devices. The enameled unit has for its field the handling of smaller quantities of the more sensitive or corrosive products.

The simple evaporation problems are accomplished in open units. Evaporation in closed units is usually of the vacuum type. The destructive acids are generally confined to the pan. A variety of accessories may be used on larger evaporators for mild service, but the unit for severe acids must be far more simple.

Distillation, a special case of evaporation, may be carried on at atmospheric or reduced pressures. The pan is essentially the same as the closed evaporator. The condenser and receiver are enameled excepting where severe acid conditions or substances sensitive to metallic contact are confined to the pan. Copper condensers are sometimes permissible.

Another evaporating unit which is finding a growing application in the chemical trade is the enameled tray for the evaporation of liquids or the drying of moist solids. These are used in both atmospheric and vacuum evaporation.

The installations of various forms of enameled evaporators are numerous. A few typical examples will suffice: The evaporation and crystallization of c.p. salts

such as thorium nitrate, sodium iodide and copper chloride, the vacuum concentration of fruit juices, concentration and fusion of zinc chloride, preparation of hydrosulphite stripping compounds, concentration of aluminum chloride, evaporation of acid rare-earth bromide solutions.

Reaction Units

As reaction units are classified those pieces of apparatus in which specific chemical reactions such as nitration or neutralization are carried on. They may be of a great variety of types as conditions demand—open or closed, plain or jacketed, large or small. Typical installations involve the chlorination of organic compounds, reduction by metals and acid, preparation of silver nitrate from metal and nitric acid, salting out of dyes, generation of hydrocyanic acid, manufacture of ethyl chloride, processing of acid sodium phosphate, manufacture of so-called "phenol condensation" products.

Standard Temperature Control

Problems of temperature control may involve heating, cooling, or holding at a given temperature.

Heating by Steam

The heating of the contents of an enameled unit is accomplished in various ways. Steam under pressure may be passed directly into the material or it may be applied externally by means of a jacket around the tank or by coils within the tank.

If a jacket is used the permissible pressure is a matter of particular importance from an enamel point of view. Steel has an elasticity by virtue of which it can safely "breathe" due to pressure changes. But the less elastic enamel cannot follow such a movement of the steel without rupture. (This point should not be confused with the relative thermal expansion of enamel and steel, to be considered later.) A safe working pressure for an enameled unit may be taken as about one-half of that which would be reasonable for the same structure unenameled. In the case of jacketed vacuum units proper correction for vacuum must be made.

If the permissible jacket pressure under a given case does not furnish the desired temperature, superheating may be resorted to.

Under chemical conditions which will permit the use of metal steam coils within the batch, more rapid evaporation or higher temperatures can be thus realized by using high-pressure steam. Such coils are commonly furnished in plain copper, nickel-plated, tinned or silver-plated copper, or aluminum.

Oil Heating

Certain types of reactions demanding high temperatures but relatively low heat absorption are often made possible by the use of oil as a heating medium. Oil heated in a separate heater may be circulated through the jacket or through metal coils within the batch. Oil in the jacket may be heated by direct fire applied to the bottom of the jacket or by high-pressure steam in coils within the jacket. Specific conditions, chemical and mechanical, will govern the procedure in a given case.

Molten Alloy Bath

Some reactions demand higher temperatures than can be obtained by steam jackets, a more rapid flow of heat than would result from the use of oil as a heating medium and involve chemical conditions such that metal coils are out of the question. Such situations have been successfully met by the use of a bath of molten alloy, heated by a fire beneath.

Direct Fire

A final possibility for the production of high temperatures is the use of direct fire. As a general rule this method is undesirable. Enamels of the proper composition have a thermal expansion so related to that of the metal beneath that the two materials can pass through a reasonable temperature change without the setting up of strains causing rupture of the enamel. But if the temperature change is severe and local, trouble may result. No conditions existing with permissible steam pressures or oil-heating temperatures should cause distress. But with direct fire the heating is likely to be locally excessive, causing severe strains on sudden changes of temperature. Under conditions of evenly applied heat, accomplished by proper checkerwork or baffles, very satisfactory service can be realized. Small units heated over a flame of low intensity applied to a large portion of the dish are found to be very practical. If the material being treated has a relatively low thermal capacity—for instance, an oil as compared with an aqueous solution—conditions of excessive strain from direct fire heating are less likely to be produced.

Cooling and Insulating

The problem of the cooling of a liquid is not frequently encountered. In a few cases cold water or brine have been circulated through jackets or coils. Condensers are usually equipped for the circulation of water or brine.

It is often desired to prevent the rapid exchange of heat between a unit and the atmosphere. Air confined in a jacket or the use of the common insulating materials are frequently resorted to.

Rate of Heat Transfer

A statement as to the rate of heat transfer through enameled metal is pertinent. The partition through which heat is called upon to pass may range from a thin coat of enamel on $\frac{1}{8}$-in. steel to a relatively thick coat on 1-in. cast iron. Hence the rate of heat transmission varies between quite wide limits. As a maximum it is approximately one-half, and as a minimum about one-fifth that of copper. These values are on the assumption that the same conditions as to temperature difference, velocity and other factors exist. The comparison also refers to copper of the thickness used in the construction of apparatus for similar operations.

Conclusion

Thus it is seen that by the combination of various standard elements of design, enamel, method of temperature control and accessories, equipment can be constructed to serve a great variety of purposes. While a given piece of apparatus may differ from any previously made, it usually embodies only standard features assembled to meet a particular case. The would-be purchaser does well, therefore, in recognition of these facts, to submit his case clearly and fully so that the manufacturer may intelligently make such a combination of standard elements as may best suit the uses to which the apparatus is to be put.

Elyria, Ohio.

Manufacture Of Alloy Steel for Airplane Shafts*

Experiments on the Manufacture of Nickel-Chromium Steel in the Basic Heroult Furnace—To Produce Airplane Shafting With No Trace of Transverse Structure, It Is Necessary to Use Very Good Raw Material and Refine With Two Oxidizing Slags as Well as the Usual Carbide Slag

By Dr. E. Kothny

INCREASING demands upon steel of quality, used in motor car and airship construction, require continual improvement in the metal. Its properties depend primarily upon the care used in its manufacture. Subsequent treatment during fabrication may spoil a good steel, but can never correct errors occurring prior to the ingot.

Furnace Investigations

It is by no means easy to investigate the influence of a particular step in the furnace operation. In our present state of knowledge this is best done in an empirical manner—by taking a series of heats, worked as nearly alike as possible except for one factor, which may be varied within reasonable limits. In the studies reported herewith, ingots made in this way were worked up into finished pieces in the regular manufacturing routine, and a study of the qualities of these finished pieces gave useful information on the effect of the variable under consideration.

Our regular melting practice on nickel-chromium steel was as follows: A heat is melted in a 2½-ton basic Heroult furnace from a cold charge of selected plain and alloy scrap in such a way that when molten the P, Mn and C are removed by an oxidizing slag. After these elements are low, the slag is removed, the bath recarburized with petroleum coke and a white slag prepared to deoxidize and remove sulphur. After the proper white slag is obtained, FeMn and FeSi are added to complete the deoxidation, whereupon FeCr is added. The furnace is tapped after holding it for a period of time depending upon the temperature of the heat.

Influence of Time of Solidification

One such heat was first used to determine the joint influence of deoxidation and time of solidification. To make sure that the heat was overoxidized, two oxide slags were made up, each of which contained an excess of ore. After the second had been skimmed and the white slag melted, only enough FeMn and FeSi were added to remove red shortness. One-half of the heat (Part A) was tapped immediately, so the influence of the deoxidizers was a minimum in this part. A second test taken of the metal remaining in the furnace (Part B) showed slight red shortness, so a little more FeMn was added, the current switched on for 30 minutes, and the furnace then drained.

We then had two ladles of metal, "A" poorly deoxidized and "B" well deoxidized. Analyses were identical (C 0.40, Mn 0.42, Si 0.22, P 0.03, S 0.015, Cr 0.48 and Ni 2.54) except Part B had 0.50 per cent Mn. Each ladle poured three ingots: (1) in a preheated sand mold, (2) a cast-iron mold at 400 deg. C. and (3) a cast--iron mold at 50 deg. C. Both ladles were poured at a low temperature—a skull was left in each. All ingots were big end up, tapering from 25 to 23 cm. on a side, 1.1 m. long. Each had a sinkhead, and charcoal was placed on the ingot to prevent rapid freezing at the top. All ingots settled during freezing and were dense except A2 (poorly deoxidized metal in a hot iron mold), which rose slightly and showed blow-holes at the upper edges.

By probing with 4-mm rods the time of solidification was noted, as follows:

A1.....35 min.	B1.....35 min.
A2.....15 min.	B2.....15 min.
A3.....13 min.	B3.....13 min.

Preheating the iron mold has no real difference, since A3 and B3 were cast last and coldest and should be expected to freeze somewhat quicker. Sand-cast ingots A1 and B1 solidified suddenly once freezing started, but those made in iron molds solidified gradually from the edge to the center and from the bottom upward.

Tests on the Ingots

All the ingots were nicked and broken in the lower third. A1 and B1 had the same fracture: coarse crystalline over the whole area, with no difference edge to center. A2 and B2 were also alike: coarse granular in the center, but columnar at the rim. A3 and B3 both revealed thin, leafy or laminated crystals throughout, reminding one of low-carbon ferrochromium. Thus the ingot structure as revealed by fracture was independent of the state of deoxidation.

A slice cut immediately back of the fracture was smoothed and pickled 24 hours in 1:1 HCl (arsenic free). Again the deoxidation practice failed to make a difference. A1 and B1 (cast in sand molds) showed a slightly porous texture, due to the sudden solidification, except about the rim, which was dense for a depth of 1.5 cm. All ingots cast in iron molds were dense throughout.

Tests on Heat-Treated Bars

Nickel-chromium steel of this analysis is ordinarily used only after working and heat-treatment. Its acceptance is based upon proper tensile and impact values and a fibrous fracture, both longitudinally and at right angles to the direction of working. Therefore the lower third of each ingot was reduced 79 per cent to a billet 11 cm. square, it having previously been found that a 65 per cent reduction was sufficient to develop the best physical properties. Temperatures (by optical pyrometer) were 1,050 deg. C. at beginning of rolling and 1,000 at end. All pieces rolled well.

Test specimens were cut from each of these small billets after they had been annealed 10 hours at 700 deg. C. (Forged pieces of Ni-Cr steel are usually an-

*Abstracted from *Stahl und Eisen*, Jan. 8, 1920, p. 41, and May 29, 1920, p. 677.

TABLE I—TENSILE AND IMPACT TESTS

Ingot	Piece	Yield Point, Lb. per Sq. In.	Ultimate Tensile Strength, Lb. per Sq.In.	Elongation, Per Cent	Contraction, Per Cent	Notch Toughness, Kg.-m.	Fracture of Impact Tests
Longitudinal Test Specimens							
A1	Bottom	107,000	122,000	11.9	60	13.6	Fibrous at rim, granular in center; flows poorly.
	Top	107,000	122,000	11.6	60	14.0	
B1	Bottom	108,000	122,000	11.0	50	17.15	Fibrous; flows very well.
	Top	111,000	122,000	11.6	60	18.30	
A2	Bottom	107,000	122,000	11.0	60	16.5	Part granular; flows well.
	Top	105,000	121,000	11.5	61	15.9	
B2	Bottom	108,000	124,000	11.4	60	17.5	Granular; flows very well.
	Top	107,000	125,000	11.3	61	16.9	
A3	Bottom	107,000	122,000	11.2	60	15.0	Part granular; flows well.
	Top	107,000	124,000	11.5	61	15.6	
B3	Bottom	105,000	121,000	11.6	60	16.5	Fibrous; flows very well.
	Top	107,000	124,000	11.5	61	17.0	
Transverse Test Specimens							
A1	.....	122,000	135,000	3.9	14	2.33	Flows poorly, pronounced transverse splintering, scattered grains.
B1	.....	125,000	137,000	3.2	14	2.5	Pronounced transverse splintering, fibrous, flows poorly.
A2	.....	118,000	134,000	7.2	24	3.1	Faint transverse splintering, partly granular, flows poorly.
B2	.....	117,000	132,000	8.4	25	3.5	Faint transverse splintering, fibrous fracture, flows well.
A3	.....	119,000	135,000	7.5	23	3.0	Faint transverse splintering, partly granular, flows poorly.
B3	.....	117,000	134,000	7.9	27	3.5	Faint transverse splintering, fibrous fracture, flows well.

TABLE II—FRACTURES OF ANNEALED BARS

Ingot	Broken Across the Grain	Broken With the Grain
A1	Center granular; fibrous at rim; loose structure; flows poorly.	Pronounced transverse splintering faintly granular; small ability to flow.
B1	Fracture fibrous and loose; flows well.	Pronounced transverse splintering; fibrous fracture throughout; small ability to flow.
A2	Fracture about two-thirds granular; flows well.	Transverse splintering; partly granular; flows well.
B2	Fibrous fracture; flows very well.	Transverse splintering; fibrous fracture; flows well.
A3	Fracture partly fibrous; flows well.	Faint transverse splintering; partly granular; flows well.
B3	Fibrous fracture; flows very well.	Faint transverse splintering; fibrous fracture; flows well.

nealed for machinability and to relieve internal stresses before final heat-treating, and test-pieces should be put through the same program.) Two pieces 5 cm. square and 25 cm. long were taken in a longitudinal direction, and two slices 3 cm. thick across the section. Longitudinal test specimens were turned to 10 mm. diameter and the transverse specimens 8 mm., with length between gage marks equaling $11.3\sqrt{\text{Area}}$. Longitudinal impact specimens were 2 cm. square, notched 5 mm. deep ending in a round hole 4 mm. in diameter. In the testing machine the anvil was set so the specimen was broken as a beam with 120 mm. clear span. Corresponding dimensions of the transverse impact specimens were: 1 cm. square, notched 2 mm. with angular groove at 45 deg., and broken on a 7-cm. span.

All test-pieces were water-quenched from 820 deg. C.; the longitudinal pieces drawn at 600 deg. C. for 15 minutes and the transverse at 500. Results are given in Table I.

Fractures were determined by taking the annealed 5-cm. bar ends, and 3-cm. slices (from which the test specimens were machined), notching them 5 mm. deep, and breaking under a steam hammer. Results are given in Table II.

Although steel such as this is rarely used in the annealed state, it was thought that physical tests would give some light on the subject. Therefore test-pieces were cut from the annealed 11-cm. billet, giving values shown in Table III.

Discussion of Results

Comparing A1 with B1, A2 with B2 and A3 with B3 in Table III shows that there is no great difference in the mechanical properties and fractures of poorly and well-deoxidized steel billets in the annealed state. There is also no difference in the longitudinal samples of steels slowly and quickly cooled (compare A1 and A3, etc., Table III); however, transverse test-pieces of the slowly solidified steel show a pronounced transverse splintering and an undesirable loose structure. To bear out these conclusions, annealed billets were smoothed and pickled. A2, B2, A3 and B3 showed a perfectly dense structure. Slowly cooled ingots A1 and B1 showed a slightly porous structure in the center and a dense structure at the rim, 15 mm. deep; despite reduction of nearly 80 per cent, the cavities in the ingot had not been closed.

As to the heat-treated specimens, Tables I and II show that the quality of the quickly solidified and well-deoxidized steel B2 and B3 is most excellent. Although the poorly deoxidized steel would pass ordinary tensile and impact requirements, the granular fractures appearing in whole or in part would be cause for great suspicion. These tests seem to show that poor deoxidation practice induces partly granular fractures in heat-treated bars, but fails to show observable differences in the fracture or macrostructure of the ingot or of the annealed bars, or in the tensile and impact properties of the latter.

Speed of solidification affects the quality to a far greater extent. It causes differences in all the tests recorded. Especially in the rolled bars, the slower the steel solidifies the more pronounced is the transverse structure or splintering (*cf.* B3 and B1, Table I). In order to avoid this last-named defect, it has become

TABLE III—PROPERTIES OF ANNEALED BILLET

ngot	Yield Point, Lb. per Sq.In.	Ultimate Tensile Strength, Lb. per Sq.In.	Elongation, Per Cent	Contraction, Per Cent	Notch Toughness, Kg.-m.	Impact Fractures	Character of Tension Fracture
				Longitudinal Tests			
A1	60,000	88,000	19.0	61	15.7	Faintly granular, fibrous at rim, flows well	Partly fibrous, flows well, loose fracture
B1	71,000	98,000	17.6	58	14.6	Granular, fibrous at rim, flows well	Partly fibrous, flows well, loose fracture
A2	60,000	90,000	18.3	58	15.0	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
B2	65,000	98,000	17.5	61	14.5	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
A3	61,000	91,000	18.5	60	15.2	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
B3	67,000	98,000	17.6	58	15.0	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
				Transverse Tests			
A1	60,000	85,000	9.8	24	4.04	Fibrous with grains, pronounced transverse splintering, flows well	Fibrous with some grains, pronounced transverse splintering
B1	65,000	88,000	7.2	16	3.60	Fibrous with grains, pronounced transverse splintering, flows well	Fibrous with some grains, pronounced transverse splintering
A2	57,000	87,000	15.4	38	5.36	Fibrous with some grains, flows well	Same as fracture of impact test
B2	64,000	91,000	14.5	40	5.40	Granular, fibrous at rim, flows well	Same as fracture of impact test
A3	60,000	87,000	12.0	35	5.20	Granular, fibrous at rim, flows well	Same as fracture of impact test
B3	64,000	90,000	13.5	37	5.45	Granular, fibrous at rim, flows well	Same as fracture of impact test

our practice to pour alloy steels at as low a temperature as possible.

Steel for Airplane Shafting

Austrian army specifications for airplane motor shafting call for the following mechanical properties, when made on pieces of dimensions given above:

	Longitudinal Test Lb. per Sq.In.	Transverse Test Lb. per Sq.In.
Elastic limit, maximum	156,500	156,500
minimum	135,000	135,000
Ultimate strength maximum	170,700	170,700
minimum	149,500	149,500
Difference between the two above (maximum)	14,200	14,200
Elongation, minimum	7 per cent	4 per cent
Contraction, minimum	45 per cent	15 per cent
Notch toughness	8 kg.-m.	2.5 kg.-m.

All fractures, and the nick and bend test, shall show a full fibrous structure, and a good ability to flow.

When called upon to make this material in large quantity, we first selected some blooms from our stock analyzing C 0.20 per cent, Mn 0.4 to 0.6, Si 0.2 to 0.3, Cr 1 to 1.5 and Ni 4 to 4.5 and made up some shafts therefrom. All tests were passed with ease, the transverse tests showing 170,500 lb. ultimate, 6 per cent elongation, 36 per cent contraction, and impact value of 6 kg.-m. Broken tensile test-pieces and the nick and bend test could scarcely distinguish between longitudinal and transverse fractures. Thereupon a number of electric furnace heats of that analysis were made, but unfortunately the steel did not give a good fibrous fracture, although the other mechanical tests were easily met.

These defective heats were made in what was thought to be substantially the same manner as the practice which produced the metal in stock (outlined in the early part of this article). As far as known, the kind of metal charged was the only difference—the older, successful metal was made of Styrian plate scrap, while the defective heats were made of electric steel scrap from our own plant. The latter was very low in phosphorus, in contrast with the plate scrap, consequently only one oxide slag was necessary to keep this element down. Judging from the experiments given in the early part of this article, two oxide slags—such as are necessary for impure Styrian scrap—would result in a harmful overoxidation of the bath. Our efforts to produce acceptable metal therefore led us first to investigate the influence of the charge upon final quality.

Influence of the Charge

A fairly large quantity of uniform scrap of highest quality was available, being, in fact, electric steel of our own manufacture. Five identical charges were made up, each consisting of Ni-Cr steels having 4 to 4.5 per cent nickel. Five other charges were made up of carbon tool steel—to these the required nickel was added directly after melting. In this way we determined that it apparently made no difference whether the nickel was residual in the melt or was added separately.

A sample taken immediately upon melting showed that all ten heats were very hard, therefore ore was added sparingly. As soon as the heats were sufficiently soft—the last samples were red short—they were deoxidized with FeMn. This addition was made before slagging off so that the deoxidation stage might be as long as possible. Immediately after slagging off FeSi was added to the bare bath and a white slag made up. After 30 minutes a sample would always show red shortness and FeMn and FeSi were added until red shortness disappeared. Thereupon FeCr was added. Ten minutes later the current was switched off.

Deoxidation with FeMn before slagging off caused unduly high manganese in the final analysis, since more FeMn had to be added after the white slag had been prepared. Five of the heats were therefore made by the old method—i.e., FeMn and FeSi added after the white slag had acted for 30 minutes.

All heats were slightly overheated; they were held in the furnace 4 minutes before pouring. Our optical pyrometer was less satisfactory than the "spoon" test[1]—the temperature of the bath in these heats was such that 15 to 25 seconds passed before the metal would crust over.

An ingot 16.4 cm. (6¼ in.) round from each heat was rolled to 6-cm. square rods. Two slices 25 mm. thick were cut, nicked 5 mm. in the center and hardened in water from 840 deg. C. One was broken in that condition by a single blow from a steam hammer. The other was broken after tempering at 400 to 450 deg. C. (depending upon its hardness) in a lead bath. Ultimate strength was estimated from the size of the Brinell impression.

All these ten heats had a fibrous fracture in the hardened state, but a very objectional granular fracture and poor ability to flow in the tempered condition. Repeating the heat-treatment did not change these results.

We were therefore reluctantly faced to the conclusion that the purest raw material (either with nickel or without it) does not always produce a steel with good transverse properties. Evidently the process of melting or working the heat influenced the quality—since, as it has been indicated, we were assured that we were able to make acceptable steel unknowingly.

Influence of Casting Practice

In order to extend the conclusions reached in former experiments—detailed in the first part of the paper—to high-alloy steel for aircraft, two heats were made of purest electric scrap and poured into 8-in. molds of various sorts and temperatures. It is unnecessary to recount these in detail, since they confirmed our expectation—viz., that long cooling in a sand mold is associated with pronounced transverse structure, and that if iron molds were used, it appeared immaterial whether they were chilled or warm, top or bottom cast. Therefore we held to our standard practice: cool pouring the steel in blood-warm molds.

Tests Taken While Working the Heat

In the hope that the circumstances which determine the structure might be recognized when testing a heat during the working, we took a series of large samples from two heats, immediately after certain additions had been made and also some time later. These samples were poured into 3-in. square molds and forged to a slab 2x10 cm. cross-section under a small steam hammer. Two pieces 5 cm. long were cut from these slabs, notched 5 mm. deep in a longitudinal direction (i.e.,

[1] The spoon used for taking the furnace tests is washed in slag and about 2 kg. melted steel dipped up, and skimmed. A stop watch determines the time required to form a skin on the surface of the steel. Comparative figures result only if all additions have been made. If FeMn alone is in the bath, gases boil up and agitate the surface, so the time recorded is unduly long. If FeCr has also been added, the time is too short, where FeSi increases the time to crust over.

TABLE IV—TESTS DURING WORKING TWO HEATS

	Time	Addition	Sample Taken	Transverse Fractures—Hardened	Transverse Fractures—Annealed	Ultimate Strength—Hardened	Ultimate Strength—Annealed
eat 1	0 hr. 0 min.	10 kg. FeMn					
	0 hr. 10 min.	.....	No. 1	Fibrous, flows well	Fibrous, flows well	163,500	148,000
	0 hr. 13 min.	4 kg. FeMn and 40 kg. FeCr					
	0 hr. 15 min.	.....	No. 2	Slightly granular, flows well	Slightly granular, flows poorly	217,000	166,000
	0 hr. 45 min.	.....	No. 3	Fibrous, flows poorly	Slightly granular, flows poorly	226,000	175,000
	In the ladle	10 kg. FeSi	No. 4	Fibrous, flows well	Fibrous, flows well	227,000	180,500
eat 2	0 hr. 0 min.	16 kg. FeMn					
	0 hr. 27 min.	.....	No. 1	Flows well, fibrous	Flows well, fibrous	162,000	139,000
	0 hr. 30 min.	20 kg. FeCr					
	0 hr. 34 min.	.....	No. 2	Fibrous, flows poorly	Slightly granular, flows poorly	189,000	156,500
	0 hr. 41 min.	20 kg. FeCr					
	0 hr. 45 min.	.....	No. 3	Fibrous, flows poorly	Slightly granular, flows poorly	220,000	172,000
	In the ladle	10 kg. FeSi	No. 4	Fibrous, flows well	Fibrous, flows well	210,000	172,000

TABLE V—TESTS ON THIRD HEAT

Time	Addition	Sample Taken	Transverse Fractures—Hardened	Transverse Fractures—Annealed	Ultimate Strength—Hardened	Ultimate Strength—Annealed
hr. 0 min	15 kg. FeMn					
hr. 20 min	15 kg. FeMn	No. 1	Fibrous, flows well	Fibrous, flows well	162,000	142,000
hr. 23 min	30 kg. FeCa and 18 kg. FeSi					
hr. 35 min	30kg. FeCr	No. 2	Slightly granular, flows well	Granular, flows poorly	183,500	166,300
hr. 45 min	.....	No. 3	Slightly granular, flows well	Granular, flows poorly	189,000	162,000
hr. 55 min	.....	No. 4	Slightly granular, flows well	Granular, flows poorly	189,000	162,000
n the ladle	.....	No. 5	Slightly granular, flows well	Granular, flows poorly	217,500	178,000

arallel to the long dimension of the slab). One was ardened and broken, the other drawn back to the hardess required for airplane shafts, and then broken.

Rather poor sheet scrap was charged for these heats: oth were worked with two oxidizing slags. After the econd one was skimmed, and the white slag obtained, nough FeMn was added to free the steel from red nortness. The first large sample was taken at this me. Sequence of further additions and samples are oted in Table IV. (It may be noted that in Heat No. the FeCr was added in two parts.) Ferrosilicon was dded to the ladle, and the fourth sample taken when puring the ingots.

Table IV shows that the finished steel of both heats ould conform to specification. Intermediate samples ow that the steel has a fibrous fracture as long as contains no chromium; the structure became granular both the hardened and drawn condition upon adding eCr and in fact the more granular the higher the romium.

Time for Adding FeSi

Ferrosilicon, in turn, improves the structure. Could show a still better improvement when exerting its fluence for a longer period?

To determine this point, another heat was made om the same kind of material, but only one oxidizing g was used. Ferrosilicon and FeCr were added simulneously to a bath which was relatively cool. A spoon t taken after the second sample (Table V) showed 2 seconds. This increased to 35 seconds just before oping; consequently the heat was held 10 minutes.

As can be noted from Table V, this heat did not f the requirements. The only differences in working re the use of one oxide slag and the time of adding FSi. We concluded that one or the other of these is sponsible for transverse structure. Since overoxidizaon is universally regarded as damaging, we rejected is as an influential factor and turned our attention to e proper way to make the FeSi addition. Other hts were made of the same sheet scrap, and the FeSi ded at various times or in the ladle. Results were uformly bad. As a last resort we then turned to the ning practice.

Thereupon we made two 6-ton open-hearth heats of st-class steel, one containing 5 per cent Ni and the er free of alloy except 0.8 per cent C—otherwise their composition was almost identical. The ingots from these heats were divided into six piles and remelted in the electric furnace. Three of the melts were made with one oxidizing slag, the other three with two; otherwise the practice was identical.[2]

Of the heats made with one oxidizing slag, two developed transverse structure and granular fracture in the rolled, heat-treated rods; the third was fibrous with only a trace of transverse weakness—it alone passed specifications. All three of the heats made with two oxidizing slags passed specifications easily, all having fibrous fractures, flowing well, and in only one was there a faint suggestion of transverse weakness.

These experiments seemed to prove beyond doubt that working a heat of alloy steel with two oxidizing slags, far from being detrimental, actually improves the quality. However, it is not able to produce steel of perfection from quite inferior material, as we very quickly demonstrated when using impure junk. Due regard must be paid to the quality of the charge.

Successful Furnace Practice

In order to avoid rejections in finished airplane shafts, the following practice was adhered to:

Selected scrap of best quality is charged, melted and worked with two oxide slags. (Use ore rather than mill scale.) After skimming the latter, the finishing slag is made up, using 1 kg. FeMn per ton of steel to hasten the reactions and bring the latter white in a minimum of time. When it is white, enough FeMn is added to eliminate red shortness, whereupon FeCr and FeSi are added. When the additions are melted, the heat is well stirred, a 3-in. ingot poured in a chill, and a spoon test for temperature should not take more than 30 seconds to film over. This indicates that the metal should be held in the furnace 5 minutes.

The test ingot is forged to a slab 2x5 cm. in cross-section. Two pieces 2 cm. long are cut off and nicked longitudinally. Both pieces are hardened in water from 800 to 850 deg. C., and one drawn back in a lead pot at 400 to 450 deg. C. If the tempered piece shows a fibrous structure and a good ability to flow, the heat is cast into forging ingots for making airplane shafts

[2]Steel melted with two oxidizing slags requires an excess of 3 or 4 kg. FeMn per ton to eliminate red shortness. It was found later that the finished steel (which must contain 1 per cent chromium in order to give it the necessary hardening properties) cannot hold more than 0.8 per cent Mn, to avoid granular fractures

If the fracture of the quenched piece only is fibrous, the steel is cast into ingots for rolling. An even better test was introduced later. A piece of the same test ingot is forged to 2 cm. square, notched 5 mm. deep, and heat-treated to 165,000 lb. per sq.in. strength. When broken, the fracture must show no trace of granular structure.

A small test ingot, 6½ in. round, is cast with the remainder of the heat. This is rolled to a 6-cm. square rod. Two slices 2.5 cm. thick are cut from this bar, nicked 5 mm. across the face, and heat-treated to an ultimate strength of 165,000 lb. per sq.in. (as determined from the Brinell test). After breaking under a single steam-hammer blow, the fracture must be fibrous and show good ability to flow. This latter test is somewhat more severe than the furnace test, and will reject occasional heats which might give trouble when making airplane shafting.

No differences in microstructure can be observed in the heats which have granular fracture and those which are fully fibrous.

Legal Notes

By Wellington Gustin

Contract to "Manufacture" May Not Be Termed "Work and Labor" So as to Evade Tax

The Circuit Court of Appeals of the United States has decided that the manufacture of munition parts under a contract and from materials furnished is subject to the munition manufacturer's tax, this finding affirming a decision of the District Court in an action brought by the Dayton Brass Castings Co. against the Collector of Internal Revenue. A certiorari has been denied the Brass Works by the United States Supreme Court, which affirms the lower courts, 277 Federal, 227.

It appears from the facts that the Canadian Car & Foundry Co. had a contract for the sale of shrapnel shells to or for the use of the Russian Government, and had sublet to a machine company at Dayton, Ohio, a contract for making the fuses for the shells. The machine company in turn contracted with the Dayton Brass Castings Co., by which it was to furnish the latter brass ingots which were to be put through the Dayton company's foundry, molding the same into small castings, which were to be united by the machine company with other parts to complete a fuse. For this service the castings company was to receive a specified price per pound.

By the provisions of title 3 of the act of Sept. 8, 1916 (39 Stat., 780) and known as the "munition manufacturer's tax," a tax was imposed upon every person manufacturing "any part of" fuses, the tax to be 12½ per cent of the entire net profits actually received or accrued during the year from the sale or disposition of such articles manufactured within the United States. This tax was imposed upon the castings company, which paid the tax under protest and brought this suit to recover.

Two propositions were considered. One was that, since plaintiff had to do with only one part of the fuse, it was not a manufacturer within the meaning of the act. But the established rule is that one who makes a part which is intended to be and does by the act of another become merged into the kind of munition specified in the act is a manufacturer subject to tax.

Then the plaintiff contended that it did not receive profits "from the sale or disposition of such articles," but was in effect paid only for work and labor expended on the property of another. The court says, taking together the sections of the statute above noted, it concludes that the tax was imposed upon the business of manufacturing, and was measured by the profit received upon the sale or disposition. If there were no profits, the tax would be nothing. That the castings company received profits from its contract was not disputed. While the company did not make "sales" it did make a "disposition" of the articles. Having received the metal and having cast it into form, the company disposed of the castings and so far disposed of the subject matter of the contract as to turn these articles over to the machine company and get payment for its service. This court held to be a disposition.

A very substantial contention against this holding was that under the doctrine of *ejusdem generis* the statutory phrase "sale or disposition" can include only dispositions of the character of a sale. But the court says this rule may not prevail to the exclusion of the other rule which requires every word and phrase be given force and meaning, if possible. And if plaintiff's contention were right, the statute could be evaded wholly or in very large part by similar contracts as this one, and a court will not sanction such evasion of the law by dividing the manufacturing process into several steps by separate persons.

Antimony Industry of Hunan, China

Hunan has been producing antimony for over [illegible] years. Discoveries were made as early as 1897, and since that time new ones have been made yearly, according to reports from Consular Clerk Gordon Burke, published in *Commerce Reports* for Oct. 9, 192[illegible] The demand during the war greatly exceeded the supply, causing the price to soar to ten times its normal level. Hunan became a large exporting center for antimony and many mines and smelters sprang up all over the province. The termination of the war resulted in a cessation of the abnormal demand and the price went down to a very low level. The selling price in many cases is still much below the actual cost of production, which has caused about nine out of every ten mines to stop operations. It is believed, however, that the lowest level in the industry has been reached, and that a slight improvement is now to be noticed. By this is meant that the richest mines and the ones that can the least to operate are now being exploited to their full worth. During 1921 there were 921 mines in operation.

Deposits of antimony are abundantly and widely distributed throughout Hunan. The districts around Paoching, Anhwa and Sinhwa are particularly rich in the supply of this mineral. Hsikuangshan, a hill located in the Sinhwa district, is called Antimony Hill because of the richness of the deposits found there. The antimony ore of Hunan is of a very high grade and is free from arsenic and other impurities. The antimony content of the ore runs from 20 to 65 per cent. Regulus exported by the Wah Chang Mining & Smelting Co. is 99.95 per cent pure. The Herrenschmidt process is generally used in extracting antimony regulus. Since the demand for regulus has fallen off, antimony ore is manufactured into trioxide, commonly called antimony oxide.

Distillation and Concentration Of Dilute Nitric Acid

An Experimental Study of the Concentration of Nitric Acid—The Distillation of Water-Nitric Acid Mixtures and of Nitric Acid-Sulphuric Acid Mixtures—Graphic Study of the Results

By E. Berl and O. Samtleben
Translated by F. C. Zeisberg*

Translator's Note: In *Chemical & Metallurgical Engineering*, vol. 25, pp. 1103-6 and 1145-50 (1921) appeared a translation of an article by P. Pascal in *Annales de Chimie* covering a very complete investigation of the distillation of HNO_3 solutions and H_2SO_4-HNO_3-H_2O mixtures. Apparently about the same time Pascal was making his experiments there was under way in Germany an independent investigation of the same problem, the results of which have recently appeared in the *Zeitschrift für angewandte Chemie*. Since the results obtained by the two investigators differed considerably and since the readers of *Chemical & Metallurgical Engineering* had already been made familiar with the earlier results, it seemed desirable to afford them the opportunity to familiarize themselves with the later work also. The following translation has hence been prepared, only such portions of the original article being used as bear directly on the work of Pascal.

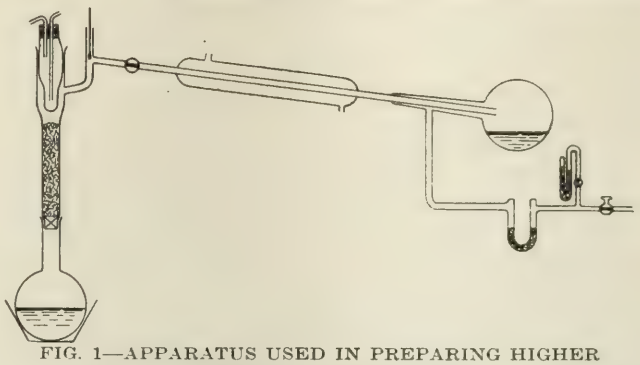


FIG. 1—APPARATUS USED IN PREPARING HIGHER STRENGTH NITRIC ACID

FORMERLY nitric acid was manufactured by decomposing Chilean saltpeter with concentrated sulphuric acid. This process was widely developed hnically; from the standpoint of distillation in stages Uebel[1] and the Badische Anilin und Soda Fabrik[2], and m that of operation in a vacuum by Valentiner and hwartz[3]. The acid obtained by these processes was hly concentrated enough to meet the needs of the lustry, and even the weak acid simultaneously obined in comparatively small amounts was utilized, or, ere no use could be found, was returned to the retort h the saltpeter and redistilled. The question of hly concentrating weak nitric acid became most portant as the problems of obtaining nitric acid from oxidation of ammonia and atmospheric nitrogen re solved. Since in the arc process a 35 per cent d and in ammonia oxidation at best a 55 to 58 per t acid is obtained, it became necessary, for most uses which the acid was put, to concentrate it to 48 deg. or higher. During the war, with the increased demand for highly concentrated nitric acid, particularly nitrating, the question assumed unusual importance. By simple distillation of an acid weaker than 68 per t, even when employing dephlegmators or changes in ssure, a concentrated acid cannot be obtained, beise, as Roscoe[4] showed, mixtures of nitric acid and er possess a minimum vapor pressure, or, what is ivalent, a maximum boiling point. At 760 mm. this t lies at 120.5 deg., with 68 per cent HNO_3, by ght, in the liquid and gas phases. As there is here stem of two substances whose liquid phases as well gas phases are miscible in all proportions, it is posle to achieve by rectification only residues of 68 per t HNO_3, while the portion that distills over in the e of mixtures weaker than 68 per cent is, with ideal ification, pure water, and in the case of mixtures nger than 68 per cent, pure 100 per cent HNO_3.

n the early years of the war the Central Powers, because the high concentration process had not been technically perfected, principally for lack of proper materials of construction, obtained most of their concentrated nitric acid by converting weak nitric acid into sodium nitrate and decomposing this with concentrated sulphuric acid. This method is fraught with an extraordinary consumption of raw materials, since per ton of HNO_3 in the form of 48 deg. acid it was necessary to use 0.8 ton sodium carbonate and 1.5 ton sulphuric acid, producing as byproduct 1.8 tons sodium bisulphate. For this latter there was at first available no rational use, since the method of Berl[5] of decomposing bisulphate with lime-nitrogen to form ammonia and caustic soda or sodium carbonate was discovered too late to be applicable to war processes.

One way to superconcentrate nitric acid lies in the action of water-binding substances on the dilute nitric acid. Of all the substances proposed for this purpose, such as sulphuric acid, phosphoric acid, arsenic acid, polysulphates, etc., only concentrated sulphuric acid has come to be used technically, since it is available in unlimited amount, the question of raw materials for its manufacture has been solved, the reconcentration of the resulting weak sulphuric acid presents no particular technical difficulty, and the superconcentrating operation itself can be carried out in simple apparatus. In principle, this process depends upon the knowledge that in the ternary system H_2SO_4-HNO_3-H_2O the H_2O vapor pressure is strongly reduced by the H_2SO_4; and the HNO_3, by virtue of its high partial pressure, can easily be driven off in a highly concentrated form. This process is carried out technically by the so-called dry method, consisting in the distillation of a previously prepared nitric acid-sulphuric acid mixture from retorts, either discontinuously,[6] in stages,[7] or continuously by the application of external heat, and perhaps under a vacuum,[8] or the process is carried out in columns, either with external heating or with internal heating from counter-current hot air or gases from an arc fur-

*rom *Z. angew. Chem.*, vol. 35, pp. 201-2 and 206-11 (1922).
er. Pat. 127,647.
er. Pat. 227,377.
er. Pat. 63,207.
nn. Chem. Pharm., vol. 116, p. 204 (1860).

[5]Berl, Defris and Von Boltenstern, *Z. angew. Chem.*, vol. 34, p. 517 (1921).
[6]Erouard, Ger. Pat. 62,714.
[7]Uebel, Ger. Pat. 210,803.
[8]Valentiner and Schwartz, Ger. Pat. 88,321; Raschig, Ger. Pat. 286,975.

nace,[9] in which the abstraction of water is effected by downward trickling sulphuric acid. Or, the process is carried out by the so-called wet method,[10] using steam as the source of heat which is blown into the bottom of a high column. In this case the nitric acid is driven out of a previously prepared mixture or one freshly formed in the tower, by the condensation and combining heat of the steam, while a sulphuric acid of about 70 per cent flows out at the foot of the tower.

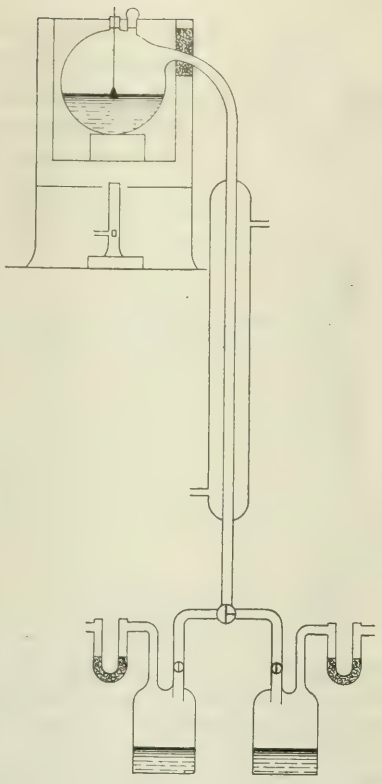


FIG. 2—DISTILLATION APPARATUS USED IN THIS INVESTIGATION

Despite the importance of the problem of superconcentration, only scattered articles appear in the literature, not only on the distillation of nitric acid mixtures but also of nitric acid-sulphuric acid mixtures. Besides the work of Roscoe already mentioned, the boiling point of the mixture with the lowest vapor pressure was determined by Mitscherlich as 120 to 121 deg., by Millon as 125 to 128 deg., and by Smith as 121 deg. C. Galle showed in a recent article[11] a graphical representation of a distillation curve of HNO_3 from a series of experiments by Guido Pauling. In Hausbrand's "Die wirkungsweise der Destillier und Rektifizier-apparate" (1921) is found a table and a graph of the vapors given off by nitric acid-water mixtures, in both cases for acids under 68 per cent. Smith[12] investigated acids above 1.5 specific gravity, and determined the boiling point of a concentrated acid of 1.517 sp.gr. to be 84.4 deg. Creighton and Githens[13] determined the boiling points of nitric acid-water mixtures at various pressures, as did also Pascal and Garnier,[14] who in addition gave a boiling point and condensation point curve for nitric acid.

Saposchnikow[15] investigated the vapor pressure and composition of the vapors of mixtures of nitric acid of 1.52 and 1.48 specific gravity with varying amounts of concentrated sulphuric acid, as well as the specific gravities and conductivities of these mixtures, the influence of water on the vapor pressure at room temperature, and the nitrating action of these acids. The results of the investigation are obscured by an appreciable NO_2 content in the mixed acids.

[9]Swedish Nitric Syndicate, Ger. Pat. 233,031; Norsk Hydro, Ger. Pats. 278,867; 289,745; 292,385, and 300,897.

[10]Pauling, Ger. Pats. 257,809 and 274,165.

[11]*Z. angew. Chem.*, vol. 34, p. 169 (1921).

[12]*Pharm. Centralbl.*, vol. 19, p. 203 (1848).

[13]*J. Frank. Inst.*, vol. 179, pp. 161-9 (1915).

[14]*Compt. rend.*, vol. 165, p. 589 (1917); *Ann. Chim.*, vol. 15, p. 253 (1921); *Chem. & Met. Eng.*, vol. 25, pp. 1103; 1145 (1921).

[15]*Z. phys. Chem.*, vol. 49, p. 697 (1903); vol. 51, p. 609 (1905); vol. 53, p. 385 (1905).

Pascal and Garnier (above) determined the vapor pressures of nitric acid-sulphuric acid mixtures at various pressures, as well as the boiling points and the vapor compositions. In a further research[16] these investigators reported the specific gravities of these mixtures and in a third[17] the specific heats. C. de la Camine[18] made a study of the heat balance in the distillation of a nitric acid-sulphuric acid mixture.

Independently of these last-mentioned researches, which were available (partly in short references) to us only very recently, and as a preliminary part of continued researches extending back to 1916, carried out by R. Leiser, the boiling point and distillation curves of nitric acid and the distillation and condensation curves of various mixed acids in the whole region of the Gibbs triangle were determined, in order to arrive at an understanding of the phenomena in the superconcentration of nitric acid.

Distillation of Nitric Acid-Water Mixtures

The purest nitric acid was used in the distillations prepared from technical nitric acid by distillation which freed it of various impurities. It was diluted with water to the various concentrations used. In preparing the highest strength of nitric acid a vacuum apparatus was used, shown in Fig. 1. In this it was possible, using five parts of concentrated sulphuric acid to one part of 65 per cent nitric acid and adding some ammonium sulphate (to decompose the NO_2), to obtain at 15 to 20 mm. pressure, in the first portion of the distillate, 100 per cent HNO_3. The receiver had to be strongly cooled, as otherwise the acid, by virtue of its high vapor pressure and low boiling point (33 deg. at 15 to 20 mm. pressure), distilled off to the vacuum pump. By raising the temperature to 45 deg. the remainder of the nitric acid was obtained as 95 to 98 per cent condensate. The acid obtained in this manner, after proper dilution and analysis, was distilled in the apparatus shown in Fig. 2. Particular care was taken that no rectification occurred within the retort-like vessel, by which the results might be changed in an unknown way. The vessel was completely surrounded by an air bath, as well as the connection between the vessel and the condenser; this connection, in addition being wrapped outside the bath with asbestos as far as its bend. The first acid fractions distilling condense first in the descending part of the condensing tube. A window in the air bath permitted the boiling point to be noted and its temperature to be read.

The analytical determinations of the highly concentrated nitric acid necessitated particular care from the very beginning, because it is noticeably more hygr

[16]*Bull. Soc. Chim.*, vol. 25, p. 142 (1919).

[17]*Bull. Soc. Chim.*, vol. 27, p. 8 (1920).

[18]*Ind. Chim.*, vol. 5, pp. 153, 187 (1918).

TABLE I.

No.	Per Cent HNO_3 in Original Acid	Per Cent HNO_3 in Residual Acid	Average	Per Cent HNO_3 in Distillate	Boil Poi Deg
1	12.25	14.64	13.45	0.46	10
2	20.15	21.00	20.58	1.28	10
3	30.22	33.28	31.75	4.94	10
4	37.13	38.85	37.99	9.20	11
5	42.73	44.27	43.50	14.86	11
6	45.57	49.96	47.77	21.71	11
7	52.48	55.44	53.96	33.51	11
8	55.37	57.83	56.60	39.37	11
9	60.94	62.00	61.47	51.43	12
10	62.00	63.27	62.64	54.46	12
11	64.95	65.41	65.18	60.62	12
12	65.41	65.92	65.67	62.11	12
13	67.30	67.56	67.43	65.97	12
14	67.84	67.94	67.89	67.84	12
15	88.00	68 00	68.00	68.00	12

TABLE II.

o.	Per Cent HNO_3 in Original Acid	Compn. of Residue Per Cent HNO_3	Per Cent N_2O_3	Average	Compn. of Distillate Per Cent HNO_3	Per Cent N_2O_3	Boiling Point, Deg. C.
6	69.76	69.11	....	69.44	71.12	....	120.8
7	70.44	69.76	....	70.10	72.56	....	120.7
8	73.51	73.01	....	73.26	79.63	....	119.5
9	79.67	78.18	....	78.92	88.54	0 04	115.4
0	82.57	80.46	....	81.52	92.08	0.07	112.0
1	83.62	80.78	....	82.20	92.87	0.08	111.1
2	85.05	83.67	....	84.36	95.72	0.08	107.0
3	89.33	87.98	....	88.66	97.16	0.09	101.1
4	91.07	88.98	....	90.02	97.34	0.10	99.0
5	91.04	89.43	0.05	90.27	97.68	0.13	98.5
6	94.50	93.24	0.15	93.93	98.52	0.15	91.5
7	97.66	97.03	0.05	97.44	99.07	0.53	86.3
8	99.10	98.75	0.13	99.04	99.24	0.75	84.0
9	99.36	98.88	0.13	99.23	99.12	0.91	83.8

opic than sulphuric acid and because, as a result of s high vapor pressure, it already begins to evaporate ordinary temperatures.

With acids of less than 68 per cent HNO_3 the results ssembled in Table I were obtained. The NO_2 content the distillate was in these always below 0.02 per cent, id a yellow coloration of the liquid was not detectable. With increasing HNO_3 content the boiling point regurly increases, reaching a maximum of 121 deg. with 68 per cent acid. At this point the original acid, the sidual acid and the distillate have the same compotion.

The distillation of 68 to 100 per cent HNO_3 mixtures ave the results shown in Table II.

In this, with increasing HNO_3 content, a more and ore noticeable decomposition of the acid and distillate ts in, despite a decreasing boiling temperature. The iling point of a 100 per cent acid, which to begin with as completely free from NO_2, was found to be 83 deg. evertheless with continued heating it rose slowly, due the resulting decomposition and the dilution of the ixture from the water formed therein. The data of ables I and II are shown in the distillation curve of Fig. and boiling point and condensing point curves of Fig. 4. hese curves, which have a completely regular course, not permit any conclusions with respect to the drates of aqueous nitric acid reported upon by

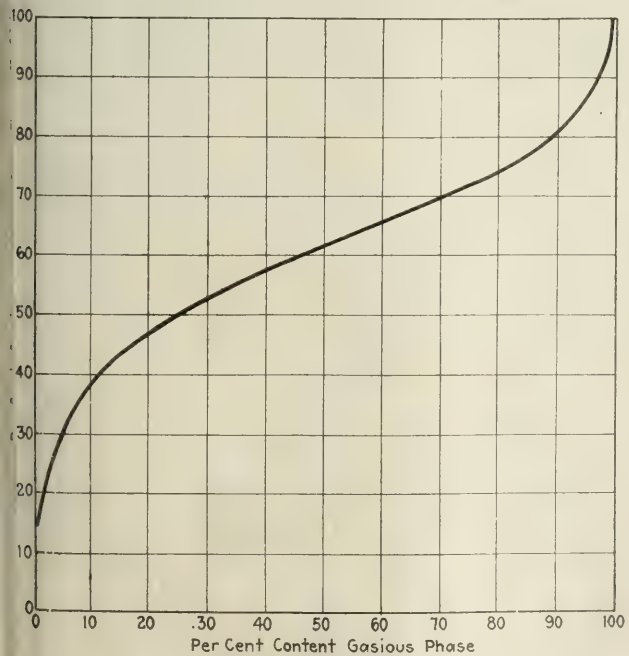


FIG. 3—DISTILLATION CURVE OF HNO_3

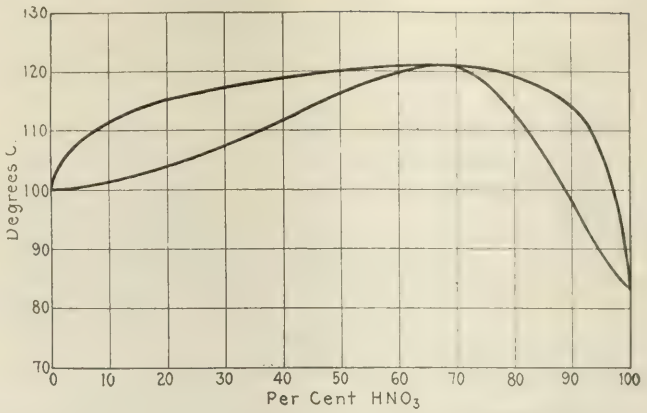


FIG. 4—BOILING POINT AND VAPOR PRESSURE CURVE OF HNO_3

Berthelot[19], Veley and Manley[20], Pickering[21] and Küster & Kreeman[22].

The distillation results at once become quite different if the evolved vapors are dephlegmated by passing them through a rectifying column. If this column is maintained at about 100 deg. with acids weaker than 68 per cent HNO_3, the mixture can be separated into a 65 to 68 per cent acid and an aqueous distillate. With acids above the eutectic point the column should be maintained at 83 deg. C., whereupon 68 per cent acid would be obtained in the residue and 100 per cent acid in the distillate. This principle is exploited in a series of patents[23]. A patent of Berl, taken out in the name of the Deutsche Gasglühlicht-Gesellschaft[24] proposes to convert acids containing less than 68 per cent HNO_3 into an acid of over 68 per cent by distillation with concentrated sulphuric acid, and then to separate this by rectification into an acid of 100 per cent HNO_3 and a 68 per cent residue. Nevertheless rectification is used technically only for pre-concentration, usually for a separation of the original acid into a 55 to 65 per cent residue and a 3 to 5 per cent distillate, since the ideal result of a separation into the eutectic mixture and pure water is not attainable with the apparatus technically available. In order to obtain a residue with 65 per cent HNO_3 or more in practice, it is necessary to accept also a strongly acid distillate. The desired advantage of conversion to a higher strength of acid is hence neutralized by the obtainment of large amounts of strong distillate acid, whose utilization cannot easily be accomplished.

Distillation of Nitric Acid-Sulphuric Acid Mixtures

In the course of this work the phenomena were studied which accompany the distillation of nitric acid-sulphuric acid mixtures, acids being used which contained no, or only a little, nitrogen peroxide. In a further communication the behavior of acids with a high NO_2 content will be reported upon. In these distillations the same apparatus was used that is shown in Fig. 2. The acids were analyzed by the method of Lunge and Berl given in "Chemisch-technischen Untersuchungs Methoden" Vol. 1, p. 878 (1921) and in "Taschenbuch f.d. anorganisch-chemische Grossindustrie," p. 256, using a Berl pipette (*ibid.*, p. 870 and 188).

[19] *Compt. rend.*, vol. 78, p. 769 (1874).
[20] *Proc. Roy. Soc.*, vol. 62, p. 223 (1898); vol. 68, p. 128 (1901); vol. 69, p. 86 (1902).
[21] *J. Chem. Soc.*, vol. 63, p. 436 (1893).
[22] *Z. anorg. Chem.*, vol. 41, p. 1 (1905).
[23] Ver. Chem. Fabriken Mannheim, Ger. Pat. 85,042; Norsk Hydro, Ger. Pat. 336,011.
[24] Ger. Pat. 299,681.

TABLE III—MIXTURE 1

Original acid and composition of residue after each single distillation.	H_2SO_4	21.82	24.48	28.00	32.10	36.80	47.80	61.01
	HNO_3	14.23	15.25	16.03	16.32	15.45	10.76	3.40
	H_2O	63.95	60.27	55.97	51.58	47.75	41.44	35.59
	N_2O_3							
Composition of the individual fractions of distillate from the above acids.	HNO_3	5.81	9.93	14.41	21.97	30.64	37.80	
	N_2O_3							
	H_2SO_4							
Per cent of the original HNO_3 in the distillate.		4.4	12.3	21.9	35.5	65.4	91.5	
Strength of total distillate, per cent HNO_3.		5.8	7.8	9.75	12.9	17.1	20.2	
B.p. of mixture, deg. C.		110-112	112-115	115-119	119-121	121-130	130-150	

TABLE IV.B—MIXTURE 2b

Original acid and composition of residue after each single distillation.	H_2SO_4	27.00	29.92	34.47	40.87	49.09	60.72	71.07
	HNO_3	22.97	22.65	21.07	17.60	12.14	4.35	0.43
	H_2O	50.03	47.43	44.46	41.53	38.77	34.93	28.50
	N_2O_3							
Composition of the individual fractions of distillate from the above acids.	HNO_3	25.84	32.91	40.05	44.81	45.23	30.55	
	N_2O_3							
	H_2SO_4						0.05	
Per cent of the original HNO_3 in the distillate.		10.97	28.2	49.5	71.0	91.6	99.4	
Strength of total distillate, per cent HNO_3.		25.84	29.8	33.5	36.1	37.9	36.8	
B.p. of mixture, deg. C.		119-121	121-122	122-126	126-133	133-147	147-172	

TABLE VI.—MIXTURE 4

Original acid and composition of residue after each single distillation.	H_2SO_4	24.31	28.35	33.50	37.83	47.63	60.03
	HNO_3	26.18	25.43	23.52	21.08	13.98	5.25
	H_2O	49.51	46.22	42.98	41.09	38.39	34.72
	N_2O_3						
Composition of the individual fractions of distillate from the above acids.	HNO_3	30.61	36.67	40.04	48.44	49.05	
	N_2O_3						
	H_2SO_4						
Per cent of the original HNO_3 in the distillate.		16.7	34.9	48.3	72.9	91.9	
Strength of the total distillate, per cent HNO_3.		30.6	33.2	35.4	38.9	40.4	
B.p. of the mixture, deg. C.		118.5-120	120-122.5	122.5-124.5	124.5-132	132-147	

TABLE VIII.—MIXTURE 6

Original acid and composition of residue after each single distillation.	H_2SO_4	9.87	10.58	12.41	13.85	17.15	23.14
	HNO_3	44.82	45.35	46.00	45.84	44.44	39.80
	H_2O	45.31	44.07	41.59	40.31	38.41	37.06
	N_2O_3						
Composition of the individual fraction of distillate from the above acids.	HNO_3	37.17	42.47	47.30	51.41	56.74	
	N_2O_3						
	H_2SO_4						
Per cent of the original HNO_3 in the distillate.		5.6	18.4	27.2	42.9	62.2	
Strength of the total distillate, per cent HNO_3.		37.2	40.1	42.4	45.6	48.6	
B.p. of the mixture, deg. C.		119	119-120.5	120.5	120.5-121.5	121.5-123.5	

TABLE X.—MIXTURE 8

Original acid and composition of residue after each single distillation.	H_2SO_4	47.95	50.90	55.22	63.19	69.83
	HNO_3	17.36	14.51	10.61	4.12	0.86
	H_2O	34.66	34.57	34.15	32.68	29.31
	N_2O_3	0.03	0.02	0.02	0.01	
Composition of the individual fractions of distillate from the above acids.	HNO_3	63.81	60.99	56.57	40.59	
	N_2O_3					
	H_2SO_4				0.19	
Per cent of the original HNO_3 in the distillate.		21.2	46.9	82.0	96.6	
Strength of the total distillate, per cent HNO_3.		63.7	61.8	59.1	53.6	
B.p. of the mixture, deg. C.		131.5-134	134-137.5	137.5-150	150-169	

TABLE XI.—MIXTURE 9

Original acid and composition of residue after each single distillation.	H_2SO_4	9.03	10.21	11.58	12.82	16.60	20.47	26.94
	HNO_3	71.06	68.45	65.45	63.13	56.87	51.09	42.85
	H_2O	19.91	21.34	22.97	24.05	26.53	28.44	30.21
	N_2O_3							
Composition of the individual fractions of distillate from the above acids.	HNO_3	91.41	90.20	87.29	84.48	81.09	77.59	
	N_2O_3		0.06	0.09	0.09	0.07	0.11	
	H_2SO_4							
Per cent of the original HNO_3 in the distillate.		17.4	28.2	37.3	56.6	68.4	79.8	
Strength of the total distillate, per cent HNO_3.		91.4	90.9	89.8	88.1	86.9	85.4	
B.p. of the mixture, deg. C.		114-115.5	115.5-117.7	117.7-118.5	118.5-119	119-121	121-122	

TABLE XIII.—MIXTURE 11

Original acid and composition of residue after each single distillation.	H_2SO_4	65.20	70.81	75.75	78.77	81.63
	HNO_3	17.50	10.61	4.70	1.50	0.09
	H_2O	17.31	18.55	19.51	19.68	18.28
	N_2O_3		0.03	0.04	0.05	
Composition of the individual fractions of distillate from the above acids.	HNO_3	96.20	93.02	82.77	48.95	
	N_2O_3	0.91	1.14	0.99		
	H_2SO_4			0.21	0.37	
Per cent of the original HNO_3 in the distillate.		44.1	76.9	93.0	99.7	
Strength of the total distillate, per cent HNO_3.		97.4	96.2	94.1	86.7	
B.p. of the mixture, deg. C.		120-136	136-160	160-178	178-216	

TABLE XV.—MIXTURE 13

Original acid and composition of residue after each single distillation.	H_2SO_4	71.87	77.03	79.35	81.71	83.54
	HNO_3	12.98	6.95	4.20	1.61	0.25
	H_2O	15.14	15.96	16.34	16.64	16.18
	N_2O_3	0.01	0.06	0.11	0.04	0.03
Composition of the individual fractions of distillate from the above acids.	HNO_3	96.25	94.13	89.42	70.77	
	N_2O_3	1.27	1.72	2.31	0.14	
	H_2SO_4			0.21	0.43	
Per cent of the original HNO_3 in the distillate.		50.1	62.6	89.1	98.4	
Strength of the total distillate, per cent HNO_3.		98.3	97.7	97.0	91.6	
B.p. of the mixture, deg. C.		121-155	155-168	168-190	190-220	

TABLE IV.A—MIXTURE 2a

H_2SO_4	12.50	14.16	16.51	20.66	26.5
HNO_3	16.31	18.03	20.30	22.85	23.7
H_2O	71.19	67.81	63.19	56.49	49.7
N_2O_3					
HNO_3	3.31	4.52	9.52	19.95	
NO_2					
H_2SO_4					
	2.3	5.8	15.3	31.3	
	3.3	3.9	6.3	9.65	
	107-109	109-111	111-114	114-129	

TABLE V.—MIXTURE 3

H_2SO_4	2.03	2.91	4.23
HNO_3	5.93	7.81	10.47
H_2O	92.04	89.28	85.30
N_2O_3			
HNO_3	1.63	1.95	
N_2O_3			
H_2SO_4			
	8.1	15.2	
	1.63	1.73	
	102	102-103	

TABLE VII.—MIXTURE 5

H_2SO_4	10.30	12.42	15.47	21.40	29.5
HNO_3	29.68	32.79	35.38	35.15	30.8
H_2O	60.02	54.79	49.15	43.45	39.6
N_2O_3					
HNO_3	14.61	22.38	35.68	46.91	
N_2O_3					
H_2SO_4					
	8.35	20.5	42.9	63.6	
	14.6	18.3	24.6	29.0	
	112-114.5	114.5-118	118-120.5	120.5-133.5	

TABLE IX.—MIXTURE 7

H_2SO_4	4.00	5.10	6.11	7.45	9.1
HNO_3	61.34	61.15	60.42	59.30	57.6
H_2O	34.66	33.75	33.47	33.25	33.2
N_2O_3					
HNO_3	62.00	64.62	65.48	66.92	
N_2O_3					
H_2SO_4					
	21.7	35.6	48.2	58.8	
	62.0	63.2	63.7	64.2	
	120.6	120.8	121	121-122	

TABLE XII.—MIXTURE 10

H_2SO_4	25.41	28.65	35.67	49.62	67.2
HNO_3	59.15	54.40	44.40	25.80	5.1
H_2O	15.44	16.95	19.93	24.58	27.5
N_2O_3					
HNO_3	96.16	94.92	91.96	82.91	
N_2O_3	0.19	0.21	0.25	0.29	
H_2SO_4					
	18.5	46.5	77.6	96.6	
	96.2	95.7	94.2	91.9	
	109-110	110-114.5	114.5-122.5	122.5-160	

TABLE XIV.—MIXTURE 12

H_2SO_4	64.11	69.32	72.4
HNO_3	20.92	14.71	11.6
H_2O	14.89	15.90	16.4
N_2O_3	0.08	0.07	0.1
HNO_3	96.73	96.23	
N_2O_3	0.55	0.70	
H_2SO_4			
	35.0	53.5	
	97.6	97.4	
	124.5	124.5-14	

TABLE XVI.—MIXTURE 14

H_2SO_4	22.25	24.94	28.05	39.00	54.41	81.1
HNO_3	75.35	72.28	68.74	56.46	39.30	9.6
H_2O	2.35	2.66	3.06	4.38	6.12	8.9
N_2O_3	0.06	0.12	0.16	0.16	0.17	0.2
HNO_3	99.10	99.14	98.88	98.94	96.82	
N_2O_3	0.93	0.68	1.01	1.06	2.84	
H_2SO_4						
	14.4	27.8	57.5	78.8	96.6	
	100.6	100.4	100.4	100.3	100.2	
	88.5-90	90-92	92-95	95-100.5	100.5-131	

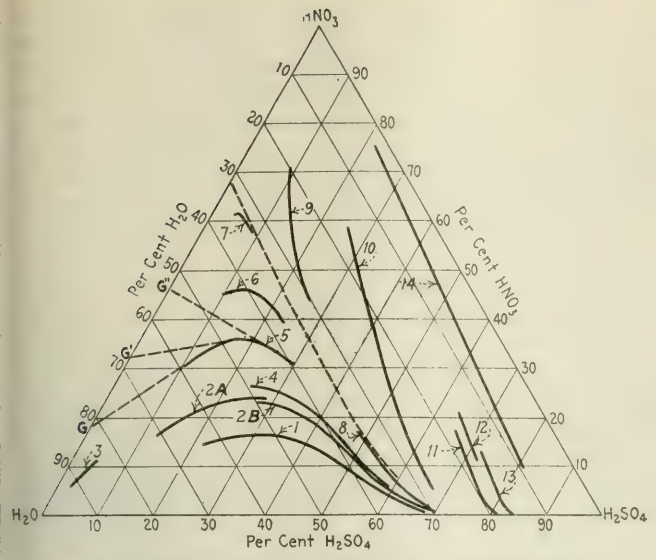


FIG. 5—DISTILLATION CURVES OF H_2O-HNO_3-H_2SO_4 MIXTURES

During the course of the distillation samples of acid were removed from the distilling flask with an arrangement modeled on the Lunge acid pipette, while simultaneously the three-way cock was turned to the second receiver. Two distillations in the same series were always made.

First, a series of experiments was carried out on acids with a high water content. The results are shown in Tables III to X, and graphically in Fig. 5.

At the start of the distillation of acid mixtures with more than 32 per cent H_2O a strongly aqueous distillate first comes over, whose HNO_3 content is lower than that of the acid in the still. The vapor pressure of H_2O in this region is strongly manifest and is only slightly influenced by the presence of H_2SO_4. A water-binding action of the H_2SO_4 does not become evident; which results in the fact that the H_2O content of the residue regularly decreases because of the distilling over of a dilute but increasingly stronger nitric acid. The distillation curves of Fig. 5 show at the start an inflection which lies at a point where the HNO_3 contents of the distillate and the residue are the same. Above this point, moreover, there comes over a distillate increasingly stronger in HNO_3, until finally a new point of inflection is reached in the curve, beyond which the HNO_3 content of the distillate regularly and very rapidly decreases. In the meanwhile the boiling point of the acid mixture rises so high (165 deg. and higher) that small amounts of H_2SO_4 come over. It is not possible, therefore, to drive off the last traces of HNO_3 free from H_2SO_4.

The phenomena with acid mixtures containing less than 32 per cent are different, as may be seen from Tables XI to XVI.

In this region (see Fig. 5) the distillation curves throughout most of their length approximate straight lines which do not vary very much from the straight

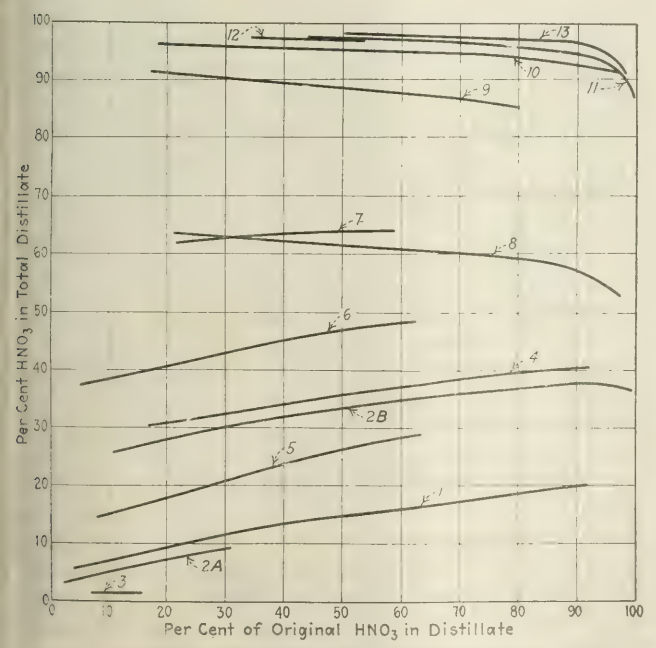


FIG. 6—HNO_3 DISTILLED AS A FUNCTION OF THE ORIGINAL HNO_3 CONTENT

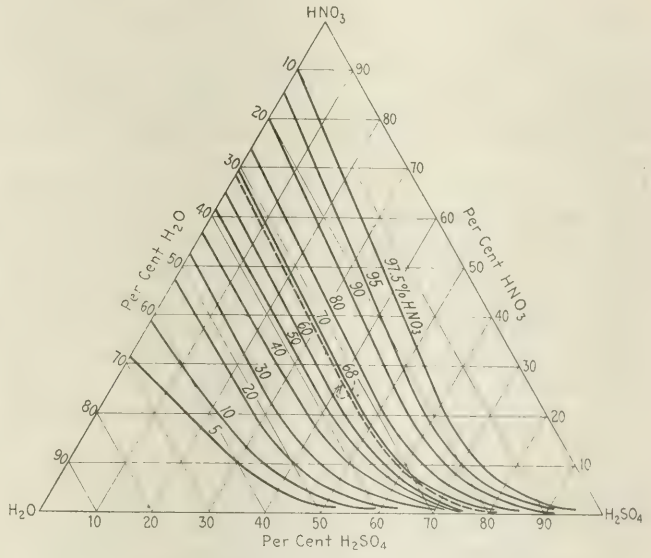


FIG. 7—COMPOSITION OF VAPORS FROM BOILING H_2O-H_2SO_4-HNO_3 SOLUTIONS

lines expressing H_2SO_4 : H_2O ratios in the various mixtures. At the very beginning of the distillation, owing to the strong water-binding action of the H_2SO_4, a strong distillate comes over, which, however, slowly decreases in strength, until, after most of the HNO_3 has been driven out, the curve breaks sharply, and thereafter a distillate more and more rich in water comes over. Through the rising boiling point of the mixture the water-binding power of the H_2SO_4 is so far lowered —i.e., the vapor pressure of the H_2O becomes so great— that greater amounts of H_2O go over with the distillate and strongly dilute it. H_2SO_4, also, distills over in the case of such H_2SO_4-rich and HNO_3-poor mixtures.

In Fig. 6 the HNO_3 content of the total fraction is graphically shown as a function of the percentage, in the total fraction, of the HNO_3 originally present in the mixture. The values are calculated by addition of the single fractions. It may be seen that in the case of the acids rich in H_2O (from 100 to 32 per cent H_2O content) the HNO_3 content of the distillate continually increases and only when the highly aqueous end fractions come over does it decrease (curve 2B). However, in this case no acid stronger than 68 per cent is obtained. In the case of the mixtures with less than 32 per cent H_2O, the strength of the distillate first slowly decreases, but when

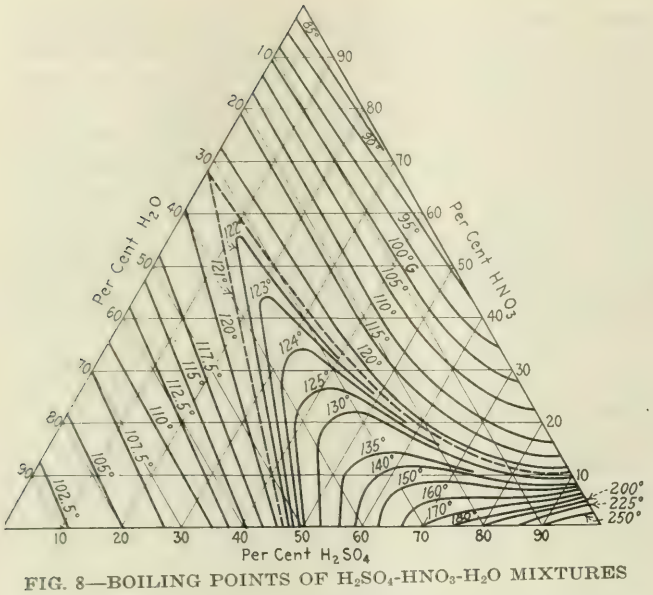


FIG. 8—BOILING POINTS OF H_2SO_4-HNO_3-H_2O MIXTURES

about 90 per cent of the HNO_3 originally present has come over, decreases more rapidly when the residual HNO_3 distills over, as is clearly evident from curves 11 and 13.

From the distillates obtained from the different mixed acids curves of mixtures evolving like strength distillates can be constructed in triangular co-ordinates, as shown in Fig. 7. Tangents to the distillation curves (Fig. 5, curve 5) produced to cut the H_2O-HNO_3 axis enable the HNO_3 content to be read directly as the distance H_2O-G; H_2O-G' or H_2O-G'', assuming, of course, that the distillate contains only H_2O and HNO_3, but no H_2SO_4. H_2SO_4 appears in the distillate from mixtures with a very low HNO_3 content.

As is evident from Fig. 7, the HNO_3 content of the distillate is almost a function of the H_2O content of the mixture, but this does not hold for mixtures low in HNO_3. Therefore, it is not practicable to superconcentrate strongly aqueous nitric acid solutions with concentrated sulphuric acid, because a relatively large amount of sulphuric acid would have to be used to reduce the H_2O content of the mixture as much as is necessary to obtain a mixture which would yield a high strength distillate. In that case a relatively great amount of dilute sulphuric acid would result which would require a greater heat consumption and heavier repair costs than if dilute nitric acid were preconcentrated by rectification, this preconcentrated acid were superconcentrated with a correspondingly smaller amount of sulphuric acid, and the resulting sulphuric acid were itself highly concentrated.

Thus, for example, to concentrate 100 parts 100 per cent HNO_3 from 35 per cent HNO_3 to 92.5 per cent HNO_3 would require 670 parts 96 per cent sulphuric acid. If the nitric acid were first preconcentrated from 35 per cent HNO_3 to 65 per cent HNO_3 the same 100 parts HNO_3 (excluding rectification losses) in the form of 154 parts 65 per cent acid would require only 147 parts 96 per cent sulphuric acid to be concentrated to 92.5 per cent.

In the first case there would have to be removed from the resulting dilute sulphuric acid, in order to reconcentrate it, 178 parts H_2O, while in the second case only 46 parts H_2O—namely, scarcely two-fifths—for the same amount of HNO_3 in the strong distillate.

In Fig. 8 the curves of like boiling points of the various acid mixtures are shown. In the region of acids rich in H_2O no particular influence on the boiling point is exerted by any one of the components. On the contrary, in the region of acids poor in H_2O and rich in HNO_3, the boiling point is strongly influenced by the HNO_3. For the H_2O-free HNO_3-H_2SO_4 mixtures the boiling points were determined in several experiments.

TABLE XVII.

H_2SO_4	33.3	60.0	75.0	80.0	86.0	94.0
HNO_3	66.7	40.0	25.0	20.0	14.0	6.0
Deg. C.	84.5	93.0	103.5	108.0	115.0	185.0

Such mixtures boil at comparatively low temperatures until an H_2SO_4 content of 90 per cent is reached (e.g., a mixture of 10 per cent HNO_3 and 90 per cent H_2SO_4 boils at 122 deg.). Further increase in the H_2SO_4 content is, however, accompanied by a marked increase in the boiling point.

Effects of Breathing Carbon Dioxide

Experiments on the effects of breathing carbon dioxide have been conducted at the Pittsburgh, Pa., station of the United States Bureau of Mines under the direction of Dr. R. R. Sayers, chief surgeon of the bureau, and A. C. Fieldner, supervising chemist. About 2 per cent of carbon dioxide in oxygen produced a slight increase in lung ventilation but no subjective symptoms; 5 per cent in oxygen caused an increase in lung ventilation of about 100 per cent, but no other signs or symptoms; 7.2 per cent produced about 200 per cent increase in lung ventilation, and moderate perspiration and a slight fullness in the head were experienced after breathing the mixture for 10 minutes; 9 to 10 per cent produced about 300 per cent increase in lung ventilation, and the subject complained of frontal headache and was dizzy and perspiring at the end of 10 minutes. About 9 per cent of carbon dioxide in oxygen was breathed by some of the subjects for as long as 45 minutes, but the breathing was very laborious, and dizziness, headache and perspiration were marked. In fact, to have done any work while breathing this mixture would have been extremely difficult.

Oxidation of Incidental Minerals Found in Clays

The purpose of an investigation being conducted by the Bureau of Mines at the ceramic experiment station, Columbus, Ohio, is to obtain fundamental data concerning the action of the incidental minerals found in clays during firing and, later, to make application of the information so obtained to explain certain phenomena that occur with the clay body. It is hoped to throw light on the physical, chemical and thermal changes taking place in clay bodies between a temperature of 400 deg. and 800 deg., the so-called oxidation period. The work is part of the industrial kiln investigation conducted in co-operation with the four heavy clay products associations—common brick, face brick, paving brick and hollow building tile associations. Data have been obtained on the dissociation and oxidation of sulphides found in clays. The work, it is hoped, will afford information on the so-called "scum" developed on some red bricks. Data for time, temperature and atmosphere curves have been worked out in reference to the oxidation of the carbonaceous matter found in clays. Clays have been distilled and the products of distillation studied. Application of the data to a study of the so-called "bloating" of clay products is being made.

The B.t.u. Chart

By Charles J. Lohman, Jr.
University of Cincinnati

THE commercial analysis of coal concerns itself chiefly with the caloric value, or British thermal units, per pound of coal. The B.t.u. determination is important, therefore, first, as a basis for knowing the actual heat value of the coal; second, as a means of comparing various coals.

The determination is usually made on a partly dried sample, and the results are reported on the actual basis and the dry basis—the dry basis being the basis of comparison.

The calculations required are greatly simplified by using the same weight of sample for each determination, or by referring results to the 1-gram basis. The calculations then reduce to these forms:

B.t.u. (actual basis) $= (ET - H)\ (1 - M')$

B.t.u. (dry basis) $= \dfrac{ET - H}{1 - M''}$

E = Calorimeter factor

T = Temperature rise corrected for radiation and thermometer correction

H = Correction for fuse wire, sulphur and nitrogen

M' = Gross moisture, or loss in weight due to first drying.

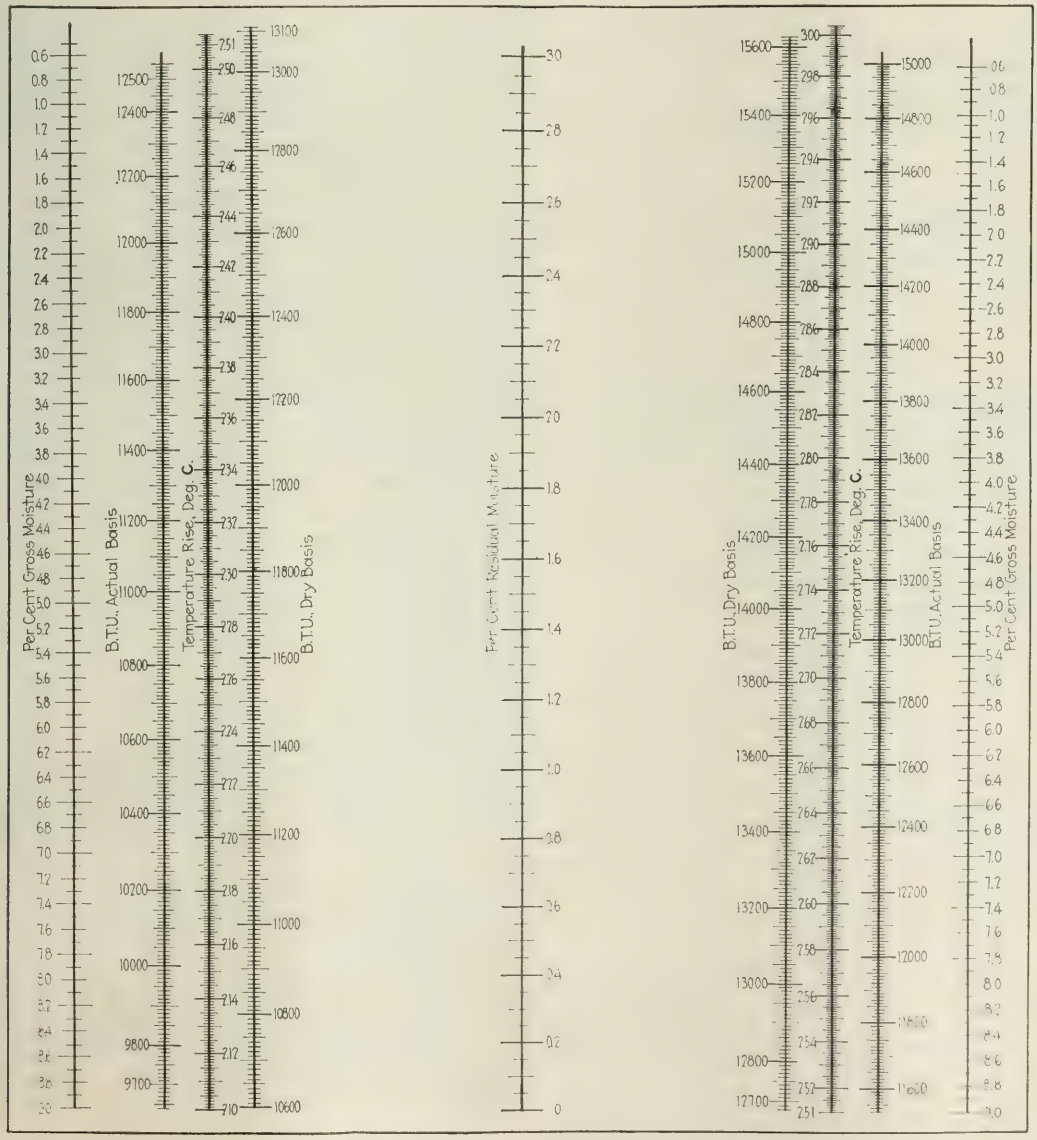
M'' = Residual moisture, or loss in weight due to second drying.

H is usually considered constant in the ordinary commercial analysis. E is practically constant, as there is very little corrosion, even in the nickel-lined bombs.

Where a large number of determinations are made, quite a little time is required to make the necessary calculations, as the numbers involved are too large to be handled with the ordinary 12-in. slide rule. The accompanying chart was therefore devised, to make the calculations quickly, as well as to eliminate the chance for errors.

The middle axis is scaled off in log $(ET - H)$, and is graduated in the equivalent temperature rise. The chart is constructed for the calorimeter factor, 5070, a correction of 53 B.t.u. being made for fuse wire, sulphur and nitrogen.

To use the chart, lay a straight edge across the chart so that it intersects the "temperature rise" and one of the "per cent moisture" axes at the values determined. Where the straight edge intersects the intervening axis, read the result in B.t.u. The chart is accurate to ±5 B.t.u., which is all the accuracy that is required.



Native Oil Production In Western China

Extraction Processes, Uses and Economic Importance of Native Chinese Vegetable Oil Industry—Nut Oils, Seed Oils and Soy Bean Sauce Manufacture—United States Takes the Largest Amount of the Exported Product

By H. K. Richardson

THE PRODUCTION of vegetable oils is one of the most important native industries in the Province of Szechuen, Western China. Almost any kind of seed or nut that will yield oil is made to give up that oil for some purpose or other. Only those oils that are obtainable in the native shops are listed below. The order followed under each heading indicates approximately the local economic importance of the oil.

Vegetable Seed Oils

T'sai Yu or Ching Yu, vegetable oil, is obtained from the seed of a cabbage grown for its seed only. This oil is erroneously called rape by foreigners. It is the common cooking oil of the common people.

Hsiang Yu, fragrant oil, from sesamum seed.

Peanut oil.

Cottonseed oil.

Tea oil, from the seeds of the tea flower.

Castor oil.

Soy bean sauce, a high-grade cooking oil made from soy beans and wheat, by fermentation.

Nut Oils

T'ung Yu or chinawood oil. This is the most important export oil of Western China.

Walnut oil made from the kernels of the english walnut tree.

Mineral Oils

It has been reported many times that crude petroleum is obtained along with the brine in the deep salt well districts of Tzuliutsing. During a stay of several days we failed to see any evidences of crude oil. Close questioning of natives and resident foreigners failed to reveal anyone who had seen this kind of oil. Oil may exist in this territory, but its quantity must be small when it has not materialized in the drilling of about 20,000 wells to a maximum depth of 3,400 ft.

Vegetable Seed Oils

The methods of obtaining oils from seeds are three: Pressing, water extraction and fermentation.

Since the *T'sai Yu* is the most common oil, the technique of its manufacture is the most thoroughly worked out. The process used for the extraction of this oil will be described in detail. Where the details of production of an oil differs from the *T'sai Yu,* these differences only will be described.

T'sai Yu, or Vegetable Oil

The process described was observed in a custom mill outside the city of Chengtu, capital of Szechuen Province. The seed was ground to a paste between millstones. The paste was steamed over boiling water for an hour and then pressed in a wedge press. The press cake was broken up, steamed and pressed again, the residue being sold for fertilizer. The extracted oil was settled, filtered through coarse grass paper and the clear oil marketed. From 600 lb. of seed about 120 lb. of oil was obtained from the first pressing and 80 lb. from the second. Thus the percentage of oil recovered to seed used was 33⅓ per cent. Consular reports from other parts of China show recoveries ranging from 34 to 45 per cent with 7 to 8 per cent oil remaining in the cake. Hosie[1], apparently describing this same mill, gave the yield as 32 per cent. His figures were obtained 15 years before ours, showing that there had been no change in the process in that time.

FIG. 1—GENERAL VIEW OF WATER GATES OF CUSTOM MILL OUTSIDE CHENGTU

The apparatus in this mill is typical of that in common use. While crude in construction, it serves its purpose well and cheaply.

The grinder consisted of two millstones about 4 ft. in diameter, and 9 in. thick. The upper stone rested upon the lower and was prevented from revolving by ropes attached to upright posts. The seeds were poured into a wooden hopper placed over a square hole in the upper grindstone and fed automatically to the grinding surface. The lower stone was driven at 28 r.p.m. by a water wheel attached to its base. The irrigation stream furnished the power. Fig. 1 is a general view of the mill. Fig. 2 is a photograph of one of the four grindstones at work. Fig. 3 gives a clearer idea of the setup of the machinery. The grinder had a capacity of 1,680 catties, or 2,240 lb., of "rape" seed per 24 hours.

The steamer is a large wooden tub with a woven bamboo sieve bottom set down over an iron pan 4 ft. in diameter and 1 ft. deep, containing boiling water. The vat holds a half ton of crushed seed, enough for two press loads. Fig. 4 gives a cross-section of the steamer.

The steamed ground seeds are packed into iron rings 1¼ in. high and 18 in. in diameter. Rice straw on top and bottom permits the seed to be made up in plinths 3 in. thick. Twenty-eight of these rings, each holding 15 to 20 lb. of crushed material, are placed in a wooden wedge press. As the wedges are driven in, the oil

[1] Hosie, "Report on the Province of Szechuen," London, 1904.

trickles out into a vat under the press. The final pressure is obtained by iron wedges driven home with a battering ram. The press is permitted to stand over night under pressure. Filling a press and bringing up to pressure take a whole day. The first press cake is taken out, broken up and re-pressed after steaming. The oil from the first pressing is considered the better, but it is rarely kept separate from the second run. The construction of this press can be seen from Fig. 5, which is a photograph of such a press taken when operating on peanut oil. The total length of press is 16 ft.; the pressing space is 6 to 7 ft.

Some general information regarding the mill is of interest. The mill operates on a percentage basis, receiving three catties out of each 150 catties of oil expressed. This was paid to the mill owner as rental of the machinery and water power. The seed owner furnished labor and fuel for the steamer as well as all seed. The labor cost of grinding was 40 cash per 240 catties, or an equivalent of 8 cents per ton of seed.

The complete grinding wheel cost 12 taels, or $9 gold. The stones last 3 years. The water turbine blades and run are replaced yearly at a cost of about $1.50. The complete press cost installed about $25. Two presses expressed about 40,000 catties (53,333 lb.) of oil a year.

FIG. 2—WATER-POWER GRINDSTONES GRINDING RAPESEED

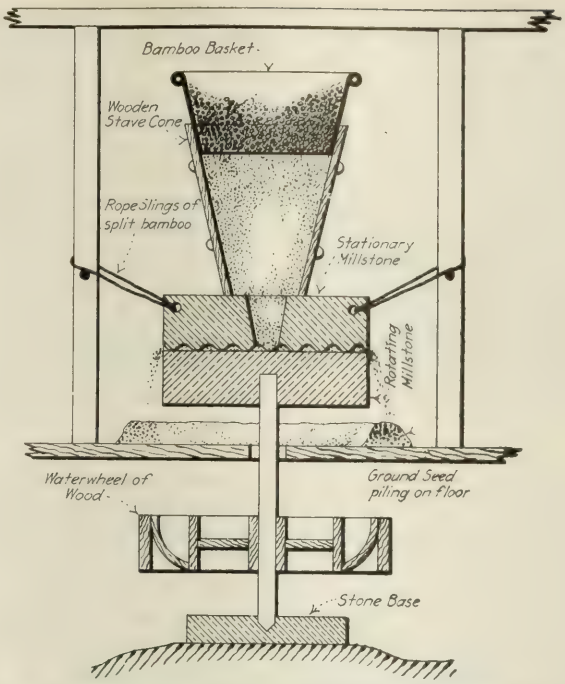


FIG. 3—CROSS-SECTION OF WATER WHEEL AND MILLSTONES

This *T'sai Yu* is the most useful oil in the Chinese economy. It is the principal cooking oil of the common people. The vegetables that accompany the rice diet are all fried in this oil. Until the advent of American kerosene it was the lighting oil of the province. Even today a rush wick dipping in this oil floating on water in a glass tumbler is the usual lamp in the wayside inns. In the cities there are few who can afford the foreign oil for lighting. For this reason the cotton-wick three-spouted copper-pewter lamps and the rush-wick earthen lamp still use *T'sai Yu* as the illuminant in the majority of homes.

This oil is erroneously called "rapeseed" by foreigners. Wilson[2] says that there is no true rape in Szechuen. He designates *Brassica juncea* and *Brassica campestris* as the members of the cabbage family that yield this seed. He estimated from his 11 years' experience that 75 per cent of all the oil produced in Szechuen came from these two plants.

Hsiang Yu, or Sesamum Seed Oil

This oil, called "fragrant" by the natives, is extracted by water, not pressed, from the seeds of *Sesamum indicum*. The white seeds are washed in cold water and

[2]Wilson, "A Naturalist in Western China," Doubleday, Page & Co., 1913.

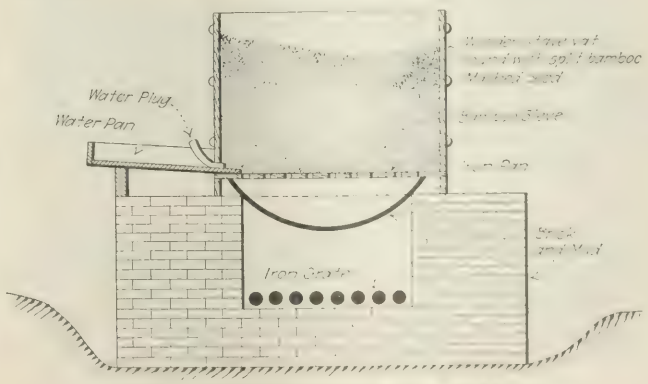


FIG. 4—CROSS-SECTION OF STEAMER

air-dried, after which they are roasted in an iron pan until they are light brown. They are then ground between millstones. Boiling water is added to the paste until no more is absorbed. The liquid mass is then lightly tapped with a weighted gourd, causing the oil to rise to the surface and the refuse to sink. The oil is poured off and the refuse removed and sold for feed for pigs.

The yield of oil is 40 to 44 per cent of the weight of the seed. In other parts of China the yield is reported to range from 50 to 57 per cent. The white-seeded oil is the most expensive edible oil in the province and is frequently adulterated with the cheaper *T'sai Yu*.

As far as the author is aware, this oil is the only one recovered by water extraction on a commercial scale.

Peanut Oil

Peanuts, *Arachis hypogœa*, grow profusely on the sandy river bottoms of Szechuen. Two varieties are grown. One, the native variety, resembles our Spanish peanut; the other is large, like the Virginia peanut, and was introduced into the country by the French priests. The oil is usually expressed from the smaller variety.

The whole peanut is roasted and ground up, shell and all, in a trough type of crusher shown in Fig. 6. The ground mass is then treated the same as we have described for *T'sai Yu*. The yield is about 16 per cent of the unshelled weight of nuts. The 40 to 43 per cent yields reported in consular reports from other parts of China must refer to the shelled nut.

Cottonseed Oil

Small amounts of cotton seed, *Gossypium herbaceum*, are pressed for their oil. The oil is looked upon as inferior and is used as an adulterant in the more highly esteemed oils.

Tea Oil

The seeds of the wild tea plant, *Camellia oleifera*, yield when pressed an oil whose principal use is for my Chinese lady's hair oil. The refuse cake has the reputation of taking out stains when used in wash water and of destroying the earth worms that attack rice plants. In the latter case the cake is mixed in the fertilizer for the paddies.

Castor Oil

The castor oil plant, *Ricinis communis*, grows to be a tree in the warm, humid climate of Szechuen. We had a plant in our yard that was 20 ft. high and 3 in. in diameter. The primary use for this oil is to moisten the colors used as stamp pads for the red Chinese seals or "Chops" as pidgin English has it. The yield is about 38 per cent of oil.

Various kinds of flax are grown in considerable quantities in the province. Fine hemp and ramie fiber is made. Except in case of the wild flax of the Tibetan frontier, the seed is used only as a birdseed. Probably the prevalence of wood oil has prevented the use of this seed for linseed oil.

Soy Bean Sauce

Soy bean sauce must be distinguished from soy bean oil, which comes mostly from Manchuria. This latter oil is expressed from soy beans mostly by modern pressure mills. When native methods are used, the process outlined for the *T'sai Yu* is followed. The yield is about 13 per cent of oil and a much-prized oil cake. Only a negligible quantity of this expressed oil is made in Szechuen. On the other hand, only 10 per cent of the beans raised in Manchuria is made into soy sauce, the remainder being expressed or shipped out whole.

In western China the soy bean, *Glycine hispida*, is extensively cultivated, but is used as a vegetable, for bean curd and for sauce. The soy bean sauce is the dark red sauce seen on the tables of Chinese restaurants in this country.

The process of obtaining soy bean sauce is one of fermentation and is long and complicated. Accurate information on this process is difficult to obtain. What follows has been pieced together from several sources. There are two kinds of soy: the red, or long process, and the yellow, or short process. The red soy is considered the better and is the only one found on the tables of good restaurants in China.

The process of manufacture extends over a period of approximately one year. The soy beans are first soaked over night in water and steamed for 5 hours. After thoroughly cooling, they are mixed with wheat flour and permitted to stand in a bamboo basket until a yellow mold appears—generally about 7 days. The mass is mixed with equal parts of water and salt in an earthen jar, covered and placed in the sun for 3 months, being stirred every day. By this time all the water has evaporated. For several months the jar is covered at night and stands open during the day. Finally, the black pickle is mixed with boiling water and thoroughly stirred. A bamboo basket sieve is placed in the top of the jar, the soy sauce passes through the sieve and is bailed out for 2 or 3 days. This is boiled with white sugar, seasoned with peppers and anise seed and is ready for use.

Twenty-eight pounds of soy beans yields 70 lb. of the soy sauce, according to Hosie[1]. The increase is due to the materials added in the process of making. This sauce is the foundation of all high-class Chinese cooking. It costs about 20 per cent more than the common "rape" oil. Very little of this material made in Szechuen is exported, for the large local demand takes care of the supply. A plant making this material looks like a drain pipe storage yard, for the big earthernware pots are set up close together, in an open courtyard.

Yellow soy is made by a similar process except that more water is added at the start and only 3 months is allowed for the complete process.

Nut Oils

Tung Yu, or Chinawood Oil

Chinawood oil, or as it is called by the Chinese, *Tung Yu*, is the most important export oil of interior China. Probably three-quarters of all the oil that reaches the United States comes originally from the Province of Szechuen. Most of the producing centers are at the eastern end of the post road from Wanhsien to Chengtu. It was our privilege to travel over this road a few years ago. The following description of how the Chinese obtain this oil is a composite of observations made on this trip and data picked up in nearby sections:

Chinawood oil is the product of a nut borne by the *Aleuritis fordii*. This tree thrives mostly on rocky soil, growing where nothing else will grow. It is found at about the 2,500-ft. elevation, although we have seen a few at higher levels. The fruits, which ripen in September, resemble smooth chestnut burrs and contain three to five nuts the size of good eating chestnuts.

To obtain the oil, the fruits are gathered just before ripening and stacked in piles until fermentation destroys the covering. Then the nuts are removed, dried and ground—shells and all—in a mill shown in Fig. 6. The ground mass is slightly roasted, then steamed and expressed in a wedge press like the one shown in Fig. 5. The yield of oil is approximately 40 per cent.

The roasting is done in shallow iron pans, 3x8 ft., set in brickwork over a coal fire. Usually a 2-in. layer of the ground seed is heated. The grinding is accomplished in a stone trough grinder such as is illustrated in Fig. 6. This type of grinder is used for all seeds with a hard coating as well as for rice hulling. They are operated by animal power as well as by man power. The construction is more clearly shown in Fig. 7, which is a top view of a small unit belonging to a peasant farmer.

The expressed oil is collected by the local merchants from the mills and sent over the post road to Wanhsien, from where it is transshipped by cargo junk to Hankow.

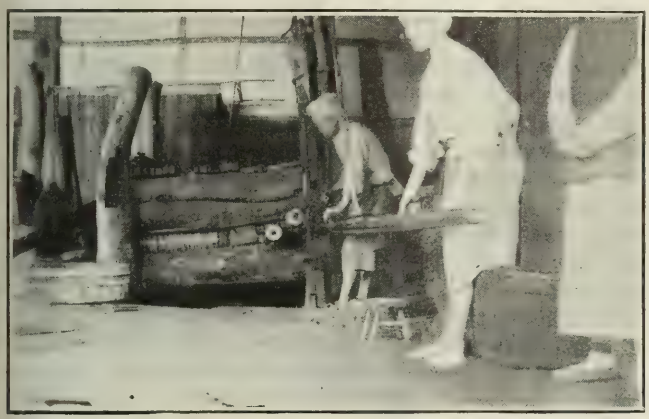


FIG. 5—WEDGE OIL PRESS SHOWING BATTERING RAM USED TO FORCE UP WEDGES

The method of packing is usually in bamboo wickerware baskets lined with paper. When oil is first poured into the paper lined basket the paper is wet, but no further oil is lost, because the oil does not filter through the paper used. A bottle of this kind holding 150 lb. of oil, suspended from a pole between two men, will be carried at the rate of 30 miles per day.[3]

The uses of the wood oil in the United States as a constituent of quick-drying cheap gum varnishes are well known. Its uses in China are manifold and less known. A few of these uses will be enumerated.

Native Uses for Chinawood Oil

All Chinese boats of the native pattern are given a thorough oiling with the wood oil. No other paint or preservative is used or needed. The putty used to calk the seams of these boats is made from a mixture of whiting, bamboo shavings and wood oil. It dries to a very hard material much superior to linseed oil putty. The oil when used for this purpose is boiled for an hour. This is the *pei yu* of the Chinese.

The first coat in painting a house or cheap furniture in China is a mixture of glue and pigment. This coat dries to a matt surface. The second coat is pure chinawood oil. The result is a fine glossy finish the color of the underlying dye or pigment. The oil used for this purpose is specially prepared. The crude oil is boiled

[3]The method of handling and financing this trade after it reaches Hankow is fully explained in *Daily Commerce Reports* for Feb. 9, 1921, p. 812.

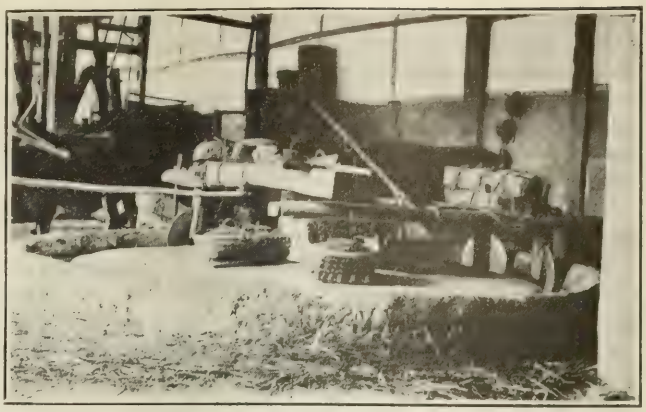


FIG. 6—CIRCULAR TROUGH GRINDER FOR WOOD OIL NUTS, PEANUTS AND HULLING RICE

up with an earth resembling fullers earth and powdered quartz. After boiling for some time, the clear oil is poured off from the sediment. This oil, called *Kuang Yu* —lustrous oil—by the Chinese, is the paint oil of the province.

Chinese lacquer, when applied in the pure state, turns to a jet black when dry. To make use of the valuable properties of the lacquer and avoid its black color, a large percentage of the lustrous wood oil is mixed with the refined lacquer. The result is a transparent varnish with most of the valuable properties of the lacquer. The greatest use for this varnish is for finishing furniture, especially that made in imitation of European goods. For this purpose it is applied as a second coat over a stain of the desired color. If no stain is used, the resultant color is a molasses brown. In either case the varnish retains the properties of lacquer in not showing hot water stains, resistance to scratches and long wearing qualities. It is contended by many writers that this use of the wood oil is an adulteration of the lacquer. However, the addition is for the definite purpose of extending the range of usefulness of the lacquer and should not be classed as adulteration.

The *Kuang Yu*—lustrous oil—is used alone upon furniture as a varnish. When applied to curly or knotted crotch or root wood, a very beautiful satin effect is produced. Sassafras wood is highly esteemed by the Chinese box makers on account of this valuable property. Unfortunately the light lemon color of the first days changes with age to a less pleasing darker shade. However, this is noticed only on the very light colored woods.

Lustrous oil applied to fabrics makes them waterproof. Cotton sheeting to which the oil is applied is used to protect bedding and goods when carried over-

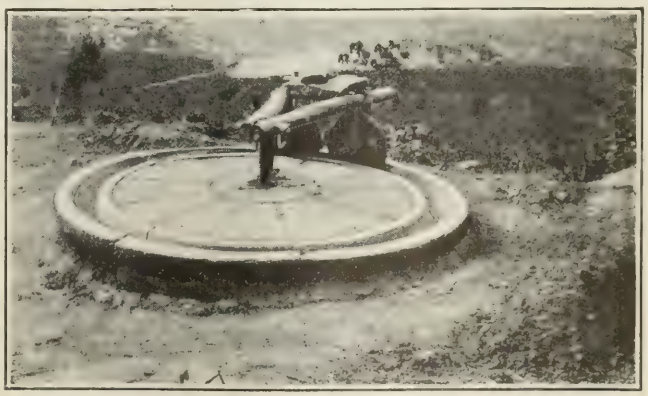


FIG. 7—SMALL-SIZED TROUGH GRINDER

land by coolies. Silk to which the oil is applied makes a fine, light waterproof material which seldom wets through, even in the driving tropical storms. The paper or silk of the native umbrellas is made waterproof by this oil. The use of the oil as a waterproofing agent has enabled the Chinese to get along nicely without rubber goods.

The best Chinese ink is made from the soot obtained by burning the wood oil in a confined atmosphere.

It is said that the wood oil is used in the producing regions as an illuminant. It is, however, so much dirtier and more expensive than the "rape" oil, or *T'sai Yu*, that its use must be limited. Its use has never come to the writer's attention.

Walnut Oil

In the mountain regions of northern Szechuen, the walnut, *Juglans regis*, the nuts of which are practically the same as our English walnuts, is used for its oil. Nothing is reported as to the process of extracting the oil. Much useful knowledge and information on the agriculture side of these oils can be found in Hosie[1] and Wilson[2].

Economics of the Oil Trade

The oils mentioned above are the source of a very large export trade for China. The extent of this trade can be seen from the data in Table I. The figures are for 1918, the last year for which complete data are available.

TABLE I—EXPORT OF VEGETABLE OILS FROM CHINA IN 1918

Kind of Oil	Exports in Pounds—Total	Exports in Pounds—To United States	Approximate Value
Bean, soy	303,622,000	284,900,000	$30,000,000
Cottonseed	17,773,000	16,665,000	1,500,000
Peanut	78,749,000	32,313,000	7,000,000
Rapeseed (*T'sai*)	740,000	486,000	44,000
Sesamum	2,753,000	658,000	165,000
Tea	3,137,000	165,000	198,000
Wood, tung	65,180,000	32,058,000	6,500,000
All others	14,920,000	3,196,000	9,000,000
Total	486,874,000	370,441,000	$54,407,000

This table indicates that China in all sections does an export trade of about $55,000,000 per year in vegetable oils. Probably not half of the total quantity produced is exported, so that the whole vegetable oil industry probably represents a yearly value of around $125,000,000, which makes it a large industry in China.

Exports Mostly Come to the United States

It is of interest to note that the United States takes about 75 per cent of the total exports. This percentage is increasing. The total trade is constantly increasing and is destined to be of considerable more importance to China as the years pass by.

The export of rapeseed oil is rapidly falling, having dropped from 4,345,000 lb. in 1916 to only 25,000 lb. in 1920. The increasing home consumption of this oil is given as the reason. In the few statistics that are available for 1920 there seems to be a healthy growth in most of the exportations.

Cyanuric Triazide as Primer

At the Pittsburgh, Pa., experiment station of the Bureau of Mines a study is being made of the properties of cyanuric triazide for the purpose of determining its suitability for use as a substitute for mercury fulminate in primers and detonators.

Cutting Massive Copper With the Electric Arc

By A. M. Candy

Arc Welding Engineer, Westinghouse Electric & Manufacturing Co.

IT MAY BE readily appreciated that owing to the great thermal capacity and heat conductivity of copper, it would be necessary to liberate a large amount of electrical energy if copper is to be fused locally, as is necessary for a cutting flame. An actual test showed that a 4½-in. square billet could be cut in 7 minutes using a current of 900 amperes. More massive pieces, such as sometimes result from a furnace accident, would require longer time.

Such a large mass or slab of copper was successfully cut up. The piece was very irregular in shape, but the approximate dimensions were 7 ft. long by 6 ft. 6 in. wide at the extreme points. In the central cut the thickness varied from approximately 1½ in. at the extreme end of the cut to approximately 7 in. maximum at the center of the cut. The average thickness over the 7-ft. length, therefore, would be approximately 4¼ in. This central cut through the slab was completed in approximately 5 hours.

For carrying on such work as this it is necessary to have available for the operator a direct-current generator which will deliver not less than 1,000 amperes through the arc circuit, developing approximately 60 volts. Current is regulated to the best value by cutting in various groups of resistances by an appropriate switch panel.

When carrying on such cutting work, using such large current values of 1,000 amperes, it is very essential

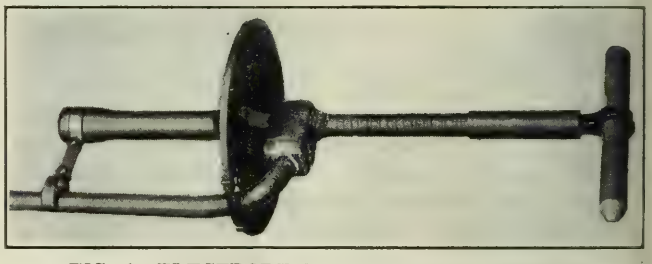


FIG. 1—ELECTRODE HOLDER FOR CARRYING EXTREMELY LARGE CURENTS

that the operator have his body thoroughly protected by closely woven clothing and wear leather gloves on his hands. The head and eyes should be thoroughly protected by a suitable helmet.

Among the most important items is that of an electrode holder which will have a sufficiently cool handle so that the operator can work continuously without experiencing discomfiture of his hands. Such an electrode holder is illustrated in Fig. 1. Current does not pass through the handle, but is carried by means of a supporting lug at one end of the handle and thence through a circular micarta disk and thence up to an aluminum casting at the rear end of the electrode holder proper. The handle is secured independently to the center of the disk, so that there is no metallic connection between the handle and the main portion of the electrode holder proper. By this construction the handle of the holder remains cool at all times.

The graphite electrode is gripped by iron "crows' feet" which are held tightly in place and in contact with the leading in circuit by a metal sleeve. A slight tap will tighten or loosen the combination, when it is necessary to adjust the carbon.

Principles of Blast-Furnace Practice*

"THERE are three principal objects in all blast-furnace practice ranking in importance in the following order—quality, economy and quantity. The first is essential. The second is commercially of great importance. The third is highly desirable, particularly in its bearing on the second. Therefore the object of modern practice is the attainment of the greatest possible quantity consistent with quality."

To justify this thesis, A. K. Reese cites four prime factors underlying the art—viz., preparation of materials, furnace design, auxiliary equipment and method of operation. He shows how each of them contribute to the desired ends.

Preparation of Materials

Satisfactory furnace operation requires an approach to uniformity in chemical and physical reactions throughout the whole cross-section in any zone. This in turn calls for correct distribution of the stock. To effect this much attention must be given to size and texture—coke must be strong enough to resist fracture during handling or crushing under load, and its density and size must not be so great as to prevent rapid combustion. It should be low in ash—since every pound of slag requires ¼ lb. of coke to melt it—low in sulphur and free from fines.

Perhaps the best chance of improvement lies in the preparation of the ore. It must be reducible and uniformly distributed. Dense magnetite may be greatly helped by an oxidizing roast. Few furnaces are troubled with an excess of massive lumps, but these must be crushed to 3- or 4-in. size, not only to allow enough surface so the surrounding gases may reduce the oxide before it enters the fusion zone, but also to permit correct distribution of the ore at the top part of the stack. On the other hand, fine ores clog the charge and produce an excessive amount of dust; they should be mixed with the dust and coke breeze and sintered. This not only produces a porous lump of proper size but also an ore very low in sulphur.

When the material shows not too great variation in size, the next problem is to get it into the furnace in the proper way. Since blast tends to hug the walls, there should be a slight excess of the finer material in this region. It can be placed there with a bell and hopper of correct design when keeping the stack constantly filled to the maximum height. A column of coarse charge surrounded by much finer material should always be avoided, because it would descend most rapidly due to rapid combustion of its fuel. Yet it smelts the slowest because the ore lumps are so large. Consequently half-smelted oxide enters the fusion zone. At the same time, fines along the wall move so slowly they chill and hang to the brickwork, slipping occasionally *en masse*, with pernicious results.

Lastly, air blast is a portion of the charge. It, too, must be as pure as possible and uniformly distributed. If tuyères are properly set, open, and receive an equal amount of wind, the distribution of the gases inside the furnace largely depends upon the condition and distribution of the charge (as outlined above). To get air as pure as possible, inlets to the blowing engines should not be adjacent to short chimneys, steam exhausts or cooling towers. Dry blast is an efficient method of controlling water vapor in the blast, and despite the fact that it has never been widely adopted, is an important factor in making uniform iron. It is impossible to operate with blast temperatures much above 1,300 deg. F. without causing an irregular descent of the ore column, except with dry blast. Given clean gas and modern stoves, the temperature can then be boosted to 1,600 deg. F. without difficulties.

*Abstract of a paper read before the autumn meeting of the British Iron and Steel Institute.

Furnace Design

Passing to the second prime factor underlying modern operations, Mr. Reese says that furnace design is largely a matter of correct adjustment of furnace lines. All the proportions are interdependent to a degree, but "the output capacity of a blast furnace, with any particular set of raw materials, is in proportion to the effective bosh area." He defines the "effective bosh area" as that portion of the full horizontal bosh area at its maximum diameter which is in normal activity. All the modern furnace lines are laid with the idea of keeping the walls clean and thus fully developing this area. Older furnaces about 80 ft. high often have maximum diameters of 19 to 20 ft. Modern, high-capacity furnaces about 90 ft. high have but a slightly larger corresponding dimension—20 to 22 ft. However, the bosh is much lower—in fact, below the zone of fusion. This prevents the pasty mass from scaffolding there. The bosh walls are also much steeper now—built at 80 deg. rather than 70 deg.—so that the material near the walls and above the tuyère line may not be chilled by being withdrawn from a supply of oxygen. Steep low boshes of course demand wide hearths—instead of the old 10 ft. diameter; we now build 16, 18 and even 20 ft.

In the old furnaces, the shaft above the bosh was vertical or had a very slight batter. Now we build a batter of 1 to 14 or 15 in order to provide more room for the free movement of the charge as it descends, gets hotter, pastier, and is compressed by the surmounting load.

A battered shaft means that the upper 20 ft. of the stack—the throat—must be plumb. It is now built slightly smaller in diameter than the hearth—small enough for efficient stock distribution, yet high enough for passage of gas at a velocity not too high. Material is not likely to hang up in this vertical throat, because it is dry and not yet hot enough to become pasty.

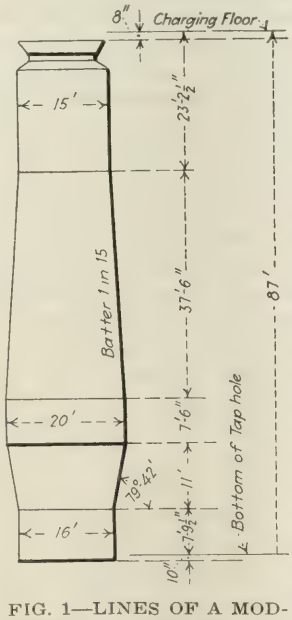


FIG. 1—LINES OF A MODERN BLAST FURNACE

Auxiliary Equipment

Auxiliary equipment comprises the third factor underlying progressive blast-furnace management. Chief among the auxiliaries are the blowers. They should be capable of compressing 40,000 to 50,000 cu.ft. of free air per minute to a pressure of 15 to 20 lb. and of delivering a constant volume under a long overload of at least 30 lb. Centrifugal blowers have been widely adopted since the development of an efficient volume governor, so the volume will not drop as the pressure increases. They are simpler, more compact, cheaper to

build and easier to operate than the reciprocating blowing engine and they deliver the wind without pulsations.

Top gas is discharged from three or four openings to downcomers of ample capacity. Many out-takes prevent channeling in the charge by gas seeking the shortest way out of the furnace. Large out-takes reduce the gas velocity and the amount of dust carried.

Equipment for cleaning this gas of all dust is essential. Burning a dust-free gas saves labor in cleaning boilers or stoves, saves costs for repairs and frequent renewals, permits more continuous and more uniform service through freedom from shut-downs, and permits a more compact redesign of stoves with smaller flues. The modern blast-furnace stove may therefore be made approximately 21 ft. diameter by 100 ft. high, with checker openings 3½ in. diameter, and still possess 80,000 sq.ft. of heating surface.

Efficient mechanical handling of the raw materials is necessary simply because the required number of tons of charge cannot be charged into the furnace by hand. The devices utilized are various—they all must handle the stuff without unduly crushing it or permitting segregation either in size or kind. Sand casting of pig is obsolete, because of the large amount of labor, floor space and clean sand required, and the heavy waste in scrap, either too light or too heavy to market. Furthermore, sand-cast pigs, when remelted, waste iron, fuel and furnace lining. Modern practice demands that liquid iron and slag be removed immediately from the neighborhood of the furnace.

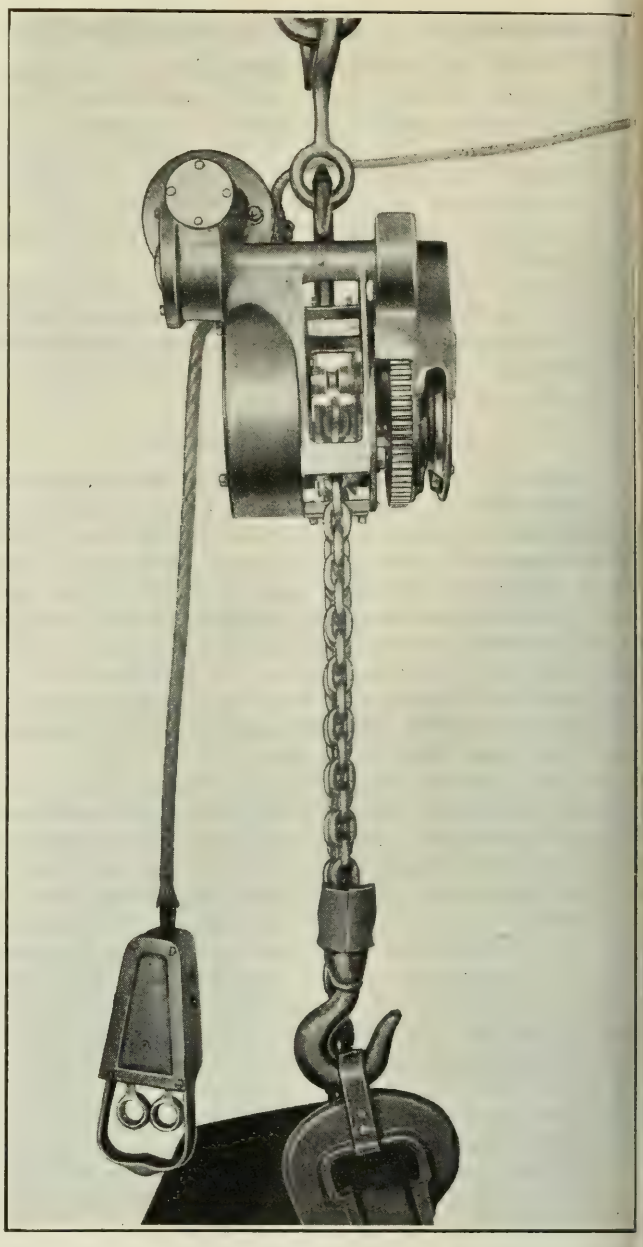
Finally, the fourth principle of modern practice—operating methods—is very hard to define on paper. Many details—such as tuyère location, amount of fuel or amount of cooling water required—are determinable only by experience with varying conditions of charge and weather. It is quite essential, however, that every effort be made to keep the operations steady—especially insuring that a constant *volume* of wind is delivered to the furnace, irrespective of furnace pressure or resistance.

The Motorbloc—A Motor-Driven Chain Hoist

An electrically operated material-handling device, known as the Motorbloc, has been placed on the market by the Motorbloc Corporation of Summerdale, Philadelphia. This new device has been developed to serve the operations lying between the well-defined field of the standard hand chain hoist and that of the traveling electric hoist, with the substantial overhead and electrical installation which its heavy duty requires. It is a readily portable hoist, which can be installed without preliminaries in any location where electric current is available. It is put in service with the facility of an electric drill or vacuum cleaner, and the self-contained pendent controller permits convenient operation as soon as the cord is plugged into the nearest electric circuit.

This hoist consists of a standardized chain hoist of steel construction, electrified by the application of a specially designed heavy-duty motor, proportioned reduction gearing and slip friction clutch, applied by means of a malleable iron supporting bracket comprising a self-contained electrifying unit, to which the pendent controller is also attached. In this way a simple mechanism has been developed for the electrification of the standard spur-geared chain hoist in capacities ranging from ¼ ton to 10 tons, proportioned to stand up under severe overloads.

The self-contained, pendent controller is easily



operated by the fingers of one hand, leaving the other hand free to guide the load. This arrangement makes it possible for one man, without physical effort, to accomplish what would otherwise require two or more men for lifting and placing the same load. The portability of the hoist is apparent from the fact that the 1-ton size complete weighs only 148 lb. The armature shaft and worm are carried in heavy duty ball-bearings, and provision has been made for adequate, automatic lubrication. The use of the ring-oiled slip friction clutch prevents damage from overrunning to the hoist parts and chain and at the same time completely protects the motor from overload, without the complication of an electric limit switch.

The accompanying illustration shows the Motorbloc built on a Franklin-Moore all-steel suspension spur-geared chain hoist. For occasional use at points where electric current is not available, or in the event of the temporary failure of electric power, the hand chain can be quickly applied, and the hoist operated as an ordinary block. While regularly furnished as a complete hoisting device, the self-contained electrifying unit can be applied to standard chain hoists already in service.

Tables and Charts for Natural Gas Users

By R. P. Anderson
Chief Chemist, United Natural Gas Co.

NATURAL GAS is one of the most important natural fuels. It has wide industrial use, particularly as fuel for heating furnaces and boilers and for operating gas engines.

Due to its former abundance and relatively low cost little attention has been given up to the present to its efficient use. Now, with the supply decreasing and the price rising, it has become worth while to devote time and study to this phase of the matter. The charts and tables which follow will be useful aids along this line.

Excess Air-CO_2 Curves and Tables

For the purpose of combustion study, natural gas may be considered as consisting of gases of the paraffine series only. When other gases are present in appreciable quantities, corrections must be applied.

In the actual combustion of natural gas, a certain amount of air in excess of the theoretical requirement for complete combustion of the gas must be present, and this quantity of air in the flue gas is known as "excess" air. If the theoretical maximum percentage of carbon dioxide in the flue gas is known (this is the percentage corresponding to perfect combustion without excess air), the percentage of oxygen in the flue gas corresponding to various percentages of carbon dioxide can easily be computed, and data of this kind have been compiled in Table I.

From the percentage oxygen in flue gas as found in Table I and a knowledge of the relation between the carbon dioxide formed and the oxygen requirement of natural gas of given specific gravity the percentage of excess air in flue gas containing a given amount of carbon dioxide can be computed. Such data form the basis of Fig. 1. The computation is made in the following manner: Assume the case of flue gas containing

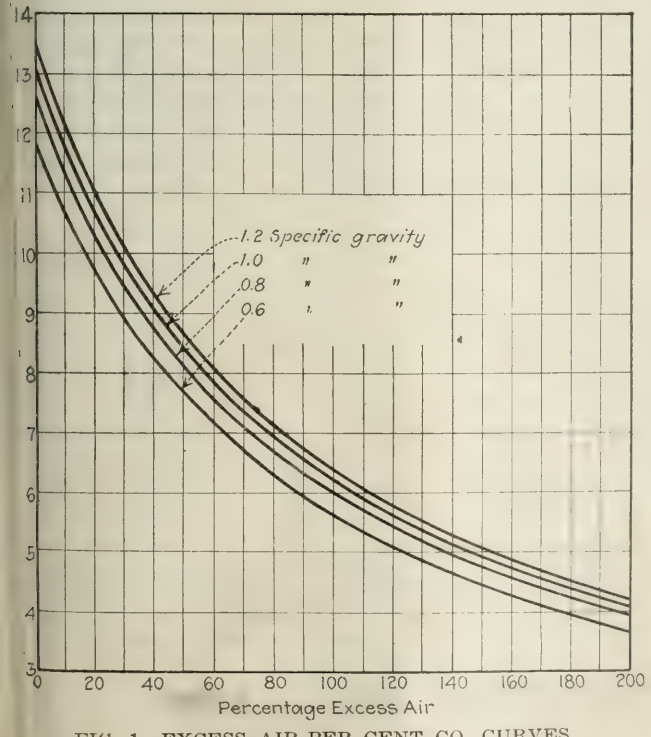


FIG. 1—EXCESS AIR-PER CENT CO_2 CURVES

TABLE I

Per Cent CO_2 in Water-Free Flue Gas	Percentage Oxygen in Flue Gas for Complete Combustion of Gas of Specific Gravity							
	0.60	0.70	0.80	0.90	1.00	1.20	1.50	2.00
1	19.1	19.2	19.2	19.3	19.3	19.3	19.4	19.4
2	17.4	17.5	17.6	17.6	17.7	17.8	17.8	17.9
3	15.6	15.8	15.9	16.0	16.1	16.2	16.3	16.4
4	13.9	14.1	14.3	14.4	14.5	14.7	14.8	14.9
5	12.1	12.4	12.6	12.7	12.9	13.1	13.3	13.4
6	10.4	10.7	10.9	11.1	11.3	11.5	11.7	11.9
7	8.6	9.0	9.3	9.5	9.7	10.0	10.2	10.4
8	6.8	7.3	7.6	7.8	8.1	8.4	8.7	9.0
9	5.1	5.6	6.0	6.2	6.5	6.9	7.2	7.5
10	3.3	3.9	4.3	4.6	4.9	5.3	5.6	6.0
11	1.6	2.2	2.6	2.9	3.2	3.7	4.1	4.5
11.9	0.0	....	....	....	....	....	....	....
12.0	....	0.5	1.0	1.3	1.6	2.2	2.6	3.0
12.3	....	0.0	....	....	....	....	....	....
12.6	....	....	0.0	....	....	....	....	....
12.8	....	....	....	0.0	....	....	....	....
13.0	....	....	....	....	0.0	0.6	1.1	1.5
13.4	....	....	....	....	....	0.0	....	....
13.7	....	....	....	....	....	....	0.0	....
14.0	....	....	....	....	....	....	....	0.0

4 per cent CO_2, produced from the combustion of natural gas of 0.70 specific gravity. By stoichiometrical calculation, 2.45 cu.ft. of oxygen is needed for the combustion of 1 cu.ft. of gas of specific gravity 0.70, and 1.30 cu.ft. of carbon dioxide would be formed. Then the formation of 4 cu.ft. of CO_2 will require 7.54 cu.ft. of oxygen. From Table I, 14.1 cu.ft. of excess oxygen accompanies every 4 cu.ft. of CO_2 and consequently the percentage of excess air will be $\frac{100 \times 14.1}{7.54} = 187$ per cent.

Heat Loss-CO_2 Curves and Tables

The losses of heat in flue gas may be classified under three headings: loss in flue gas proper, loss in excess air, and loss through incomplete combustion.

Heat Loss in Flue Gas—The loss of heat in flue gas proper is due principally, under ordinary conditions, to the heat of vaporization of the water vapor in the flue gas. The total heating value of natural gas in B.t.u. per cu.ft. at 60 deg. F., 30 in. mercury, dry, is given by the following expression, where n represents the average number of carbon atoms per molecule of paraffine hydrocarbons:

$$T.\ H.\ V. = 755.2n + 253.2$$

While the net heating value on the same basis may be found from the formula

$$N.\ H.\ V. = 704.8n + 202.8$$

the difference between the two formulas representing the heat of vaporization at 60 deg. F. of the water formed on the combustion of 1 cu.ft. of gas. If the natural gas contains only paraffine hydrocarbons, these heating values may be expressed in terms of the specific gravity (G) of the gas as follows:

$$T.\ H.\ V. = 1559.7G + 144.6$$

and $$N.\ H.\ V. = 1455.6G + 101.4$$

The difference between the total and the net heating value for natural gas of four different specific gravities is shown in Table II.

Column C—The data in this column represent the

TABLE II.

A	B		C	D	E	F	G
Sp.Gr. of Gas	Heating Value		$\frac{\text{Total-Net}}{\text{Total}} \times 100$	Per Cent. Water Vapor in Flue Gas	Minimum Temp. Flue Gas, Deg. F.	Sensible Heat Loss, Per Cent	Total Heat Loss, Per Cent
	Total	Net					
0.6	1,080	975	9.7	18.5	138	1.6	11.3
0.8	1,392	1,266	9.1	17.3	135	1.5	10.6
1.0	1,704	1,557	8.6	16.6	134	1.5	10.1
1.2	2,016	1,848	8.3	16.0	132	1.4	9.7

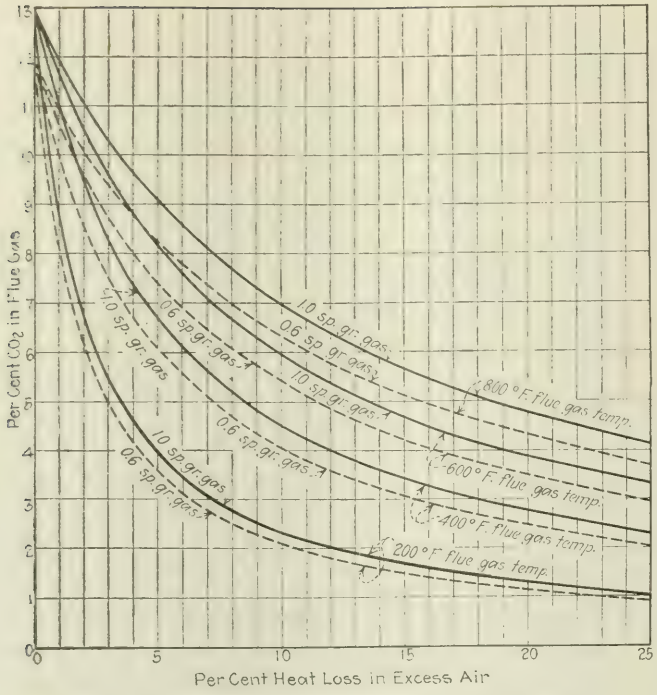

Per Cent CO_2 in Flue Gas
Per Cent Heat Loss in Excess Air
1.0 sp. gr. gas
0.6 sp. gr. gas
800° F. Flue gas temp.
600° F. Flue gas temp.
400° F. Flue gas temp.
200° F. Flue gas temp.

FIG. 2—HEAT LOSS-PER CENT CO_2 CURVES

percentage of the total heat in the gas that is lost in the water vapor formed on combustion.

Column E—The temperatures in this column correspond to the partial pressures of water vapor in flue gas, assuming a barometric pressure of 760 mm.

Column F—These data represent heat loss in flue gas constituents escaping at temperatures of column E rather than at 60 deg. F. Volumetric specific heat of nitrogen taken as 0.018 B.t.u. per cu.ft., of water vapor 0.022 B.t.u. per cu.ft., and of carbon dioxide 0.024 B.t.u. per cu.ft.

Column G—This column is the sum of columns F and C.

The loss of heat in flue gas proper, resulting from its leaving the appliance at a temperature higher than that of the entering air and gas, depends of course upon this temperature difference as well as upon the nature of the gas burned. It is generally desirable to cool the flue gas as much as possible before it leaves the appliance in order to avoid unnecessary heat losses, but where condensation of water in the appliance is undesirable, the flue gas must be allowed to leave the appliance at a temperature such that the percentage of water vapor in the flue gas will not exceed the saturation point.

It will be noted from Table II that this limiting temperature varies from 132 to 138 deg. F. if no excess air is present and that the heat loss which is unavoidable under these conditions amounts to from 9.7 to 11.3 per cent of the total heat of the gas, depending upon its specific gravity.

Heat Loss in Excess Air—The loss of heat due to excess air has been computed for different percentages of carbon dioxide for natural gas of specific gravity 0.60 and 1.00, and for flue gas temperatures of 200, 400, 600 and 800 deg. F. and the results have been shown graphically in Fig. 2. The volumetric specific heat of air was taken as 0.018 B.t.u. per cu.ft. in making these calculations.

Heat Loss Through Incomplete Combustion—The loss of heat through incomplete combustion of natural gas can be ascertained only through knowledge of the nature and quantities of the combustible constituents in th products of combustion, and this information is no usually available. Where combustion is nearly complete carbon monoxide may be assumed to be the principa combustible constituent of the flue gas and the approxi mate heat loss due to the presence of 1 per cent of thi constituent in the flue gas formed from the combustio of natural gas of 0.70 specific gravity will be abou 3 per cent of the heating value of the gas, if the flue ga does not contain much excess air.

The Danish Margarine Industry During 1921

The total number of margarine-manufacturing plant in Denmark in 1921 was 67, as compared with 64 i 1920 and 50 in 1919, according to an issue of the *Ber lingske Tidende*, published in *Commerce Reports* fo Aug. 14, 1922. The number of plants as compare with pre-war figures shows an increase of nearly 5 per cent. The greater number of plants have, howeve a comparatively small production capacity, as only of the 67 produce over 1,000,000 kilos per year, whil 39 have a yearly production of less than 100,000 kilo During 1921 the industry gave employment to 1,06 workers, of which 760 were men and 300 were wome or minors.

The production during 1921 amounted to 55,700,00 kilos, of which 6,400,000 kilos were from animal ingre dients while the rest was produced from vegetable oil The total value of the year's production is estimate at about 96,000,000 crowns. The 1920 productio amounted to 55,500,000 kilos valued at 146,000,00 crowns. The drop in prices was exceedingly heav during 1921. While during the normal years prior t 1917 there was an excess of imports of from 1,500,00 to 2,000,000 kilos per annum, the years following 191 have witnessed a very small importation. The import in 1919 amounted to 300,000 kilos; in 1920, 440,00 kilos; and in 1921, 508,000 kilos. Exportation durin 1919 amounted to 1,500,000 kilos; 1920, 2,300,000 kilos and in 1921, 506,000 kilos.

The total Danish consumption of margarine in 191 amounted to 58,000,000 kilos; in 1917, 33,200,000 kilos in 1919, 38,400,000 kilos; in 1920, 54,000,000 kilos; an in 1921, 56,000,000 kilos. In 1918, due to lack of ra materials, practically no margarine was produced.

The consumption of raw materials in the industr during 1920 and 1921 is shown by the following table:

RAW MATERIALS USED IN THE DANISH MARGARINE INDUSTR

Kinds of Oil Used	1920 Kilos	1921 Kilos
Oleomargarine	550,000	790,00
Premier jus	1,910,000	2,080,00
Neutral lard	430,000	500,00
Other animal oils	90,000	170,00
Total animal oils	2,980,000	3,540,00
Coconut oil	30,000,000	29,320,00
Palm fat	720,000	760,00
Arachid oil	1,580,000	1,240,00
Cottonseed oil	3,650,000	5,590,00
Sesame oil	4,590,000	4,180,00
Soy bean oil	2,640,000	1,540,00
Hardened oil	850,000	870,00
Total vegetable oils	44,030,000	43,500,00
Mixed oils	10,000	10,00
Grand total	47,020,000	47,050,00

Besides the raw materials enumerated above there ar used also in the production certain quantities of butte salt, milk and water from the use of which comes th difference between the quantity produced and the quan tities of raw materials used.

The production of margarine from animal material is fast decreasing while that produced from vegetabl matters is increasing.

Book Reviews

AZOTE. LA FIXATION DE L'AZOTE ATMOSPHÉRIQUE ET SON AVENIR INDUSTRIEL. By *L. Hackspill,* professor of chemistry at Strasbourg. Published by Masson & Cie., Paris. 275 pages.

The author demonstrates that there a national and world need for the nthesis of compounds of nitrogen and at such a process would accomplish tional security and economies in ace and in war. Each nitrogen cycle, tural and artificial, is carefully con-lered and its relative merits and dis-vantages are estimated. The experi-ental results obtained in France and other countries are freely discussed. The synthesis of ammonia is par-ularly well treated because of the ique qualifications of Dr. Hackspill. had had a personal acquaintance th the preliminary experiments of Chatelier and of La Rossignol upon so-called Haber process; he was sociated with M. Guichard in the nch investigations upon this process ring the war; and he has a friendly owledge of the Claude process. The sition as officer in charge during the nch occupation of the German Haber cess plant at Oppau enabled Captain ckspill to see and learn interesting ails which he now reveals.

t is popular and non-mathematical its style and may be understood by beginner in chemistry. It has the nch charm of perspicacity and pre-ion. RESTON STEVENSON.

RBUCH DER EISEN- UND STAHLGIESSEREI. By *Bernhard Osann, professor* at the Clausthal School of Mines. Fifth, revised edition. 693 pp., 758 illustrations. Publisher, Wilhelm Engelmann, Leipzig.

t would be useless to give a price o the book. The fourth edition, dated ty, 1920, cost 42 marks in paper or in cloth. A circular describing the h edition showed the prices 620 and 0 marks respectively, but before it d be issued a rubber stamp was ed showing the revised price to be 8 marks in paper or 950 marks n cloth bound. Since the cost of man marks at this moment is 1¾ s per hundred, the bound book at revised price would cost just 17 s in American money. However, will probably cost about $3.50 ugh an importer.

he fourth edition, which was re-ed favorably and at length by ard Moldenke in our issue for ch 23, 1921, was evidently very ular. The fifth, now at hand, has reset, but only very minor changes to be found. Brief notes on what happened in the 2 years are given by cutting out obsolete material he earlier edition. Fortunately for usefulness of the book to Ameri-, a new and much more extensive k accompanies the text.

E. E. THUM.

Recent Chemical & Metallurgical Patents

American Patents

Issued Oct. 31 and Nov. 7, 1922

The following numbers have been selected from the latest available issues of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,433,533—Production of Arsenic.
1,433,634—Collecting Main for Coke Ovens.
1,433,654—Recovery of Sucrose.
1,433,655—Recovery of Sucrose.
1,434,047—Method of Uniting Metals.
1,434,089—Counter-current Washing Device.
1,434,090—Settling Apparatus.
1,434,650—Manufacture of Calcium Arsenate.
1,434,892—Manufacture of Vulcanized Rubber.
1,434,908—Process of Vulcanizing Rubber.
1,434,909—Process of Vulcanizing Rubber.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Dehydrating Pyridine—In the refining of pyridine, the crude water solution is usually salted out to effect a preliminary separation of the water. For this purpose ammonium sulphate or sodium chloride may be used. The pyridine is not very soluble in the concentrated water-salt solution. The salt solution separates by gravity from the pyridine, in which it is immiscible. The supernatant pyridine, which is then drawn off, contains considerable water, often as much as 15 to 20 per cent. It is the purpose of the process described in the present patent to complete the dehydration in a practical and economical way. The crude pyridine solution is charged into a still and heated. The first portion of the distillate is a constant boiling mixture of pyridine and water, in the proportion of three mols of water to one of pyridine. This distillate is, therefore, much richer in water than was the original still charge.

The distillate is passed over a suitable soluble salt, such as ammonium sulphate. Ordinarily this salt does not complete the dehydration in the distillate, but is used because it is cheap and readily available in a byproduct coke plant. The vapors and condensate are passed over a mass of ammonium sulphate crystals to form a saturated solution, giving two liquid phases; one the saturated solution of ammonium sulphate and the other the pyridine from which most of the water has been extracted. This is passed into a separator, where the water layer is trapped out and from which the pyridine layer is returned to the still. The distillation and dehydration with ammonium sulphate are continued until the distillate no longer forms a water solution when in contact with ammonium sulphate crystals. When this point is reached, the charge in the still is completely dehydrated. (1,416,205, assigned to the Koppers Co., of Pittsburgh, Pa.; May 16, 1922.)

The Aluminum-Chloride Method of Cracking Petroleum Distillates—Probably the most important single patent issued in recent months is that granted to Almer M. McAfee, of Bayonne, N. J., and assigned to the Gulf Refining Co., of Pittsburgh. The patent has for its purpose the specification of a process of converting high-boiling petroleum oils into high-grade low-boiling products of the nature of gasoline, etc., by means of anhydrous aluminum chloride. The original application was filed Sept. 30, 1913, and the patent was issued Aug. 1, 1922.

The process may briefly be outlined as follows: A high-boiling oil is subjected to long-continued heat at a temperature below "cracking temperature" but sufficient to cause reaction to take place in the presence of aluminum chloride. Low-boiling products are formed which are removed from the reaction as fast as produced and proportionate quantities of fresh oil are added to maintain the volume and at the same time to keep the concentration of aluminum chloride practically constant. It is the claim of the inventor that, in contradistinction to the usual cracking methods, substantially complete results are obtained—that is to say, 80 to 85 per cent of the original oil reappears in the form of a water white, sweet, low-boiling oil of substantially saturated character needing little or no refining before being marketed as gasoline or kerosene.

The use of aluminum chloride in petroleum refining has been proposed by others, but it is stated that the results have never been entirely satisfactory, principally because the reaction conditions have never been carefully controlled. Aluminum chloride has a marked tendency to produce resin and tar, and in certain cracking processes in which it has been used, a very large production of gas and heavy oils has been obtained instead of a production of light oil, such as is desirable for motor fuel.

In the McAfee process, a substantially uniform concentration of aluminum chloride is maintained in the oil under treatment and the low-boiling

products formed by its catalytic action are removed from its sphere of influence as fast as they are formed, in order to prevent retrogressive changes. This is accomplished by feeding in new or fresh oil as fast as the low-boiling materials are removed from the reaction. Furthermore, the whole mass must be kept in vigorous agitation throughout the process, in order to prevent the formation of insoluble coky bodies by the aluminum chloride. Provision is also made to condense and return to the reaction the vapors of high-boiling oil, as well as any aluminum chloride which may itself vaporize. This is not only useful in maintaining the concentration of the aluminum chloride in the body of the oil, but also has the further advantage of condensing the gasoline being formed.

The particular temperature which is desirable in the oil mass will vary with the constitution of the petroleum oil being treated, but as a general rule the temperature will not rise above 500 deg. F., even in the case of very high-boiling oils.

The oils and apparatus should be free of water, air or dissolved oxygen. Both moisture and oxygen lead to the production of undesired side reactions as well as decomposing the aluminum chloride. The process may be used on any crude petroleum or on any high-boiling residual oil, such as fuel oil, still bottoms, etc. High-boiling distillates like gas oil and lubricating oil may be treated by the present process to make low boiling products. The aluminum chloride employed may be any commercial preparation, but should be anhydrous. (1,424,574. Aug. 1, 1922.)

Aluminum Alloy of High Strength—Francis C. Frary, of Oakmont, Pa., notes that certain aluminum alloys, containing about 4 per cent Cu, about 0.5 per cent Mg and with or without about 1 per cent Mn, are known to have very valuable properties; notably that by heat-treatment they acquire the tensile strength of mild steel and retain elongations of 10 to 20 per cent in 2 in. These alloys are very hot-short and are difficult to roll into sheets, cracks start at the edges and necessitate deep shearing and much discard. He finds that an alkaline earth metal cures this defect, retaining the other excellences of the metal, even increasing the facility of working in the cold. He recommends an analysis Cu 4.0, Mn 0.6 to 1.0, Mg 0.3 to 1.0, and Ca 0.3 to 0.6 per cent, remainder aluminum. Alloys of this family are easily made by melting ingot aluminum, 99 per cent pure, in a crucible with correct amounts of an 80:20 Al:Cu alloy and a 92:8 Al:Mn alloy, care being taken that the temperature does not exceed 1,500 deg. F. The crucible is then removed from the fire, a correct amount of metallic magnesium and an 80:10:10 Al:Ca:Cu alloy added, dissolved and thoroughly stirred. After reheating and skimming the alloy is cast into ingots. (Original 1,412,280, April 11, 1922. Reissued July 11, 1922, as No. 15,407. Assigned to Aluminum Co. of America.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Depilating Hides—The process set forth in the parent specification (Br. Pat. 175,314) for depilating hides or skins by means of gaseous ammonia in certain concentrations is improved by defatting the skins prior to or in the early stages of the ammonia treatment. In addition, the flesh sides of the skins are protected from the action of the ammonia, warmed concentrated ammonium hydroxide solution is used instead of steam to maintain the necessary degree of moisture in the chamber, the hides or skins and the gaseous or vaporous contents of the chamber are kept in relative movement and the unconsumed ammonia is expelled from the chamber by warm air or other warm gases which do not react with ammonia. The skins may be defatted by extraction with solvents, by saponification with alkali solutions or by regulating the temperature of the chamber in the initial stages of the ammonia treatment so as to effect saponification with the production of ammonia soaps. To protect the flesh sides, two skins may be placed in contact or the flesh sides may be provided with coatings impervious to ammonia. The unconsumed ammonia expelled from the chamber may be absorbed in cold water and concentrated for use in maintaining the required degree of moisture. (Br. Pat. 182,240. O. Richter, Brandenburg. Aug. 23, 1922.)

Synthetic Resins — Artificial resins produced by heating aldehydes with alkali are rendered stable toward water by dissolving them in a solvent and then precipitating them, preferably by water. If the initial resin has not been condensed as far as the hard stage, hardening may be effected by prolonged heating after the precipitation. The products may be used as protective paints for radiators, boilers, etc., being soluble in alcohol, benzene, carbon tetrachloride, trichlorethylene, acetone and fatty oils, such as linseed oil. They are also useful for the production of oil and spirit varnishes, impregnating or polishing solutions. According to the examples, (1) acetaldehyde and alkaline lye are subjected to continued heating after distilling off the volatile residue, the product dissolved in glacial acetic acid and then precipitated in powder form by the addition of water; after drying, the powder may be directly dissolved in a solvent to form a varnish or first converted by more or less prolonged heating into a resin of desired degree of hardness; (2) a viscous resin is formed from crotonaldehyde and alkaline lye, dissolved in acetone and precipitated by adding water; the precipitated resin is then hardened by heating it alone or dissolved in a solvent such as linseed oil. (Br. Pat. 182.459; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Aug. 23, 1922.)

Synthetic Resins—Diazo compou are incorporated with the resinous c densation products of phenols wh aldehydes or of ketones with aldehyd preferably before the condensation complete. The resulting materials resinous in character and can be u as oil-soluble dyestuffs, as a shel substitute, for electric insulation in pyrotechnics for making artifi flames; they may also be employed fat- and oil-soluble varnishes for pa textile fabrics and leather, or to p duce a bright, hard, polishable coat on wood, metals, etc. According to examples, (1) melted phenol and h amethylenetetramine are stirred gether, while diazotized *p*-nitraniline added; the product solidifies on cool to a green- or orange-colored oil-sc ble resin; instead of hexamethyle tetramine, formaldehyde, paraformal hyde or furfural may be used, wh cresol or other hydroxy-benzenes, chlorinated phenols, may replace phenol; (2) acetone and formaldeh are condensed by the aid of potash, diazotized *p*-nitraniline is then ad to the oily liquid. (Br. Pat. 1 497. H. Plauson, Hamburg. Aug. 1922.)

Ferric Oxide—Red iron oxide suita for use as a pigment is obtained heating ferrous chloride in a current air and steam. The ferrous chlori preferably in granular form obtai by evaporating pickle liquor while s ring, is spread on the floor of a mu furnace and air moistened by pass through water at 60 deg. C. is hea to 250 to 300 deg. C. and passed o it. The exit gas is cooled to obt hydrochloric acid, and the rate at wh the current is passed should be s that the acid condensed contains more than 30 grams HCl per 100 The gases leaving the condenser passed to a scrubber fed with water pickle liquor. Iron compounds deco posable under the conditions of process, such as hydrated ferric ox or ferrous carbonate, which may be the natural condition, may be mixed finely divided form with the ferr chloride, and in that case the tempe ture may be carried higher — instance, to 350 deg. C. There may a be added to the ferrous chloride sm quantities of salts having a cataly effect—namely, salts of copper, m nesium, tin, sodium and potassium. addition of a copper salt is stated improve the red color of the prod (Br. Pat. 183,323. D. Tyrer, Stockt on-Tees. Sept. 13, 1922.)

Dyeing Cellulose Acetate—Cellul acetate threads, films or fabrics, mixed goods containing it, are treat prior to or during dyeing, by me of trisodium phosphate solution. In example, acetate silk is treated at to 70 deg. C. in a bath of disodi phosphate and caustic soda. The trea silk may be mordanted with tannin a tartar emetic before dyeing. (Br. P 183,806; not yet accepted. Soc. Chimi des Usines du Rhone, Paris. Sept. 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

merican Institute of Chemical Engineers Plans Big Program for Richmond Meeting

ifteenth Annual Convention Gives Promise of Important Technical Sessions and Interesting Inspection Trips

HE PROGRAM for the fifteenth annual meeting of the American stitute of Chemical Engineers has en approved by the Council. It will held in Richmond, Va., Dec. 6 to 9, th headquarters at the Hotel Jeffern. The New York delegation will go wn in special Pullman cars leaving e Pennsylvania Station at 8:45 p.m. d reaching Richmond at 7 o'clock the xt morning.

Materials of Construction

The feature of the technical papers ll be a comprehensive survey of maials of construction. Papers have en prepared on wood, chemical stoneare, glass, cement and lime and their e in chemical industries. In addition pers on such new developments as gnesium oxychloride, cement and ctile tantalum will be presented.

One of the outstanding papers of the ogram will be that of J. H. Young the Mellon Institute on "Asbestos-Protected Metal and Its Use." This presents several years of extensive estigation at the famous Pittsburgh boratory.

Attractions of Richmond

Mayor George Ainslie will welcome e Institute to Richmond, and Director Public Works Allen J. Saville will ake an address on the advantages hich Richmond offers to chemical dustries. The Institute will have opportunity to investigate these industries: The fertilizer plants of the Virginia-Carolina Chemical Co., the Richmond Car Works, the Standard Paper Co, and finally the industry which in e public mind is most intimately sociated with Richmond — tobacco.

An automobile excursion to Hopewell d Petersburg will include an inspection of some of the Hopewell industries in the morning, a luncheon and a drive ck through historic Petersburg in the ternoon.

The secretary of the Institute, J. C. Olsen, the Polytechnic Institute, Brooklyn, N. Y., will make reservations for the special Pullmans which go from New York to Richmond. Hotel reservations should be made direct to the Hotel Jefferson, Richmond.

The local committees have been very active and their energy and interest promise an enthusiastic meeting. The committees are as follows:

General Committee—John G. Armistead, chairman; W. T. Dabney, Dr. J. B. Robb, Graham Edgar.

Committee on Plant Visits—Dr. F. C. Carpenter, George H. Nash, A. G. Ryland.

Committee on Papers Concerning Richmond—Dr. Julius B. Weems, Dr. Samuel H. Sheib, Henry Froehling.

Committee on Entertainment—W. F. Rudd, J. G. Armistead, A. H. Allen, A. G. Ryland.

Committee on Hopewell-Petersburg Trip—John G. Armistead, A. H. Allen.

Gentlemen's Entertainment Committee—James F. Ryland.

Ladies' Entertainment Committee—Mrs. J. Allison Hodges.

Wednesday, Dec. 6

Meeting at Hotel Jefferson

9 a.m. Registration.

9:30 a.m. Address of welcome by George Ainslie, Mayor.

"The Advantages Richmond Offers to Chemical Industries," Allen J. Saville, Director of Public Works.

Symposium on Materials of Construction.

"Wood," J. V. N. Dorr, president of the Dorr Co.

"Application of Stoneware to the Chemical Industry," P. C. Kingsbury, chief engineer, General Ceramics Co.

"Ductile Tantalum," Dr. Clarence W. Balke, chemical director of the Fansteel Products Co., Inc.

"Magnesium Oxychloride," Max Y. Seaton, technical director, National Kellastone Co.

"Glass Rings—A New Filling Material for Towers," F. C. Zeisberg.

"Glass," A. E. Marshall. (One-half hour) Lantern slides.

12:30 p.m. Luncheon at Hotel Jefferson, $1.25.

2 p.m. Excursions. Optional trips.

1. Seeing Richmond.
2. Inspection of Standard Paper Manufacturing Co.
3. Richmond Car Works.
4. Southern Manufacturing Co. (baking powder).
5. Cheek-Neal Coffee Co. plants.

8:30 p.m. Reception and entertainment.

Thursday, Dec. 7

9 a.m. Business session. Canvass of ballots for officers. Reports of officers and Council. Reports of committees.

10 a.m. Papers.

"Effect of Rate of Flow on Absorption of Gases," Wallace B. Van Arsdel, chemical engineer, Brown Co.

"Resistance of Packing to Fluid Flow," F. C. Blake, E. I. du Pont de Nemours & Co.

"Absorption and Scrubbing Tower Design," R. T. Haslam, Massachusetts Institute of Technology.

"Integral Waterproofings for Concrete," Prof. A. H. White.

"The Density of Lime as a Function of Burning Conditions," Gerard Osterhof and Prof. J. R. Withrow.

"Defects of the Patent Laws in the United States," Maximilian Toch.

"Tobacco Industry of Richmond," Thomas M. Carrington, president Tobacco Association of the United States.

12:30 p.m. Luncheon.

2 p.m. Excursions.

Inspection of Allen & Ginter division of Liggett & Myers Tobacco Co. (cigarettes).

Whitlock branch P. Lorrilard Tobacco Co. (cigars).

Larus Bros. & Co. (smoking and chewing tobacco) plants.

8 p.m. Papers—Hotel Jefferson.

"Asbestos-Protected Metal, Its Development, Manufacture and Use," Dr. J. H. Young, senior fellow, Mellon Institute. (Illustrated by slides.)

"The Uses of Concrete in Chemical Works," A. C. Irwin, engineer, Portland Cement Association.

Friday, Dec. 8

9 a.m. Business.

10 a.m. Papers.

"Oil Substitution Products, W. B. Pratt.

"Some Engine Experiments With Oxidized Oils," J. H. James. (Lantern.)

"Use of Propane for Refrigeration," H. D. Edwards, Linde Air Products Co.

"A Method for the Analysis of Stirrer Performance and Its Application to a Common Type of Paddle Stirrer," J. C. Wood, E. R. Whittemore and W. L. Badger.

"Purification of Sewage by Aëration in the Presence of Activated Sludge—IV.", Edward Bartow.

"The Importance of Impurities," Jerome Alexander.

12:30 p.m. Luncheon.

2 p.m. Excursions.

Inspection of Virginia-Carolina Chemical Co.'s Richmond Chemical Works (complete fertilizers), Richmond Cedar Works (woodenware) plants.

7 p.m. Subscription dinner, Hotel Jefferson (informal), $4.

Saturday, Dec. 9

8:30 a.m. Excursion to Hopewell and Petersburg, where the following plants will be visited: The Stamsocott Co., Hummel-Ross Fibre Corporation, Hopewell Chemical Co., Water Purification System.

Fatal Explosion at Columbia Kills Graduate Student

William E. Spandow Instantly Killed and Reginald G. Sloane Injured by Bursting Autoclave

An accidental explosion Nov. 17 in the chemical engineering laboratories of Columbia University resulted in the death of William Eastman Spandow, a graduate student from the University of Denver, and in serious injury to Reginald Gordon Sloane, a Harvard graduate. The students were experimenting on a semi-technical scale in the manufacture of diphenylamine. The experiment was proceeding in a normal manner when suddenly the pressure mounted and before it could be released the top was blown off the heavy steel autoclave and shattered into pieces which were hurled in all directions, imperiling the lives of at least seven other students at work in the laboratory. Spandow, who was standing directly over the instrument in order to read the pressure gage, was hit by a heavy piece of steel which crushed his head, killing him instantly. Sloane had been assisting in the experiment and was a short distance from the autoclave when it exploded. He was painfully burned by the chemicals plastered over his face and eyes, his scalp and face were cut by flying missiles and he was badly bruised.

The force of the explosion was sufficient to do considerable damage, principally to the windows and glass apparatus and equipment.

Had Been Tested for 750 Lb.

The apparatus, which had previously been used for this and other experiments, was a heavy steel autoclave having a capacity of 2 gal. It was about 2 ft. high, 1½ ft. in diameter and had been tested for a pressure of 750 lb. per sq.in. The lid, about 2 in. thick, was held in place by twelve lugs, six of which were sheared off even with the flange. The bolts were broken or threads stripped on the others. The ... was broken into hundreds of pieces, the largest probably not weighing more than 10 lb.

The force of the explosion was mostly expended vertically. A large hole in the wooden floor of the balcony directly above the apparatus indicated the path of part of the flying steel.

The experiment on which Spandow and Sloane were engaged was the production of diphenylamine by the standard commercial method. Aniline and aniline hydrochloride were being heated at 240 to 260 deg. C. for 24 hours to form diphenylamine, ammonia and hydrochloric acid. This was one of a series of preparations which go to make up a course in the manufacture of dye intermediates and organic chemicals. Under the direction of Prof. Arthur W. Hixson this course has been one of the most popular in the chemical engineering school. Its purpose is to give the student experience in actual chemical manufacture on a scale approximating semi-commercial practice. This particular experiment, the preparation of diphenylamine, had been successfully carried out by students in the preceding classes. The aniline used was the commercial product taken directly from the shipper's drum. The aniline hydrochloride had been made by Spandow and Sloane from this same aniline and had been purified and thoroughly tested.

Sloane's Account of Accident

Spandow and Sloane began their experiment about 11 o'clock and were heating up the autoclave by means of the gas heater directly beneath it. The reaction was proceeding normally and by means of its valve the apparatus had been vented twice in order to remove any air or oxygen it contained. At about 12:20 Professor Hixson read the gage, which then showed a pressure of 112 lb., and after warning the students to turn off the gas in case the pressure increased, he started for lunch. Before he had left the building, however, the explosion occurred and he rushed downstairs and assisted the students in giving first aid to Sloane.

In giving an account of the accident Sloane said that the gage had shown a sudden rise of pressure, from 112 to about 250 lb. per sq.in., and that he had hurried to the cock 20 ft. away and turned off the gas supply. Returning, he saw Spandow opening the valve on the autoclave and apparently this act was followed by the explosion. The theory has been advanced that the flame, not yet completely extinguished in the gas burner, ignited the escaping gases and shot back into the chamber to cause the explosion.

Paint and Varnish Makers Meet

Four Associations Hold Conventions in Atlantic City

Well-attended and enthusiastic meetings characterized the convention of paint and varnish associations in Atlantic City, Nov. 15 to 17. The four national organizations of the paint and varnish industries—the National Paint, Oil and Varnish Association, the National Varnish Manufacturers' Association, the Paint Manufacturers' Association of the United States and the Federation of Paint and Varnish Production Clubs—held simultaneous conventions, and the opportunity for association and social intercourse offered by the assembly of so many representatives of the trade in "America's Playground" was no less valuable than the business sessions.

Business Good

Ernest T. Trigg, president of the National Paint, Oil and Varnish Association, sounded a keynote of optimism at the opening session of the convention, saying that in the 4 years since the armistice, American business has reached a degree of stability that it took Europe 40 years to reach after the battle of Waterloo. The whole business life of the present generation, said President Trigg, must be devoted to the task of world reconstruction to make good the wastes of the war.

"The paint and varnish industry," he said, "more than all others, as the industry of preservation, is the very incarnation, in spirit and substance, of the things needed to combat the waste of those years that were dedicated to destruction and waste."

Arthur E. Foote, of the division of simplified practice of the Department of Commerce, addressing the National Paint and Varnish Manufacturers' Association, expressed the desire of the Department of Commerce to co-operate with the trade. He stressed the importance of standardization in eliminating waste, saying:

"Business men should realize that the Department of Commerce is at their service and that the government's only object in creating the simplification of practice movement is to eliminate waste. Over one hundred different industries throughout the country are considering simplified practices, and when the tremendous value of this movement is realized there will be many more."

Industrial Alcohol

A resolution requesting the Commissioner of Internal Revenue to issue reasonable restrictions to insure ample supplies of alcohol to the industry was drawn up as a result of a report by committee of the N. P. O. and V. A.

Flaxseed Situation

A. C. Dilman, of the U. S. Department of Agriculture, discussed the flaxseed situation in this country as a factor of vital importance to the paint industry.

For the past 10 years, he said, production of flaxseed in the United States has averaged only a little over one-half the quantity consumed, so that considerable imports have been necessary.

Mr. Dilman told how this shortage can be overcome by growing combination crops of flax and wheat. He told of the successful experiments in this direction in Minnesota, and said that climatic conditions make similar combination crops possible in other states.

Election of Officers

Officers of the four associations were elected as follows:

National Paint Oil and Varnish Association: President, Louis R. Atwood; vice-presidents, E. V. Peter, J. W. Bray, Sydney Rasmussen, H. Kuhn, George Henderson; treasurer, John H. Pine; secretary, George Horgan.

National Varnish Manufacturers' Association: President, Henry L. Calman; vice-presidents, C. J. Roh, W. ... Carnegie.

Paint Manufacturers' Association of the United States: President, Charles L. Cook; vice-presidents, S. R. Matlack, Samuel Rosenthal; secretary-treasurer, G. B. Heckel.

Federation of Paint and Varnish Production Clubs: President, E. W. Fasig; secretary-treasurer, G. B. Heckel.

Weeks Recognizes Peace-Time Value of C.W.S.

War Secretary Points Out Important Sanitary and Industrial Applications of Poison Gases

Peace-time activities of the Chemical Warfare Service were discussed as follows by John W. Weeks, the Secretary of War, in the course of an address before the Boston Chamber of Commerce:

"Does the average citizen know that the deadly mustard gas, as well as several other war gases, is being employed experimentally with great hopes of its proving a valuable retardant in the treatment of tuberculosis?" Contrary to the popular impression that the poison gas causes respiratory diseases, he continued, it has been established that it tends to prevent such diseases. "Among the employees of large war gas factories, influenza and similar diseases were practically unknown during the period of the plagues that swept our country at the close of the world war. Extensive arrangements are being made in the laboratories of the Chemical Warfare Service to conduct research into the fields of medical employment of war gases and byproducts."

Extermination of Vermin

One of the greatest problems of modern sanitation is that of effective and safe fumigation. It is necessary to wage continuous war against the rats and other vermin which carry plagues. Only recently, in the fumigation of a ship in San Francisco, several men were killed and many injured by the fumes of hydrocyanic acid. The Chemical Warfare Service offered its co-operation and has already given promise of solving this problem. Tear gas was finally selected as the best possibility for use in fumigation. Near the end of October a test was made with a concentration of one-eighth the strength which would injure human life. Several officers spent the night in a room adjoining the kitchen which was selected for the test. The gas was projected into the kitchen in the evening, and the officers in the next room reported that they were not inconvenienced thereby. In the morning it was discovered that every mouse, fly, cockroach and other insect was dead. The gas was then projected into a large warehouse, killing hundreds of rats, mice, bats and other vermin. The experiment was repeated in fumigating a ship and the results were beyond expectations. The Public Health Service is enthusiastic about this work and the possibilities seem limitless.

Industrial Value

Tear gases have also been demonstrated as very effective in employment against barricaded criminals and in attempted jail deliveries and other riotous actions. The gas mask is becoming very valuable for use in mining activities. The Chemical Warfare Service has produced the only substance suitable for protection of miners against the deadly carbon monoxide gas. In their development of gas masks and suitable materials therefor, the scientists of the Chemical Warfare Service have made another valuable contribution to the industries in the form of a very active charcoal which is useful in manufacturing gasoline from natural gas and coal-tar products.

Boll Weevil Control

It is becoming recognized that any effective control of the boll weevil and similar pests must come from the use of these poisonous compounds. The Air Service is co-operating in experiments by spraying the fields and orchards with the vapors. Experiments are being conducted by the Chemical Warfare Service in co-operation with the Navy Department in hopes of producing a non-fouling paint and thereby avoiding the results of barnacles which gather on ship bottoms. Gases are being used in experiments with the hope of destroying the teredo and limnoria, which bore into submerged timbers in our southern waters. Finally, in addition to all of these constructive activities, one must recognize that the work of the Chemical Warfare Service has led the way to the foundation of an American dye industry that should one day be one of our most valued assets.

R. E. Swain Chosen for Chandler Foundation Award

Friends of Professor Chandler presented in 1910 to the trustees of Columbia University a sum of money which constitutes the Charles Frederick Chandler Foundation. The income from this fund is used to provide a lecture by an eminent chemist and to provide a medal to be presented to the lecturer in further recognition of his achievements in science. Previous lecturers on this foundation were L. H. Baekeland, W. F. Hillebrand, W. R. Whitney, F. Gowland Hopkins and Edgar F. Smith.

The lecturer this winter will be Robert E. Swain, professor and head of the department of chemistry, Stanford University. Dr. Swain's subject will be "Atmospheric Pollution by Industrial Wastes." The lecture will be in Havemeyer Hall, Columbia University, on Jan. 9, 1923.

Rose Polytechnic Institute Plans Mining Engineering Course

Philip B. Woodworth, president of the Rose Polytechnic Institute, Terre Haute, is developing plans for a course in mining engineering at the institution. A portion of the new college buildings will be assigned for this branch of study, which will be placed on an equal footing with the five other departments of the school. The Bureau of Mines will co-operate with the new department and Prof. R. L. McCormick, now in charge of applied mechanics studies at the college and active in mining engineering for 30 years past, is considered as the probable head of the new course of instruction. No definite date has as yet been established for the inauguration of the department.

Electrochemists Hear of Burma

Rangoon, Mandalay and Other Familiar Places Made Lively by A. C. Matheson

A regular meeting of the American Electrochemical Society was held in Rumford Hall on Friday evening, Nov. 17. The principal speaker, A. C. Matheson, gave a delightfully informal talk on his trip around the world. His trip had for its primary purpose the inspection of a silver mine in Burma.

Shipping from Marseilles, he went through the Suez Canal, where he saw the tremendous army base for the British Mesopotamian army. One extremely interesting point in connection with this place was the piping of Nile water from a tributary underneath the canal to supply the base with drinking water. This supply was carried along with the army in a piping system as it advanced into Palestine. There were pictures, too, of the rugged Arab boats which can be found throughout the African coast and even out in the Indian Ocean.

Ceylon Tea and Perfumes

Everyone knows of Ceylon tea, but few have heard of the perfumes. These seem to be indigenous to the soil, or perhaps it should be said to the inhabitants. Each tribe has its own characteristic aroma. Here, too, the curious fishing catamarans were novel and the fish unusual but highly edible.

Early Chinese Metallurgy

Through the wonderful rice fields of Rangoon to the silver mine in the highlands back of Mandalay. Here the old silver mine worked by the Chinese as early as the fourteenth century and not abandoned until 1868, probably because of water in the mines, for they were down to the 300 ft. level. The old Chinese metallurgical furnaces and cupels are still intact.

Another interesting paper was presented by W. A. Davis, of the American Brass Co., on "The Analysis of Metals by Spectroscopy."

At the conclusion of the technical program, election of officers of the section took place. H. C. Cooper was elected chairman, James Kendall, of Columbia University, vice chairman; Paul DeV. Manning, New York City, secretary.

Extensive Program for Peat Production in Michigan

The Peat Products Corporation, Eaton Rapids, Mich., recently organized with a capital of $100,000, is making ready for intensive operations on a 440-acre peat bog, near the city. A complete mechanical plant is in course of completion and it is purposed to produce at the rate of 100 tons of dried peat per day, commencing early in December. John H. Collins has been appointed secretary-treasurer and general manager at the plant.

Training and Aiding Workers in Industry

Personnel Association Discusses Timely Questions Affecting Selection and Welfare of Employees

Development of organized effort to study the human factor in commerce and industry and to apply the principles and practices arising therefrom to the realities of American industrial life mark a 3-day national forum of personnel experts held in Pittsburgh Nov. 8, 9 and 10 under the auspices of the National Personnel Association. Many of the country's principal manufacturing and mercantile enterprises, public service corporations, universities, engineering societies and civic bodies were represented as active participants in the movement, sponsored and directed from the association's headquarters in New York City.

Co-operation With Colleges

Among the notable reports presented to the convention was one dealing with "Co-operation With Engineering Colleges," prepared by a committee of which W. E. Wickenden, American Telephone & Telegraph Co., New York, is chairman, and of which F. L. Bishop, dean of engineering, University of Pittsburgh, and G. H. Pfeif, secretary of the educational committee of the General Electric Co., are members. Outlining ways and means by which assistance, through the association, can be rendered by industries to engineering colleges, the report says:

"The engineering colleges have a strong claim on the assistance of the industries in return for services rendered. The schools have made inestimable contributions to scientific knowledge from which the industries have profited without cost. Education has increased earning power and so has made possible the markets on which many industries depend for existence. The colleges have expended on each engineering graduate from $800 to $2,000 above all fees received. The industries profit by this training and would be compelled to provide costly substitutes for it if it were not available."

Immigration

Immigration was a principal topic of the convention. Magnus W. Alexander, managing director of the National Industrial Conference Board, discussed "Our Immigration Policy and Its Social and Economic Effects." "The Immigrant's Point of View" was the subject of Michael I. Pupin, immigrant, inventor, consulting engineer and professor of electromechanics in Columbia University. W. W. Kincaid, Niagara Falls, N. Y., delivered an address on "Nationwide Co-operation in Personnel Work," and E. K. Hall, vice-president of the American Telephone & Telegraph Co., on "Management's Responsibility for and Opportunities in the Personnel Job."

A committee, headed by E. K. Strong, Jr., director of the Bureau of Educational Research, Carnegie Institute of Technology, submitted a report saying that "psychological tests and rating scales are used today by a considerable number of corporations, and it is very evident that their use is being extended within those companies and to still other companies."

Vocational Training

Discussing the development of men for executive positions, a committee, headed by C. R. Dooley, manager of personnel and training, Standard Oil Co. of New Jersey, said that "companies having had training courses for several years invariably report that the effort and expense involved are justified by the results."

H. M. Jefferson, manager of the personnel department, Federal Reserve Bank, New York, presented a report on industrial motion pictures, finding that many non-theatrical films are distributed and used and that the demand for them is increasing.

Numbering of Steel

A conference to consider the desirability of providing a system of designating qualities or kinds of steels by code numbers has been called by the American Engineering Standards Committee at the request of the U. S. Bureau of Standards. The conference will be held in Room 704, Department of Commerce Building, Nineteenth St. and Pennsylvania Ave., Washington, D. C., at 10 a.m., Dec. 6.

This conference will attempt to determine the desirability of applying a uniform numbering system to forging steels, casting steels, structural steels, including plates, tool steels or other steels not so classified.

While the American Engineering Standards Committee has invited to this conference representatives of all technical and industrial associations known to be interested in the subject, any organization which feels that it should be represented in the conference, but has received no formal invitation, is urged to communicate with the American Engineering Standards Committee, 29 West 39th St., New York City.

Germany Imports Chilean Nitrate

On account of the great demand from farmers and to maintain trade relations with Chile, the importation of 200,000 tons of Chilean saltpeter has been sanctioned by the German Food Ministry, the right to import being given only to the Verein der Saltpeter Importeure at Hamburg, according to the *Frankfurter Zeitung*. In return the verein must sell 50 per cent to German farmers and 50 per cent to the fertilizer trade.

It is said that the German Government was influenced to permit imports of Chilean saltpeter by the fact that the restrictions on its import previously existing were leading to demands in Chile that imports of German goods into that country be similarly restricted.

Government Officials to Form Association

Branches in All Important Cities to Bring About Better Co-operation in Federal Business

Under the direction of the Bureau of the Budget a definite effort is being made for the first time to increase the efficiency of our great federal business machine by bringing together, in the larger cities of the country, all officials of the government in whatsoever department they are engaged. The work is under the personal supervision of General Herbert M. Lord, director of the Bureau of the Budget, and Colonel H. C. Smither, his chief co-ordinator. According to the plan federal business associations are to be organized in the larger cities for the purpose of bringing about a closer co-operation and co-ordination in carrying out the government's business.

Expect Economies

In these associations it is expected that economies will be realized from the interchange of transportation facilities, the consolidation of purchases, the storage of supplies and the co-ordination of many other activities to the common advantage of each of the different departments concerned. It is expected that the association will make possible the elimination of much duplication and a reduction in the expense of operation of the government.

The first Federal Business Association was formed in Chicago. At the organization meeting it was found that few federal officials stationed in that city were acquainted with officials representing departments and bureaus other than their own. Other associations have been formed in Detroit, Milwaukee and Boston and have already been in existence sufficiently long to prove their utility. It is now planned to carry the organization into Philadelphia, Baltimore and other large cities.

Before this plan was conceived there was little or no contact among federal officials stationed in the same city, but it is now apparent that economies and other advantages of the greatest importance will be brought about.

Rise of German Potash Price Charged to Production Cost

Inland potash prices in Germany increased 250 per cent between Oct. 1 and Nov. 15, according to cable advices reaching Washington. The increase is chargeable largely to increases in freight rates, in coal prices and in miners' wages. Despite the increase in prices, it is estimated that the Germans will sell more potash in 1922 than in any pre-war year, deprived as they are of the Alsatian mines.

The same cable states that the German chemical industries had a good month in October with the sole exception of the dye producers, who report further decreases in the demand.

Dickson Will Be Dye Expert of State Department

Move May Presage Organization of Government Distributing Agency for Reparation Dyes

Announcement that the State Department has temporarily employed F. S. Dickson as an expert on dyes has been made. It is believed that this move indicates plans of the government to undertake the distribution of the reparation dyes.

Mr. Dickson, who directed the dye license plan under the emergency tariff act, will give the department the benefit of his expert knowledge of the dye situation and will advise as to the best method for the handling of the German dyes. As Mr. Dickson had to pass upon the applications of importers for the entry of foreign dyes and had to consult the American manufacturers to learn whether or not these dyes were satisfactorily produced in this country, the State Department feels that he is well qualified for the position.

The Secretary of State has made known that a note from the Allies has been received, notifying the United States that they will not oppose the receipt of German reparation dyes without cost, to be applied against the costs of the army of occupation.

Agricultural Chemists Hold Sessions in Washington

Chemists and professional men generally must be particularly careful to guard against any influencing of their opinions by the fee which they are receiving or by the desires of their employer. Senator Ladd, of North Dakota, himself a chemist, sounded the foregoing warning in the course of an address before the thirty-eighth annual convention of the Association of Official Agricultural Chemists, which was held in Washington last week. Senator Ladd fears that there is an increasing tendency to yield to the temptation to bring forth the opinions desired by the employer. He made specific references to expert witnesses. It is unethical, he said, for a witness to bring out only such part of the facts as will help the side which is paying his fee. It is the belief that it undermines the reputation of the processions, as well as that of the individual, when it is known that the expert witness would be able to make a strong showing for either side that employed him.

Dr. Harvey W. Wiley told the association that despite all of the research and effort it must be admitted that there is no known cure for cancer. He regards the possibilities of radium as promising, but it may be difficult to confine its effects to diseased tissue.

Officers were elected as follows: A. J. Patten, Michigan Agricultural College, president; R. E. Doolittle, of the Chicago office of the Bureau of Chemistry, vice-president, and W. W. Skinner, assistant chief, Bureau of Chemistry, secretary and treasurer.

Attempt to Stop Long Working Hours for Government Employees

The 12-hour day and 7-day week in government service and what is to be done to stop it was one of the questions under consideration by the executive council of the National Federation of Federal Employees, in session last week in Washington. In countless instances throughout the country the 12-hour day and 7-day week prevail in government employ. Specific instances of this abuse are cited by Vice-President Lee R. Whitney of Milwaukee, Wis., as occurring in his part of the country among firemen in the government buildings and lock masters on the Fox River in Wisconsin. The lock masters, according to Mr. Whitney, are on duty really day and night and often as long as 16 hours.

Engineers in most of the federal buildings in Washington work 7 days a week and in the Custodian Service in Baltimore, according to Vice-President Charles L. Wiegand of that city, the employees are on duty 7 days a week without extra pay and with no compensatory time. Similar conditions prevail in the Custodian Service almost everywhere in the country. Immigration and customs officers on the Canadian border are likewise working the 12-hour day and 7-day week.

These matters will be taken up by the council with the various departments or with Congress, as the situation may require.

Liquid Carbon Dioxide Research Fellowship Established at Mellon Institute

The liquid carbonic division of the Compressed Gas Manufacturers' Association announces the establishment of an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, for the purpose of classifying, studying and developing the uses for liquid carbon dioxide. The founding of this fellowship is in accord with the desire of the members of the association to cooperate with users and prospective users of liquid carbon dioxide, with the object of developing efficient means of applying the gas and of obtaining fundamental data bearing on its use in various industries.

In addition to conducting research work, the fellowship will be made a clearing house of information regarding various uses of liquid carbon dioxide, and data will be kept on file for the accommodation of prospective users of this product.

The present incumbent of the industrial fellowship is Charles L. Jones, who will be glad to correspond with anyone interested in the use of liquid carbon dioxide in industry.

Bayer Co. Complaint Dismissed

The Federal Trade Commission announces the dismissal of its complaint against the Bayer Co., Inc., of New York City, manufacturer and distributor of Aspirin tablets.

Power Show Promises to Be Interesting

Exhibits Planned Will Touch Every Phase of Power Development and Application

The great interest aroused forecasts a phenomenal success for the first National Exposition of Power and Mechanical Engineering, which will open Thursday, Dec. 7, at the Grand Central Palace and extend through Dec. 13, with the exception of the intervening Sunday. Practically all of the exhibition space has been leased and requests for approximately two hundred thousand tickets have been received by the management.

The exposition covers the field of power and mechanical engineering from the moment the coal is taken from the ground until the power is turned into work in the final machine. Not only will there be representatives of prime movers and steam-generating devices but also exhibits of manufacturers who have devoted their efforts to the solution of the troublesome problems involved in burning fuel and making and using power.

Educational Aspects

Engineering university students are to be made especially welcome at the exposition. Special facilities have been offered for organized college classes to visit the show in a body and rooms will be set aside for special lectures about any of the material that is displayed at the show. In this manner the students will be given an intimate contact with the practical application of the various types of engineering apparatus exhibited. The exhibitors are planning to have properly equipped representatives who may explain fully the technical reasons for any apparatus or detail.

Interesting Exhibits

Among the exhibits of special interest will be that of Gillis & Geoghegan, who will show four models of telescopic hoists with complete equipment for removing ashes. Two electric models will be in operation.

The Keasbey & Mattison Co. will operate a steam unit with sections covered by various forms of insulating material. By means of thermometer readings and charts the actual savings in B.t.u. will be clearly demonstrated and the results will be worked out in various ways to show the savings in tons of coal and dollars and cents by the use of the proper kind of insulation.

The display of the Lunkenheimer Co. will feature two motor-controlled valves equipped with the Deane system of control. One of the valves is a 12-in. cast steel Monel mounted gate valve which made such a notable showing at the Essex tests, in which by means of this control the flow of steam from the open valve was stopped. A remarkably complete line of cast steel Monel mounted valves for operating conditions of 350 lb. W.S.P. and 800 deg. F. total temperature will also be presented.

Caetani to Be Guest of Honor at Engineers' Banquet

A reception and banquet at which Prince Gelasio Caetani, the new Ambassador from Italy to the United States, will be the guest of honor, is being planned by the Federated American Engineering Societies. L. W. Wallace, executive secretary of organization, has written Ambassador Caetani telling him of the desire of the engineers in this country to pay him this mark of respect. No information has been received as yet at the Italian Embassy as to the time of the new Ambassador's arrival. It is believed, however, that he will be in this country by the first of the year, in which case Mr. Wallace hopes to arrange to have Prince Caetani as the guest of honor at the annual banquet of American Engineering Council. If that proves to be practicable, arrangements will be made so that all engineers who desire may attend.

Personal

Dr. JEROME ALEXANDER has established himself as a consulting chemist in the Chemists' Building, 50 East 41st St., New York City.

Dr. CLARENCE W. BALKE, of the Pfansteel Products Co., of North Chicago, Ill., is to be chairman of a symposium on "Rare Metals in Industry" to be presented at the New Haven meeting of the American Chemical Society.

W. M. CORSE presented, to the Chemical Society of Washington, an address illustrated by motion pictures, entitled "The Mining and Smelting of Nickel Ores," on Nov. 9.

PAUL CROLL, formerly research chemist of the N. J. Zinc Co., has been engaged by the Patton-Pitcairn division of the Pittsburgh Plate Glass Co., Milwaukee, Wis.

WILLIAM P. CUTTER has resigned from the position of librarian of the research library of the National Aniline & Chemical Co. at Buffalo, to accept a position with Arthur D. Little, Inc., of Cambridge, Mass.

D. D. DROBYNS has been elected president of the Pennsylvania Oil & Fuel Co., Pittsburgh, Pa.

PETER FEIBERGER, a chemist who specializes in color work, has been appointed head of the dye investigation laboratory of the Customs Division of the Treasury Department in New York, and will be in charge of the tests of comparability which are necessary under the new tariff act in the coal-tar products paragraphs. He will also assist in the standardization work under the same paragraphs. Mr. Feiberger for the last several years has been retired from active work. He will appoint three assistant chemists to help in the work in New York.

HARRY GLAIR has recently been appointed assistant superintendent of the Whiting plant of the Standard Oil Co. of Indiana. Previously he had charge of the paraffin department of that company.

R. T. GOODWIN has joined the research staff of the Standard Oil Co. of N. J., specializing on shale oil.

Dr. ELLWOOD HENDRICK, consulting editor of *Chem. & Met.*, spoke at the open forum of the Peoples' Institute at Cooper Union, on Sunday evening, the 12th inst. His subject was "A Vision of Science." On Nov. 22 he will address the Wilmington, Del., section of the American Chemical Society on "The Language of Chemistry" and on Dec. 14 he will speak before the Chemistry Club of Princeton, N. J., on the same subject.

L. F. HOYT, chemical expert of the research department of the Larkin Co., Buffalo, N. Y., manufacturer of soaps, etc., gave an interesting address, Nov. 6, before the chemical group of the local Chamber of Commerce. He spoke, in part, on the importance of the chemical laboratory in modern plants.

SIDNEY HULL, at one time a research chemist in the organization of the Cincinnati Chemical Works, Inc., and later employed by the Newport Chemical Works, is now in the Chicago laboratory of the Western Electric Co.

CLIFTON N. JACOBS, formerly chemistry instructor at the Massachusetts Institute of Technology, is now chief chemist of the Diamond State Fibre Co., Bridgeport, Pa.

JOHN R. KEUBLER, editor of *The Hexagon* of Alpha Chi Sigma, the professional chemical fraternity, is in charge of the chemistry department at the Shortridge Technical School of Indianapolis.

Dr. OTTO KRESS has resigned his position as technical director for the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., to accept a similar position with the Thilmany Pulp & Power Co., Kaukauna, Wis.

L. G. KRUG, formerly with A. Daigger & Co., of Chicago, was recently appointed assistant sales manager for the Chicago Rawhide Co.

THOMAS LECLEAR, formerly with the Uniform Color & Chemical Co., of Perth Amboy, N. J., is now associated with H. B. Baldwin, chemist to the Newark Board of Health.

CURTIS C. MEIGS, formerly president of the consulting chemical engineering firm of Meigs, Bassett & Slaughter, Inc., with offices at 1304 Finance Bldg., Philadelphia, has sold his interest to Messrs. Bassett and Slaughter, who will continue to carry on the business at same address under the name of Bassett & Slaughter, Inc. Mr. Meigs has taken offices at 709-710 Stephen Girard Bldg., and has associated himself with Hugo Schlatter, formerly with the Hercules Powder Co., and W. B. Goentner, who was assistant chief mechanical engineer for the old firm. These men will carry on the work of consulting chemical engineering at this address.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, discussed radium in an address before the students of Smith College, on Nov. 10. On the following day he addressed the Connecticut Valley section of the American Chemical Society at Westfield. His remarks on that occasion were confined to helium.

Dr. C. R. MOULTON, director of the department of agricultural chemistry of the University of Missouri, has been appointed director of the bureau of nutrition of the Institute of the American Meat Packers' department of education and research, which position he has accepted, effective Jan. 1. Dr. Moulton was graduated from the University of Illinois in 1907. He received his master's degree from the University of Missouri in 1909 and took his doctor's degree at the same institution in 1911. From 1917 to 1918 he was an assistant in animal nutrition to the late H. P. Armsby at the Institution of Animal Nutrition, Pennsylvania State College.

Dr. W. H. RODEBUSH, professor of physical chemistry at the University of Illinois, addressed the Illinois section of the American Chemical Society on Nov. 21. His subject was "The Production of Helium for Military Purposes."

JOHN WALDO, who taught chemistry last year at Morningside College, is now an instructor in inorganic chemistry at Purdue University.

GEORGE B. WATERHOUSE has been appointed professor of metallurgy at the Massachusetts Institute of Technology, Cambridge, Mass.

W. R. WHITNEY, director of the research laboratory of the General Electric Co., Schenectady, N. Y., expected to sail for Europe on Nov. 21.

HENRY WIGGLESWORTH, formerly director of development of the General Chemical Co., has returned to the United States for a short season, after an absence of a year. Mr. Wigglesworth has made a number of valuable connections in chemical industry abroad, and will return shortly to Great Britain and the Continent on pressing business. He is stopping with his family for the present at Hotel Vanderbilt, New York.

W. W. WITMER, formerly a chemical engineer with the du Pont company and later connected with the Hoskins Process Development Co., of Chicago, has recently been appointed superintendent of the plant of the Special Chemicals Co., at Highland Park, Ill.

The Paint Manufacturers' Association of the United States has elected the following officers: President, Charles R. Cook of the Cook Paint & Varnish Co., Kansas City; first vice-president, Samuel R. Matlock, of Philadelphia; second vice-president, Samuel Rosenthal, of Chicago, and secretary-treasurer, George B. Heckel, of Philadelphia. The following directors were also elected: Dr. D. A. Kohr, of Dayton; L. T. Minehart, of Denver; H. J. Kuhn, of Houston; Andrew Butler, of Buffalo, and S. B. Woodbridge, of Philadelphia.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Successful Business Promotion

National Paint, Oil and Varnish Association Well on Its Way Toward Doubling the Industry

A year ago when the general business depression was admittedly at its worst the national trade association of the paint and varnish industry outlined a most ambitious program of business promotion. Two campaign slogans were adopted: "Make 1922 the greatest paint and varnish year" and "Double the industry by 1926." Already there is abundant evidence that in spite of the unfavorable situation during the early months of the current year, the paint and varnish manufacturers will have attained the goal set for 1922. Furthermore, a great step has been taken toward the successful fulfillment of the 5-year program.

President Ernest T. Trigg, in his address last week before the annual convention of the National Paint, Oil and Varnish Association, predicted that 1922 will exceed the banner year of 1920 by 11.6 per cent. This is an increase of 31.6 per cent over last year's volume of production. Thus 1922 must be conceded "the greatest paint and varnish year" in the history of the industry. In one year the industry has attained almost a third of the 100 per cent increase set for 1926.

The "Save the Surface" and "Clean Up and Paint Up" campaigns have had a great deal to do with this remarkable showing, but back of these ideas is a story of intensive work, improved selling and advertising methods and constructive co-operation on the part of manufacturers and dealers.

More Thought to Fundamental Business Conditions

A study of the causes of business failures shows that the success or failure of individual enterprises depends largely on three sorts of factors: (1) Those within the particular plant or factory. (2) Those within the trade or industry. (3) Those involved in the general business situation. Or, as is stated by the Harvard Economic Service in one of its recent letters, "An enterprise may fail because its plant is antiquated or its technical methods are wasteful. Or it may fail because the trade in which it is engaged is decadent or temporarily overdone. Or it may fail because it is unable to survive the throes of widespread business."

Many of the industrial embarassments and bankruptcies of 1920 were largely due to the drastic monetary deflation, the general credit contraction and receding prices. Thus it was factors outside of their own organization and beyond their immediate control that were most responsible for their troubles. Out of this has come a realization of the value of a better understanding of general business conditions. The broader use of statistics and the more general study of the fundamentals of business are some of the progressive developments resulting from the lessons taught us by the business depression.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

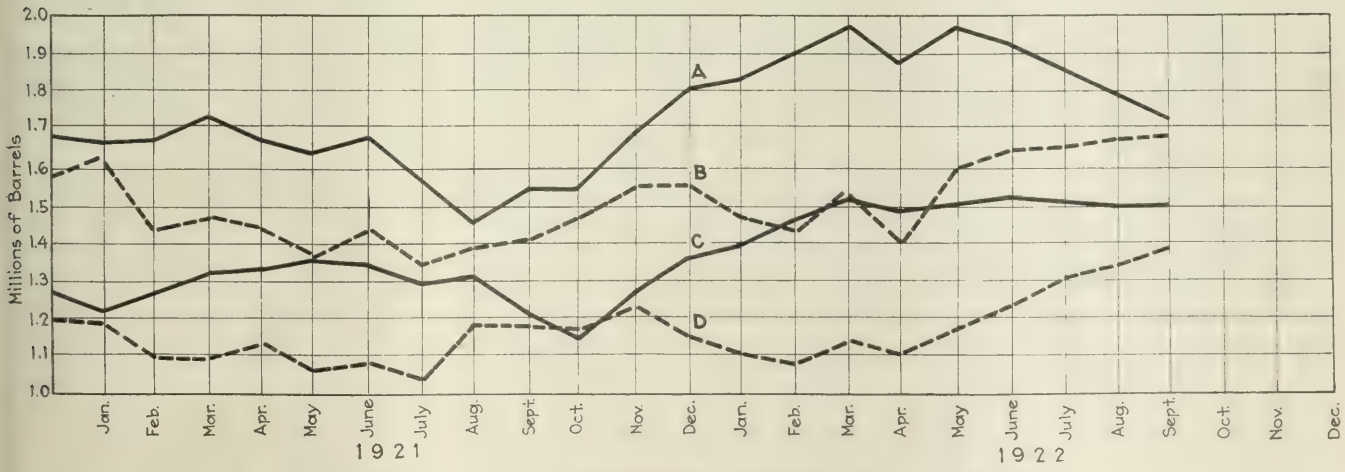
This week	162.83
Last week	158.70
November, 1921	146.82
November, 1920	240
April, 1918 (high)	286
April, 1921 (low)	140

The continued advance in this index shows an encouraging condition in the chemical market. Higher prices for methanol, formaldehyde, caustic potash and cottonseed oil more than offset the weaker market for ammonium sulphate, aniline and linseed oil.

Crude Petroleum Production for September, 1922

The outstanding trends in the statistics of crude petroleum for September, 1922, are that imports continued to decrease and consumption to increase. Since production was almost stationary, this resulted in the smallest net addition to stocks. 1,363,000 bbl., that has been recorded since October, 1921.

The daily average production, which has remained close to 1,500,000 bbl. for the last 7 months, amounted to 1,508,200 bbl. in September, according to the reports made to the U. S. Geological Survey. A gain of 24,616 bbl. in California was partially offset by losses in other states, including 7,711 bbl. in Texas and 6,868 bbl. in Oklahoma. The decrease in the imports of light crude oil from Mexico from 6,217,000 bbl. in July to 2,683,000 bbl. in September emphasizes the declining production in the Southern fields.



STATISTICS OF CRUDE PETROLEUM, JANUARY, 1921, TO SEPTEMBER, 1922
Daily Averages for —

(A) Domestic production of petroleum plus imports of "mineral crude oil."
(B) Consumption plus exports of domestic and imported petroleum.
(C) Domestic production (petroleum transported from producing properties).
(D) Consumption plus exports of domestic petroleum.

The New York Market

NEW YORK, Nov. 20, 1922.

Firmer prices throughout the list of chemicals were reported and the general demand for some of the basic chemicals was regarded as quite satisfactory. Prices are on a steady basis, with the tendency toward higher levels. Foreign competition has been less noticeable during the interval and spot stocks were greatly diminished among second-hand merchants. The feature of the week's activities appeared in the market for alcohol products. Manufacturers announced another advance on methanol and the entire list of solvents suddenly became the center of unusual activity. Arsenic still continued on its upward trend and was regarded as one of the strongest items of the list. Consumers have shown a desire to purchase at the high levels and spot supplies have become exceedingly limited. Domestic dealers in camphor announced an advance of 3c. per lb., bringing their price to 93c. per lb. The export market on caustic soda and soda ash revealed little change and transactions were mostly for small lots. Yellow prussiate of potash showed a very strong market and dealers advanced prices 1c. per lb. during the week. Bleaching powder, prussiate of soda, permanganate of potash, barium carbonate, bichromates and sodium compounds continued along moderate lines, with very little selling pressure noticeable.

GENERAL AND SPECIAL CHEMICALS

Acetate of Soda—Importers have been in direct competition with domestic makers and the market recorded a slight decline. Quotations were reported around 7¼c. per lb. for the imported and domestic grades.

Acetone—Carload quantities were held around 18½@19c. per lb. Most trading, however, was for small lots and sellers were asking 22@23c. per lb. Spot stocks are rather limited.

Alcohol—Makers of methanol have announced another advance of 10c. per gal. The 95 per cent material is being quoted at $1 per gal. in drums and $1.07 in barrels. The 97 per cent is held at $1.03 per gal. in drums and $1.10 in barrels. Ethyl alcohol is quotably unchanged at $4.75@$4.90 per gal.

Arsenic—Transactions have been recorded at 12¼@12½c. per lb. on spot. The inside price was difficult to ascertain during the latter part of the week and most holders were asking 12½c. Consumers have come into the market in larger numbers and dealers predict a 15c. per lb. market in near future.

Barium Chloride—The tone of this market has been somewhat unsteady and trading was restricted to small lots. Prices on spot ranged from $95@$105 per ton, with shipments held at $95.

Chlorate of Soda—The spot market is quite strong at 6¾c. per lb. Supplies are very scarce and producers report a well sold-up condition at the works.

Cyanide of Soda—The general condition is somewhat weak and sales were reported for small lots at 19½c. per lb. The domestic price is still holding at 25c. per lb., f.o.b. works.

Formaldehyde—The recent advance in methanol placed this product in a much stronger position. Dealers were not inclined to quote round lots and were asking as high as 14¼c. per lb. for 10-bbl. lots. Factors reported a sold-up condition for the remainder of the year. The tendency is toward much higher levels.

Prussiate of Potash — Several transactions have been recorded up to 39c. per lb. Supplies remained very light and dealers showed little disposition to offer material at the market figure. The red variety was in good demand at 90c. per pound.

Prussiate of Soda—The spot market is easier and prices are fractionally lower. The demand is only moderate and small-lot sales were recorded at 21¼c. per lb., with the range around 21¼@21½c. per pound.

COAL-TAR PRODUCTS

The feature of the coal-tar products market was the outstanding strength in all crude products. Producers report a sold-up condition at the works and a very strong demand from consumers. One of the largest factors has been consistently turning down orders for cresylic acid, phenol and benzene over the remainder of the year and as far ahead as February, 1923. Raw materials have been exceedingly difficult to purchase and deliveries on old contracts have been delayed in several instances. Imported material is being brought into the market very slowly and factors are not fearing any selling pressure, in view of the present tariff rates. Phenol continues quite scarce on spot and demand is exceedingly strong. Prices have been again advanced in the resale market, although makers have announced no new price.

Aniline Oil—Producers report the market fairly active, with business along moderate lines. The lowest price heard is around 16c. per lb. with the general range at 16@17c. per pound.

Beta Naphthol—The technical variety is moving in fair volume and the general tone is firm at 24@25c. per lb. Sublimed material is held at 55@60c. per pound.

Dimethylaniline—There has been a much stronger demand, due to the higher producing costs. The recent alcohol advance has added new interest and prices were advanced to 36@38c. per pound.

Ortho-Nitrophenol—Higher costs of raw material have caused an advance in this product. Spot offerings are limited and sellers have advanced prices to 85@90c. per pound.

Cresylic Acid—Domestic factors are still quoting 60c. per gal. for the 97 per cent and 55c. per gal. for 95 per cent material, but announce a sold-up condition for the remainder of the year and as far ahead as February, 1923. Imported 97 per cent goods on spot, in drums, is being quoted as high as 90c. per gal. and is finding a ready market.

Phenol—Producers continue to quote 22c. per lb. on contract, but report a completely sold-up condition at the works. Spot goods are very scarce and dealers are quoting up to 37c. per lb. for limited quantities. All indications point to a much higher market in the very near future.

Chemical Exports Continue to Gain

But Nine Months Total for 1922 Is Still Slightly Below Same Period of 1921

Although the exports of chemicals and allied products for the first nine months of 1922 still show a decrease over the corresponding period of 1921, the proportion of decrease continues to be lessened until the decrease is now only one-half of one per cent. The figures for 1922, according to a recent report of the Chemical Division of the Department of Commerce, are $79,741,439, and for 1921, $80,193,257.

The increases and decreases remain in about the same general classes—namely, fertilizers, explosives, and naval stores, gums and resins, for increases, and in coal-tar chemicals, and pigments, paints and varnishes for decreases.

Of the heavy chemicals exported, the largest increases are, as before, in caustic soda and borax, the per cent of increases being 330 and 210, respectively. However, some of the other sodium compounds did not fare as well, the exports of soda ash diminishing from $646,291 in 1921 to $502,518 in 1922, and of sal soda from $154,191 to $134,908. The following table shows some of the more important items.

Gains for the period under discussion over the corresponding period of 1921 occurred in the exports of explosives (55 per cent), perfumery and toilet waters (30 per cent), and fertilizers (7 per cent), exports of explosives increased from $1,515,205 (6,343,754 lb.) to $2,350,539 (12,979,433 lb.), and of perfumery and toilet waters from $3,515,070 to $4,551,619. Of the amounts of fertilizers exported for the 9 months of 1922, shipments of ammonium sulphate continued to increase from $4,119,858 in 1921 to $7,075,225 in 1922, and superphosphates from $94,030 to $317,087, while phosphate rock decreased from $5,803,811 to $4,442,948.

	Jan.–Sept., 1921		Jan.–Sept., 1922	
	Lb.		Lb.	
Acetate of lime	12,971,575	$283,711	22,884,395	$457,137
Calcium carbide	9,252,730	478,477	10,844,493	536,297
Bleaching powder	12,045,336	343,074	29,650,830	485,523
Copper sulphate	3,110,487	195,030	4,574,375	218,733
Glycerine	1,156,146	198,417	2,422,461	354,558
Bicrbonate of soda	8,371,534	225,819	11,853,935	256,332
Benzol	64,161,598	2,744,346	64,109,833	2,110,631
Colors, dyes and stains	.....	4,089,897	.....	2,736,177
Sulphuric acid	10,070,572	229,553	10,943,370	167,067
Formaldehyde	.....	275,901	.....	149,425

The St. Louis Market

ST. LOUIS, MO., Nov. 16, 1922.

Firmness is the important feature of the chemical market today, although very few price changes have taken place in the leading industrial chemicals since our last report. The volume of business transacted to date has been very satisfactory. Although a natural decrease in buying is expected at this period of the year for inventory purposes, it is not believed that this reduction will be above the normal this year, and it is expected that with the beginning of the year there will be a noticeable increase in business. Furthermore, it is not expected that the natural decrease this year will have any tendency to weaken prices, but that a steady tone will be maintained over the remainder of this year. Transportation facilities are still abnormal and not much improvement is expected for some time on account of the poor equipment with which the carriers are now operating.

THE ALKALI MARKET

As yet there is nothing startling or in fact nothing new to report in the alkali market. *Caustic soda* is moving only in a routine way and still maintains the prevailing price of the last 30 or 60 days. In 5-drum lots the solid is being quoted at $3.80 per 100 lb., and the flake at $4.25. *Soda ash* is slightly weaker. No price decline in general has been noted, though in one or two instances quotations have been made 5c. under prevailing schedule, which is as follows: in quantities of 5 bags or more for the 58 per cent light, $2.20 per 100 lb., while the usual differential of 20c. for barrels over bags prevails. *Bicarbonate of soda* has for some time maintained a steady price of $2.40, and while no large orders are passing, the price is holding firm. *Sal soda* is entering a slow season, but prices have not declined any since our last report and sales are light.

GENERAL AND SPECIAL CHEMICALS

Sales of *citric acid* are very small, and of a routine nature. The firmness in the *oxalic acid* market was broken about 10 days ago with the arrival of a large lot of imported material. Apparently, however, this has now been absorbed and the market has again assumed a firmer tone. Domestic producers now quote 17c. per lb. in barrels and 17½c. per lb. in kegs, f.o.b. St. Louis. Trading in *tartaric acid* is normal and no sales of consequence have been reported. *Aqua ammonia* 26 deg. has shown no unusual activity in the past few weeks and prices remain unchanged. The *white arsenic* market is still soaring, and the best that can be done today is 12½c. per lb. in carload lots, f.o.b. St. Louis. The supply is very scarce and spot stocks are practically out of the question, and it appears that this shortage is going to last for some time, as some of the large producers report that their entire output for next year has been taken up. Further advances might be seen shortly. *Cream of tartar* remains very dull, with the demand practically nil. *Glycerine* is moving in good volume and prices remain firm at 18½c. in drums. The market is entirely in the producers' hands. Only small lots of *phenol* are offered and the aggregate of spot stocks is very small, and some imported material is in evidence. *Bichromates of potash and soda* are in fairly good demand, and contracts for next year's requirements are being offered at slightly lower prices than the spot market.

VEGETABLE OILS AND NAVAL STORES

Castor oil is still holding at its previous level of 13½c. in drums and moving in good volume. *Turpentine* continues to hang around $1.70 per gal., being quoted today at $1.68, 4c. lower than when we last reported. However, it has been above as well as below that price during the interval. *Linseed oil* has scarcely changed during the last 2 weeks and continues around $1.

The Iron and Steel Market

PITTSBURGH, Nov. 17, 1922.

Steel production continues at fully as heavy a rate as in October, when ingots were being produced at 40,000,000 tons a year, representing an operation of the steel industry as a whole at slightly above 75 per cent of capacity.

Shipping of steel is as difficult as ever, but in general shipments total as much as production. There has been a further accumulation of sheets. Even in October the independent sheet mills that make monthly reports showed 20,000 tons more produced than shipped, although at the beginning of October there was 102,198 tons produced on order and awaiting shipment.

FINISHED STEEL MARKETS QUIET

The finished steel markets are all very quiet, and some lines are practically stagnant. The market turnover is easily the lightest of any time this year. The condition does not reflect any decrease in actual consumption, being rather the result of the heavy deliveries on old orders now being made.

Finished steel prices are steady at basis rates—i.e., the rates that have obtained lately on late deliveries. The rather heavy delivery premiums that were ruling a couple of months ago on bars, shapes, plates and sheets have disappeared, that being the principal change in the market. It is possible now to get quite early deliveries on new orders, except in nails and the smaller sizes of merchant steel pipe. In these, particularly in pipe, the mills fall quite short of meeting customers' desires. This exceptional condition is of course a reflection of the remarkable boom in garage and dwelling house construction.

Basis prices referred to above, which have lately been the regular prices of the Steel Corporation, are: Bars, shapes and plates, 2c.; merchant steel pipe, 66 per cent basing discount; hoops, ordinary specifications, including cooperage stock, 2.90c.; plain wire, 2.45c.; wire nails, $2.70; tin plate, $4.75; black sheets, 3.35c.

While black sheets have in the past week completed their decline to the Steel Corporation price, blue annealed sheets are frequently bringing above 2.50c. and galvanized above 4.35c., while automobile sheets seem to command 5c. in all cases, though the corporation's price, at which it has been sold out for some time past, is 4.70c. The corporation's prices on sheets for first quarter and tin plate for first half have appeared on the verge of being announced for 2 or 3 weeks past.

NO INDICATIONS OF PRICE CUTTING

From the viewpoint of last September, so large an increase in steel shipments as has occurred would probably have been expected to produce either price cutting or curtailment in operation at some mills through scarcity of orders, but there has been no such development as yet. Apparently there are few independent mills and perhaps no large independent mills needing additional business to carry their present operating rate through the year. There is of course the contingency of some customers instructing mills to curtail the rate of shipment.

Prospects are that the Steel Corporation will show a decrease in unfilled obligations for the present month, in view of the heavy shipments, the quiet market at present and the fact that the September increase of 741,502 tons and the October increase of 210,680 tons were due chiefly to heavy contracting for rails and track material, business that is now concluded. The unfilled obligations of 6,902,287 tons at the end of October is equivalent to nearly 6 months of production at a 75 per cent rate, the obligations being quite unequally divided, however, among the different products.

PIG IRON AND COKE

The pig iron markets in all districts continue stagnant and weak, with prices declining slightly at frequent intervals. Birmingham iron is down to $23, a drop of $2 in the week, and many of the Northern markets have declined $1. Valley basic has sold at $28 furnace, $1 under the nominal quotation of a week ago, but furnaces elsewhere are making prices that will force further declines if the valleys are to retain their trade. Valley foundry is down 50c. to $28.50, bessemer remaining at a nominal quotation of $32.

Connellsville furnace coke has lost 25c. this week, being now at $6.75@$7.25. The further decline brings little if any comfort to merchant furnaces, because these furnaces very largely covered to the end of the year on the decline of a month ago from $12 to $8, while the further decline in coke exerts an adverse sentimental effect on pig iron prices. Connellsville foundry coke remains at $8@$9.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.		$0.38 – $0.40
Acetone	lb.	$0.19 – $0.20	.20 – .22
Acid, acetic, 28 per cent	100 lb.	2.92 – 3.00	3.05 – 3.20
Acetic, 56 per cent	100 lb.	5.85 – 5.90	5.95 – 6.25
Acetic, glacial, 99½ per cent, carboys	100 lb.	11.16 11.20	11.25 – 11.50
Boric, crystals	lb.	11 11½	.11½ – .12
Boric, powder	lb.	11 11½	.11½ – .12½
Citric	lb.		51 – 52
Hydrochloric, 18 deg.	100 lb.	.90 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg.	100 lb.	1.00 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 11½	11½ – 12
Lactic, 44 per cent tech	lb.	.11 – .11¼	.11½ – .12
Lactic, 22 per cent tech	lb.	.06 – .06¼	.06½ – .07
Molybdic, c.p.	lb.	2.00 – 2.10	2.15 – 2.25
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg.	lb.	.05 05½	.06 – .06½
Nitric, 42 deg.	lb.	.06 06¼	.06½ – .07
Oxalic, crystals	lb.	.15 – .15½	.15½ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ .09
Picric	lb.	.20 .22	.23 – .27
Pyrogallic, resublimed	lb.		1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 10.00	
Sulphuric, 60 deg., drums	ton	12.00 14.00	
Sulphuric, 66 deg., tank cars	ton	14.50 15.00	
Sulphuric, 66 deg., drums	ton	19.00 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 20.00	
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.		.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.		.30½ – .31
Tartaric acid, imported, powdered	lb.		.31 – .32
Tartaric acid, domestic	lb.		.32
Tungstic, per lb. of WO	lb.		1.00 – 1.20
Alcohol, ethyl (Cologne spirit)	gal.		4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.		.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.		.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech.	gal.		2.35 – 2.60
Arsenic, white, powdered	lb.	.12½ – .12¾	.13 – .13¼
Arsenic, red, powdered	lb.	.12 – .12¼	.13 – .13½
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	95.00 –100.00	102.00 –105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate		.09 – .09¼	.09½ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	
Blanc fixe, pulp	ton	45.00 – 55.00	
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)			
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.00 – 3.15	3.20 – 3.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.		1.40 – 1.50
Calcium phosphate, tribasic	lb.		.15 – .16
Camphor	lb.		.90 – .92
Carbon bisulphide	lb.	.07 – .07¼	.07¼ – .07½
Carbon tetrachloride, drums	lb.	.10 – .10¼	.10½ – .12
Carbonyl chloride, (phosgene)	lb.		.60 – .75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	
Chalk, precip.—imported, light	lb.	.04½ – .05	
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05½ – .06	.06½ – .06¾
Chloroform	lb.		.35 – .38
Cobalt oxide	lb.		2.10 – 2.40
Copperas	ton	27.00 – 28.00	29.00 – 30.00
Copper carbonate, green precipitate	lb.	21 – 21½	.22 – .22½
Copper cyanide	lb.		.50 – .55
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.		.25 – .26
Epsom salt (see magnesium sulphate)			
Ether, U. S. P., 100 drums	lb.		.14 .15
Ethyl acetate com., 85%	gal.		.72 .75
Ethyl acetate, pure (acetic ether, 98% or 100%)	gal.		.90 .95
Formaldehyde, 40 per cent	lb.	.14½ – .14¾	.14 – .15
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	
Fullers earth—imported powdered	net ton	30.00 – 32.00	
Fusel oil, refined	gal.		3.00 – 3.50
Fusel oil, crude	gal.		2.00 2.25
Glauber's salt (see sodium sulphate)			
Glycerine, c.p., drums extra	lb.		.18 .18¼
Iodine, resublimed	lb.		4.40 – 4.50
Iron oxide, red	lb.		.12 .18
Lead acetate, white crystals	lb.		.12 12½
Lead arsenate, powd.	lb.	.13 – .13½	13 .14½
Lead nitrate	lb.		15 .20
Litharge	lb.	.07½ – .08	.08½ .09
Magnesium carbonate, technical	lb.	.06 – .06½	06 .07¼
Magnesium sulphate, U. S. P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.		1.00 – 1.80
Methanol, 95%	gal.		1.00 – 1.07
Methanol, 97%	gal.		$1.03 –$1.10
Nickel salt, double	lb.		.11 – .11½
Nickel salt, single	lb.		.12 – .12½
Phogene (see carbonyl chloride)			
Phosphorus, red	lb.		.40 – .45
Phosphorus, yellow	lb.		.30 – .35½
Potassium bichromate	lb.	$0.10 – .10¾	.10½ – .11
Potassium bromide, granular	lb.		.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06½	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07½ – .08	.08¼ – .09
Potassium cyanide	lb		.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7.00
Potassium iodide	lb.		3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.16 – .16½	.16½ – .17
Potassium prussiate, red	lb.		.90 – .95
Potassium prussiate, yellow	lb.	39 – .39½	.39½ – .40
Rochelle salts (see sodium potas. tartrate)			
Salammoniac, white, granular	lb.	.06½ – .06¾	.07 – .07½
Salammoniac, gray, granular	lb.	.08 – .08½	.08½ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bisulphite (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .07	.07¼ – .07½
Sodium chloride	long ton	12.00 –13.00	
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09¾ – .10	.10¼ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09 – .09¼	.09½ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¾ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.		.18 – .21
Sodium prussiate, yellow	lb.	.21¼ – .21½	.21¾ – .22
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04¼ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.		2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	
Talc—domestic powdered	ton	18.00 –25.00	
Tin bichloride	lb.	.10 – .10¼	.10½ – .10¾
Tin oxide	lb.		.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15¼
Zinc chloride, gran.	lb.	.07 – .07½	.07¾ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08¾
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.29 — .31
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.80 — .95
Benzidine sulphate	lb	.82 — .85
Benzoic acid, U.S.P.	lb.	.77 — .75
Benzoate of soda, U.S.P.	lb.	.5 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97-99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — 58
Cresylic acid, 97%, resale	gal.	.90 — 95
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — 60
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — 22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — 24
Dip oil, 25%, car lots, in drums	gal.	.25 — 30
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — 75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½

Naphthalene, flake	lb.	$0.06½ —	$0.07
Naphthalene, balls	lb.	.07½ —	.08
Naphthionate of soda	lb.	.58 —	.65
Naphthionic acid, crude	lb.	.65 —	.70
Nitrobenzene	lb.	.10 —	.12
Nitro-naphthalene	lb.	.30 —	.35
Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.85 —	.90
Ortho-nitro-toluene	lb.	.10 —	.12
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.37 —	.40
Pyridine, domestic	gal.	1.60 —	1.75
Pyridine, imported	gal.	1.40 —	1.60
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.29 —	.31
Salicylic acid, U. S. P	lb.	.35 —	.36
Solvent naphtha, water-white, in drums, 100 gal	gal.	.37 —	.40
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.20 —	.23
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.35 —	.37
Toluene, in drums	gal.	.40 —	.43
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.45 —	.50
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.40 —	.42
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.22 —	$0.24
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.36 —	.40
Candellila, wax	lb.	.33 —	.34
Carnauba, No. 1	lb.	.39 —	.40
Carnauba No. 2, North Country	lb.	.24 —	.25
Carnauba, No. 3, North Country	lb.	.17 —	.18
Japan	lb.	.15 —	.15½
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04¼
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	.02¾
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½ —	.03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¾
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09¾
Stearic acid, double pressed	lb.	.09½ —	.09¾
Stearic acid, triple pressed	lb.	.10 —	.10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.60	—	....
Rosin E-I	280 lb.	6.65	—	....
Rosin K-N	280 lb.	6.75	—	$7.15
Rosin W. G.-W. W	280 lb.	7.75	—	8.25
Wood rosin, bbl	280 lb.	6.25	—	....
Spirits of turpentine	gal.	1.57	—	1.58
Wood turpentine, steam dist	gal.	1.35	—	....
Wood turpentine, dest. dist	gal.	1.25	—	....
Pine tar pitch, bbl	200 lb.	.....	—	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	—	12.50
Retort tar, bbl	500 lb.	.....	—	11.00
Rosin oil, first run	gal.	.43	—	....
Rosin oil, second run	gal.	.51	—	....
Rosin oil, third run	gal.	.53	—	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.			.90
Pine oil, pure, dest. dist	gal.			.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.			.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.			.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.			.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.			.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.			.25
Pine wood creosote, ref	gal.			.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55	—	3.60
Blood, dried, f.o.b., N. Y	unit	4.60	—	....
Bone, 3 and 50, ground, raw	ton	42.00	—	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10	—	3.20
Nitrate of soda	100 lb.	2.35	—	2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50	—	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50	—	4.00
Tennessee, 78-80%	ton	7.00	—	8.00
Potassium muriate, 80%	ton	33.00	—	34.00
Potassium sulphate	unit	1.00	—	....

Crude Rubber

Para—Upriver fine	lb.	$0.24	—	.24¼
Upriver coarse	lb.	.18	—	.18¼
Upriver caucho ball	lb.	.18½	—	.18¾
Plantation—First latex crepe	lb.	.24	—	.24¼
Ribbed smoked sheets	lb.	.24	—	.24¼
Brown crepe, thin, clean	lb.	.20	—	.20¼
Amber crepe No. 1	lb.	.20	—	.20¼

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12	—	$0.12
Castor oil, AA, in bbls	lb.	.12½	—	.13
China wood oil, in bbls	lb.	.12½	—	.12
Coconut oil, Ceylon grade, in bbls	lb.	.08¾	—	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.08¾	—	.09
Corn oil, crude, in bbls	lb.	.10¼	—	.10¼
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½	—	....
Cottonseed oil, summer yellow	lb.	.11	—	.11¼
Cottonseed oil, winter yellow	lb.	.12	—	.12½
Linseed oil, raw, car lots (domestic) bbls	gal.	.86	—	.87
Linseed oil, raw, tank cars (domestic)	gal.	.82	—	.83
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.86	—	.88
Olive oil, denatured	gal.	1.15	—	1.17
Palm, Lagos	lb.	.07½	—	.07¾
Palm, Niger	lb.	.06¾	—	.07
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10	—	.10¼
Peanut oil, refined, in bbls	lb.	.13½	—	.13¾
Rapeseed oil, refined in bbls	gal.	.77	—	.78
Rapeseed oil, blown, in bbls	gal.	.84	—	.85
Soya bean oil (Manchurian), in bbls. N. Y	lb.	.11½	—	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09	—	.09¼

Miscellaneous Materials

Shellac, orange fine	lb.	74	—	.75
Shellac, orange superfine	lb.	76	—	.77
Shellac, A. C. garnet	lb.	.75	—	.77
Shellac, T. N	lb.	.72	—	73

Other prices remain same as previous report.

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	net ton	50
Chrome cement, 40-50% Cr_2O_3	net ton	23–27
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b., Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	43–46
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	39–41
Magnesite brick, 9-in. straight (f.o.b. works)	net ton	75–80
Magnesite brick, 9-in. arches, wedges and keys	net ton	85–90
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	50–53
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	45–47
Silicon carbide refractory brick, 9-in	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00	—	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10	—	.10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½	—	.11
Ferromanganese, 78-82% Mn, Atlantic seaboard	gross ton	67.50	—	69.00
Spiegeleisen, 19-21% Mn	gross ton	39.00	—	40.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00	—	2.25
Ferrosilicon, 10-15%	gross ton	38.00	—	40.00
Ferrosilicon, 50%	gross ton	63 00	—	65.00
Ferrosilicon 75%	gross ton	115.00	—	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.85	—	.90
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00	—	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50	—	4.00

Ores and Semi-finished Products

Coke, foundry, f.o.b. ovens	net ton	8.00	—	9 00
Coke, furnace, f.o.b. ovens	net ton	6.75	—	7.00

Other Quotations Remain Same as Previous Report.

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent	20.00-21.00
Antimony, wholesale lots, Chinese and Japanese	6 60
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	37.125
Lead, New York, spot	7.05
Lead, E. St. Louis, spot	6 90
Zinc, spot, New York	7.275–7.325
Zinc, spot, E. St. Louis	6.95–7.00

OTHER METALS

Silver (commercial)	oz.	$0.64¾
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	52.00@55 00
Mercury	75 lb.	72.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

EL DORADO—The Lion Oil & Refining Co., 624 Finance Bldg., Kansas City, Mo., has arranged an appropriation of about $400,000 for the extensions and improvements in its local oil refinery, previously announced. A complete new plant unit will be constructed to increase the output to 8,000 bbl. per day. A 17-mile pipe line, with pumping plans, will also be built. Victor H. Smith is vice-president and general manager.

California

EMERYVILLE—The American Rubber Co. has awarded a contract to R. W. Littlefield, 351 12th St., Oakland, for the erection of a new 1-story plant at Emery and Park Sts., to cost about $25,000.

FRESNO—The Fresno Paper Co. has plans nearing completion for the erection of a new mill for the production of paper and paperboard, to be equipped for a capacity of 40 tons per day, estimated to cost in excess of $400,000, with machinery.

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg., San Francisco, will take bids late in December for its proposed new 2-story refining plant in the Harbor District, Wilmington, 250x400 ft., estimated to cost close to $1,000,000, with machinery, power house, etc. Albert C. Martin, Higgins Bldg., Los Angeles, is architect.

Colorado

DENVER—The Colfax Pressed Brick Co., Clay St., has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, Nov. 4, with loss approximating $30,000, including equipment.

Connecticut

STAMFORD—Richards & Co., Inc., a subsidiary of the Darco Corp., manufacturer of decolorizing carbons, guncotton products, etc., will commence the immediate erection of a new building at its plant, 26x30 ft., to be equipped for lacquer service and experimental work.

STAMFORD—The Charles H. Phillips Chemical Co. has construction in progress on a new 2-story operating and service building, with machine shop and power house.

ROCKY HILL — Supplementing a 1-story structure, placed in course of erection a few weeks ago, the Connecticut Foundry, Inc., has awarded another contract to C. P. Waterman, Inc., Hartford, Conn., for a new 2-story foundry, 30x70 ft.

Delaware

WILMINGTON—The Hammond Oil Products Co., recently organized, is planning for the erection of a new oil-manufacturing plant on site in the vicinity of the Brandywine River. Application has been made to the Board of Water Commissioners for water supply for the works.

Georgia

COLUMBUS—The W. C. Bradley Co. has acquired the local plant of the F. S. Royster Co., and will make improvements and extensions in the structure for the manufacture of fertilizer products. The factory will be used to replace the plant of the purchaser destroyed by fire a number of months ago.

MACON—The Chamber of Commerce is considering plans for the establishment of a local plant for the manufacture of calcium arsenate and kindred products. A company will be formed to operate the factory.

Idaho

WALLACE—The Galena Mining Co., a subsidiary of the Callahan Zinc-Lead Co., operating in the Coeur d'Alene district, is considering tentative plans for the installation of additional milling machinery and other equipment at its plant.

Illinois

GRANITE CITY—The National Enameling & Stamping Co. has foundations in progress for its proposed new 1- and 2-story sheet steel mill, adjoining its present works, estimated to cost in excess of $1,000,000, including machinery. The United Engineering & Foundry Co., Farmers' Bank Bldg., Pittsburgh, Pa., is in charge of construction. George W. Niedringhous is president.

Indiana

WARSAW—The D. J. Dalton Co. is planning for the rebuilding of its local foundry, partly destroyed by fire, Oct. 31, with loss estimated in excess of $15,000, including buildings and equipment.

INDIANAPOLIS—The Pure Oil Co. has acquired the local distributing plant of the Tiona Refining Co., located on a 4-acre tract of property on Madison Ave., and plans for extensions and improvements. Headquarters of the purchasing company are in the Pure Oil Bldg., Columbus, O.

Kentucky

LOUISVILLE—The National Forge Co., 1572 Cherokee Road, will commence the immediate construction of a new 1-story foundry for the production of iron castings, 60x120 ft., estimated to cost close to $15,000, exclusive of main equipment, to be located on Garland Ave. Whitfield Clark is president.

Louisiana

SWARTZ—The Atlas Oil Co. plans for the rebuilding of its gasoline-refining plant, destroyed by fire, Oct. 31, with loss estimated at about $100,000, including machinery.

Maryland

BALTIMORE—The Johns Hopkins University, Homewood, has plans in progress for the erection of its proposed 2- and 3-story chemical laboratory, and will call for bids in the near future. Carrere & Hastings, 52 Vanderbilt Ave., New York, are architects.

BALTIMORE — The Union Chemical Co., formerly of Philadelphia, Pa., has acquired a building at 621 South Regester St., for a new plant. The present works will be removed to this location.

BALTIMORE—The Red "C" Oil Co., Keyser Bldg., is taking bids for the construction of a 1-story plant addition at the Key Highway and Lawrence St., 70x70 ft. W. W. Pagon, Lexington Bldg., is engineer.

Massachusetts

WHITINSVILLE—The Kupfer Brothers Co., 112 Wooster St., New York, N. Y., manufacturer of coated papers and other paper stock, has awarded a contract to the E. D. Ward Co., Worcester, for the erection of a large addition to its Riverdale mill, Whitinsville.

EAST LONGMEADOW — The New England Steel Casting Co., 100 School St., Springfield, will hold in temporary abeyance the rebuilding of its foundry at East Longmeadow, destroyed by fire several months ago. When the work is authorized, the proposed structure will be 1-story, 70x125 ft., estimated to cost approximately $50,000. Morris W. Maloney, 145 Chestnut St., Springfield, is architect.

CAMBRIDGE — The United States Tire & Rubber Co., 560 Commonwealth Ave., Boston, has commenced foundations for a new plant at 660 Charles River Rd., 84x135 ft., estimated to cost $100,000, including equipment. The structure will be occupied under lease. F. A. Norcross, 46 Cornhill St., Boston, is architect.

SPENCER—The Spencer Gas Co., 110 Main St., is considering the erection of an addition to its artificial gas plant on Elm St., to cost about $45,000. W. M. Russell, 77 Franklin St., Boston, is architect.

Michigan

DETROIT—The Charles B. Bohn Foundry Co., 3651 Hart St., manufacturer of brass, bronze and kindred metal castings, has plans in progress for a new plant addition.

MUSKEGON—The Central Paper Co. has completed plans for the erection of a new 3-story addition to its plant on Lake St., to cost about $22,000, exclusive of equipment. The company has disposed of a bond issue of $1,100,000, a portion of the proceeds to be used for expansion.

Minnesota

RED WING—The Red Wing Sewer Pipe Co., manufacturer of vitrified pipe, has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, Nov. 1, with loss estimated at $150,000, with machinery.

Missouri

SPRINGFIELD—Immediately upon completion of its initial plant unit, 100x135 ft. on West Commercial St., now in course of erection, the Springfield Tanning Co., will commence the erection of a new 1-story and basement adjoining works, 60x100 ft. Headquarters of the company are at 214 Holland Bldg., Springfield. W. R. Wolfe is head.

New Jersey

CAMDEN—The Camden Pottery Co., manufacturer of sanitary earthenware, has awarded a contract to E. R. Hall, 34 South 17th St., Philadelphia, Pa., for the erection of a 2-story addition, 70x140 ft., estimated to cost approximately $30,000, to be located at Mt. Vernon and Mt. Ephraim Aves.

PLAINFIELD—The British-American Metals Co., 200 Broadway, New York, N. Y., manufacturer of metals and metal alloys, has awarded a contract to the Levering & Garrigues Co., 552 West 23rd St., for the erection of a 1-story addition, 40x150 ft., to its plant on South 2nd St., Plainfield, estimated to cost about $27,000. N. A. Staples is vice-president.

WAYNE—E. I. du Pont de Nemours & Co., Wilmington, Del., have discontinued operations at their local plant, used for the manufacture of naval powder, and will close the works permanently. The equipment will be removed to Beeling, Pa., where a similar plant is now being operated, the capacity of which will be increased.

TRENTON—The Enterprise Tire & Rubber Co., North Clinton Ave., has filed plans for the erection of a 1-story addition to its plant.

New York

COHOES—Fire, Nov. 4, damaged a portion of the plant of the Peerless Fibre Co., Ontario St., with loss approximating $10,000. It will be rebuilt.

North Carolina

CHARLOTTE — The American Machinery Equipment Co., Providence Rd., Myers Park, machinery dealer, is making inquiries for a quantity of chemical equipment for installation in a local plant.

Oklahoma

BARTLESVILLE — The Phillips Petroleum Co., operating gasoline refineries, has acquired two local gasoline absorption plants, heretofore operated by Waite Phillips. The new owner will take possession immediately, and plans for extensions and improvements in the plants.

TULSA—The local plants of the Pure Oil Co., the Tidal Oil Co. and the Roxana Oil & Gas Co. were partly destroyed as a result of a recent tornado, with aggregate loss estimated in excess of $600,000, including equipment. The mills will be rebuilt.

Pennsylvania

MARCUS HOOK — The Sun Co., Finance Bldg., Philadelphia, Pa., has plans under consideration for the erection of an addition to its oil refinery at Marcus Hook, in the vicinity of 7th and Green Sts., to increase the output by about 10 per cent. J. Howard Pew is president.

PHILADELPHIA—The Paper Manufacturers' Co., 826 Cherry St., has awarded a contract to the J. S. Rogers Co., Drexel Bldg., for the erection of a new 6-story plant at 5th and Willow Streets, 127x180 ft., estimated to cost close to $500,000, including equipment.

NEW CASTLE—The National Radiator Co. will commence the immediate erection of a 1-story foundry addition, 30x365 ft. A list of equipment for installation will be arranged at an early date. Headquarters of the company are at Johnstown, Pa.

NORRISTOWN—E. F. Woodhead, Swarthmore, Pa., has acquired the local plant of the Norristown Coal & Ice Co., vacated some time ago, and will remodel and improve the structure for a paper mill. Equipment will be installed at an early date.

NEWPORT—Fire, Nov. 8, destroyed a large portion of the plant of the Mineral Products Co., East Newport, manufacturer of prepared roofing specialties, with loss estimated at about $25,000, including equipment. John R. Morgan is head.

PHILADELPHIA—The Foreign Trade Bureau, Philadelphia Commercial Museum, 34th St., is in receipt of an inquiry from a company at Alexandria, Egypt, desiring to purchase equipment for a cottonseed oil mill, with capacity of 35 to 40 tons of cottonseed per 24 hours. Full information available upon request.

Rhode Island

PAWTUCKET — The Whatcheer Chemical Co., manufacturer of soaps, fertilizers, etc., has tentative plans under consideration for the rebuilding of its plant, destroyed by fire, Nov. 7, with loss estimated at close to $200,000, including machinery.

South Carolina

CLOVER—J. F. Pursley, Clover, is planning for the organization of a company to establish and operate a local mill for the manufacture of fertilizer products.

Texas

PASADENA — The Stauffer Chemical Co., Freeport, Tex., has acquired a tract of land near the Houston ship channel, Pasadena, totaling about 30 acres, as a site for a new plant for sulphur refining. Plans will be prepared at an early date.

TEXAS CITY—The Terminal Oil & Refining Co. is perfecting plans for its proposed local plant extensions, to include additional units at the topping works for the handling of 15,000 bbl. of crude oil daily, and the construction of 9 steel storage tanks. Considerable new machinery will be installed.

KENEDY—E. L. Patilo, Kenedy, is perfecting arrangements for the establishment of a local plant for the manufacture of soaps, washing powders, etc.

Virginia

STUART—S. A. Thompson, Stuart, is organizing a company for the development of mica properties in this section. A grinding mill and other equipment will be installed.

NORFOLK—Fire, No. 5, destroyed a large portion of the fertilizer manufacturing plant of the Fisheries Products Co., Money Point, Norfolk, with loss estimated at about $300,000, including machinery and stock. Preliminary plans for rebuilding are under consideration.

NEWPORT NEWS—A chemical laboratory will be installed in the new local high school to be erected by the School Trustees at 31st and Hungtington Ave., to be 3-story, 196x220 ft., estimated to cost approximately $600,000.

LEXINGTON — The Washington and Lee University has plans nearing completion for a new chemical laboratory building, estimated to cost about $110,000. Flournoy & Flournoy, Union Trust Bldg., are architects.

Washington

EDMONDS—The Union Oil Co., Seattle, has surveys in progress for the construction of a new oil-distributing and storage plant at Ten-Mile Point, near Edmonds, where a 20-acre tract of land has been obtained. Estimated to cost about $500,000, with equipment. The new works will supplant the present Seattle station.

West Virginia

WHEELING—The Interstate Oxygen Co., 4th St., has awarded a contract to H. L. Bearight, Wheeling, for the erection of a 1-story plant addition, 100x150 ft., estimated to cost in excess of $50,000, including equipment.

WEIRTON — The Weirton Steel Co. will commence the immediate construction of a new byproducts coke plant estimated to cost approximately $3,000,000. The Koppers Co., Union Arcade, Pittsburgh, Pa., is engineer and contractor.

PENNSBORO—John B. Yates, vice-president of the Premier Window Glass Co., with local plant, has acquired the factory of the Pioneer Window Glass Co., West View, Marietta, O. Possession will be taken immediately and improvements made. It is planned to resume operations at the plant early in the coming year.

Wyoming

RAWLINGS—The Producers' & Refiners' Corp., California Bldg., Denver, Colo., has selected a site at Greensville, near Rawlins, for its proposed new oil refinery, and has plans in progress for the initial unit. It will have a capacity of about 10,000 bbl. per day, and which will be increased to 25,000 bbl., with the erection of additional units at a later date. A pipeline will be constructed from the Ferris oil fields to the site. The company has also arranged for the construction of new storage and distributing plants at Ferris and Wertz.

Canada

ST. JOHN, N. B.—The Stephen Brick Co., Ltd., has tentative plans under consideration for the rebuilding of its plant at Little River, destroyed by fire, Nov. 5, with loss approximating $100,000, including equipment. The plant was practically new and only in service for a few months.

VANCOUVER, B. C.—The Powell River Co., Ltd., has preliminary plans under consideration for the erection of a large new unit at its paper mill, and addition to the power plant. The work is estimated to cost approximately $3,000,000.

VICTORIA, B. C.—The Seaman Paper Co., 208 South La Salle St., Chicago, Ill., in conjunction with the Bridge River Power Co., Victoria, and affiliated interests, is formulating plans for the construction of a new pulp and paper mill at Seton Lake, estimated to cost in excess of $750,000.

Industrial Developments

GLASS — The Scott-Warman Glass Co., East Stroudsburg, Pa., is completing the rebuilding of its plant destroyed by fire some time ago, and plans to place the works in service within the next fortnight. The company specializes in the manufacture of hollowware.

The Premier Window Glass Co., Pennsboro, W. Va., is perfecting plans for a resumption of operations at its plant about Jan. 1, giving employment to close to the maximum of 200 men.

Window glass plants in western Pennsylvania and eastern Ohio are granting a 10 per cent wage advance to operatives.

LEATHER—The William Amer Co., Philadelphia, Pa., is operating its tannery at full capacity, with incoming orders insuring continuance for some time to come.

Dungan, Hood & Co., Philadelphia, Pa., are running at approximately 75 per cent of normal at their local tanning plant.

The Castle Kid Co., Camden, N. J., is running full at its tannery, with heavy domestic and export orders for future delivery. Kid and cabrettas are the main items of production.

The Keystone Leather Co., Philadelphia, Pa., is advancing production at its plant.

Burk Brothers, Philadelphia, Pa., are operating on a basis of 65 to 75 per cent of normal at their tanneries.

C. J. Matthews & Co., Philadelphia, Pa., specializing in the production of glazed kid, are running in excess of 60 per cent of capacity at their tannery, and have orders on hand to insure this schedule for a number of months ahead.

METALS—The New Jersey Zinc Co., Palmerton, Pa., has placed two additional spelter furnaces in service at its local plant.

The International Nickel Co., New York, is advancing production at its new plant at Huntington, W. Va. Present sales are averaging about 1,500,000 lb. of nickel monthly and 400,000 lb. of Monel metal.

The Boston & Montana Corp., Butte, Mont., is arranging for the immediate resumption of operations at its local mill.

The Calumet & Hecla Co., Calumet, Mich., is advancing production at its smelting plant, which has been operating on a basis of about 80 per cent of capacity. Repairs have been completed to the furnaces at the electrolytic plant and increased output is being arranged.

The Ray Consolidated Mining Co., Ray, Ariz., is increasing shipments to its concentrating plant and a basis of approximately 2,500 tons a day has been established.

The Nevada Consolidated Copper Co., Ely, Nev., has placed two additional mills in service, making four mills now operating at the plant. It is planned to add two more mills by the close of the month.

The United Verde Extension, Jerome, Ariz., is developing a production of 3,000,000 lb. of copper per month at its plant, and expects to maintain this output for an indefinite period.

IRON AND STEEL—The Bethlehem Steel Co. is increasing production at its Steelton, Pa., works, and adding to the operating force. Practically all departments are now running on a full time schedule.

The Alan Wood Iron & Steel Co., Conshohocken, Pa., has postponed the blowing in of its No. 3 stack, recently announced, and will defer operations at the furnace until Jan. 1.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has placed its tie plate mill on a double turn, and expects to maintain this basis of operation for an indefinite period.

The Eastern Steel Co., Pottstown, Pa., relighted its furnace No. 1 on Nov. 9, following an inactivity of about 24 months. Repairs and improvements have been made to the unit during the curtailment. It is expected to maintain production for an indefinite time. The No. 2 furnace of the company at Swedeland, Pa., is still idle; it was shut down last July owing to coke shortage.

The Lavino Furnace Co., Philadelphia, Pa., affiliated with E. J. Lavino & Co., is arranging to change production at its Sheridan furnace from foundry iron to ferromanganese.

The Reading Iron Co., Reading, Pa., is maintaining full production at its different mills. The wages of puddlers have been advanced from $8 to $8.80 a ton. The increase affects about 600 men, engaged at the Reading, Columbia and Pottstown, Pa., mills.

The Claire Furnace Co., Youngstown, Pa., is arranging for the early resumption of operations at its blast furnace. This addition will make an active list of 31 furnaces out of a total of 47 in the Youngstown district.

The United States Steel Corp. has advanced production 5 to 7 per cent at its mills at Gary, Ind., during the past fortnight. The Illinois Steel Co., a division of the Gary mills, is running on a basis of 75 to 80 per cent of capacity.

MISCELLANEOUS—Paper mills at Monroe, Mich., are developing maximum capacities. Four plants devoted to boxboard production have adopted a night shift in addition to regular day operations, and are turning out about 1,000 tons of material per day.

The Procter & Gamble Co., Cleveland, O., manufacturer of soaps, powders, etc., is operating its four plants on a capacity basis, located at Cleveland; Port Ivory, Staten Island; Kansas City, Mo.; and Dallas, Tex. A wage advance has been made covering all plants, affecting about 10,000 workers. It will approximate $250,000 a year, gross.

The Trans-Continental Oil Co., Bristow, Okla., is completing its new local oil-refining plant, and will place the unit in service at an early date. It will have a capacity of 5,000 bbl. a day, and will increase the company's refinery production to 14,000 bbl. daily, maximum.

The National Fireproofing Co., Pittsburgh, Pa., manufacturer of hollow tile and other kindred burned clay products, is operating its plants at from 80 to 85 per cent of capacity, and has orders on hand and in prospect to maintain this basis of production for the next 12 months.

The H. C. Frick Co., Connellsville, Pa., has placed its Leith plant in operation after a shut-down for about 5 months past. All company plants in Fayette, Westmoreland and Greene Counties are now in service, and practically on a 100 per cent basis.

The Interstate and Foreign Trade Department, Chicago Association of Commerce, 10 South La Salle St., Chicago, Ill., reports an inquiry (No. 1605) from the Shanghai, China, branch of an American company, for a first-class chemist and engineer for the local office at Shanghai.

Capital Increases, etc.

THE ACME RUBBER MFG. CO., Trenton, N. J., manufacturer of mechanical rubber products, has filed notice of increase in capital from $500,000 to $2,000,000.

THE EMPIRE REFINING CO. OF DELAWARE, Oklahoma City, Okla., has filed notice of increase in capital from $2,750,000 to $4,850,000.

THE UNION STARCH & REFINING CO., Edinburg, Ind., has arranged for an increase in capital from $340,000 to $2,000,000 for expansion. A plant has recently been acquired at Columbus, Ind., and operations will be transferred to that location.

THE CHICKASAW REFINING CO., 60 Broadway, New York, N. Y., manufacturer of petroleum products, a Delaware corporation, has filed notice of reduction in capital from $10,000,000 to $2,500,000.

THE GENERAL CHEMICAL CORP., Detroit, Mich., has filed notice of dissolution under state laws.

THE MILLER & WRIGHT PAPER CO., 65 Duane St., New York, N. Y., has filed notice of increase in capital from $50,000 to $400,000.

THE CAMAGUEY SUGAR CO., George H. Houston, president, 60 Broadway, New York, N. Y., operating sugar refining plants in Cuba, has disposed of a bond issue of $6,000,000, a portion of the proceeds to be used for general operations, financing, etc.

THE ATLAS STEEL CORP., Dunkirk, N. Y., has arranged for a stock issue of $6,500,000 preferred, and 100,000 shares of common stock, no par value, a portion of the proceeds to be used for plant operations, financing and expansion.

THE GREAT NORTHERN PAPER CO., Madison, Me., is arranging for an increase in capital from $8,300,000 to $25,000,000, a portion of the proceeds to be used for general operations and expansion.

E. I. DU PONT DE NEMOURS & CO., Wilmington, Del., manufacturers of powder chemicals, etc., are perfecting plans for an increase in capital from $80,000,000 to $100,000,000.

THE SOLAR REFINING CO., Lima, O., manufacturer of oil products, will increase its capital from $2,000,000 to $4,000,000, for proposed expansion.

New Companies

THE NATIONAL CARBON COATED PAPER CO., Sturgis, Mich., has been incorporated with a capital of $650,000, to manufacture coated and other papers. The incorporators are James G. Van Horn, D. A. Hopping and C. L. Spence, 128 South Nottawa St., Sturgis. The last noted represents the company.

THE BUFFALO REFINING CO., Sherman, Tex., has been incorporated with a capital of $75,000, to manufacture refined oil products. The incorporators are F. M. Thompson, D. L. Cooke and B. F. Smith, all of Sherman.

THE REIS RUBBER PRODUCTS CO., care of J. I. Berman, 346 Broadway, New York, N. Y., representative, has been incorporated with a capital of $100,000, to manufacture rubber specialties. The incorporators are A. L. Berman, E. Tumin and A. S. Wechsler.

THE PLYMOUTH ROCK PAINT CO., Boston, Mass., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. Charles C. Mann is president; and Charles J. Landen, 3 Monadnock St., Dorchester, Mass., treasurer and representative.

THE MIDWAY CITY GLASS CORP., Huntington, W. Va., has been incorporated with a capital of $50,000, to manufacture glass products. The incorporators are B. W. Walton, N. Christian and R. T. Morris, all of Huntington.

THE PALATKA CLAY PRODUCTS CO., Palatka, Fla., care of the United States Corporation Co., 65 Cedar St., New York, N. Y., representative, has been incorporated under Delaware laws with capital of $300,000, to manufacture burned clay products. The incorporators are Robert W. Lyle, Keasby, N. J.; Elliott Norton, New York; and Alexander H. Jackson, Rutherford, N. J.

THE ALLOYS FOUNDRY CO., Room 750, 407 South Dearborn St., Chicago, Ill., has been incorporated with a nominal capital of $6,000, to manufacture special castings and kindred metal products. The incorporators are Charles B. Carter, Samuel W. Booth, Jr., and Allen Erikson.

THE HATFIELD RUBBER WORKS, INC., Newark, N. J., has been incorporated with a capital of $250,000, to manufacture rubber tubing and other rubber products. The incorporators are Andrew L. Hatfield, Abraham and Louis Beller, 92 Academy St., Newark. The last noted represents the company.

THE MISSISSIPPI VALLEY PETROLEUM CO., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $125,000, to manufacture petroleum products.

THE SIMPSON-COHEN-BOESCH CO., Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are H. I. Cohen, George Boesch and George L. Simpson, 391 Albany Ave., Hartford. The last noted represents the company.

THE COMMERCIAL IRON WORKS, INC., Portland, Ore., has been incorporated with a capital of $100,000, to operate a foundry for the production of iron, steel and other metal castings. The principal incorporator is William T. Casey. The company is represented by John M. Joyce, 606 Concord Bldg., Portland.

HOLTAGE & REMINGTON, INC., Providence, R. I., has been incorporated with a capital of 100 shares of stock, no par value, to manufacture refined metals. The incorporators are B. A. Remington, Wallace Holgate and Ernest C. Baker, 60 Harvard St., Providence.

THE GATTI PAPER STOCK CO., New York, N. Y., care of Smith & Bowman, 38 Park Row, New York, representative, has been incorporated with a capital of $200,000, to manufacture paper products. The incorporators are H. Cowan, W. Meighan and N. H. Bowman.

THE RAY RUBBER PRODUCTS CO., Irvington, Newark, N. J., has been incorporated with a capital of $10,000, to manufacture rubber goods. The incorporators are E. A. London, Thomas J. Ryan and Daniel R. Smith, 54 Woolsey St., Irvington. The last noted represents the company.

THE CALUMET BAKING POWDER CO., 4400 Filmore St., Chicago, Ill., has been incorporated with a capital of $8,500,000, to manufacture baking powder. The company is now operating a local plant. The incorporators are Frederic O. Mason, Warren Wright and Sidney S. Gorham.

THE COMMODORE OIL CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $3,000,000, to manufacture petroleum products.

PAPER PRODUCTS, INC., Mechanic Falls, Me., has been incorporated with a capital of $10,000, to manufacture paper specialties. Ralph T. Parker is president, and Leroi G. Limerick clerk and representative, both of Mechanic Falls.

THE SEMI-STEEL CASTING CO., St. Louis, Mo., has been incorporated with a capital of $15,000, to manufacture steel alloy and other metal castings. The incorporators are J. H. Connor and C. F. Storckman, both of St. Louis.

THE UNITED LABORATORIES, 36 Clinton St., Newark, N. J., has filed notice of organization to manufacture chemical specialties. The company is headed by Herman G. Fauer and William H. Robinson, 10 Ridgewood Ave., Newark.

THE WHITEHOUSE PRODUCTS CO., 564 West Randolph St., Chicago, Ill., has been incorporated with a capital of $5,100, to manufacture chemical specialties. The incorporators are E. F. Menkin and Leo B. Samuels.

THE BARBERS' HILL OIL CO., New York, N. Y., care of H. P. Freece, 35 Wall St., New York, representative, has been incorporated with a capital of $100,000, to manufacture oil products. The incorporators are R. Constantian and C. O. Dunaway.

THE REPUBLIC GLASS CO., Monroe, Mich., has been incorporated with a capital of $150,000, to manufacture glass products. A local plant has been completed and operations will be started at once. The incorporators are Manuel M. Llera, William N. Mathews and Thornton Dixon, Monroe.

L. DEL TURCO & BROTHERS, INC., Newark, N. J., care of Toby Furst, 164 Market St., Newark, representative, has been incorporated with a capital of $100,000, to manufacture ceramic tile and kindred products. The incorporators are Louis and Peter Del Turco.

THE RELIABLE CHEMICAL & EXTERMINATING CO., New York, N. Y., care of H. N. Herber, 23 West 31st St., New York, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and affiliated products. The incorporators are C. Zanisek and M. M. Marcus.

THE WESTERN KENTUCKY REFINERY, INC., Warren, Ky., has been incorporated with a capital of $10,000, to manufacture petroleum products. The incorporators are J. Robert Kirby and Kirk Massey, both of Smiths Grove Ky.; and John B. Rhodes, Bowling Green. Ky.

THE SEMPLE MFG. CO., Trenton, N. J., has been incorporated with a capital of $100,000, to manufacture rubber specialties, tubing, etc. The incorporators are L. Bathews, George T. Nutt and Charles H. Semple, Brookville, Trenton. The last noted represents the company.

THE EASTERN ELECTROCHEMICAL CO., Brooklyn, N. Y., care of M. D. Bohrar, 154 Nassau St., New York, representative, has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are D. Goldklang, F. Paul and M. Loris.

THE KING LOUIS OIL CO., INC., Worcester, Mass., has been incorporated with a capital of $100,000, to manufacture oil products. Zephire Lagasse is president and M. R. Lagasse, 17 Dean St., treasurer. The last noted represents the company.

THE NORTHERN NEW JERSEY OIL CO., Montclair, N. J., has been incorporated with a capital of $50,000, to manufacture and deal in petroleum products. The incorporators are H. Russ Van Vleck, Arthur B. Marvin and Henry W. Trimble, 483 Bloomfield Ave., Montclair. The last noted represents the company.

THE INTERNATIONAL CHEMICAL CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $500,000, to manufacture chemicals and chemical byproducts.

THE AMERICAN MOULDED COMPOSITION CO., 1-5 Market Sq., Lynn, Mass., has filed notice of organization to manufacture composition insulation products. The company is headed by Thomas J. Cannon.

THE PEERLESS PAPER SPECIALTY CO., Brooklyn, N. Y., care of Myer Efros, 25 West 43rd St., New York, representative, has been incorporated with a capital of $30,000, to manufacture paper products. The incorporators are S. J. Rosenthal, B. Mossman and A. Robbins.

THE IMPERIAL OIL CO., Tampa, Fla., has been incorporated with a capital of $100,000, to manufacture oil products. W. F. Miller is president; A. Murray Allen, vice-president; and B. L. Hammer, secretary, all of Tampa.

THE MASON-GIBBS CORP., Buffalo, N. Y., care of Arthur J. Adler, Erie County Bank Bldg., Buffalo, representative, has been incorporated with a capital of $5,000, to manufacture chemicals and affiliated products. The incorporators are A. H. Mason and W. E. Gibbs.

THE JAMES A. MUIR CO., Whippany, N. J., has been incorporated with a capital of $100,000, to manufacture paper and paperboard products. The incorporators are E. R., Louis, and James A. Muir, Jefferson Station, Whippany. The last noted represents the company.

THE AMERICAN INTERNATIONAL OIL CORP., New York, N. Y., care of the Registrar & Transfer Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $3,000,000, to manufacture petroleum products.

THE H. R. KUHNHARDT, JR. CORP., New York, N. Y., care of Max Schenkman, 56 Pine St., New York, representative, has been incorporated with a capital of $400,000, to operate a metal refining plant. The incorporators are W. W. Wait, E. Armstrong and L. Debrigard.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9. Headquarters will be at the Hotel Jefferson.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20 — Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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CHARLES N. HULBURT
Assistant Editors

Volume 27 — New York, November 29, 1922 — Number 22

Your Support Is Solicited

SEVERAL current developments in Washington are competing for the attention of the chemical public. The Tariff Commission has already begun to unravel the knotty problems involved in the flexible tariff provision on chemicals. The State Department, apparently, is still scheming with dyes and reparations, while Congress and the Internal Revenue Commissioner continue to play football with industrial alcohol. But with these issues furnishing the pyrotechnics, there is a less spectacular development in the Commerce Department which is likely to be overlooked. Our reference is to the rather faltering progress being made by the new chemical commodity division in its efforts to serve our industry.

Four months ago, when the chemical division was organized, we naturally expected great things from it. There appeared to be a definite need in our industries for co-operative study of export problems, foreign markets and competition, and of such domestic questions as standardization, trade statistics and cost finding. The man put in charge of the work was admirably fitted for it, and the different branches of the industry through associations and individuals pledged him their support. In the short time he held that position Mr. DELONG accomplished considerable, but it is now evident that his work was severely hampered. In fact, the meager appropriation allowed the chemical division practically prevented it from filling its true function of constructive service. With but $10,000 for personnel expenses during the present fiscal year, and that to be distributed among two chemists, a clerk and a stenographer, it is evident that the possibilities for startling accomplishments were definitely limited.

But the chemical division is facing a second predicament. Its former chief, Mr. DELONG, has now returned to the Tariff Commission, where his services and experienced judgment were sorely needed in connection with the administration of the new tariff law. To find a successor with a sufficiently broad experience in the chemical industry and at the same time qualified to deal with its foreign trade problems has been one of the Commerce Department's most difficult problems and is yet one that is far from being solved.

It would seem, therefore, that there are two things to be accomplished and for which those in charge may quite logically look to the chemical industry for a helping hand. First and of more immediate importance is the appointment of the division chief. Such a man should know the chemical industry thoroughly, particularly from the business viewpoint; he should be a good organizer, something of a diplomat, and, most important of all, possessed of a generous supply of common sense. In addition, the Commerce Department is anxious that the man should have some experience in foreign trade, but it is our opinion that this is not nearly as essential as a good grounding in the chemical industry as a domestic business. Surely, somewhere a man of these qualifications is available, and we in the industry would be unmindful of our duty if we did not help the department in making this important appointment.

Our second obligation is in the matter of support—financial and otherwise. If the Bureau of Foreign and Domestic Commerce is granted an increased appropriation for the next fiscal year, funds can be made available for strengthening the chemical division so that it can function effectively in serving the chemical industry. Lending approval to Mr. HOOVER'S request of the Congressional Appropriations Committees, therefore, is merely an effort in our own behalf. And in the meantime the industry should continue to stand squarely behind the work of the new division. Its measure of service will depend primarily on whether or not it receives the indorsement and hearty co-operation of all branches of the chemical industry.

Combating Tuberculosis

HEALTH hazards in the chemical industry are usually so definite and well recognized that proper precautions are taken against them. Of a more insidious character, however, and consequently not so thoroughly appreciated is the menace to industry as a whole of the ravages of tuberculosis. Many diseases to which the human animal succumbs take their toll only in the later years of the average span of life. Tuberculosis, on the contrary, is essentially a disease of the producer, for 80 per cent of the deaths from this cause occur in persons between the ages of 15 and 44.

There is a definite personal obligation on executives and technical men in industry to give thought to this industrial health hazard. Enlightened leadership in the elimination of the scourge is afforded through the National Tuberculosis Association, which makes its annual public appeal at the holiday season through the sale of Christmas Seals. There is little need here to describe the splendid work of this association in educating the public to better hygiene or to quote the astounding results achieved—results which in many places have cut in half the mortality from tuberculosis. But it is appropriate and vital for men intimately associated with industry to remember that the wage earner is the most frequent victim of tuberculosis, and industrial leaders must be concerned with the health of the wage earner.

Exposure to dust, smoke fumes and poisonous chemicals as well as poor lighting and ventilation and long hours of labor, all have their effect in undermining the health of the worker and reducing his resistance to

disease. Technical men in many industries have control over these working conditions and should exercise a vigorous, intelligent and sustained effort toward improvement. While this is humanitarian, it may also be regarded as almost selfish, for it has been proved time and again that money invested in improving the health of the worker is more than balanced by a decrease in labor turnover, spoilage of product and lost time due to illness, and by a distinct increase in per capita production. Of all this we are reminded, annually at least, by the appearance of the Christmas Seals, inviting our support for a movement that in the end brings a definite benefit to industry.

An Opportunity for The Fertilizer Division

AT NO TIME in its history has the fertilizer industry needed as much as it does today constructive thought for its highest development. In many respects it stands on the threshold of a new era. Among the agencies that should be making a regular contribution to its progress is the fertilizer division of the American Chemical Society. Representing as it does not only individual chemists of recognized merit but also our largest chemical society, it is in an unusually fortunate position to render service. There is a feeling, however, backed by some evidence, that the division is altogether missing its opportunity.

The program of the recent A.C.S. meeting in Pittsburgh included a series of titles for papers in the fertilizer division that was most impressive. Particularly the group of papers in the symposium on "The Modern Trend of the Fertilizer Industry" promised to be of great interest and value. Performance, however, fell far short of the promise. The forenoon meeting was devoted almost wholly to papers on analytical chemistry in the fertilizer industry, which were presented at painful length and in much greater detail than the circumstances justified. The afternoon session, which was to include the symposium, suffered even more acutely by the fact that only two of the six speakers in the symposium were present. Of the remaining four papers, two could not be presented at all because neither author nor paper were on hand. Finally, the attendance at this meeting apparently reached low water mark, with an average of less than a dozen for each session.

Three specific criticisms grew out of this meeting, all of which can be profitably considered for the future. First, it has been argued that, on account of the small attendance and the apparent lack of interest, the division should be disbanded. Second, the discussion of analytical methods, while not wholly out of place in the fertilizer division, is not worthy of as much attention as it has received. Third, it was said in some quarters that the division was not going to the root of things, and was playing around on the fringe of an important subject in a way that looked as though it was trying to suppress criticism of the industry.

With the first of these we are not in sympathy, although we should be so inclined if we felt there were no hope for improvement. The fertilizer industry is more and more engaging the attention of competent chemists and engineers and is getting out of the realm of rule of thumb into that of scientific control and operation. Consequently the A.C.S. division should enlist the active co-operation of a large number of important men. The industry already has some excellent leaders, and more good chemists are constantly entering the field. There is need for the division.

Attendance, however, will depend in large measure on the program, which leads us to the second item of criticism. Without decrying the importance of analytical methods, we think it fair to say that they are not the most vital things in the fertilizer industry today. However interesting they may be to those who have to use them, they are dry and tedious to others who have the larger problems of industrial development in view. The proper place for detailed study and debate on methods of fertilizer analysis is in the meetings of the Association of Official Agricultural Chemists. Methods must have their approval before they can be widely adopted. Consequently it is a waste of time to duplicate the work of that association in the fertilizer division of the A.C.S. In our judgment the discussion of analytical methods can well be left to the A.O.A.C. because, being organized for that purpose, it will handle the subject more sympathetically and effectively.

What then shall be the function of the fertilizer division? In our judgment it should discuss the larger aspects of the fertilizer industry as a whole; apparent trends in fertilizer manufacture and application; the future of the industry in 10 to 20 years, as indicated by the general development and the obvious limitations of the present processes and products; the chemistry of raw materials and the methods of treating them, with special reference to new developments; engineering and economic problems involved in the manufacture, transportation, storage and application of fertilizers. A discussion of these and many other similar subjects will give the impression that the division is going to the root of things, and will successfully dispel the notion that the industry wants to suppress criticism of its present methods and does not care to receive suggestions that involve radical changes.

On the whole we have the impression that it would be a backward step to disband the division. There is a vast amount of worth-while work for it to do; but we are equally certain that if it is to justify its existence it must give some thought to its highest functions and take steps to rejuvenate its membership.

The Wisdom Of Fulton

HANGING in a corridor of the Engineers' Club in New York is a document of historic interest, being ROBERT FULTON'S "estimate for the expense of a steam ferryboat for one year." The items are penned in a firm hand, and while the document as a whole shows the effect of age, the paper has not disintegrated nor has the ink faded to a noticeable degree. Dated January 22, 1810, the paper bears the autograph of the famous engineer and inventor.

It is not so much the actual cost of operating a steam ferryboat in 1810 that attracts one's interest today as he reads the specifications. They have long since lost their value or usefulness. Of course it is interesting to note that FULTON required two firemen who would "also act as engineers to keep the engine in order," and "two boatmen to take turns in steering." Fuel was required at the rate of "1½ cords of wood for 12 or 13 hours," while "ware tare and repairs" came in for substantial consideration.

But the significant item in the estimate, to one who has followed the trend of science in industry, is the fact

that FULTON had a clear appreciation of the value of trained men; for in commenting on the two firemen, he wrote, "they must be engaged for the year, as such men cannot be turned away in the winter and got in the spring." Chemists will warm to FULTON'S sentiments and wish for more of his type in industry. This is particularly true of those who, in the past year, have been "turned away in the winter" of business adversity without even the certainty of seasonal employment "in the spring" of a business revival.

Punishment for The Innocent

ON November 6 the prohibition authorities at Washington issued a new ruling in regard to alcohol for rubbing purposes. Heretofore one of the principal denaturants for rubbing alcohols has been diethylphthalate. This is practically odorless, is a solvent for essential oils and makes alcohol completely unpotable. No one would want to drink it after his first "gulp." The new ruling which goes into effect December 6 requires that besides this "the denaturer shall add to each 100 gallons of the two specified formulas (39-A and 39-B), as now authorized, three-eighths of a gallon of approved benzol of the quality specified."

Now, benzol is not odorless; it has a definite and unpleasant smell, and is a poison recorded as the cause of many deaths. Of course three-eighths of one per cent is very little, but some persons are remarkably sensitive to it. In our issue for September 20 we published an article on benzol poisoning, its occurrence and prevention. The author said that benzol may be absorbed through the skin, but he doubted if this mode of entry presents a serious hazard in industry. This referred to benzol by itself. The mixture of benzol and alcohol, however, is more volatile than either of the two, and the solution will penetrate when benzol alone will not.

After diligent inquiry among the best authorities the only excuse we can get for the use of benzol in alcohol for this purpose is that it "probably" would not have a toxic effect in three-eighths of one per cent dilution. But this is far from a guaranty. Chemists familiar with the operation of tar distilleries tell us that mere contact with benzol frequently produces eruptions like boils on the skin. Dr. ALICE HAMILTON reported in 1916 that, from inhalation of the fumes alone, fourteen new cases of acute poisoning and seven deaths occurred. Here is a typical example of the effect on one who is sensitive: A benzol kettle had been empty 24 hours, was then washed out twice with steam and permitted to stand filled with water over night. As a workman went into the kettle a strong stream of air was blown through it. Nevertheless he was overcome by the fumes. He was rescued, but one of his fellow workmen who merely assisted at the rescue was also overcome, and died within 10 minutes. Not only are persons supersensitive to this poison but those in bad health have also been observed to be especially susceptible to its dangers. There are plenty of instances of a similar nature. Benzol poisoning is a serious industrial hazard.

All nurses are trained to give patients an alcohol bath, especially in cases of fever. Denatured with diethylphthalate it has been tried and found acceptable. But to add benzol with all its hazards to this universal solvent, when its potency is increased by such a solution, and to threaten the sick and afflicted with its poisonous consequences, seems to us clear beyond the province of the prohibition authorities.

Home Tanning and The Leather Industry

WITHIN recent years the Department of Agriculture has received more than 20,000 inquiries regarding methods of home tanning. The reason for these requests, which often arrive at the rate of twenty-five to fifty a day, is not difficult to find. The disposal of a single hide or a few hides by a farmer or country butcher presents a marketing problem which often attracts more attention than other similar instances because of the opportunity for direct observation of the spread between the prices of raw material and finished product. Thus a farmer may have a single hide which he considers of excellent quality and yet be unable to dispose of it except to a junk dealer, from whom he may receive $1. About the time of this transaction he may have occasion to buy some leather and find he must pay anywhere from 90 cents to $1.50 per pound at retail. Small wonder that his first thought is to do his own tanning!

This feeling will continue as long as the farmer fails to understand thoroughly the factors that make the situation possible. As the total domestic supply of hides and skins falls short of the demand, it would seem as though there should be no trouble in marketing country hides, which constitute from 20 to 50 per cent of domestic production according to kind. But all too frequently these hides have been taken off in a careless manner and improperly cured so that they are naturally worth much less to the tanner than packer hides which have been removed by experts, thoroughly cured and carefully graded. The tanner's efforts are attended with enough difficulties even when working with uniform raw materials. There is little excuse for the farmer's failure to understand these points, for the whole subject of skinning, curing and marketing has been thoroughly covered by the Department of Agriculture in Farmers' Bulletin 1055, which may be had for the asking. As for the possibility of reducing the price spread between country and packer hides, the essential requirements have been summed up in a recent bulletin of the National Leather and Shoe Finders' Association as follows: "Unless farm organizations, working with the Department of Agriculture, can develop a plan by which country slaughter can be done by experts, sorted by experts and marketed from central points in carload lots, it will be otherwise impossible for country hides to be marketed in competition with packer hides."

Another point which the average farmer fails to appreciate is the increase in value during the conversion of the hide into leather. In this connection it seems probable that the circular on "Home Tanning" which has been prepared by the Department of Agriculture in response to the demand previously noted will prove of real value. At first sight it would seem that a pamphlet containing such information would tend toward the establishment of thousands of miniature tanneries which would be highly undesirable from an economic standpoint, even though the competition might not be felt by the tanning industry as a whole. Indeed, the bulletin points out alternatives which under normal conditions should prove more advantageous than attempting to tan one or two hides. But it seems more likely that the farmer who has the patience to follow through the entire process will gain an understanding of the tanner's problems which could be obtained in no other way—an understanding that will go far toward eliminating the present feeling of dissatisfaction.

Readers' Views and Comments

Why Not Get Away From Traditions?

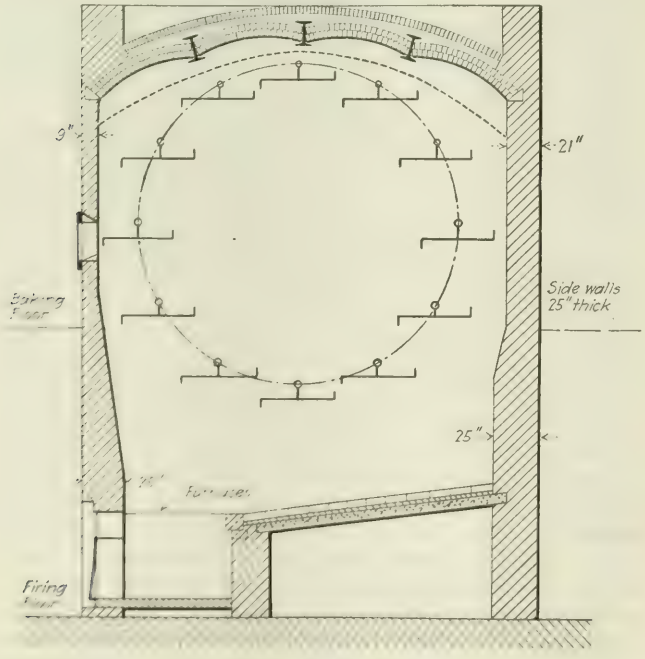
To the Editor of Chemical & Metallurgical Engineering

SIR:—The failure of one industry to avail itself of the technology of another is puzzling to engineers whose practice carries them into several fields of industry. This is explainable by conditions that lead to a state of "inbred talent" and which produce a mental state that does not permit of receiving impressions from without. There has grown a condition of self-satisfaction, or of mental inertia, that persists until the force of competition moves the management to a change of practice.

Many a business is retarded by the fact that a piece of equipment *works*. It has been developed by a process of addition and subtraction, or, as some one has said, "by guess and by gosh," until a fair degree of success has been attained; then the inbred talent rests and beholds this *ne plus ultra*, and refuses to progress further.

Sometimes, however, the check to development is given by the operator who, because the apparatus is successful from his point of view, does not wish to "experiment" and adopts a let-the-other-fellow-do-the-experimenting attitude, in spite of the fact that the "experiment" is not an experiment at all, but only the adaptation of the successful practice of another industry.

While we occasionally see an apparatus or a structure that is barely standing up, the trend is in the opposite direction, sometimes because of the lack of design data, but much oftener because of inability to design. The result is a job that costs much more than it should because the "designer" worked after a fashion that is called "playing safe." The subjects of heat transfer and thermodynamics are somewhat involved and to some people extremely abstruse, so that when called upon to produce a design there is a temptation to "play safe" and the product is a monstrosity.



SECTION OF OVEN

The figure shows a section of a reel oven such as used by the bakers of crackers, cookies and the like. The front wall is 9 in. and 25 in. thick; the back wall 21 in. and 25 in. thick, and the side walls 25 in. thick. The roof is formed by four arches sprung between steel I-beams and the front and rear walls. The top of these arches is covered with ashes, asbestos and a layer of brick. Two furnaces serve the oven; this to get a uniform distribution of the heat across the oven.

Being struck by the thickness of the walls and noting that they had no particular structural significance, I concluded that their principal function was the conservation of heat. Being desirous of reducing the weight (because these ovens would be installed in the upper stories of an old building, necessitating a new and heavy supporting structure), I suggested that a course or two of insulating brick be used, thereby permitting thinner walls and a consequent great reduction of weight. The representative of the manufacturer then assured me that the thick walls were not for the purpose of heat conservation but for heat storage (regeneration). The heat-regenerative value of thick walls, heated on one side only (not checkerwork) at a temperature of less than 600 deg. F., must be slight; and were this the main function of the brickwork, the thickness need be no greater than a single course.

The four arches in the roof next attracted my attention. I wondered why a single arch (as indicated in the figure by the dotted line), which would be cheaper to construct and also of greater stability, would not serve better than the series of arches shown. I was informed that the roof with four arches gave better baking results, which was apparently attributable to the heat stored in the volume of hot gases occupying the approximately triangular space bounded by the front (and back) wall, the adjacent arch and the circle described by the shelves of the reel. A calculation showed that the gases occupying the entire volume of the oven, in cooling 100 deg. F., would give up the heat equivalent of less than a half pound of coke. The oven described bears evidence of having been designed by bricklayers who have had experience in building boiler settings. The wall thickness, however, is even greater than is the average practice in boiler setting—and the boiler settings carry much higher temperatures.

The processes involved in the foregoing are well known to engineers familiar with the development of industries. An apparatus or process with a nebulous beginning is developed by a process of evolution to a point where progress seems to stop. This is the *ne plus ultra*. Any suggestion that an engineer or chemist be employed with a view to improvement would be met with scorn. Has not the apparatus (or process) been improved from year to year, by men trained in that particular work? What chance has an outsider, unfamiliar with the industry, to improve on the practice of experts?

Instances of "outsiders" improving the practice of "experts" are too numerous to be set aside as "flukes."

There must be a psychological explanation. Occasionally the operators of long experience are so steeped in the dogmas and superstitions of the business that they are blind to new principles or methods when they present themselves. The "outsider" will often come with a fund of experience gathered from other and somewhat similar lines of endeavor, and see at a glance opportunities for improvement.

About a dozen years ago I paid my first visit to a cement plant. One of the things I observed was a building over the full length of a number of rotary kilns. I asked the engineer responsible for the design, why the building was made to house the entire length of the kilns. His answer was, "To protect the kilns, of course." "But," I said, "the building is covered with corrugated steel sheets less than $\frac{3}{32}$ in. thick, while the kiln shells are $\frac{7}{8}$ in. thick—a case of the weaker protecting the stronger." "Well," said he, "they all do it."

C. O. SANDSTROM.

Kansas City, Mo.

Appreciation of the Engineer

To the Editor of Chemical & Metallurgical Engineering

SIR:—This appreciation of the engineer, from an editorial in the November *Current Opinion*, deserves wide circulation for its clear exposition of the engineer's position in, and duty to, organized society.

Cornell, Wis. ALLEN ABRAMS.

The Engineer

What the world needs is engineering. What has impeded the progress of the world has been its theorists, metaphysicians, philosophers, theologians and other speculators and hair-splitters.

An engineer is a man who takes a force and finds out how to work it that he may do some good to the race. This is much more to the point than speculating where the force came from, what is its nature and where it is going to.

We need the engineer in politics. The Socialist and every other kind of an ist are merely dealing in riddles. An engineer deals with facts. Instead of constructing some fine-spun theory about government, he would take people as they are and the laws of nature and of business economics as they are and try to work out something from them that would do good to humanity.

We need the engineer in religion. Religion deals with moral force. It is vastly more important to set this moral force to work, to learn its laws and to operate it for the communal good than it is to find out where it came from.

We need the engineer in the schoolroom. Instead of puzzling with theories of education, we should take the child as he is and try to make something out of him.

We need the engineer in the business world. Whenever a man begins to talk about capitalism or labor you may know he is up in the clouds. Really there is no such thing as capitalism nor as labor. These are artificial abstractions—mere counters to argue with. The real things are human work and human welfare. Work is the energy of living people and capital is the stored energy from dead people.

And there is but one problem, and that is how to manage these two forces of energy in a way to produce the most human welfare.

Some day we are going to kick the speechmakers, flag-wavers and phrase-makers out of our legislative bodies and elect engineers who will address themselves to the problem of running the country.

And some day our schools and churches will likewise be put into the hands of practical engineers who shall produce results.

EDITOR'S NOTE:—We agree with our correspondent that this is an exceptional appreciation of the engineer from an unexpected source. There are some conspicuous examples of engineers filling the needs to which the editor of *Current Opinion* refers. In politics, or rather in public life, we have Mr. Hoover, Secretary of Commerce, and Mr. Caetani, lately appointed Ambassador from Italy. In religion we recall no engineers who are following that vocation, although recently Dr. Steinmetz was a distinguished lay-preacher in a series of religious talks by laymen at Schenectady. In the schoolroom examples are more numerous, as they are also in the business world. The ability to achieve results seems to be the quality that attracts the public to these men.

Tests on Bearing Metals

To the Editor of Chemical & Metallurgical Engineering

SIR:—"Tests on High-Tin Bearing Metals," by P. W. Priestley, in your issue of Nov. 8 has reopened a very interesting subject.

Bearing alloys have received a great deal of attention by many investigators, but the technique of "testing" has not been standardized, because too many factors (only partly metallurgical) enter into such investigations. Lacking a well-established basis of comparison for any product of the metallurgical industry, we shall always find a large number of producers that make grossly exaggerated claims for their "secret compounds." Unfortunately, this patent medicine situation has existed for many years in alloys for bearings, solders and other specific purposes.

Bearing alloys have so far eluded definite testing methods because great difficulties surround this problem. The "efficiency" of bearing metals is not solely a question of metallurgy, but is also one of mechanical engineering, of physical chemistry and of lubrication. The testing of bearing metals is undoubtedly the most difficult problem in the art, being equaled only by the problem of determining the cutting efficiency of tool steels.

In order to investigate systematically a series of bearing alloys, quite a number of laboratory tests must be carried out, to detect any basically faulty materials. Such preliminaries often eliminate the necessity of further commercial tests. Among the laboratory tests are:

1. *Microstructure of the Alloys.* This is required to determine, first of all, whether the basic requirements of a bearing alloy (a soft background with imbedded hard grains) are met. The "micro-character" and tentative scale of micro-hardness developed by the research sub-committee of the American Society of Mechanical Engineers will be found very useful. It will be quite important, I believe, to insure that the hardest grains in the bearing alloy are not harder than the shaft, so that the latter is not scored if the lubrication should fail.

2. *Elastic Limit Under Compression.* The Martens mirror extensometer can often be replaced by gradually compressing a cube of the alloy. One side of this specimen is prepared for microscopic investigation; it is continually observed, and the load determined at which the microstructure begins to change. However, the only certain method for determining the elastic limit which is of practical importance with bearing alloys is to determine the load at which a definite permanent set, say 0.2 per cent, takes place.

3. *Compressive Strength.* This test is usually carried out by compressing cylindrical specimens of the alloy until cracks appear at the surface of the specimen. This method suffers from a similar error as our standard tensile tests: the result is calculated on the basis of a cross-section undergoing progressive changes. The only

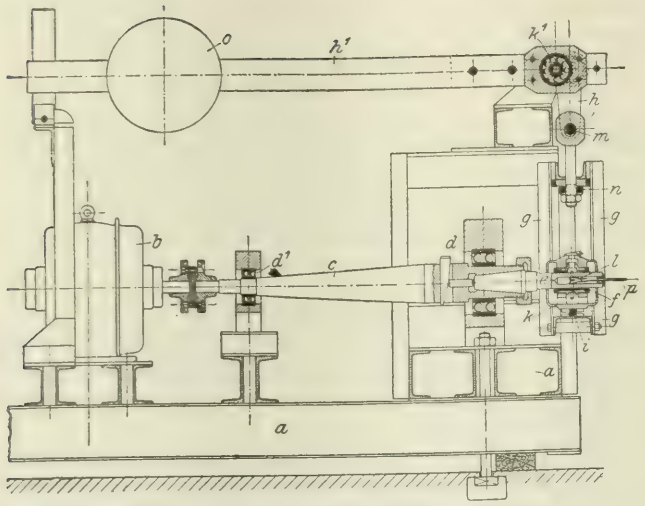


FIG. 1—KAMMERER'S TEST BENCH FOR JOURNAL BEARINGS

correct method of carrying out such tests is to establish curves in which the progressive increase of diameter of the specimen is shown against the increase of load.

4. *The Melting Point of the Alloy Should Be as High as Possible.* New lead-barium and lead-calcium alloys have a melting point of about 290 deg. C. (554 deg. F.). Since the lubricating material will give off penetrating odors before these temperatures are reached, an alarm signal is given before the bearings fail. If bearings are air-cooled as in moving railroad cars, such high temperatures cannot be reached; it will be of interest to note that such alloys permitted the German State Railways to run its trains successfully during the war without any lubricant whatever.

5. *Hardness.* While a knowledge of micro-hardness is very useful to determine the correct microstructure, the Brinell test (500 kg. load) will yield valuable information as to whether the alloy is in general suitable for its purpose. The Brinell test cannot, however, serve as a criterion of the comparative quality of such bearing alloys. Its largest value is to be found in controlling one definite alloy—each possesses highest efficiency at one certain Brinell hardness, and the engineer is thus in a position to determine conveniently whether a particular alloy is in its prime condition. The Brinell machine will also permit one to determine a figure which has considerable value in bearing alloys: the relation between the hardness unit, obtained by increasing the load at a determined rate to 500 kg. and then releasing immediately, and the hardness unit obtained on the same alloy by exposing a specimen to the maximum load for a period of 3 minutes. The figures thus obtained both at room and at elevated temperatures give information on the plasticity of the alloy, a property which largely affects its general efficiency.

Bearing alloys can best be investigated on a "test bench" similar to those used for automobile engines. According to my experience, the simplest and most useful is the one designed by Professor Kammerer at the Institute of Technology of Charlottenburg. Its construction is illustrated in Fig. 1. Shaft *c* runs in ball bearings *d* and *d'*, and is driven by a variable-speed motor *b*. The bearing *f* under test is pressed upward against the journal *e* by a lever system; the load can be adjusted by weights sliding on the lever arm h^1. The machine and lever system is constructed with suspensions of spherical joints in such manner that the pressure of journal against bearing surface is perfectly uniform. Thermometer *p* measures the temperature of the bearing during the test. The main factors of such a test are the pressure between shaft and bearing, the surface of bearing and the bearing temperature (which is influenced to a considerable extent by the former two and the nature of the lubricant). Tests are run systematically in series; after the bearings are "run in" at a definite load, the speed is increased from lowest to highest limit and the maximum temperature reached is determined in definite steps, say at 300, 500, 1,000 and 1,200 r.p.m. After the temperature no longer changes with time, the speed is again reduced to a minimum but the load increased by a definite amount. Then the speed is again increased by steps, and so to failure.

Such a test bench can be provided with simple attachments to reproduce adverse conditions often encountered in practice. For instance, an eccentric shaft may bear against the load lever, producing periodic pressure releases on the test bearing. Or a cam arrangement might be installed producing impact forces.

The importance of viscosity of a particular lubricant has been overrated. The usefulness of a lubricant depends upon the forces of adhesion to the metal and not upon the cohesion of the oil molecules to one another—i.e., its viscosity. Bare mention of this important point shows that the testing of bearing metals is not a purely metallurgical and mechanical problem.

At any rate it should not be difficult to standardize commercial tests for bearing metals by means of a simple test bench that anybody can operate and that is quite definite in its indications.

New York City. HERMAN A. HOLZ.

Road Tests for Comparing Fuels

For the past 2 months, in conjunction with the Society of Automotive Engineers, American Petroleum Institute and the National Automobile Chamber of Commerce, the Bureau of Standards has been conducting a co-operative fuel research program.

The purpose of this work, according to a statement recently made by Major R. E. Carlson of the Bureau of Standards, is to obtain data which can be used as a basis for estimating the effect of change in gasoline volatility on the average fuel consumption of cars now in service throughout the country. The effect of these fuels on crankcase dilution, change in viscosity of the lubricating oil and ease of starting of the motor will also be investigated.

This co-operative fuel research program is still in progress at the Bureau of Standards and the form in which the results obtained will be published is a matter for final decision by the bureau and the three societies.

The personnel employed in these tests consists of representatives of the oil and automotive industries who have been loaned to the bureau and two representatives from the bureau to direct the work. In a problem of this sort where the results are of such far-reaching importance both to the petroleum and the automotive industries, it is of vital importance that the results be accepted at their true value when the program is completed. It is believed that the representation of both industries throughout the entire program of tests will greatly facilitate this acceptance of results because at all times both industries were entirely familiar with what is being done and how it is being done. Besides, these tests have been conducted by an impartial agency.

The Twelve-Hour Shift

A Discussion of the Present Status of This Great Problem and a Review of the Report of the Federated American Engineering Societies on the Twelve-Hour Shift in American Industry

By Charles Wadsworth, 3d

PERHAPS at the very beginning we should adopt a text which shall serve as the underlying theme of this discussion. It is from the introduction to the Federated American Engineering Society's report on this subject, which will be reviewed during the latter part of this article: "The desirability of abandoning the two-shift system lies not in its extent in industry but in the fact that the 12-hour day is too long when measured by twentieth-century ideas as to the proper conduct of industry. Economic considerations demanding a length of day which will give maximum production are influenced today by humanitarian considerations."

Thus we are shown to believe that the 12-hour shift should go. This article will deal with the reasons for the existence of the 12-hour shift, with the reasons why it has persisted in the face of great pressure, and with the two questions, so ably discussed in the report above referred to, the extent of the 12-hour shift and the remedies or substitutes which have been used to replace it.

There are in this problem three points of view which we should establish before we can understand the puzzle: The point of view of the public, that of the management or employer and that of the worker.

The Public's Opinion

There is still an unintelligent minority of the public who call to mind the concept of the farmer, with 16 hours of uninterrupted (?) work. They remark with conviction that the industrial worker is being babied anyway and that 12 hours is shorter than 16. Not a few employers feel that the industrial worker is being babied, but there will be relatively few whose views would coincide with that just mentioned.

A decreasing percentage of the public is uninformed on the 12-hour day. This is partly due to the strong artisan unions which have been universally successful in eliminating it from their trades; partly to progressive manufacturers who have successfully installed a shorter shift; but mostly, no doubt, to the widespread press publicity which is always given to the U. S. Steel Corporation and its decisions, changes and problems.

The vast majority of the public is passively opposed to the 12-hour working day. They wonder at its persistence and even professional investigators and reformers are puzzled. Everything seems to point to its speedy elimination and yet here it is. Why?

Part of the answer can be found in the employers' point of view and the rest of it in the laborers' attitude. These we shall try to make as graphic as possible.

The Employer Thinks?

The manufacturer (or employer) who uses the two-shift (12-hour day) system has an attitude which varies between rather narrow limits. We can take as a basis for his attitude the background that the 12-hour day exists and *status quo* has great inertia. In his industry there probably has been until recently, and perhaps even yet, little sentiment against the 12-hour day. Grandfather or father (or if not his ancestors at least his predecessors) used the two-shift system and nothing has called his attention to the necessity of changing it —neither public opinion, nor labor demand, nor yet law. So there is an understandable *laissez faire* background for his attitude. With such a base the attitude of the individual employer will be seasoned by the combination of a number of ingredients. There are many to whom progressive ideas are infrequent. Again, a larger number believe that the 8-hour day is much more expensive and any humanitarian impulse has been either stillborn or strangled by commercial instinct. Of course this is no crime, but it is not progressive, and the question of whether the 8-hour day is more expensive is at least debatable. There are others who bow to the demand of labor for a 12-hour day! Yes, that's a fact, though it seems strange. Possibly there are other ingredients in the developed attitude of the individual employer, but these are the principal ones. So by properly balancing them we can construct a given employer's thought on the 12-hour day where it still persists.

The technical man in industry reflects the attitude of the employer. He must if he wants to butter his bread with salary from that firm. We heard of one man who objected strenuously to a labor wage reduction. "The men couldn't live on the reduced wage. It was unfair." His colleagues looked on the protest as foolish and with a kind of pained tolerance. His employer wished him farewell with the next pay check. So with enough exceptions to permit a healthy generalization the technical man's attitude on labor questions is necessarily a blind following of employer's views.

But Why Does the Laborer Stand for It?

Remember first that those workers who are still on a 12-hour shift basis are wholly unorganized and then reflect on these three stories which perhaps bring out the laborer's attitude better than an abstract description.

It was still night and the glare of the arcs was the only light on a rather wide street except for a few cheap restaurants. Every half minute a first cousin of the original Toonerville trolley bumped and rocked down the track toward the plant, filled to overflowing. One knew there was a plant there, for a bright bessemer flame said so. There were several. On the sidewalks a silent army plodded rather than walked, hundreds of them, thousands actually. There was some talk, sometimes a shouted sally and a retort. Then we turned off from the crowd to an interurban station which carried us to a nearby plant.

Back again at night and the interurban brought us in just as this same crowd was coming home. And if these plodded in the morning, they dragged now and there were no shouted sallies and no talk. Just a procession of tired out animals seeking only rest, food and those pleasures which satisfy without effort and which help to drown the dreary drudgery.

Such was the background for the answers that came to our question during some months of contact, "Why do you stick on this 12-hour shift work?" Three men can give answers which are typical of a vast majority.

Bill Brown was a Yankee who referred to all foreigners as "hunkies." All "hunkies" were either "pretty good hunkies" or "——— — ———." He would have been over 6 ft. if he had not stooped. If he was on night shift, he got shaved Saturday afternoon before he went on to the 24-hour shift. (Twenty-four hours were necessary in order that each shift would work one week at night and one week in the daytime.) If he was on day shift, he got shaved Saturday evening after he came off for his 24-hour rest. Bill had a son doing "railroadin'" and a rather numerous family. He handed in a tax return of over $2,100 in 1920. It was under $1,500 in 1921, for the same work, 12 hours a day nearly every day in the year. "Oh," said Bill, "I get enuff to live on and I know the game. It's a hell uv a life, but what kin yuh do? No, I couldn't afford to work only 8 hours. ——— — ———. Somebody'd haf tuh quit eatin'." You can translate it if you so desire. It means more to us as Bill said it.

Then there was Roman Bdfghijklmnpqr (it doesn't matter what his last name was) a bright-looking Slav of 25. A Ukrainian from farmer-peasant stock whose industry had commended him to his bosses and he was already a foreman. "Oh yes, I stay this country. Most my countrymen they come make money, go back. They buy farm. They live with nothing while they here. No, this factory job no good. Make you sick, but it pay good. You work like hell 10, 15 years—then you quit."

And finally there is Joe—"Boiler" Joe to distinguish him from a couple of other Joes in his gang. He has been in America 12 years and he knows three English phrases well enough to say them. Two of them are unprintable, the other is "No good." From somewhere in Russia where the Nordic strain is slender, stupid and dull, understanding English enough to grunt and nod when he is told to do something and to nod assent when someone answers for him. Already he has gone back with as many thousands as there were years of service. He had several times refused to work at all rather than go on an 8-hour job. Twelve hours or nothing! Thinking no more of America than an exploiter would think of the place where oil fields happen to be. The real reason why Americanization campaigns are stillborn and educational campaigns fail in some districts. America is a place to make money in and then return to God's country. These three men are common types, and it is not a far disproportion to assume that the 12-hour shift problem is two-thirds a foreign problem.

Present Status of the Puzzle

So we have the public largely passively opposed to the 12-hour day, but without a sufficiently active sentiment to have anything crystallize; the manufacturer inactive principally because of the inertia of existing conditions, hesitant further because of the fear of greatly increased costs; and finally the laborer completely lacking organization, largely of foreign origin, regarding his work has a necessary penance for either a comfortable old age or for the "crime" of having to support a family, and for the most part either unable to find work at shorter hours or unwilling to consider it. Therefore the 12-hour day persists and to anyone who has lived in a 12-hour shift community the institution looms as a menace to civilization, for civilized living is impossible under it.

How Extensive Is This Menace

The report of the Federated Amercan Engineering Societies discusses the extent of the 12-hour shift in American industries and some of the substitutes which have been tried in place of it. The study was made possible by a grant from the Cabot Fund and the work with which we are concerned was carried out by Horace B. Drury.

Confined to Continuous Industries

Mr. Drury points out that the 12-hour shift is confined almost exclusively to the continuous process industries and these in general belong to one of three types. The first type consists of those industries which employ high temperatures and cannot afford to let a large bulk of equipment cool off only to be heated up again the next day even if this were possible. There are of course many industries in which it takes days to heat up the equipment to a point where production is possible. These are called the heat process industries. To the second type belong those which, because of chemical reactions, cannot be stopped and started again, such as chamber sulphuric acid, soap saponification and hundreds of others. These are the chemical process industries. Finally there are industries in which the investment in equipment is extensive and the overhead charges would be prohibitively high per unit produced, if the work were not continued throughout 24 hours.

All of the men in these industries are not on 12-hour shift, of course, and an accurate estimate is impossible. Mr. Drury says that from 5 to 10 per cent of American industry is continuous process work and that from five hundred thousand to a million men are engaged in it. Those depending on the wages of these men will number close to two million persons. Finally, as nearly as can be estimated, about 300,000 wage earners work on the 12-hour shift. Thus the problem from its mere extent might not merit the attention it is receiving. But it has been justly condemned, and this condemnation has been increasing so extensively that it is not un-

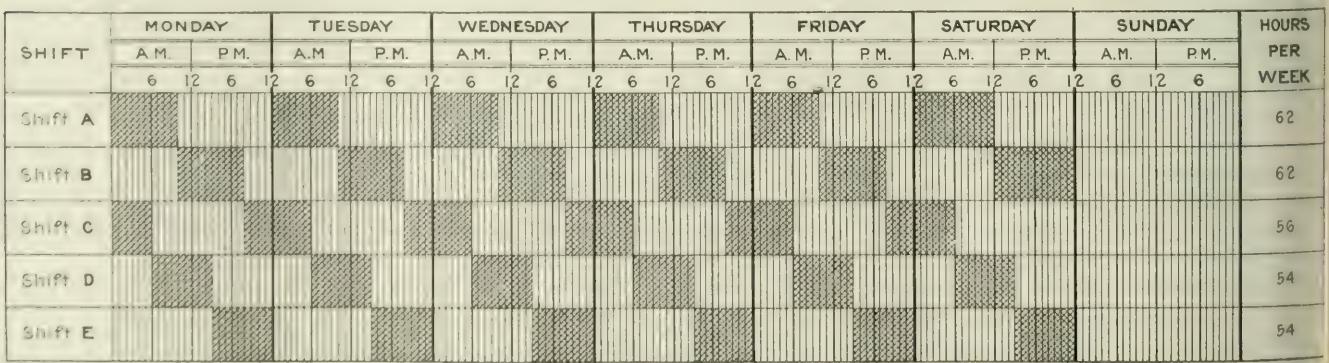


FIG. 1—FIVE-SHIFT SCHEME WITH 9- AND 10-HOUR SHIFTS

likely to take the form of legislative action. What, then, are the industries affected and what remedies have proved successful?

Method Used in Obtaining Data

Unfortunately there were practically no data available on this subject and it was necessary to accumulate the information by exhaustive field work. Mr. Drury's investigation could not of course be complete, so he has made it representative. He has investigated forty-four different industrial centers, among which are New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Buffalo, Akron, Youngstown, Gary, Birmingham, St. Louis, Kansas City and Denver. In addition such localities as the southern New Jersey glass plants and the pottery plants near East Liverpool, Ohio, were also studied. He has grouped the continuous industries into four main groups indicated in the table below. We are of course primarily interested in groups I and II.

Group I.	Iron and steel	Group III.	Paper
	Non-ferrous metals		Flour
	Glass		Rubber
	Cement		Breakfast foods
	Lime		Autos
	Brick		Textiles
	Pottery		Mines
Group II.	Heavy chemicals	Group IV.	Power
	Fertilizers		Gas
	Explosives		Water
	Dyes		Ice
	Industrial alcohol		Shipping
	Wood distillation		Railroad
	Refined corn products		Street railways
	Soap		Telegraph
	Glue		Telephone
	Drugs		Mails and express
	Sugar		Policemen
	Electrochemicals		Firemen
	Petroleum		Watchmen
	Salt		
	Cottonseed oil and other oils		

How Much Will the Three-Shift System Increase Labor Cost?

Already the estimated extent of the 12-hour shift has been given. There are nine other questions dealing largely with the change from the two-shift system to some other operation plan. Therefore a brief discussion of these alternatives is appropriate. Perhaps the most obvious and familiar substitute is three 8-hour shifts. The cautious manufacturer is apt to conclude that this will increase the payroll by 50 per cent, and right here lies the greatest problem in eliminating the 12-hour shift. If the manufacturer wants to keep his costs the same, he naturally infers that he must keep labor costs where they are. In this case the wage earner will receive just two-thirds of his former daily wage. No such conclusion is warranted. In a very few instances, one a sulphuric acid plant, it has been found that the number of shift workers was increased just 50 per cent with no increase in production. Yet in another plant producing the same material the increased production attributed by the manager entirely to a reduction in working hours from 12 to 8 per shift was startlingly large.

It is therefore necessary to be very cautious about making dogmatic deductions with regard to this change. Each plant is an individual case. Few generalizations can be made even within a given industry. So much depends on the kind of equipment, the type of process, the caliber of management, the attitude of the laborer, the progressiveness of the industry and the plant, the proportion of labor cost to total cost, etc.

Suppose we have a plant manufacturing a product where the labor cost is 25 per cent of the total cost. In most chemical industries this proportion is higher than actually exists, for the labor cost is often below 10 per cent and seldom above 20 per cent. If we increased labor cost 50 per cent, it would increase the cost of the product only 12 per cent. That, then, is a kind of limiting figure for changing from 12-hour to 8-hour shift. It assumes that the weekly wages would be kept exactly the same, the hourly rate would then be 50 per cent more and the total number of laborers increased by one whole shift.

Some Factors Which Would Diminish the Three-Shift Increment on Labor Cost

In the first place, there are few works in which all the men would be on 12-hour shifts. Hence the increment would naturally be decreased in proportion to the number of men on shorter hours. Again it is a pretty safe generalization to claim that in a rearrangement of tasks which would accompany a fundamental change of this kind, a decided cut could be made in the number of workers per shift. In one plant I recall a large cut in the personnel of a shift by having each shift stay 9 hours and in that extra hour complete all the tasks incidental to actual operation. Therefore again the increment of cost necessary to effect a change from 12- to 8-hour shift would decrease, still maintaining the same weekly standard of wages.

In a sufficient number of cases to justify its inclusion the change from two shifts to three has focused the attention of the management on equipment and kindred problems, and a pronounced increase in plant efficiency has resulted. Perhaps the benefit cannot be solely attributed to the three-shift change, but its inception was undoubtedly due to the study made necessary by the three-shift change.

In many industries labor will do more work per hour in an 8-hour shift than in the longer session. This is, of course, much less true of the continuous process industries than of those in which a more skilled labor is necessary and a higher type of manual efficiency. Yet the sulphuric acid plant referred to above is only one example of many in which this result has been accomplished and there is no doubt that industrial accidents, absenteeism and labor turnover have all been favorably affected by the three-shift program.

Each of these points has been advanced to indicate the certainty that in changing from a two- to a three-shift program the labor costs would not be increased greatly even if the weekly earnings of the shift workers were kept to the figure obtained in 12-hour work. With slight reductions in total wages (but a higher hourly rate) and a slightly higher labor charge, the change can probably be effected in every industrial plant that is well managed.

The message which the report brings to the manufacturers is: "Don't shy at three-shift operation; investigate it. If it does cost more, you may be more than repaid by diminishing accidents, labor turnover and absenteeism. And it may not cost you anything." Furthermore, such a message is very timely when the immigration and emigation statistics are studied—a net loss in 1921 of 67,000 laborers (continuous process labor)! If that continues will it pay to diminish labor

turnover? It will not only pay, it will be absolutely essential.

Other Substitutes for the 12-Hour Day

In addition to the three 8-hour shifts which have been discussed at such great length, there are other substitutes which have been used, as follows: (*a*) Cessation of work allowing two 10- or 11-hour days. (*b*) Nominal 12-hour day, but work completed in 10 to 11 hours. (*c*) Three overlapping 9-hour shifts. (*d*) Nine- and 10-hour shifts on a five-shift scheme.

This last alternative is so interesting that we have reproduced the diagram which is now used by Procter & Gamble for their shift labor. (See Fig. 1.) It is self-explanatory. You will note that there are always two shifts at work.

Some Further Conclusions Which Are Made in the Report

There are other conclusions which Mr. Drury finds closely related to those already discussed. He has found no technical difficulties in the way of changing from two- to three-shift operation. This is to be expected and could have been stated *a priori* by those who are acquainted with shift work. It was wise to include it in the report, however.

Mr. Drury found a general favoring of the three-shift plan and a negligible number of firms returning to a two-shift system after the three-shift plant had been tried. Another gratifying conclusion is that the daily wage earnings tend to equalize those of the two-shift system by an increase in the wage rate. You can argue at greater length than we did earlier in this report that wages won't have to be reduced, but an ounce or two of proof such as the above is worth much more.

Finally it is also gratifying to learn that the leisure time of the employee is well used. This is not necessarily to be expected from the type engaged in shift work, and many a manufacturer has remarked that the workers would drink away their spare time, advancing that as one reason why it would be foolish to change to three-shift work. It now becomes a boomerang and an added reason for adopting the shorter day.

What Is Meant by Co-operation of the Worker

The summary concludes with a word of caution: Do not change without careful preparation. A sudden change not preplanned and which has not enlisted the co-operation of the workers is almost certain to result in lower production. And this is a word of great wisdom. It is a point which is worth enlarging, for those unfamiliar with operating work will completely miss the significance of the term "co-operation of the worker."

There was once a bright and ambitious chemical engineer who was assigned to the task of studying and revising a process. It was a batch process that required careful furnacing to an end point and subsequent leaching. If the end point was not reached, the material cooled to a hard, impenetrable mass. If it overburned, considerable destruction of product was involved. The chemical engineer wished to make some changes in operation which were logical and scientifically sound, but somehow or other they did not work. The yield did not improve. In fact it fell off. He was worried and went to the superintendent. The superintendent listened, waited a week spending an imperceptibly longer time in the department each day and assigning the chemical engineer to other work. Then he spent an hour or more a day talking with the furnace men not about the work or the low yields (which the furnace men didn't know). Then one day they told him how they had fooled the chemical engineer. He had come in and changed the process so that it meant more coal to haul in and shovel. It was no cinch to stand up in front of that roaring blast and shovel in more coal. But they had fixed him, doctored the coal weights and run a hotter fire by building up from the start instead of burning gradually. So the particles were glazed and no additional action had been possible. It had not been a poor piece of technical work, but the "co-operation of the worker" had not been enlisted.

So the co-operation of the worker would have to be enlisted in this change to a three-shift plan. If it had been applied to the above process and the furnace men had been unsympathetic, you would have had every charge glazed or overburned. The reason would have been that the previous or the subsequent shift ruined the charges and "you can't get the furnace in shape on a short shift."

Mr. Drury struck a keynote when he mentioned the co-operation of the worker, and that is why earlier in this discussion so much emphasis was placed on not reducing the daily wages, for this is an important factor in labor co-operation. Even then there will be trouble in some organizations, especially where you have foreign elements. Their argument will be, "If you can pay the higher rate per hour, then we'll take it and work 12 hours too." They are horses for punishment! This subject of "labor co-operation" would be extremely appropriate for detailed investigation. It is the crux of success or failure in the two- to three-shift change.

Too Optimistic Claims Must Be Avoided for the Shorter Shift

There is one other point of caution that must be urged. In many industries careful and thoughtful attention on the part of the management would increase process efficiency greatly. This careful and thoughtful attention is necessary when the change from two- to three-shift operation is made. Thus many improvements may be attributed to the change in working hours which are actually due to the study which accompanied it. We would be the last to desire in any way to put a damper on the splendid movement toward the elimination of the 12-hour shift, and we do not wish this to be interpreted in that light. Too often, however, a movement defeats itself by claiming too much and failing of accomplishment. We know organizations that still retain the 12-hour shift and which would not be benefited by the change to shorter shift. They have already been vigorous in their quest for labor efficiency. To try to sell them the 8-hour shift on the basis of marked improvement shown when other firms in the same industry adopted the shorter work day would be a mistake. No management engineer could produce the goods. Hence this word of caution that we should not attribute all the gains to the change in hours!

In an appendix to this discussion is given a summary of the 12-hour day problem in some of the industries in which the readers of *Chem. & Met.* are interested. There remains only a word of commendation and approval for the exhaustive and balanced report. The Federated American Engineering Societies is to be congratulated. The contribution to knowledge is signal. The direct gain to industry and to civilization should

be permanent and immense. The report will do more toward eliminating one of the black corners, fester spots, from our civilization than all the rant and chatter of the zealous reformers combined. It is distinguished evidence that the organization is fulfilling the worthy ideal expressed in its constitution: "To further public interest wherever technical knowledge and engineering experience are involved."

Appendix to the Report on the 12-Hour Day in American Industry

Herewith is a summary of the detailed studies made in industries in which *Chem. & Met.* readers are interested:

Glass—In the average glass factory, those men operating the furnace are involved in a continuous process work and there are probably more of them on 12-hour shifts than on 8-hour shifts, but there are relatively few men actually on furnace work. If the cutters and the annealers are also on continuous work, it brings the number up to a very considerable figure. On the other hand, in many phases of the glass industry, there has never been anything but relatively short hours. Bottle blowers, window-glass manufacturers and now even plate-glass manufacturers are all on a predominantly three-shift basis. Individual members of the organization, however, still retain the two-shift status.

Cement—Better and more inclusive data exist in the cement industry than in any other industry, due to the activities of the conservation committee of the Portland Cement Association. This committee has made a very interesting comparison between the man-hours required to produce one barrel of cement in those factories on two-shift operation and in those factories on three-shift operation. The table is important and is herewith reproduced. (Table I.) The difference is pronounced and the investigator was careful to inquire whether the more progressive concerns might have gone on three shifts, leaving the less progressive on two shifts, but the conservation committee of the association believed that the difference was not due to any extraneous conditions. The present view of the association, through the chairman of its conservation committee, seems to be that a combination of two-shift and three-shift operation is at the present a little more economical than the wholly three-shift operation, but it believes that ultimately the three-shift operation will be universal.

TABLE I—COMPARATIVE LABOR EFFICIENCY OF 86 PORTLAND CEMENT PLANTS IN 1920

(Data Supplied by Committee on Conservation, Portland Cement Association)

Shift System	Number of Plants	Man-Hours to Produce One Barrel: Average of Group	Most Efficient Plant in Group	Least Efficient Plant in Group
Two-shift group	51	1.035	0.551	1.940
Three-shift group	22	.823	.466	1.540
Two-three-shift group	13	.756	.470	1.140

The hourly wage of the men as they went from two to three shifts was raised 6 or 7 cents an hour, so that they received slightly less than the 10-hour men, but only slightly less, and this increase in hourly wage has been more than wiped out by increased efficiency in the workers.

Lime—The lime industry has a smaller proportion of shift workers than the cement industry, with the result that the shift work is even less significant, only about 15 per cent of the men being involved. They are the ones that handle kilns, and in general they are on a two-shift basis, particularly in the East and the South. One plant is successfully running now on a three-shift basis, at the request of the workmen, and no increase in manning the kiln was necessary by a rearrangement of labor. Tables were given showing how this was worked out in practice.

Heavy Chemicals—There is relatively a small amount of two-shift operation in the production of heavy chemicals, and in the South this is principally on a 12-hour basis. In the North, except among smaller plants, the shift is 8 hours. In most cases the managers of heavy chemical plants express doubt as to any marked improvement in efficiency under three-shift operation. Most of them felt that there could be no increase in output, although they admitted it would have a favorable effect on accidents, inferior work, etc. The experience of one company, however, is exactly the reverse of this and production on a three-shift basis was increased markedly over the two-shift basis.

Fertilizers—In fertilizer plants the only department which has continuous work is the sulphuric acid department, and here in a plant having 100 laborers there would be only eight or nine on shift work. These are very largely on the 12-hour shift basis. It is the expressed opinion of a leader in acid production in the country that three-shift operation would be beneficial.

Explosives—Here again the number of men engaged in shift work is small and so far as is known, most of the work is carried out on a three-shift basis.

Dyes—Again, in this industry the processes are so varied that a generalization is somewhat unwise, but there are very few men on shift work and those that are on shift work usually work an average of 12 hours.

Industrial Alcohol—This commodity is manufactured in a number of plants. The largest company is entirely on a three-shift basis.

Soap—This is principally a daytime proposition in the majority of plants, except for a few men engaged in auxiliary processes. Ordinarily soap fats are boiled by day and permitted to settle by night. Some plants run on a two 12-hour shift basis when the market permits the plant to run at this capacity, but soap makers in general are against continuous operation except when it is essential.

Some companies, such as the Procter & Gamble Co., of Ivorydale, because they undertake more preliminary treatment of materials than is customary, have a larger percentage of men on shift operation. About 25 per cent of this company's employees are on continuous operation work.

Sugar—There are three branches of the sugar industry. (1) The sugar mills of the South which take Louisiana cane and manufacture white sugar from it. The majority of these mills are at the present time seasonal and work on two 12-hour shifts, with no thought of change.* (2) The refining of imported sugar by large refineries on the Atlantic, Pacific and Gulf seaboards. This type of factory employs no greater than 50 per cent of shift workers, although the whole process is practically continuous. Most of the refineries operate on two shifts, although some of the companies have tried out the three-shift operation with some success. Indeed, one of the plants of the American Sugar Refining Co. has been working for the last 4 years under a three-shift basis with excellent success. (3) Beet sugar. Here again we have a seasonal industry which does not last over 100 days and in which there is practically universal 12-hour shift work. It attracts many men year after year to this seasonal work, and in general they find it desirable. One company has, however, tried out the three-shift policy with satisfactory results, but it is the pioneer in this particular field.

Table Salt—This is an industry which requires very few men on shift work and with few exceptions the plants retain the 12-hour shift basis.

Petroleum—Together with rubber and some of the nonferrous metals, this industry has the distinction of being solidly three-shift. The Standard Oil, and all of the important independents, are on the 8-hour system. With oil drilling, of course, the situation is different; contractors are in charge and govern their own crews and in addition the excitement of work in the field results in rush work and long hours.

Cottonseed, Linseed and Other Vegetable Oils—The crushing industry presents the largest 12-hour shift problem in American industries. The operation is seasonal, although in the larger companies it has been extended to 8 or 9 months, but the shortness of the season has demanded two-shift operation and the predominance of colored help may also influence the tendency toward two-shift operation. In refining very little work is done at night time and the crews engaged in this work are relatively small.

*Editor's Note—It will be interesting to follow the effect of the use of vegetable chars on this industry. There are some of the plants now which operate continuously throughout the year and perhaps other arrangements than the 12-hour shift will come into vogue.

European Conditions as I Saw Them*

Status of the French Chemical and Metallurgical Industries, Notably Dyes, Synthetic Nitrogen, Fuel for Internal Combustion Engines, Iron and Steel—Hydro-Electric Power Development—Impressions on the General Situation in Italy and Switzerland

By J. S. Negru

BEFORE the war France had a flourishing heavy chemical industry, but was obliged to depend largely on Germany and partly on Switzerland for organic chemicals, especially dyes. The present status shows no material change. When the plants in the devastated regions shall have been fully reconstructed and put in operation, all of France's need for heavy chemicals can be met from home production, and she will even be in a position to export. With respect to the dye industry, she has made great efforts to become independent, but with no tangible success. Before the war there were in France four French dye plants, producing about 10 per cent of her requirements, although even these plants were obliged to import from Germany a large part of the necessary intermediates. In addition to these four, there were a few German-owned dye plants, but the combined production of all was not sufficient to meet domestic needs, and accordingly there was an annual import of about 2,000 tons of dyes, valued at about $1,500,000. The total yearly consumption was about 9,000 tons, valued at about $5,000,000.

French Efforts to Build Up a Domestic Dye Industry

Strenuous efforts were made during the war to build up a domestic French dye industry. It was in 1917 that the Compagnie Nationale des Matières Colorantes (National Dye Co.) was definitely established. Since then other companies have been formed, but all have had to struggle hard for existence and have been badly in need of government aid. This help has been given in some degree, but it has not been enough to insure the establishment of a self-supporting dye industry. The French have made mistakes in this industry, just as the other nations have. Primarily the construction program was far too ambitious. They put up plants of large size that could boast a capacity of 15,000 tons a year, but they found themselves without the necessary chemists, engineers, foremen and even common laborers to man them, not to speak of the difficulty of obtaining sufficient raw material to operate them. Of course this policy was wrong and bound to meet with failure. The experience has been a hard teacher, but the lesson has been learned, and in July I discovered that the industry was making a fresh start in the direction of educating and recruiting trained personnel with which to man the plants.

French Dye Industry to Get German Technical Assistance

In connection with the French dye industry, our readers will recall that when Dr. Hendrick returned from his summer in England he wrote a review of the dye situation in Great Britain and Europe as he had observed it. Particular emphasis was laid upon the Franco-German working agreement whereby the German firms were to give the French company technical assistance and information regarding the processes of manufacture and to supply German chemists to supervise work in the French dye plants. In return the French company was to limit its field of commercial activity and allow the Germans a share of the profits. I was in Belgium when news of this arrangement was published in the London *Times* for Aug. 1, and I immediately took occasion to discuss the proposal with all who might be expected to have an opinion on it. The general reaction to this prospect of Germany becoming an international partner in the dye industry of various countries was distinctly favorable; and however surprising and distasteful this view may be to Americans, I am sure that as far as Europe is concerned it has much to recommend it. The nations of the world are all desirous of establishing their own dye industries, having been impelled to take this step as a matter of national defense, if not of industrial advantage. Germany, on the other hand, has 50 years of knowledge and experience in dye manufacture. It is well recognized that this knowledge and experience are of more value than all the plants that European countries can erect at the present time, if they find themselves unable to operate them efficiently. Why, then, it is not good business for France or any other country to enter into an agreement with Germany whereby the latter will furnish the necessary knowledge, experience and supervision of manufacture in return for a share of the profits? France can thus at one stroke obtain the benefit of 50 years of experience; can begin immediately the establishment of a domestic dye industry; can train her own chemists and technicians in the necessary technique of the business, and ultimately develop at home a dye industry quite as efficient and serviceable as exists in Germany itself.

Advantages of Franco-German Dye Industry Agreement

Much has been made of the necessity for establishing a dye industry in countries other than Germany on account of the close relation of this business to chemical warfare. The industry is rightly recognized as a factor in national defense, although I feel that Germany's erstwhile advantage in this respect has now largely disappeared. And with the continued infiltration of German dye chemists into France and other countries and the gradual building up of a domestic industry and trained personnel, the German advantage is bound to diminish to a point where it will disappear altogether. No one knows better than the Germans that their original advantage lay in their knowledge and experience, more than in their plants; and accordingly it is they who recognize the waning of this advantage as the other nations develop experienced men.

*This is the sixth of a series of articles by Mr. Negru on this subject. The preceding articles appeared in the issues of Oct. 18, Oct. 25, Nov. 8, Nov. 15 and Nov. 22.

Regardless of how others may look at the problem, the French see clearly the advantage of using their present plants as practical schools under German tutorship, knowing that otherwise the industry will become more and more of a liability. This is a beginning in the international diffusion of knowledge that in my judgment will do more than solemn peace agreements to abolish chemical warfare, by putting the nations of the world on an equal footing with respect to it. This view is prevalent even among some thoughtful heads in Germany who know that it is not plants, but chemists, that really count. Plants can be erected quickly enough, but chemists cannot be made to order, at least not on short order.

Synthetic Nitrogen Industry

The synthetic nitrogen industry is absorbing the attention of the French to a degree even greater than that of her dye industry. This results from the ever-increasing need of ammonia fertilizers. Thus the French consumption of ammonium sulphate was only 127,000 tons in 1921, when more than 300,000 tons is needed. Warm debates and discussions are held as to whether France shall adopt the Haber-Bosch process in her prospective plants or whether she shall wait until Claude has solved all the problems of commercial production by his high-pressure process. The cyanamid process also has its advocates, and even the arc process is considered. The question is so important that the French Society of Civil Engineers devoted two meetings to a discussion of the problem. The four processes were presented by experts, and later the relative merits of each were discussed by chemists and engineers in the hope of reaching a well-considered decision. Messrs. Gros, Patart, Claude and Garaix presented respectively the arc, Haber-Bosch, Claude and cyanamid processes. The weight of opinion is in favor of the second and third, although no final conclusion has been reached.[17]

Fuel for Internal Combustion Engines

One of the most important problems now confronting France is the development of a new fuel for internal combustion engines. It it known that she possesses very small petroleum fields and that practically her entire requirements of gasoline have to be imported. On the other hand, France is a large producer of alcohol and a great deal of experimenting has been done to use at least a part of this material as fuel. The first practical attempts were not very encouraging, and it seemed that something would have to be done to encourage further experimenting. With this in view the Agricultural Committee of Béziers instituted a national competition, offering prizes for the best practical solution of the problem. The main requisite is that the fuel shall contain at least 10 per cent alcohol. The result of this competition was made public on April 9, 1922, and revealed more than 100 formulas which were submitted to a specially instituted committee for exhaustive study.

The principal difficulty to be overcome in producing a suitable fuel is to bring about a homogeneous mixture of commercial alcohol and gasoline. The methods presented were classified into two general groups. In the first, a third liquid is added to act as a solvent for the mixture of commercial alcohol and gasoline, the main solvents suggested being butyl alcohol, cyclohexanol, noncaustic derivatives of cresols and isopropyl alcohol. In the second, methods were proposed for dehydrating commercial alcohol and thus making possible the comparatively easy mixture of absolute alcohol and gasoline.

Other suggestions involved the mixture of light oils and commercial alcohol, while still others proposed the use of fractions from the distillation of wood tar. Finally, another group of suggestions proposes the use of an easily obtained admixture of alcohol and an ether derived from alcohol.[18]

Iron and Steel

The iron and steel industry of France is one of great potentiality. She is now a leading producer of iron ore, and the market for this ore as well as for the finished product is most encouraging. For years to come she will have as her own best customer her war-devastated industries.

There is much talk in France and in Belgium about the policy of the French Government in raising an almost prohibitive tariff against the importation of finished products of iron and steel. Belgium especially resents this, as she is suffering quite as much from the French policy as she did from German competition. Another even stronger complaint of the Belgian metallurgist is that although the French compete effectively for export business, they prevent the importation of iron and steel even when Belgian bids are lower than their own. This leads to the conclusion that French metallurgical companies are getting for their products in their home market prices above those asked by the Belgians.[19]

Development of Hydro-Electric Power

The development of French hydro-electric power is very encouraging. A little over 2,000,000 hp. is now being developed, and new plants are constantly being built. In this connection the activities of the Electrochemical and Electrometallurgical Institute at the University of Grenoble have been of the greatest service, because through it France is enriched every year with a number of engineers particularly familiar with hydroelectric development. In addition to this, the magazine *La Houille Blanche*, devoted entirely to water power, is keeping the French engineers informed of progress in this important industry.

The electrification of the greater part of the French railways is seriously studied, but no definite plans have been announced. I was impressed with the great field for this development when I observed coal-fired interurban tramways within walking distance of the Romanche River in the Grenoble district with its many hydro-electric plants.

France as an Industrial Country

The potentiality of France as a great industrial country is conspicuous to an engineer traveling from border to border. It will be necessary for her to import fuel for many years to come, but the steady development of her water-power resources will enable her gradually to overcome this handicap. Her colonies will supply her with many of the raw materials which she is now lacking, and to a certain extent even with common labor. With respect to the latter, however, I learned that France is now making tempting offers in her western

[17] A summary of the proceedings of these meetings will form the subject a separate article in this journal.

[18] A detailed description of the effort to develop a national liquid fuel for France (Comburant National) will form the subject of a separate article in this magazine.

[19] The *Exportateur Belge* of July 9 cites the case of Belgian rails being offered in France at about 20 francs per ton less than the price asked by the French, and yet the Belgians did not get the order.

industrial districts for immigrants from Italy, Poland, Spain and other eastern and southeastern European countries.

France still has many difficulties to overcome, the principal one being her fear of German aggression, against which she feels the need of assurance. In consequence of this fear she is now in the full grip of a military preparedness policy that imposes upon her economic system a heavy burden in military expenditures, in addition to depriving her of the productive work of many hundreds of thousands of young Frenchmen.

Trip Through Italy and Switzerland

My trip through Italy and Switzerland was only of short duration and I did not have an opportunity to corroborate my first impressions by a subsequent trip. It must suffice, therefore, for me to say that both these countries are suffering from unemployment and that their economic ills are the consequence of the fact that Italian money is badly depreciated, while Swiss money is still worth its face value.

In Italy the domestic industries are suffering because, in the absence of domestic fuel and raw material, they are limited in their ability to import by the low exchange value of the lira. Apparently it is much cheaper to import finished German goods, especially in view of the German industrial policy of exporting at ridiculously low prices. I was told that practically all of the money received in payment for these imported products is invested by the German industrials in Italian industries, and that this policy is assuming alarming proportions.

In Switzerland, with her money at pre-war value, it is practically impossible for domestic industries to compete with those of any other European country. Accordingly, Germany is very active in supplying Switzerland with finished products, especially in view of the fact that they are paid for with Swiss francs, which are then placed to the account of the exporters in Swiss banks. Pre-war revenues from tourists, which formerly assumed large proportions, are now practically non-existent, due to the high cost of living. Switzerland is, therefore, among the least favored of the European countries from an economic point of view. As already shown in a previous article, Swiss manufacturers are reduced practically to the rôle of middlemen for German manufactured goods—a very pathetic situation.

Both Swiss and Italian banks, I was told, are enjoying a large and profitable business due to the abnormal conditions in international exchange, and the large volume of German commercial transactions.

At Geneva I had an opportunity to investigate the objects and workings of the International Bureau of Labor. This will form the subject of a separate article on this important adjunct of the League of Nations.

Other articles on this subject by Mr. Negru will appear in subsequent issues.

Weighing CO_2

IT HAS been recognized that excess air is the enemy to economy of boiler operation, and it is no longer unusual to see the engineer hunting for air leaks on the outside of the furnace with a smoky candle. Perhaps the one source of excess air which is most damaging and at the same time the most difficult to detect is a hole through the bed of fuel—in other words, what the fireman knows as a "hole in the fire." This, of course, may be caused in various ways. The fire may burn out faster at one point than at another, the fuel bed may not have been placed on the grate evenly, etc. In the case of hand fires, one of the principal duties of the fireman is to watch for such holes in the fire as they admit excess air, which, passing up the chimney, carries with it valuable heat.

Holes in the fire are difficult to detect in the case of some mechanical stokers, especially where boilers are placed close together in battery or there is a forced draft arrangement boxing in the grates. To detect holes in the fire should be one of the principal functions of the CO_2 apparatus, and to do this the apparatus should be of such a nature and location as to communicate the message to the fireman promptly. In other words, as a steam gage indicating the boiler pressure located in the chief engineer's office would be very little help to the fireman, so also the CO_2 apparatus placed too far away from the firing floor is of little use to him.

There is another difficulty with some CO_2 apparatus as it exists today, and that is that the scheme depends on the dissolving of the CO_2 gas in potassium hydrate solution. This means that the apparatus is, in a sense of the word, a small chemical laboratory. It is slow in operation, expensive, more or less troublesome to maintain, so placed as to be of little use to the man on the firing floor and, above all, necessarily operating in such a way as to deliver its message some little time after the condition took place in the furnace. So far as the CO_2 apparatus is concerned, the fireman is still going it blind as a general thing.

Some months ago Dr. Zacharius Olsson, who has had considerable experience in power house work, had his attention called to the inadequacy of the present method of following excess air and CO_2 from the standpoint of the man on the firing floor. Appreciating how valuable it would be to the fireman to have some sort of an indicator that could be placed on the front of the boiler exactly as the steam gage is placed and which would require no more attention than does the steam gage, Dr. Olsson conceived the idea of building a CO_2 apparatus which would weigh the gases as they pass through and indicate differences in CO_2 percentage by gravity rather than to use the principle of dissolving them in solution with all the attendant evils of the small laboratory. There would be no solutions, no glass containers, no laboratory—simply a weighing machine reduced to its lowest terms and of the simplest possible nature.

The writer remembers a visit to Dr. Olsson's laboratory at Staten Island where he saw this gravity CO_2 apparatus attached to a small heater. It was interesting to note how the doctor could make the pointer go down from 14 per cent to zero in 3 or 4 seconds by opening the fire door, bringing it back to maximum again almost instantaneously by reversing the process. This might be called remarkable considering the lag of the ordinary apparatus due to the necessity of dissolving and measuring the sample of gas.

No large modern boiler plant is now considered efficient or complete unless it has been provided with steam flow meters, automatic feed regulators, draft control, soot blowers, feed water treatment and control, pyrometers and, not least of all, CO_2 apparatus. Dr. Olsson's CO_2 indicator will go a long way toward bringing this particular instrument into the easy range of vision of the man handling the shovel.

Decarburizing Ferrochromium by Hydrogen

By Louis Jordan and F. E. Swindells
Chemist and Assistant Chemist Bureau of Standards

Rustless Iron

CONSIDERABLE publicity has recently been given to the development in England of a rustless or stainless iron and the uses to which such material may be put. Stainless steel has become a familiar class of material. It contains in the neighborhood of 13 to 16 per cent chromium and usually 0.3 to 0.4 per cent carbon. Rustless iron contains about the same proportions of chromium, but its carbon content is lower, in the neighborhood of or less than 0.1 per cent.

Some of the advantages claimed for rustless iron[1] over stainless steel are that it is more ductile, more easily rolled or forged, does not require special heat-treatmnt of the ingots before working, and machines more readily. It is said to have stainless or rustless properties close to those of stainless steel. It is also stated that marine growths will not adhere to plates rolled from rustless iron.

Need for Low-Carbon Ferrochromium

Commercial ferrochromium contains 60 per cent chromium and 4 to 8 per cent carbon. In order to produce an iron alloy containing not over 0.1 per cent carbon and as high as 12 per cent chromium it is evident that such alloy cannot be used. In order to produce a 12 per cent chromium alloy with not over 0.1 per cent carbon a 60 per cent ferro should contain not more than 0.5 per cent carbon.

"Carbon-free" metallic chromium and ferrochromium is manufactured by aluminothermic reduction methods. These materials, however, command 40 to 60 cents per pound of contained chromium, as against about 11 cents for the ferro containing 4 to 6 per cent carbon. Chromium in 100 lb. of rustless iron would cost from $4.80 to $7.20 when added as carbon-free aluminothermic alloys. Rustless iron would thus be too seriously handicapped in commercial uses compared with ingot iron, copper-bearing steel, or many non-ferrous metals.

It is reported that an English process for low-carbon ferrochromium enables a selling price of 20 cents per pound for ferro containing only 0.25 per cent carbon.[2]

Refining High-Carbon Ferrochromium

Recent patents have described the production of low-carbon ferrochromium by subjecting crude, high-carbon ferro to an oxidizing blast in a converter;[3] to electric furnace treatment with oxides of iron or chromium,[4] or of titanium,[5] or by blowing molten high-carbon ferrochromium in a converter with the injection into the blast of steam, or some other gas or vapor.[6] Ballantine has also patented[7] the method of reduction of chromium oxides with calcium carbide in the presence of an alkaline earth oxide with or without calcium silicide or aluminum. A still more recent patent[8] claims the method of producing rustless steel containing low carbon by adding a mixture of aluminum and chromium ore to a molten decarburized steel in an electric furnace.

Decarburization by Hydrogen

The use of hydrogen for the removal of carbon from iron and iron alloys has previously been suggested and demonstrated experimentally. Schmitz[9] showed that heating cast iron in hydrogen at 1,200 deg. C. for ½ hr. reduced the carbon from 3.46 per cent to 2.74; by further successive heatings of 2 to 3 hours each the carbon was reduced to 2.16, 1.38, 0.53, and finally to 0.03 per cent. Plain carbon steels were appreciably decarburized in 15 to 35 minutes at 1,200 deg. C. A 25 per cent nickel steel containing 0.99 per cent carbon was treated three successive times for 2 hours each. The carbon dropped to 0.61, 0.11 and 0.08 in the successive heatings. Schmitz also heated 0.05 gram of "kish" for 15 hours at 1,100 deg. C. in hydrogen; it lost 63 per cent of its weight. A 0.2-gram sample of graphite heated 3 hours at 1,000 deg. C. in hydrogen lost 8.7 per cent of its weight.

Campbell[10] decarburized several steels by heating in moist hydrogen at 950 to 1,000 deg. C. for 4 to 12 days. Chromium-molybdenum steel of an original carbon content of 1.67 per cent was reduced to 0.22 per cent after 12 days at 950 to 1,050 deg. C. Campbell concludes from results on plain carbon and alloy steels that pure carbides of iron are less stable when in solid solution than are the carbides which are formed if some other elements are present—e.g., manganese.

Austin[11] has recently described the surface decarburization of three carbon steels treated in both moist and dry hydrogen at several temperatures between 400 and 1,000 deg. C.

Ferrochromium used in the present tests was a commercial grade crushed to pass 80 mesh. This fine material contained 56.6 per cent chromium and 8.47 per cent carbon. The results of all tests are summarized in Table I.

Action of Hydrogen on Solid Ferrochromium

Twenty grams of the material was placed in a silica boat and heated within a silica tube at 900 deg. C. in a nichrome-wound electric combustion furnace. Temperatures in all runs in tube furnaces were controlled by the power consumption of the furnace, a calibration having previously been made with the thermocouple placed in the usual position of the boat. Hydrogen gas used was commercial compressed hydrogen purified by passing successively through tubes containing soda lime, platinized silica at a red heat, concentrated sulphuric acid and phosphorus pentoxide. Carbon dioxide, oxygen and moisture should be removed by this purification.

In the first trial the pure dry hydrogen was passed over the sample of ferrochromium for 1 hour after the furnace tube reached the desired temperature. The rate of passage of hydrogen was 4½ liters per hour. Three-quarters of an hour was required for the boat to reach 900 deg. C. The sample was cooled in the stream of hydrogen. Analysis of the treated sample showed no loss in carbon. (Table I.)

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[1] L. Aitchison, *Foundry Trade Jour.*, vol. 24, p. 418 (1921), also pp. 413 and 435, *Chem. & Met.*, Oct. 12, 1921, p. 717; Dec. 14, 1921, p. 1108.

[2] *Iron Age*, vol. 109, p. 597 (1922).

[3] W. B. Ballantine, U. S. Pat. 1,386,981; Brit. Pat. 159,568; *Chem. Abs.*, vol. 15, p. 2060.

[4] A. W. Clement, U. S. Pat. 1,365,091; *Chem. Abs.*, vol. 15, p. 824.

[5] H. C. Sicard, U. S. Pat. 1,341,939; *Chem. Abs.*, vol. 14, p. 2141.

[6] Krupp Akt.-Ges., Brit. Pat. 148,456; *Chem. Abs.*, vol. 15, p. 230.

[7] W. B. Ballantine, Brit. Pat. 152,399; *Chem. Abs.*, vol. 15, p. 667.

[8] W. B. Hamilton and T. A. Evans, Brit. Pat. 174,271; *Chem. Abs.*, vol. 16, p. 1737.

[9] F. Schmitz, *Stahl und Eisen*, vol. 39, p. 373 (1919).

[10] E. D. Campbell, *J. Iron and Steel Inst.*, vol. 100, p. 407 (1919).

[11] C. R. Austin, *J. Iron and Steel Inst.* (advance proof), May, 1922; *Chem. & Met.*, Sept. 6, 1922, p. 510.

TABLE I—DECARBURIZATION OF FERROCHROMIUM BY HEATING IN HYDROGEN

Run No.	Duration of Run; At Max. Temp. Hr.	Min.	Approx. Temp. Fe-Cr., Deg. C.	Carbon in Original Fe-Cr, Per Cent	Carbon in Fe-Cr After Treatment, Per Cent	Reduction in Per Cent Carbon In Fe-Cr.	Remarks
1	1	0	900	8.47	8.57	....	.....
2	1	30	1,000	8.47	8.14	0.33	Fe-Cr, noticeably oxidized after treatment. Moist hydrogen used.
3	3	30	1,000	8.47	8.14	.33	Fe-Cr, oxidized. Moist hydrogen used.
4*a*	4	15	1,100	8.47	8.16	.31	Fe-Cr, bright, indicating no oxidation.
4*b*	2	45	1,100	8.16	8.14	.02	Residue from Run 4*a* reheated.
4*c*	4	15	1,100	8.14	7.88	.26	Residue from Run 4*b* reheated.
7	4	0	1,350	8.41	6.54	1.87	Unfused portion.
					5.21	3.20	Fused portion.
8	4	0	1,350	8.41	6.80	1.61	Unfused portion.
					6.23	2.18	Fused portion.
9	..	4	1,500–1,600	8.47	7.50	0.97	Hydrogen bubbled through molten Fe-Cr.
10	..	20	1,600–1,700	8.47	6.91	1.56	Hydrogen blown on surface of molten Fe-Cr.

The conditions in run 2 were modified to conform more nearly to those used by Campbell[10] in the decarburization of steels. The hydrogen, free from oxygen, was bubbled through water at room temperature before passing into the furnace. The temperature of the furnace was raised to 1,000 deg. C. The heating period: 1 hour to reach 1,000 deg. C. and 1½ hours at full temperature. The carbon in the sample after treatment was 8.14 per cent, a drop of 0.33. A longer test, other conditions being repeated, gave no greater loss in carbon. In both runs, the ferrochromium was noticeably oxidized. Carbon may have been lost due to oxidation by moisture rather than reduction by hydrogen.

Consequently, in trials 4a to 4c the hydrogen entered the furnace dry. At the same time the temperature was increased to 1,100 deg. C. Tests 4b and 4c (Table I) represent a second treatment of the ferro-alloy used in 4a and 4b, a small sample for carbon determination being removed between heatings. For runs 4a to 4c the total time of heating was 11¼ hours, but the total loss in carbon was only 0.57 per cent. After treatment the ferro was bright and not oxidized.

It thus appears that somewhere between 900 and 1,100 deg. C. the reduction of carbon by dry hydrogen became appreciable, although the reaction was slow at the upper temperature. The next tests were made with a still further increase of temperature.

A platinum-wound tube furnace was used in runs 7 and 8. A porcelain tube was used to contain the boat and sample, and in experiment 7 the boat also was of porcelain. The furnace was operated at 1,350 deg. C. and the hydrogen was thoroughly dried as before. When the boat was removed (after 4 hours' heating) it was found that the ferro-alloy in one end had melted, while in the other end it was slightly sintered. Analysis showed a loss of 1.87 per cent carbon in the unfused portion and 3.20 per cent in the fused portion. There were indications of some attack of the glaze of the porcelain boat by the molten ferrochromium, and the greater loss of carbon in the fused portion might have been caused by reaction with this glaze.

In the next trial all conditions were identical with the exception that an alundum boat was used. After heating, the sample was found to have been partly melted as in run 7. The loss of carbon was 1.61 per cent in the unfused portion and 2.18 in the fused.

The two tests at 1,350 deg. C. pointed to the conclusion that there is a sudden and marked change in the rate of decarburization at the melting point of the ferro-alloy. The Krupp patent[6] seems to cover the use of any gas or vapor in the blast of the bessemer converter. The above tests would indicate that hydrogen might be used effectively in such a manner.

Action of Hydrogen on Molten Ferrochromium

To obain some indication of the effectiveness of blowing molten ferrochromium with hydrogen, two tests (Nos. 9 and 10) were made in which the ferro-alloy was melted in a high-frequency induction furnace. The alloy in experiment 9 was melted in a magnesia crucible under a stream of hydrogen and then held somewhat above 1,500 deg. C. and dry hydrogen bubbled through the melt for 4 minutes by means of a fused silica tube leading to the bottom of the crucible. This silica tube was corroded slightly. Carbon was reduced from 8.47 to 7.50. That this loss in carbon was not due to oxidation by silica from the small tube was indicated by the fact that the silicon in the original ferro-alloy was 0.87 per cent, while after run 9 it was 0.55 per cent. The efficacy of blowing molten ferrochromium with hydrogen is striking when compared with the reduction of 1.87 per cent in the unfused alloy after heating for 4 hours at approximately 1,350 deg. C.

Molten metal heated by direct induction is very rapidly stirred by the magnetic flux. It was thought worth the trial to make a test in which hydrogen was blown only on the surface of molten and rapidly stirred ferrochromium. For run 10 the alloy was melted in a crucible made of 85 per cent magnesia and 15 per cent zirconium silicate. The molten metal was unintentionally permitted to attain a temperature of 1,700 deg. C., a much higher temperature than in run 9, and the silica tube through which the hydrogen was flowing was rapidly melted off at the end, although not touching the molten metal. Hydrogen was blown on the surface of the melt for 20 minutes.

The carbon content of the alloy in this run was reduced from the original 8.47 to 6.91, a loss of 1.56 per cent. This loss in carbon was caused in large part by the reduction of silica at this high temperature, as is indicated by the increase of the silicon content of the ferrochromium from the original 0.87 to 1.61 per cent.

Summary

These preliminary tests indicate that while the decarburization of ferrochromium by means of hydrogen takes place to some extent at temperatures below the melting point of the alloy, the most promising condition for refining high-carbon alloy by this method is probably by blowing the molten alloy with a blast of hydrogen in a converter.

Metal Corrosion Report

"Corrosion of Metals and Materials by Acids and Alkalis" is a report by Maurice Siegel, who has made an elaborate study for the Chemical Division of the Chemical Warfare Service. The report is made up of an extended discussion of the theoretical considerations and practical methods of measuring corrosion, supplemented by a full bibliography and a tabular summary of many hundred experimental results which have been calculated to a common basis of presentation. It may be obtained from the Chief of Chemical Warfare Service, Washington.

Evaporation—A Study of the Various Operating Cycles In Triple Effect Units

By A. L. Webre
Consulting Engineer

A General Method of Discovering the Best Operating Cycle for Triple Effect Evaporators Described—"Heat Balance" Worked Out for a Sample Case and the Type of Conclusions Which Can Be Reached Is Indicated

WE WERE TAUGHT in the old textbooks, and are still taught in some of the new ones, that in a multiple-effect evaporator, for each pound of steam supplied to the equipment, we obtain 1 lb. of evaporation in each vessel. This is not exactly true under any condition, and far from being true under average operating conditions. It was originally based on the assumption that for all pressures existing in the various bodies the latent heat of steam, L, was constant and to all intents and purposes 1,000 B.t.u. per pound. That this assumption is not justified is shown by the curve in Fig. 1, which shows the varying values of this latent heat within the range of temperatures commonly encountered in evaporator practice.

Another error which is quite prevalent is the fact that the liquid fed to the evaporator passes usually through the various bodies in series, from the high-temperature end to the low-temperature end, and as it goes from a hot to a cooler body a "flash," or self-evaporation, takes place, bringing the feed down to the temperature of the body into which it is entering. When this evaporation is taken into account, it has a very material effect on the balances of heat flow, depending upon the weight per unit of time and the range of temperature fall.

Temperature of Feed Liquor Most Important

By far the largest variable in estimating the amount of evaporation per pound of steam is the temperature of the liquid as it enters the multiple effect, as compared with the existing boiling temperature in the first body. Obviously if the liquid must be heated to the boiling temperature, steam must be used up which would otherwise be available for evaporation. On the other hand, if the liquid temperature is higher than that in the first body, a "flash" takes place and actually more than a pound of water will be evaporated per pound of steam. The same condition exists as a rule in the subsequent bodies of a multiple, since there is always a "flash," and the evaporation will be greater than the amount of vapor condensed on the steam side. Therefore, in making calculations of the evaporation possible in a given effect it is a matter of balancing the latent heat available from the condensation of steam in the calandria against the latent heat represented by evaporation on the liquor side, to which must be added the heat required to bring the liquor to a boil if it is too cold, or from which must be subtracted the heat represented by "flash" if it is too hot.

The Use and Calculation of Heat Balances

The only way to determine accurately the operation of an evaporator is by making a thorough study of the heat transferred, with the aid of a heat and liquor flow sheet, or heat balance, in which all the steps and their interrelations are shown. When conditions are known, it is not difficult, and this method of analysis permits us to acquire a comprehensive grasp of relatively complicated evaporator problems. We shall illustrate by submitting an analysis of what to our mind is one of the most interesting problems in evaporation—namely, the determination of the most advisable cycle of feed, governed by the consideration of steam economy alone.

Let us assume that we have a triple effect, whose bodies are numbered 1, 2, 3, beginning at the steam end and finishing at the condenser end. The question we wish to discuss is this:

All conditions being precisely the same, with the exception of the temperature of the liquid entering, which is variable, is it advantageous that the feed shall go through the three bodies in series, 1, 2, 3, commonly known as "parallel current," or 3, 2, 1, "counter-current," or shall each body be fed independently?

There are many conditions aside from heat economy which preclude the possibility of using some of these cycles, but we shall in this case assume that heat economy is the only determining factor.

In order to avoid unnecessary complications which would cloud the issue, we will arbitrarily assume the following conditions, which are not perhaps what we would find in practice, but which will serve well enough for this discussion, which we do not wish to complicate by the introduction of some forty-odd variables entering in evaporator work:

Liquid to be treated per hour	100,000 lb.
Evaporation required	70,000 lb.
Evaporation in triple effect.	
Initial feed temperature	Unknown and variable
Specific heat of solution	Unity
Viscosity	Negligible
Boiling temperature rise	Negligible

	St. Belt 1	St. Belt 2	St. Belt 3	Vapor Belt 3
Press and vac..	5.0 lb.	2 in vac.	14 in vac.	26 in vac.
Temperature...	227 deg.	209 deg.	182 deg.	125 deg.
Latent heat....	960.7 B.t.u.	972.2 B.t.u.	988.7 B.t.u.	1021.6 B.t.u.

Complete heat balances have been calculated for "parallel current" operation, also for "counter-current" and "parallel feed" for initial feed temperatures of 50, 100, 150, 200 and 250 deg. It would take up too much space to give them all completely here. We have therefore made abstracts for each cycle, giving the information required to compare performances. We shall detail for illustration one of these heat balances for each cycle, calculated for a feed temperature of 150 deg., as representing probable average conditions encountered in practice.

Calculation of "Parallel Current" Heat Balance

In the calculation given in Table I, we begin by admitting into the steam belt of the first effect 27,800 lb.[1] of steam per hour at a pressure of 5 lb. gage, corresponding to a temperature of 227, which upon condensation gives up its latent heat 960.7 B.t.u. per pound, making a total of 26,700,000 B.t.u. liberated.

[1]This figure is reached by a process of trial and error which necessitated calculating the complete heat balance after assuming this initial figure. Three or four calculations are usually sufficient to arrive at a figure which will check out within operating limits of accuracy.

TABLE I—PARALLEL CURRENT HEAT BALANCE
Feed Temperature = 150 deg. F.

Specifications:	Heat	Liquor
(1) Steam, 27,800 lb. @ 5 lb. = 27,800 × 960.7 =	26,700,000	100,000
Deduct for heating 100,000 × (209 − 150 = 59)	5,900,000	
Available for evaporation	20,800,000	
L @ 209 = 972.2. $E_1 = \frac{20,800,000}{972.2}$ =		21,400
		78,600
(2) Vapor ex. 1	20,800,000	
Add flash, 78,600 × (209 − 182 = 27) =	2,120,000	
Available for evaporation	22,920,000	
L @ 182 = 988.7. $E_2 = \frac{22,920,000}{988.7}$ =		23,200
		55,400
(3) Vapor ex. 2	22,920,000	
Add flash, 55,400 × (182 − 125 = 57) =	3,160,000	
Available for evaporation	26,080,000	
L @ 125 = 1,021.6. $E_3 = \frac{26,080,000}{1,021.6}$ =		25,500
Excess		29,900

This is transmitted to the liquor through the heating surface, part of it being used to bring the feed temperature to the boiling point, in this case, 209. The initial temperature being 150, the necessary rise is 209 — 150, or 59. Inasmuch as the entire feed enters the first body, we must heat it all, 100,000 lb., through this rise of 59 deg., thus absorbing 5,900,000 B.t.u. The heat left available for evaporation is therefore 26,700,000 — 5,900,000, or 20,800,000 B.t.u. The latent heat at the temperature of ebullition, 209 in the first effect, is 972.2 B.t.u. per pound. The evaporation in the first effect will therefore be 20,800,000 divided by 972.2, or 21,400 lb., and the amount of feed transferred from the first to the second effect will be the amount of the original feed, 100,000 lb., less this evaporation, 21,400, or 78,600.

For the second effect, we obtain heat from two sources: First, the vapor from the first effect, which upon condensation gives up its latent heat, shown above

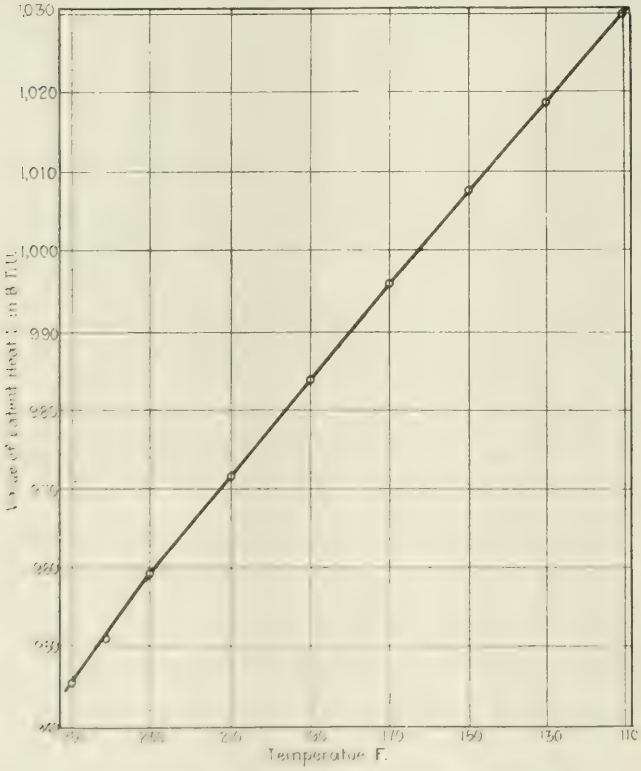

FIG. 1—VARIATION OF LATENT HEAT WITH TEMPERATURE

to be 20,800,000 B.t.u.; and second, the heat obtained from the flash or self-evaporation taking place when the feed leaves the first body at a temperature of 209 and enters the second at 182, thus giving up 27 B.t.u. per pound. The amount of this liquor being 78,600, as shown above, the total heat liberated in this way will be 78,600 times 27, or 2,120,000 B.t.u., making a total of 22,920,000 available for evaporation in the second body. The latent heat at this point at the existing temperature of 182 is 988.7 B.t.u. per pound, and the corresponding evaporation will be 22,920,000 divided by 988.7, or 23,200, and the liquor transferred from the second to the third effect will be the amount which entered this body, 78,600, less this evaporation, 23,200, or 55,400 lb. per hour.

A similar exchange takes place in the third effect. First the vapor from the second body condenses, giving up its latent heat, shown above to be 22,920,000 B.t.u., and the feed from the second flashes down from its original temperature of 182 to that of the third effect, 125, thus giving up 57 B.t.u. per pound. The quantity being 55,400 lb., the heat thus liberated is 3,160,000 B.t.u., which when added to the above gives us a total

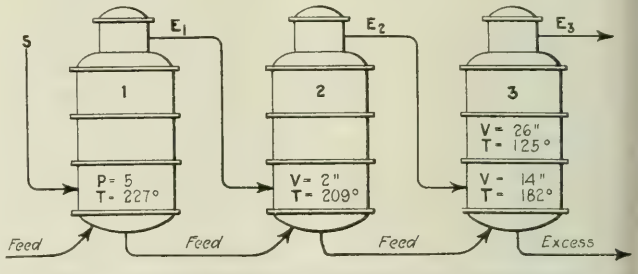

FIG. 2—DIAGRAMMATIC SKETCH OF PARALLEL CURRENT OPERATION

of 26,080,000 available for evaporation in the third effect. The latent heat of steam at the third body temperature, 125, is 1,021.6 B.t.u. per pound, and the evaporation here is therefore 25,500 lb. per hour, which when deducted from the feed into the third effect, 55,400 lb., leaves 29,900 lb. which is removed from the last body as concentrated liquor. This compares closely with the 30,000 which we should obtain. The variation is negligible.

Fig. 2 is a diagram plotted from a summary of the five heat balances calculated for various feed temperatures for "parallel current" operation, which represents the cycle used most extensively. The reader must bear in mind that in all these cases the total evaporation for the triple effect is the same—namely, 70,000 lb. per hour—and the total feed is the same, 100,000 lb. per hour. The only variation is in the temperature of this feed. The steam supply is then varied to give 70,000 lb. evaporation per hour in all cases. With the "parallel current" cycle the evaporation in each body does not vary as the temperature of the feed changes. By referring again to the heat balance shown in Table I the reason for this can be readily seen. In order to accomplish the evaporation required, the first body must produce 21,400 lb. of vapor. In order to do this, there must be available for evaporation 20,800,000 B.t.u. If the liquor enters at the boiling point, then we must put into the steam belt of the first effect 20,800,000 B.t.u. by condensing the corresponding amount of steam. If the feed is below the boiling point, we must add sufficient heat to bring it to a boil, increasing the steam consumption to that extent. If, on the other hand,

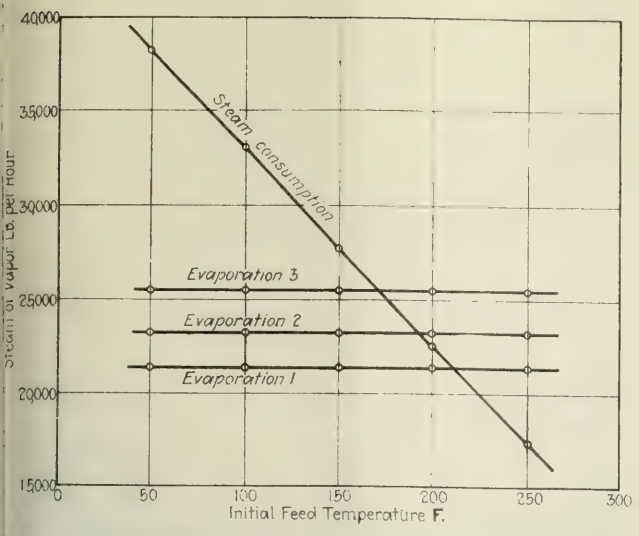

FIG. 3—TRIPLE EFFECT PERFORMANCE WITH PARALLEL CURRENT OPERATION AT VARYING TEMPERATURES

iquor enters above the boiling point, a corresponding lash takes place, liberating a certain amount of heat, hus decreasing the amount of steam required to make ıp the necessary 20,800,000 B.t.u. as vapor leaving the irst body. The evaporation is greater in the second han in the first effect, and greater in the third than in he second, for reasons discussed previously. The tem- erature of the concentrated liquid is 125 deg. F. It ıust be noted that the steam consumption varies within ather wide limits as the feed temperature changes, a act well worth remembering.

"Counter-Current" Heat Balance

We shall now go over the calculations for the counter-current" heat balance, summarized in Table I. In this case we find it easier to work backward, nasmuch as the feed flows backward.

We begin by feeding into the third effect 100,000 lb. f liquor at the given temperature of 150. We evap- rate by assumption 22,880 lb. at this point. The tent heat of steam at the existing temperature, 125, 1,021.6 B.t.u. per pound, and the heat in this vapor therefore 22,880 times 1,021.6, or 23,360,000. Part this heat is derived from the flash or self-evaporation the feed, 100,000 lb., which enters at 150 deg., opping down to the boiling point, 125, and giving up 5 B.t.u. per pound, or a total of 2,500,000 B.t.u. Inas- uch as the vapor contains 23,360,000 B.t.u., as stated ove, the difference, 20,860.000 B.t.u., must be made by the condensation in the steam belt of the third effect of vapors from the second at a temperature of 182, having a latent heat of 988.7 B.t.u. per pound. The amount of vapor thus condensed will therefore be 20,860,000 divided by 988.7, or 21,100 lb., which of course represents the evaporation in the second effect.

The feed transferred from the third to the second effect is the total feed, 100,000 lb., less the evaporation in the third effect, shown above by assumption to be 22 880 lb., giving us 77,120.

In the second effect, we must supply not only the latent heat contained in the vapors going to the third, shown above to be 20,860,000 B.t.u., but in addition we must heat up the feed, 77,120 lb., transferred from the third effect at a temperature of 125 to the second at a temperature of 182, a rise of 57 deg., giving us 77,120 times 57, or 4,400,000 B.t.u., which when added to the latent heat of the vapor above, 20,860,000, gives 25,260,000 B.t.u. as the total heat requirements in the steam belt of the second body. Now the temperature of this steam is 209 and the latent heat for this is 972.2. The amount of steam condensed in the steam belt of the second effect will therefore be 25,260,000 divided by 972.2, or 26,000 lb., which is also the evaporation in the first effect.

The feed transferred from the second to the first effect will be the amount fed into the second from the third, 77,120, less the evaporation in the second, shown above to be 21,100, or 56,020 lb.

In the first effect, we must also provide heat enough to correspond to that contained in the vapors therefrom, given above as 25,260,000 B.t.u., plus the heat required to bring up the feed, 56,020 lb., from the temperature of the second body, 182, to the temperature of the first, 209, a rise of 27 deg., thus making up 56,020 times 27, or 1,511,000 B.t.u., which, when added to the heat in the vapors from this effect, 25,260,000, gives a total of 26,771,000 B.t.u. This heat must be supplied by condensing steam in the first steam belt at a temperature of 227, at which the latent heat of steam is 960.7 B.t.u. per pound. The quantity of steam required is therefore 26,771,000 divided by 960.7, or 27,850 lb. per hour.

The concentrated liquor discharged from the first effect will be the amount fed from the second to the first, 56,020, minus the evaporation in the first, shown above to be 26,000, giving us 30,020. In this case also, by premise, this quantity should be 30,000.

In Fig. 5 the heat balances are plotted graphically for different temperatures. The feed enters the third body, and is pumped from there to the second and then to the first, going in opposite direction to the steam, hence the name. The evaporation in each body varies considerably as the initial feed temperature changes. The steam consumption as well as the evaporation in the first and second effect decreases as the feed tem-

TABLE II—COUNTER-CURRENT HEAT BALANCE
Feed Temperature = 150 deg. F.

Specifications:	Heat		Liquor
Vapor ex.3 = 22,800@26 lb. = 22,880×1,021.6=23,360,000			100,000
Deduct flash, 100,000 × (150 − 125 = 25) = ..	2,500,000	E_3 =	22,880
Heat required S.B.3	20,860,000		77,120
L@182 deg. = 988.7. $E_2 = \frac{20,860,000}{988.7} =$		E_2 =	21,100
Vapor ex. 2	20,860,000		56,020
Add for heating, 77,120 × (182 − 125 = 57) =	4,400,000		
Heat required S.B.2	25,260,000		
L@209 = 972.2. $E_1 = \frac{25,260,000}{972.2} =$ ...		E_1 =	26,000
Excess			30,020
Vapor ex. 1	25,260,000		
Add for heating 56,020 × (209 − 182 = 27) = ..	1,511,000		
Heat required S.B.1	26,771,000		
L@227 deg. = 960.7. Steam = $\frac{26,771,000}{960.7}$	.....		27,850

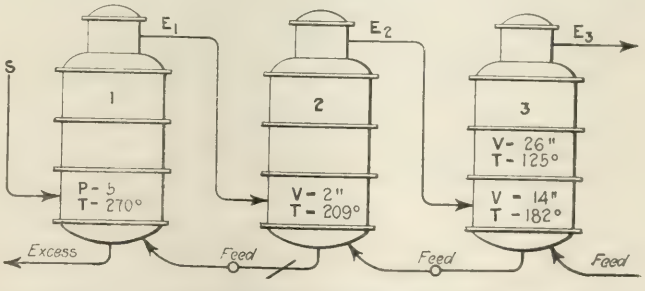

FIG. 4—DIAGRAMMATIC SKETCH OF COUNTER-CURRENT OPERATION

TABLE III—PARALLEL FEED HEAT BALANCE

Feed Temperature, 150 deg. F.

Specifications:		Heat	Evaporation
(1) Heat available steam belt No. 1. 26,700 lb. at 5 lb. = 26,700 × 960.7 =		25,680,000	
Heat required per lb. evap. as follows: L@ 209 =	972.2		
Add for heating (70 per cent evap. $\frac{100}{70} \times (209 - 150 = 59)$ =	84.3		
Total	1,056.5		
Evaporation 1 = $\frac{25,680,000}{1056.5}$ =			24,300
(2) Heat available steam belt No. 2. 24,300 lb.@ 209 deg. = 24,300 × 972.2 =		23,600,000	
Heat required per lb. evap. as follows: L@ 182 =	988.7		
Add for heating (70 per cent evaporation) $\frac{100}{70} \times (182 - 150 = 32)$ =	45.7		
Total	1,034.4		
Evaporation 2 = $\frac{23,600,000}{1,034.4}$ =			22,800
(3) Heat available steam belt No. 3. 22,800 lb @ 182 deg. = 22,800 × 988.7 =		22,550,000	
Heat required per lb. evap. as follows. L@ 125 deg =	1,021.6		
Deduct for flash (70 per cent evap.) $\frac{100}{70} \times (150 - 125 = 25)$	35.7		
Total	985.9		
Evaporation 3 = $\frac{22,550,000}{985.9}$ =			22,800
			69,900

perature increases. The evaporation in the third effect, however, does just the opposite. This is readily understood by studying the heat balance.

When the feed temperature is below 125, as it enters the last body, it must be heated up before it evaporates, thereby increasing the heat requirements in the steam belt. When this temperature, however, is higher than 125, a flash takes place, and this vapor is not used in multiple, but goes directly to the condenser. Thus, in the case of feed at 250, there is 12,500,000 B.t.u. liberated as flash and 17,750,000 of transmitted heat, making a total of 30,250,000 B.t.u. in vapor to the condenser. With temperature of feed at 50 deg. F., just the reverse takes place. There is 24,050,000 of transmitted heat, of which 7,500,000 is used in bringing the liquid to a boil and 16,550,000 represented as vapor.

It is to be noted that with counter-current operation there is a flash only in the last body and only when the temperature of the entering feed is above 125 deg. F., the boiling point. Except where there is a flash, each preceding body evaporates more than the succeeding one, for the liquid must be heated in each case before it evaporates, thus increasing the heat requirements of

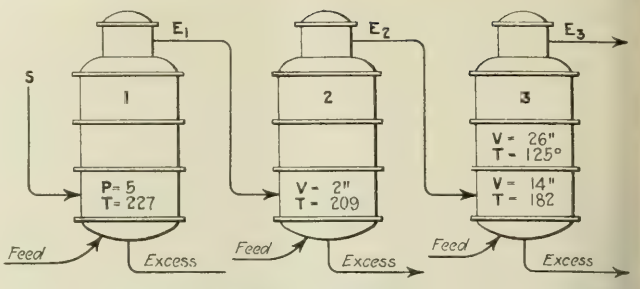

FIG. 6—DIAGRAMMATIC SKETCH OF PARALLEL FEED OPERATION

the second body over the third and the first over the second.

Generally speaking, the load on the condenser (the evaporation in the last effect) is much less than with "parallel current" operation, especially at low feed temperatures. It is also to be noted that the concentrated liquid leaves the first effect at a temperature of 209, as against 125 for parallel current operation, a fact well worth considering if subsequent heating operations are required after the concentrated material leaves the apparatus. When viscous materials are to be evaporated, it is very advantageous to operate "counter-current," as, in view of the high temperatures at high concentration, the annoying effects of high viscosity are very much reduced.

Parallel Feed Heat Balance

Parallel feed heat balance is calculated with initial feed at 150 deg. F., as before. (*Cf.* Table III and Fig. 7.) We begin by admitting 26,700 lb. of steam into the calandria of the first effect, obtaining for useful work its latent heat at the existing temperature 227, which is 960.7 B.t.u. per pound. The heat thus liberated is therefore 25,680,000 B.t.u. Each pound evaporated will require in the first place an amount of heat equal to the latent heat at the temperature existing in the first effect, 209, or 972.2 B.t.u. This pound which we are to evaporate represents only 70 per cent of the corresponding liquor fed, for, by premise, we evaporate 70 per cent by weight in each body. We must heat this liquor from its initial temperature of 150 to the temperature of the first body, 209, a range of 59 deg.; therefore the amount of heat required for this operation will be 59 divided by 0.7, or 84.3 B.t.u. per pound of evaporation, which when added to the latent heat above, 972.2, gives a total of

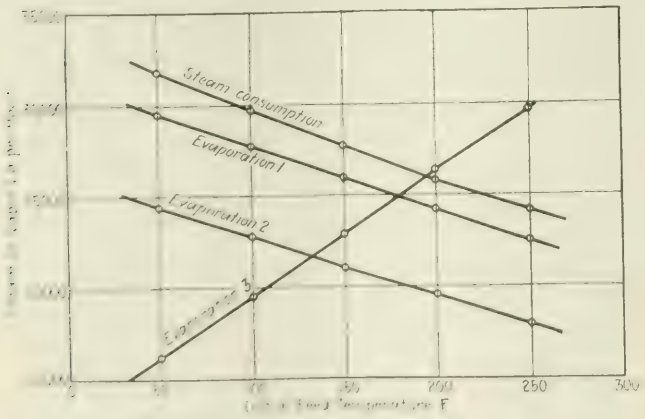

FIG. 5—TRIPLE EFFECT PERFORMANCE WITH COUNTER-CURRENT OPERATION AT VARYING TEMPERATURES

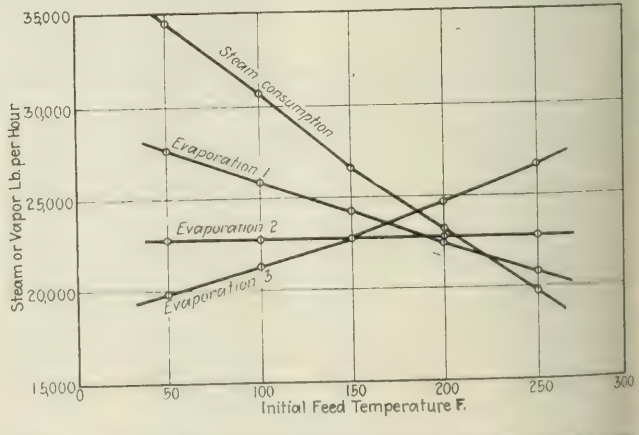

FIG. 7—TRIPLE EFFECT PERFORMANCE WITH PARALLEL FEED AT VARYING TEMPERATURES

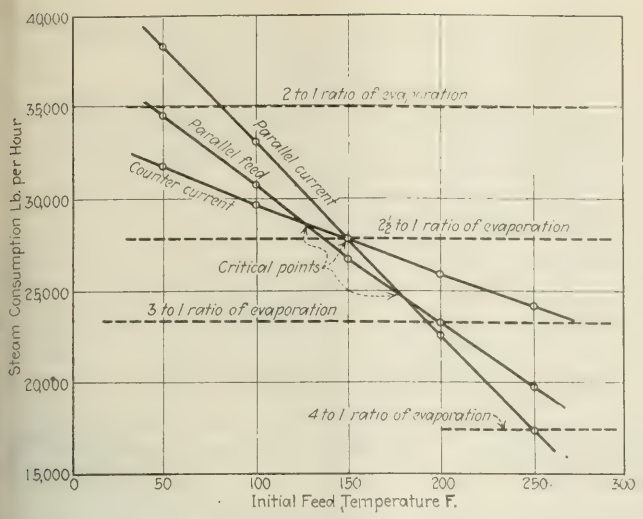

FIG. 8—COMPARISON OF STEAM CONSUMPTION WITH DIFFERENT METHODS OF OPERATION AND AT VARYING TEMPERATURES

1,056.5. The evaporation in the first effect will therefore be the total heat available given above as 25,680,000 divided by this 1,056.5, or 24,300 lb. per hour.

In the second effect, when this vapor condenses, it gives up its latent heat only, or 972.2 B.t.u. per pound. The available heat at this point will therefore be 24,300 times 972.2, or 23,600,000 B.t.u.

The heat required per pound of evaporation will be the latent heat at the temperature of the second effect, 182, which is 988.7, to which must be added the necessary amount to bring up the feed from 150 to 182, a rise of 32 deg. Here again the evaporation represents only 70 per cent of the liquor fed in, and this heating will therefore require 32 divided by 0.7, or 45.7, which when added to the latent heat above, 988.7, gives us 1,034.4 B.t.u. required for each pound of evaporation as before. The total heat available was shown above to be 23,600,000 B.t.u., and the evaporation is therefore 22,800 lb. per hour.

As in the case of the second effect, when this vapor condenses in the third steam belt it gives up only its latent heat, stated above as 988.7 B.t.u. per pound. The heat available for evaporation in the third effect is therefore 22,800 times 988.7, or 22,550,000 B.t.u.

The heat required per pound of evaporation will be, as before, the latent heat of steam at the temperature of the third effect, 125, which is 1,021.6. The correction for the heating effect in this case is negative, for the feed enters at a temperature of 150, which is 25 deg. higher than that of the third effect. A flash will therefore result liberating 25 divided by 0.7, or 35.7 B.t.u. per pound of evaporation. Deducting this from the latent heat of steam for this temperature, given above as 1,021.6, we have 985.9 B.t.u. as the amount of heat required for each pound of evaporation in the last effect. The available heat in vapors from the second body is given above as 22,550,000 B.t.u. The evaporation is therefore 22,800.

The total evaporation for the entire equipment is as follows:

First effect	24,300
Second effect	22,800
Third effect	22,800
Total	69,900

By premise this amount should be 70,000, and the discrepancy is therefore 100 lb. per hour.

In the case of "parallel feed" operation each body of the triple is fed independently, and the concentrated liquor removed separately from each. In performance, this cycle lies roughly between the other two. It has only very few limited applications in practice, and is discussed here more as a matter of interest. Perhaps its most important use is in the salt industry, where we start with saturated brine and the same concentration exists in each body. It is true that for a certain limited range it is more economical than either of the other two cycles, in this case, from feed at 125 to feed at 175. According to the temperature of the feed, there may be flashing in all bodies, heating in all bodies, or heating in some and flash in others. The steam consumption decreases as the temperature of the feed increases; so does the evaporation in the first effect. The evaporation in the second effect is practically constant, and in the third increases as the feed temperature increases.

Conclusions

Variation in Steam Consumption in Various Cycles

Fig. 8 shows a comparison of the steam consumption of the triple effect with varying feed temperatures, operated according to the various cycles suggested above. The crossing point of the parallel and counter-current curves is at a temperature of 150 deg. F. We wish to particularly warn our readers that this critical point applies only for our assumed conditions, and would be different if these conditions are changed. We can say, therefore, that under our prescribed conditions, the "parallel current" method of operation is more economical if the temperature of feed is above 150 deg. F., and the "counter-current" if this temperature is less than 150.

Condenser Load Variations

Fig. 9 indicates the varying load on the condenser, which of course is the same as the evaporation on the last effect. This is worked out for the three cycles for all temperatures. There is a decided advantage here in favor of the "counter-current" cycle at lower feed temperatures.

The amount of evaporation in every case is the same by premise for the whole equipment—namely, 70,000 lb. per hour. If we divide this figure by the steam consumption in any particular case, we have the ratio of evaporation in pounds of evaporation per pound of steam used in the equipment. These data we have worked out as shown in the accompanying log and Fig. 10.

In view of the discussion at the beginning of this article, it is of interest to note the wide divergence from accepted information. These curves also bring out very forcibly the importance of keeping the feed

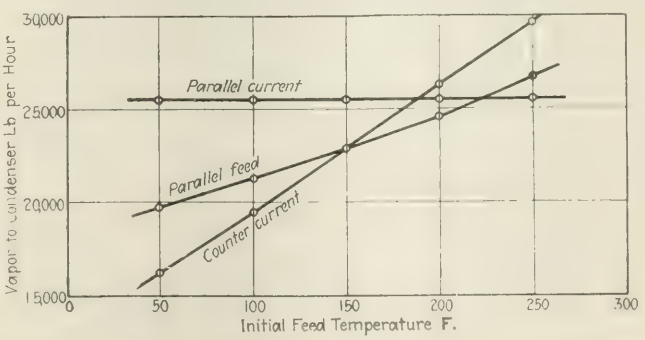

FIG. 9—CONDENSER LOAD UNDER VARYING CONDITIONS

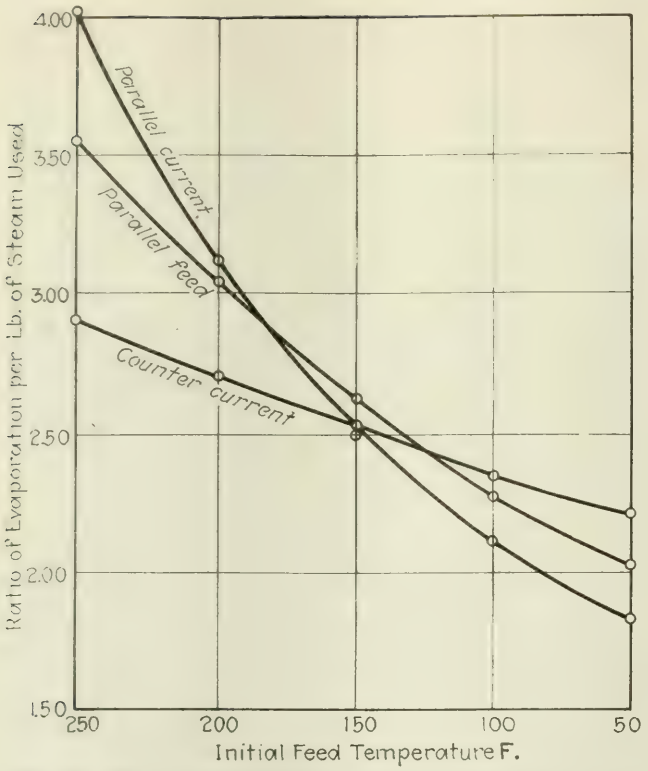

FIG. 10—EVAPORATION PER POUND OF STEAM UNDER VARYING CONDITIONS

temperature as hot as possible, and of keeping it so when once attained, if steam economy is of any consequence.

Importance of Detailed Study of Evaporator Problems

There is a general tendency among both builders and users of evaporators to discount the importance and magnitude of a thorough analysis of their problems for the purpose of arriving at the best solution, and before closing, we cannot refrain from calling attention to the unusually large number of interrelated and independent variables which enter into this work. Below we have listed some of the more important items to consider:

(1) Design of evaporator.
(2) Size of evaporator.
(3) Number of bodies possible, advisable and permissible.
(4) Diameter of tubes.
(5) Length of tubes.
(6) Thickness of tubes.
(7) Material of which they are made.
(8) Material of which the evaporator is made.
(9) Method of admitting feed.
(10) Method of removing feed.
(11) Method of feed control.
(12) Level at which liquor is carried.
(13) Proportion and arrangement of downtakes.
(14) Effect of various rates of liquor circulation.
(15) Effect of various rates of vapor circulation.
(16) Influence of one over the other.
(17) Merits of mechanical and natural circulation for the problem involved.
(18) Composition of solution to be treated.
(19) Initial temperature of same.
(20) Maximum temperature to which it may be heated.
(21) Initial density.
(22) Final density.
(23) Specific heat of solution at various densities.
(24) Viscosity at various densities and temperatures.
(25) Rise in boiling point at various densities.
(26) Surface tension under various conditions.
(27) Latent heat of solution under varying conditions.
(28) Scale-forming constituents and their characteristics.
(29) Best method of removing same.
(30) Method of steam admission and distribution.
(31) Method of removing non-condensible gases.
(32) Method of removing condensate.
(33) Temperature and pressure of steam available.
(34) Vacuum obtainable.
(35) Total temperature fall.
(36) Losses of temperature fall.
(37) Distribution of temperature fall.
(38) Type of condenser.
(39) Temperature of cooling water.
(40) Size and type of vacuum pump.
(41) Determination of probable coefficient of heat transfer.
(42) Probable loss of heat by radiation.
(43) Cycle by which evaporator will operate.

There are other variables not mentioned here, but the above list will suffice to show that proper study of such problems requires laborious and painstaking work.

Importance of Temperature and Humidity Conditions in Factories

The Bureau of Mines, in co-operation with the United States Public Health Service and the Society of Heating and Ventilating Engineers, is engaged in a study of the relative importance and correct correlation of the many individual factors concerned in the problem of the physiological effects of different conditions of temperature, humidity and air motion. A special room has been constructed for this purpose at the Pittsburgh station in which the air conditions are controlled by apparatus outside the chamber and entirely separate from it. A comprehensive program, which includes a quantitative study of a considerable number of bodily functions, is being carried out.

The work of the investigators has not yet been completed, but enough has been done to demonstrate the importance of determining the physiological reactions to environment as a measurement of the harmful effects of heat and humidity, and to show that feelings of discomfort as a standard of measurement cannot be depended upon because there is a certain adaptation of the sense organs to an unchanging environment, and individuals differ in their sense reactions.

Mineral Filler Investigation

In the course of the investigation of mineral fillers being made by W. M. Weigel, mineral technologist, at the Southern experiment station of the Bureau of Mines, Birmingham-Tuscaloosa, Ala., three special problems have been studied: Determination of grain size of fillers, involving elutriation and microscopic measurement, followed by methods of calculation; the effect of heat-treatment on the physical properties of white clays with respect to their use as fillers; and the utilization of Alabama flake graphite. The size of particle is a basic property of fillers upon which many of the other physical properties depend, consequently considerable work is being done in this direction. Work has been completed on the study of the effect of heat-treatment on the physical properties of clays. The lubrication tests on graphite were satisfactory, while results of the molding tests were negative. Experiments in the use of graphite as a remover of boiler scale were only partly satisfactory, being partly negative. A special investigation has been made of a series of clays from central Georgia and western Georgia with respect to their value as fillers.

Thermal Curves for Chromium-Vanadium Steels

AN EXTENDED REPORT of some co-operative work done by the Bureau of Standards and the Fixed Nitrogen Research Laboratory of the Department of Agriculture on chromium-vanadium steels was made by J. S. Vanick and W. W. Sveshnikoff, speaking before the Detroit meeting of the American Society for Steel Treating. First the thermal curves of plain carbon steels were compared with a series of steels containing Cr. 1.0, V 0.18, Mn 0.65 and Si 0.25, with carbon varying from 0.16 to 1.16. One such comparison follows:

	Ac_1	Ac_2	Ac_3	Ar_1	Ar_3
Plain 0.34 C steel	734	764	787	680	750
0.30 Cr-V steel	768	764	807	697*	747*
0.30 Cr-V steel	..	..	..	709†	768†

*Cooled from 975 deg. C.
†Cooled from 852 deg. C.

Ac_1 and Ac_3 temperatures are raised by chromium, but the latter is lowered by the increasing carbon; the two points merge at about 760 deg. C. with 0.60 C (1.0 Cr, 0.18 V). As shown, Ac_1 is above Ac_2 for the low-carbon steels of this series, so the magnetic point cannot be used for hardening. An increase in the temperature from which the piece is cooled (T_{max}) is seen to lower Ar_1 and Ar_3, even in this low alloy.

Ar_1 point, however, is reasonably constant in position, and its intensity varies with the carbon content, therefore this arrest is probably due to carbon alone. Ac_2 is very difficult to determine from the thermal curves, but shows very plainly as a large increase in hardness when the quenching temperature passes that point.

A series of steels varying in vanadium content from 0.02 to 0.58 and containing C 0.35, Mn 0.50, Si 0.23 and Cr 1.05 were examined. The influence of V in these analyses is slight. Ac_1 and Ar_1 are both raised about 5 deg. C. for each 0.10 per cent V. Ar_3 is slightly raised by V; but 0.01 per cent carbon will overbalance seven times as much V. Vanadium is thought to enter a complex carbide for three reasons: (1) The intensity of Ar_1 varies as the carbon content; (2) T_{max} has no effect upon the Ar points as in Cr steels; and (3) the hardness vs. quenching temperature curves are similar to those of plain carbon steels, and a sample quenched from above Ac_3 shows no excess constituent.

Several chromium steels containing from 0 to 2½ per cent Cr and 0.35 C, 0.50 Mn, 0.2 Si and 0 to 0.3 V were investigated, together with three similar ones containing 7.7, 14.4 and 21 per cent Cr, respectively. As noted early in the paper, small amounts of Cr raise Ac_1; at 0.75 per cent Cr it merges with Ac_2 and at 3.1 per cent with Ac_3. Up to 7.7 Cr, however, Ac_2 remains unchanged, and therefore thus far there seems to be no free chromium in the annealed steel.[1] Beyond that point Ac_2 drops rapidly, reaching 675 deg. C. at 21 per cent Cr, an evidence that these high alloys have chromium dissolved in ferrite. Chromium carbide hinders the normal solubility of carbon in austenite, and also impedes the $\alpha \rightarrow \gamma$ change, thus raising both Ac_1 and Ac_3.

When cooling these low-chromium steels from 975 deg. C. at the rate of 7 seconds per deg. C., Ar_3 gradually lowers and Ar_1 gradually raises, the two merging at 2½ per cent Cr at about 710 deg. C.[2]

[1]The analysis 7.7 per cent Cr, 0.37 per cent C agrees very closely to the formula $Fe_3C.Cr_3C$ suggested by Murakami.

[2]At a hypothetical zero cooling rate, $A_{1,3}$ would occur at about 3 per cent Cr in steels containing 0.30 per cent C, a ratio corresponding to Edwards' proposed Cr_5C_2.

High-chromium steels show a "split" transformation on slow cooling from 975 deg. C., the upper portion being called Ar′ and the lower Ar″, as is shown in the following table:

Cr Content	Ar′	Ar″
7.7 per cent	small, at 701	small, at 395
14 per cent	very small, at 695	large, at 387
21 per cent	none[3]	feeble, at 350 to 170

Such effects of increased chromium can be produced to a degree in a single steel by increasing the rate of cooling, or by increasing T_{max}. Ar″ is exceedingly sensitive to changes in the cooling rate, producing corresponding changes in the structure and hardness.

These facts are explained by the supposition that the steel above Ac_1 contains chromium and carbon in solid solution, and upon cooling, the chromium retards the re-formation and accumulation of the carbides, stable at lower temperature. Furthermore, dissociation of carbides proceeds continuously upon heating past Ac_1, all free constituent disappearing from the microscopic field when the 7.7 Cr steel is heated to 950 deg. C. Increasing amounts of free Cr as T_{max} increases cause a strengthening of Ar″; more uniform distribution of the materials in solid solution at the high temperatures is thought by the authors to be responsible for the coincident suppression of Ar′. At maximum dispersion, Ar′ should vanish and Ar″ be unaffected by further superheating.

Quenching the 7.7 or 14.4 per cent Cr steels from 1,000 deg. C. does not suppress Ar″, so the microstructure is coarse-grained martensite. Cooling to above A′ and quenching give fine-grained martensite plus small globules of carbide, and a lower hardness. If the mass is cooled to within Ar′ and quenched, there appear minute black specks of troostite throughout the ground mass. Cooling to below Ar′ and quenching give a coarse-grained martensite outlined by thick troostite meshes. Quenched from within Ar″ shows some martensite grains, but distinct granulation in the troostite area. Slow cooling gives sheroidized carbides. Of course, since all these structures are unstable, with the exception of the latter, they depend upon the conditions existing at the time of their formation.

In explanation of the cooling curves shown and the structures obtained, the authors think that Ar″ is the suppressed $Ar_{3,1}$ transformation. The fact that a high-chromium steel showing only Ar″ may give martensite as a sole constituent upon quenching supports the French view that Ar″ is the lowered Ar_3 change (γ to α iron). The degree to which the Ar″ transformation has progressed marks the degree of martensitization of the austenite.

On the other hand, a split transformation (Ar′; Ar″) is invariably accompanied by the appearance of troostite in the structure.

The authors show that where Ar″ occurs with Ar′ the former transformation is accompanied by the coalescence of carbides in the troostitic meshes. This leads them to the conclusion that when Ar′ and Ar″ occur, the latter is a combination of $Ar_{3,2}$ and Ar_1. In such cases it is thought that $Ar_{3,2}$ proceeds to completion in the grain-like, austenomartensitic areas, while Ar_1, marked by the coalescence of the carbides, proceeds simultaneously in the troostitic meshes. Troostite actually granulates before the matrix changes, therefore Ar_1 proceeds to completion at Ar″.

[3]A feeble A_2 point shown at 675 deg. C.

The Colloid Mill and The Ultra-Filter Press

The Impact and Friction Types of Colloid Mills—Various Proved and Suggested Uses for These Mills—The Ultra-Filter Press—Its Use With the Colloid Mill and Some Other Applications

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IN SPITE of the constantly increasing appreciation of the importance of colloids in the industries there has not been any generally applicable industrial process for producing ordinarily massive substances in the colloidal state. Within the last 2½ years, however, Hermann Plauson, a Russian physical chemist, and Berthold Block, a German engineer, have published a series of articles* on a "colloid mill" which they have developed; and although our information in regard to this apparatus is limited, its promise is so great as to deserve our attention. By means of this colloid mill such various substances as coal, wood, phosphate rock and rubber can be reduced mechanically to stable colloidal suspensions, and applications of a novel nature have been developed in many unrelated processes.

The mill is the culmination of work carried on by Plauson for nearly 10 years, and its performance to date has demonstrated its remarkable possibilities in many lines. A surprisingly large number of technical problems have been attacked with its assistance, and the results claimed deserve the careful consideration of American chemists and engineers.

Still in the Development Stage

It must be clearly understood at the outset that sufficient data are not yet available to enable the commercial value of this new equipment to be estimated accurately. The inventors are naturally enthusiastic in their claims; and there is much in the results already obtained to justify their enthusiasm. Although the processes described may be carried out as they say, there are still such undetermined factors as power costs, production capacity and depreciation. These, as well as the qualitative results, will determine the economic value of each projected process. It must also be stated that not all the claims for the mill appear to be well founded. With the exception of patents and a few articles by other writers, our only source of information are the publications of the inventors themselves in German magazines.

Plauson has attempted to protect his interests in the various developments with which he is concerned by applying freely for patents in various countries—Germany, Great Britain, France and the United States. By no means all of these patents have been granted at this date, and, as Frydlender suggests, it is somewhat questionable whether the mill itself can be patented. Many of its applications are, however, protected. The inventor's policy has been to sell territorial rights to the exploitation of his patents, and it is reported that arrangements are already complete for most of the industrial countries of the world. In the United States, the rights are owned by the Newport Co., Milwaukee, Wis.

*See bibliography at end of article.

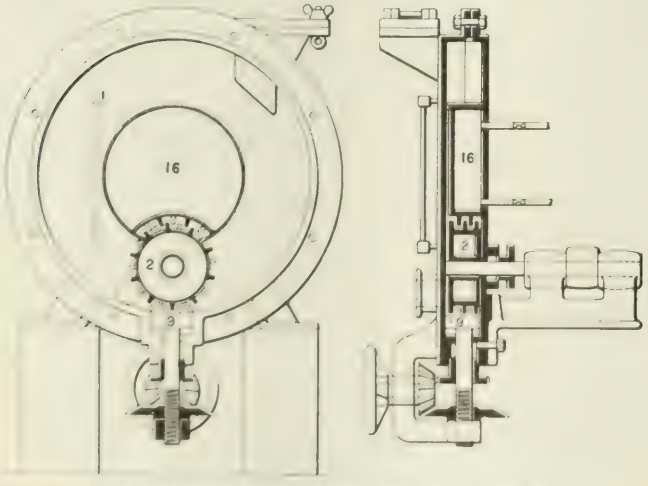

FIG. 1. THE IMPACT TYPE OF COLLOID MILL

The Impact Type of Colloid Mill

Plauson believed that if any massive materials could be subdivided to particles between 1 and 0.01 microns in diameter and suspended in a non-conducting medium, colloidal solutions would result. With this in mind, he studied the effectiveness of the various grinding and crushing appliances in use and singled out impact mills as the most promising type for development. In the colloid mill he utilizes two principles which his work indicates are fundamental. First, in order to obtain extremely fine disintegration it is necessary to have the crushing force applied at high potential. For instance, if we consider the action of a hammer and anvil as exemplifying the process taking place, Plauson has determined that a hammer applied at the highest possible velocity is more effective than a heavy, slowly-moving one. The mill, therefore, operates at high speed. The second principle is that it is essential to disintegrate in a liquid medium, which serves to propagate the force of the blow in the same way that seawater transmits the explosive force of a depth bomb to the submarine which is to be destroyed. Accordingly, the charge fed to the mill consists either of two or more liquids or of a finely ground solid mixed with a considerable excess of the liquid used as dispersion medium.

How the Impact Mill Operates

Plauson's first "colloid mill" is illustrated in the accompanying cut, Fig. 1. This represents an early form of the mill, and it very probably differs from the latest improved designs, although no later description of this type has been published. In this mill the toothed cylinder 2 rotates at very high speed, causing the teeth to beat the liquid charge and to throw it violently against the toothed resistance 9. The high speeds employed do not permit the liquid to flow around the teeth, so it is hammered just as when the surface of water is struck with the flat of the hand: and the force

of the blows which it receives is transmitted to the suspended particles, causing them to disintegrate. The electrical and heat effects produced by the violent impacts also tend to cause disintegration. The centrifugal action of the beater keeps the liquid at the circumference of the container and brings about a continuous circulation, so that new particles are constantly being subjected to the beater action. In order to control conditions more exactly, the mill is equipped with means for heating or cooling the charge as desired, by circulating water through the tank 16.

High Speed in the Impact Mill

The use of very high speeds is essential to successful operation. Peripheral speeds as high as 200 meters per second have been attained in a specially designed unit where the mill is driven by a direct-connected steam turbine. The corresponding rotating speed is 12,000 r.p.m., so the rotating beater must have a diameter of about 32 cm., about one-third that of the earlier mills described. The method of applying the power to drive mills at such speeds is in itself a problem. The direct turbine-driven unit appears to be the best design so far developed; but stepping-up gears specially designed for the purpose have been used for speeds around 6,000 r.p.m.; and direct drive by electric motor, or belt drive can be used for speeds not greatly in excess of 3,000 r.p.m.

The quantitative effect of speed on the size of particle obtainable is illustrated by the following figures cited by Plauson. If the peripheral speed is less than 10 meters per second, no better effect is obtained than by grinding in air (particles 0.001 mm. in size under best conditions). At 20 meters per second, an improvement is perceptible, and particles 0.0003 mm. in size are obtained; at 30 meters per second, particles of 0.0001 mm. are produced; and at 40 meters per second, true colloidal solutions. Higher speeds are actually used in order to accelerate the action.

The Friction Type of Colloid Mill

It is obvious that the use of such high speeds as Plauson recommends (peripheral speeds of 1,000 meters per second are mentioned in some of his patent claims) introduces difficulties. The suggestion that the speeds of the moving members might be reduced by having adjacent parts rotate in opposite directions is a natural one and led to the development of another type of colloid mill. In this type, two grinding surfaces brought very near together are rotated at high speeds in opposite directions. This design is illustrated diagrammatically in Fig. 2.

The solid material to be ground (suspended in liquid as before) is forced axially under pressure into the space between the rotating disks 59 and 62, and after being subjected to the grinding or rubbing action is thrown into the chamber 64, from which it flows out through the outlet 65. The pressure between the disks is regulated by the lever 50 and the adjustable weight 51.

Where the Friction Mill Should Be Used

These two colloid mills are adapted to somewhat different uses, though it is not always clear to which type reference is made in accounts of the various applications. The impact type of mill is the one first developed by Plauson, and with it he was able to achieve many novel results with varied materials. The friction type of mill is apparently a later development, though less original in design. According to the inventor, it is the one better adapted to making colloidal solutions from massive, non-colloidal material. The impact mill, on the other hand, is better adapted for use with emulsifiable liquids or naturally occurring colloids such as gelatine, rubber, gums, etc. It can also be used on solid material, but apparently the high speeds necessary for its effective operation on such material offer difficulties of design or are not economical. Indeed, when Plauson's early articles are considered, it may be suspected that the development of the friction mill was due to the fact that the impact type did not come fully up to his expectations.

The Technique of Making Colloidal Solutions

Working with the mills just described, Plauson obtained many interesting results, some of which could have been predicted from our knowledge of colloids. As already mentioned, Plauson considered the manufacture of colloids to be merely a mechanical process of disintegration in a non-conducting liquid medium. His early experiments show how very important it is that the liquid medium actually be non-conducting. The presence of very small amounts even of weak electrolytes, formed by hydrolysis from the material under treatment, renders it impossible to obtain particles sufficiently small to form a colloidal solution. The most rigid precautions have to be taken to preclude the presence of electrolytes.

Another interesting phenomenon which Plauson observed is that of saturation. He found that it is not possible to take any two substances, say *A* and *B*, in any proportions whatever and by means of the mill

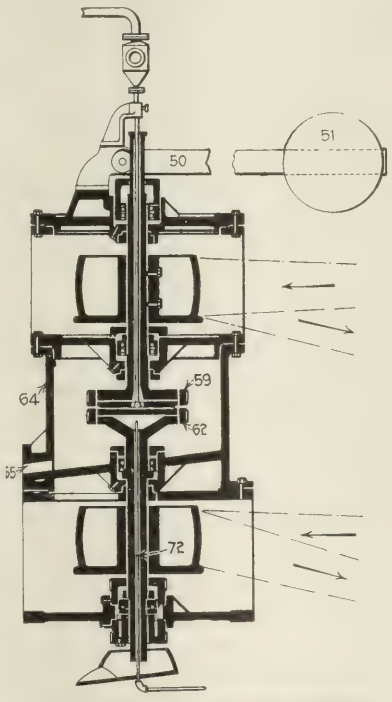

FIG. 2—THE FRICTION TYPE OF COLLOID MILL

produce a colloidal solution of that composition. Only a definite concentration of *A* in *B* can be attained; and if there is an excess of *A*, another phase forms, a solution of *B* in *A*. Plauson calls these colloidal solutions, to which no more of the dispersed phase can be added, saturated solutions in analogy to the solubility relations

of solids in liquids. No amount of treatment in the colloid mill serves to produce solutions of higher concentration than these saturation values. It was found, moreover, that this relationship is very specific, depending on the nature of the dispersed phase and of the dispersion medium. As illustrations the following figures may be cited showing the saturation concentration of copal in various dispersion media:

	Per Cent		Per Cent
Benzene	1.8	Glycerine	2.8+
Water	2.2	Amyl alcohol	5.0+

It may be noted that Plauson found thus two difficulties to be overcome in technical applications of his mill: one the deleterious effect of even small amounts of electrolytes, and the other the formation of saturated solutions, many of such low concentration as to be of little commercial value. In the use of "dispersors" Plauson found a means of overcoming partly both of these difficulties. He found that small amounts of "dispersors" (protective colloids or, as we should more commonly say, peptizing agents) added to the mixtures to be treated neutralize to a large extent the influence of weak electrolytes in small concentration, and also enable solutions of much higher concentration to be produced.

These dispersors, to use Plauson's term, are of the utmost technical importance. They are used in almost every commercial application, and the selection of a properly functioning dispersor may be the critical point in many technical problems. Several illustrations of the use of dispersors may be given. Glue (partly decomposed with alkali) is added in manufacturing colloidal solutions of coal. Tannin accelerates the disintegration of graphite, and soap solution that of talc. Sugar is used in grinding mineral colors, and glycerine in making colloidal solutions of iodine, mercury and sulphur.

The action of the dispersor is specific, as may be seen from these illustrations. Plauson distinguishes three classes of dispersors: (1) substances capable of dissolving the material to be dispersed (without forming electrolytes)—for example, alcohol in the dispersion of phenol condensation products in benzene or water; (2) substances which, with the material to be dispersed, form reactive chemical compounds with colloidal properties—e.g., potash with fats and oils; (3) substances which are capable of forming complex compounds with chemically indifferent substances, but cannot form free ions. Tannic acid used with coal or carbon is an instance of this class.

Use of the Ultra-Filter Press

Another way out of the difficulties which arise from too dilute solutions is by use of the ultra-filter press invented by Plauson. By means of this press thick colloidal pastes may be obtained directly from dilute solutions simply and cheaply. A description of this equipment is given at the end of this article. The colloid mills and the ultra-filter press are complementary, for the mills could not realize their full possibilities without the aid of the press in concentrating the dilute solutions produced. Where it is desired to disperse a substance completely, the procedure followed is to treat it with a dispersion medium in the mill until a satisfactory colloidal solution is obtained. Ordinarily only a part of the material will be colloided. The solution is separated from the non-colloidal residue by settling or ordinary filtration and the residue returned to the mill for further treatment. The dispersion medium is recovered from the solution by filtration in the ultra-filter press, and the dispersed material, on the other hand, is ejected from the press in the form of a viscous solution or paste.

Industrial Applications of the Colloid Mills

The many applications already devised for the mills may be classified according to the nature of the action effected. The mill may be used simply for stirring—for example, in dissolving salts. Plauson claims that it is very effective in such work; and it probably is, though hardly economical. In some instances, the mills are used merely to produce very fine grinding, as in the case of pigments, or to produce suspensions or emulsions; in others, they are used for the extraction by selective emulsification of one or more constituents from a mixture; it has, for instance, been used for recovering oil from shale. There are also many processes where the mills are used to induce or accelerate chemical reactions.

As an instance of the use of the mills merely to produce an extremely finely divided product, the disintegration of phosphate rock for fertilizer may be mentioned. It is claimed that the rock can be reduced to so fine a powder that it is directly assimilable by plants without being treated with sulphuric acid. It is also stated that in compounding rubber the mill yields products of exceptional excellence owing to the fineness of disintegration and the homogeneity of the resulting mix. The grinding of pigments in the mill—for example, ultramarines—greatly increases the brilliancy of hue. Blanc fixe can be made merely by milling barytes.

Making Plastic Cellulose

The manufacture of plastic cellulose is another accomplishment of the colloid mill. Wood is reduced by grinding to a fine powder and the finest particles are separated by air and mixed with a large volume of water to which a small amount of alkali or other dispersor is added. After treatment in the mill, the resulting colloidal solution is precipitated with acid and the cellulose gel carefully washed free of salts and dried *in vacuo* to prevent the action of air. The powdered or gel cellulose thus obtained may be molded hot, and the resultant product possesses excellent mechanical properties as well as high di-electric strength. Its tensile strength is 300 to 500 kg. per square centimeter, it machines well, and a plate 3.5 mm. thick will withstand a potential of 55,000 volts.

The ability to make stable solutions, regardless of the solubility relationships of the different constituents, enables lacquers and varnishes of an entirely new type to be developed. The desired gums can be dispersed in any cheap solvent by means of the colloid mill. While a variety of such varnishes has been prepared, their properties have not been reported in any detail. The possibility is, however, a very attractive one.

Making Emulsions

In making emulsions of oil and water, Plauson believes that he has developed a new type of lubricant which, while very effective, is extremely economical on account

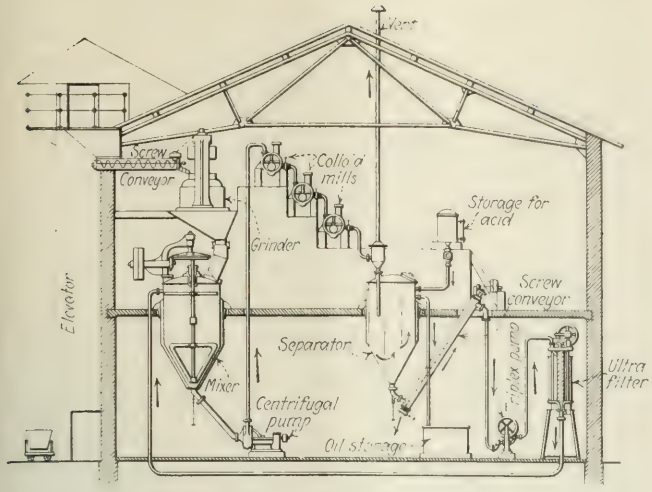

FIG. 3—PLANT FOR OBTAINING NAPHTHA FROM BITUMINOUS SHALE

of the considerable water content. If, for example, a mixture of two parts of oil and two to three parts of water are emulsified, a thick, pasty grease is obtained. It is possible to add to this paste solid lubricants such as graphite, talc, etc., and the lubricating mixtures thus formed carry heavy loads very well. Plauson points out that such lubricants are perfectly neutral and asserts that the emulsions are very stable. In Germany, where oils and fats are scarce, their economic advantages will be much more appreciated than they would be here.

One of the industrial applications of the mill for which the inventor feels there is exceptional promise is the making of "liquid coal," a colloidal suspension of coal in fuel oil. Thirty to forty parts of powdered coal is mixed with seventy to sixty parts of fuel oil, a suitable dispersor is added, and the mixture treated in the mill at high speeds ½ to 3 hours. The resultant sirupy liquid can be burned like other liquid fuels, but has, of course, a higher heating value per unit volume, which makes it especially desirable for marine work. As much as 15 per cent water can be added to the mixture without causing precipitation of the coal.

Separation by Colloidal Mill

In many instances Plauson has used the colloid mills for the separation of difficultly separable mixtures by colloiding one of the constituents. A process which he says was received very favorably in this country (presumably on the experimental scale) is the recovery of naphtha from petroleum slimes or shales. Some of these contain so large a portion of earthy material that separation by distillation is not feasible. Plauson proposes, therefore, to treat the finely ground shale in the mill with a large excess of water, with which the naphtha forms an emulsion. From the resulting mixture the mud settles rapidly on standing, permitting the emulsion to be drawn off, and the naphtha and water are then separated by heating. It is claimed that from an original content of 24.6 per cent oil, a yield of 19.8 per cent was obtained, and further oil was extracted by subsequent treatment. A diagram of a plant operating on a slight modification of this process is shown in Fig. 3. The shale is ground, mixed with water, and fed to three colloid mills operating in series. Acid is used to break up the resultant oil-water emulsion, and the oil is separated by gravity. The mud and water are then conveyed to a filter press and the water, still containing some oil, is returned to the system. This method is, of course, applicable only to those shales, well known both in this country and in Russia, from which the oil can be extracted with solvents.

Some Ill-Founded Claims

An instance in which the claims for the colloid mill appear to be ill-founded is in the manufacture of colloidal resins. It was stated in one of Plauson's early contributions that by treating crude domestic (German) resins in the mill a colloidal suspension of the true resin could be obtained very economically. In fact, a company was organized to exploit these colloidal resins. Their success must have been very limited, however, since a correspondent of the *Seifensieder-Zeitung* pointed out very emphatically that such resins were by no means pure; that in addition to large amounts of water which had been incorporated with them, the original impurities were still present; and that, due to the treatment in the mill, these impurities were so thoroughly incorporated that no economical method was available for purifying the product.

This case reminds us that the colloid mill cannot be a panacea for all industrial ills. In the enthusiasm of discovery, claims are doubtless made which will not be substantiated by experience. While there are many cases where separation can be effected, as in the extraction of oil from petroleum shales, or of vegetable oils from oil-cake, there are also many cases where treatment in the mill will serve to render the impurities much more difficultly removable than before. It must be realized, however, that mistaken applications should not prevent the real merits of the mill from being appreciated.

Accelerating Chemical Action by Use of Colloidal Mill

There are many cases in which the mill is used to accelerate chemical reactions. One of the more recent of these is in the making of viscose for artificial silk, plastics, etc., and this is an excellent example of the use of the mill for such purposes. By treating the cellulose first in the colloid mill, it is reduced to the colloidal state, and is then in a condition to react directly with the theoretical amount of alkali to form the monosodium derivative. This reaction is carried out in the mill, as well as the following step in which the carbon bisulphide enters into the reaction. For this process the following advantages are claimed: (1) The action of the theoretical quantity of alkali is possible at ordinary temperatures. (2) The reaction time is considerably shortened, so there is less hydration and decomposition of the cellulose by the alkali and consequently less contamination with byproducts. (3) No treatment with acid is necessary at any stage. (4) Less carbon bisulphide is used, and the reaction proceeds very smothly. (5) The viscose solution obtained is very pure. (6) A long ripening of the viscose is not necessary. It can usually be used in a few hours. (7) The silk produced from the viscose is of higher quality and is produced at less expense.

In the cuprammonium process the colloid mill can be used in a similar manner.

The reduction of the cellulose particles to colloid size makes them, of course, very susceptible to any chemical action, and the saccharification of cellulose as a pre-

liminary step in the manufacture of alcohol from wood-waste is very greatly accelerated by using the cellulose in this form.

Hydrogenation of Oils

A quite different application of the mill in accelerating chemical reactions is in the hydrogenation of oils. The very thorough mixing of the hydrogen and the oils which may be obtained by this means greatly increases the velocity of reaction. Plauson found, too, that instead of adding a catalyzer of powdered nickel to the oil before hydrogenation, it was sufficient if the parts of the mill in contact with the oil were covered with nickel. This proved to be a convenient and effective method of operation.

Still another use of the mill in this field is in the soap industry. By treating the fats and oils with caustic alkali in the mill, the reaction time is greatly

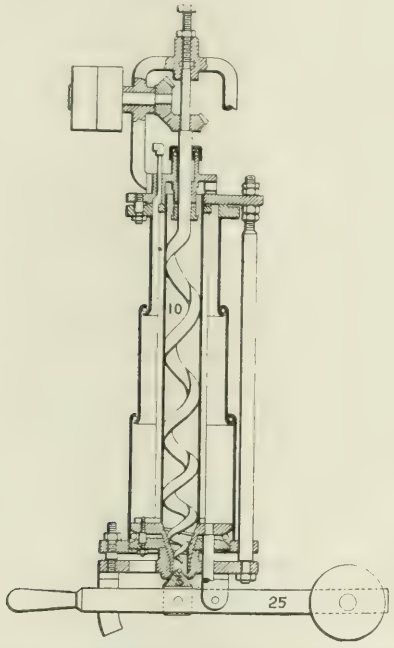

FIG. 4—THE ULTRA-FILTER PRESS

reduced and a very uniform product is secured. Little supervision is necessary, and one man can run several mills, so the operating expense is considerably reduced.

The Ultra-Filter Press

Reference has already been made to the ultra-filter press. Its design is shown diagrammatically in Fig. 4. The outside is constructed with telescopic joints. The charge is pumped in at the top and the solids are forced constantly downward by the screw 10 till discharged through the conical joint 3. The pressure required to expel this material is regulated by the lever 25 and an adjustable weight. The filtering surface is the cylinder surrounding the screw 10 and consists of several superimposed perforated metal sheets, the pressure between which may be regulated by means of a screw. The particles of precipitate gradually obstruct the small interstices formed by these sheets and thus build up a cake which effectually prevents the passage of further colloidal particles, but which does permit the liquid to pass through. In some cases a preliminary cake may be built up of plaster of paris, or asbestos, or similar materials. The revolving screw maintains a constant thickness of filtering material on the wall so that the conditions of filtration are uniform; and the colloid becomes more and more pasty as it descends in the press until it is discharged. The filtrate obtained is said to be exceptionally clear.

A number of advantages are claimed for this design. The press is continuous in operation. It uses no filter cloth. It operates under high pressures (as high as 200 atm.) or it may be used as a vacuum filter. It is easily washed. The pore size and thickness of cake are adjustable.

Plauson has also constructed another type of filter surface using instead of the wire mesh fabrics a coil of fine wire outside a coarsely perforated metal cylinder. In that case the colloidal particles gradually plug the spiral passages along which the liquid escapes and thus a filtering membrane is formed as before. If the wires used are wound with cotton, or paper, and the like, an especially effective filter is obtained.

Applications of These New Filter Presses

The ultra-filter press has found many industrial applications apart from its use in conjunction with the mills. In the beet sugar industry, for instance, the juice is subjected at present to a purification process which consists in treating it with lime and subsequently charging the solution with carbon dioxide. The precipitate, which in addition to calcium carbonate contains many of the organic impurities, is removed by filtration. This whole process, which requires considerable time and equipment, may be eliminated by filtering the juice directly through the ultra-filter press—previously adding only a small amount of lime to decompose non-sugar substances.

In the ceramic industries, also, the filter press has a large field in the dehydration of clays.

Another use of the ultra-filter press is in the crushing of oil seeds and in the purification of oils. The oil seeds after the usual cooking may be treated directly in the press, which operates like an expeller press. The oil, being thus simultaneously subjected to a filtration, leaves the press clear and free from albuminous matter. Crude oils may readily be purified by treatment with barium hydroxide solution in the colloid mill and subsequent filtration in the ultra-filter press with a pore size of 0.4 to 0.1 μ. By this means, not only the coarser contaminations such as albumins are removed, but also the coloring material; so that a pure, clear oil flows out. The use of the filter press in conjunction with the mill has also proved effective in removing oil from substances containing it such as anthracene, paraffine, etc.

By making the pores sufficiently fine, it is even possible to prevent the passage of bacteria, and it is suggested that the filter may find application in water purification, where its compactness will be an advantage over the extensive filter beds now in use.

Conclusion

The various applications cited above are by no means all those mentioned in the articles already published; and they certainly do not exhaust the possibilities of the new machines described. Very possibly many of the processes described may not prove to be commercially successful, but certainly this new technique for producing colloids on an industrial scale offers an opportunity for the solution of many difficulties and opens up

possibilities of a varied nature to the chemical technologist.

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Small Electric Furnaces for Experimental Heats

During the war a large number of special alloys were tested by various agencies to determine their fitness for munitions. One series, made by H. W. Gillett and E. L. Mack,[1] was for determining their resistance to erosion by hot explosive gases. For this purpose, a sound ingot weighing 30 lb. was sufficient.

A small single-phase direct-arc furnace was first tried. The iron shell 11x15x13 in. high was lined with magnesite brick 1¼ in. thick; the bottom rammed up with magnesite and water glass, and the top covered with a zirkite brick slab. Side walls were water-cooled. Graphite electrodes, 2 in. in diameter, were set 2 in. apart, and carried 500 to 700 amp. at 75 to 90 volts. At first an iron mold was filled direct from the furnace. This practice always resulted in gassy steel, and a preheated ladle was later used. Sound ingots resulted from a lower pouring temperature. The furnace was unsatisfactory, however, because from 0.2 to 0.6 lb. graphite was taken from the electrodes in restarting the arc during melting down. With such a small charge, this was responsible for wide variations in the carbon content of the resulting steel. The thin side walls also spalled badly—zirkite brick did better, lasting fourteen heats.

A cylindrical furnace, much like a rocking brass furnace,[2] was then built, and proved very satisfactory for making about 200 intermittent heats of high-alloy steels. From operating experience, the authors recommended the following: The furnace should have a steel shell, 32½ in. in diameter and 45 in. long. The outer lining should be 1 in. of Sil-O-Cel or some similar reliable low-temperature insulator; a second layer 2½ in. thick of high-grade aluminous (corundite) firebrick; the third layer consisting of 4-in. magnesite brick in the lower or hearth half, and bare Carbofrax in the roof. If the furnace is to do refining, the hearth should then be covered with electrically sintered, dextrin-bonded magnesia. If a mere series of similar melts is to be made, the hearth is preferably lined with 1 to 2 in. of alundum cement, rammed in in layers, each layer being dried thoroughly with a gas flame and moistened with a thin wash of alundum before a fresh layer is placed and dried.

The furnace ends should be built of magnesite blocks with a total thickness of 15 in., and the corners filled with alundum so that the hearth is a roughly spherical chamber, 14 in. in diameter.

Such a thick end wall forms an admirable support for the electrodes. There are to be 2 in. graphite rods, 40 to 48 in. long. Split bronze castings may be used for connectors, good contact being insured by wrapping the carbon with copper gauze. When the electrode shortens so the connection becomes hot, it may be covered with asbestos cloth kept wet by a water drip. Adjustment may be done by hand. When charging or repairing the lining, the electrode hole should be punched with a 2⅜-in. steel bar.

A 12-in. square opening in the shell forms a charging and pouring opening. It is to be closed by a plug of carborundum brick, cemented and covered with alundum cement. The door is iron bound and held in place by keying to eye-bolts attached to the furnace shell. After charging, the door and electrode openings should be luted with alundum cement, and as the furnace heats up, any cracks are brushed with thin wash. In this manner the furnace is kept air-tight.

The entire furnace should be bound with two iron hoops, running on trunnions. Iron levers attached to the side permit rotation by hand when pouring and patching the lining. During melting the furnace is stationary.

Such a furnace takes from 60 to 70 minutes to preheat the lining. A current of 500 to 750 amp. at 60 to 90 volts will be required. After charging and closing the furnace, it is run until a calculated amount of power is put in, as experience with similar conditions requires (40 to 50 kw.-hr. for a 50-lb. charge).

Molybdenum and Cerium Alloy Steels

In the study of molybdenum and cerium alloy steels at the Ithaca, N. Y., field office of the Bureau of Mines, endurance tests on bars taken both with and across the direction of rolling show that the relationship between endurance and tensile strength (or hardness), which holds fairly closely for longitudinal bars, does not hold nearly as well on transverse bars. The endurance of transverse bars is lower, and the amount by which they are lower appears to depend primarily on the type, size, number and distribution of the non-metallic inclusions.

[1] Bulletin 199, Bureau of Mines; "Experimental Production of Alloy Steels."

[2] "A Rocking Electric Brass Furnace," by H. W. Gillett and A. E. Rhoads. *Met. & Chem. Eng.*, vol. 18, p. 583.

Cored Structure in Quenched Manganese Steel

By Sergius S. Beliaeff

FOR close examination a polished surface of steel is usually etched with an acid or some other solution to develop its structure. A number of different solutions are employed, depending on the alloy or steel used and the characteristic it is desired to study. But all those reagents could be divided into two groups. In Group I would be classed etching reagents for micro-examination—in other words, the examination of the structure of steel under high magnification (from 20 up to 1,000 times). Reagents in Group II are used for studies at low magnification, such as two or three diameters, or even at natural size with the naked eye. Sometimes very interesting results are obtained by using a reagent of Group I in parallel with those of Group II or of a deep pickling with acid.

An entirely different structure may be obtained from the same sample of manganese steel which has been etched with a reagent of Group I, by repolishing and etching with a reagent of Group II. For instance, Fig. 1 is cast manganese steel (C 1.25 and Mn 12.0 per cent), which has been quenched in water from 1,850 deg. F. and etched with 3 per cent nital. At 100 diameters it shows typical austenitic network structures, with inclusions of free manganiferous carbide. Fig. 2, on the other hand, is a photograph of the same surface after it has been repolished and etched with Le Chatelier's solution[1] No. 1. This shows typical dendritic structure.

Both photographs are practically of the same magnification, but their appearance is totally different; at first sight they have no relation whatsoever. But if a photograph is taken from the same specimen after double etching, but without repolishing between the nital and the cupric reagent, a close connection is found between the grain boundaries of austenite and dendrites.

The deposit of copper must be washed off with strong ammonia before photographing. This method of etching not only develops the grain of the alloy but even reveals non-homogeneity in the grain itself, showing that each dendrite forms a crystal, even after a quench from 1,850.

A sample of the same steel in its cast condition, etched with nital, has the same structure as Fig. 2, which was etched with copper solution after heat-treating. The typical dendritic structure of cast manganese steel, revealed by etching with nital, was apparently entirely changed by heat-treating into a network of austenitic grains. This is true as far as can be shown by etching with nitric acid, but by etching with Le Chatelier's solution or other reagent, each grain of austenite will be shown to contain many features of the original dendrite.

[1]Copper chloride 10 grams, magnesium chloride 40 grams, hydrochloric acid 20 c.c., water 180 c.c., and methyl alcohol 1,000 c.c.

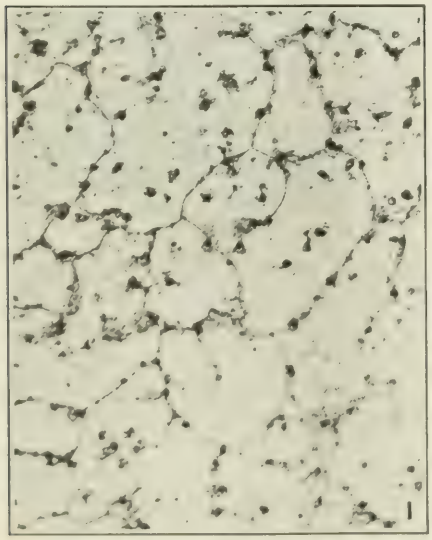
British Experiments in Enamel-Kiln Firing

A series of interesting experiments in connection with the insulation of enamel kilns has been carried out recently by a British firm, according to an article in the *Staffordshire Gazette*.

In enamel kilns, owing to the radiation of heat from the iron doors, difficulty is experienced in firing up the ware in front of the kiln, so that the custom is to fill the front with ware requiring slight firing as compared with the goods in the other parts of the kiln. The experiments have been directed toward preventing the loss of heat by radiation and obtaining uniformity of temperature throughout the kiln. It is stated that success in the experiments has been obtained by the firm after numerous attempts.

To prevent the radiation of heat, a mattress packed with blue asbestos fiber has been constructed on an iron frame to cover the kiln doors. In blue asbestos there is a stronger fiber and a better heat resistance, and it is claimed that this mattress retains practically all the heat that would otherwise be wasted in the kiln. Obviously this increases the temperature in the front of the kiln, and the ware in the front of the kiln can be fired just as in any other part. It is essential that the doors of the kiln should be lined with firebrick. This prevents damage being done to the mattress through the doors becoming too hot. The iron doors, of course, become much hotter than they do without the mattress, as a result of the heat being kept in by the mattress.

The apparatus is quite simple and inexpensive and is actually only an application of the asbestos covering of boilers and steam pipes in pottery ovens.



FIGS. 1 TO 3—STRUCTURE OF QUENCHED MANGANESE STEEL

Fig. 1—Etched with 3 per cent nital; × 100.

Fig. 2—Etched with LeChatelier's solution No. 1. × 120.

Fig. 3—Etched with both in succession and washed in NH_4OH. × 100.

Ethylene From Trent Amalgams As a Source of Alcohol

By J. D. Davis
Research Chemist, Pittsburgh Experiment Station
U. S. Bureau of Mines

SIXTY YEARS AGO M. Berthelot found that ethylene could be selectively absorbed from gaseous mixtures by concentrated sulphuric acid and that the compound formed by the chemical union of the gas and acid was readily decomposed by heating with water, yielding ethyl alcohol. Only within the last few years has there been any attempt to make use of this discovery technically. Bury,[1] working in England at the Skinningrove Iron Works and on a commercial scale, developed a technical method for converting the ethylene of coke-oven gas into alcohol. With a gas containing less than 3 per cent of ethylene, he obtained a yield of 1.6 gal. of alcohol per ton of coal carbonized.

De Loisy[2] perfected a technical method for treatment of coke-oven gas for alcohol. Evidently this work was carried out on a semi-commercial scale. His method is based on the use of catalytic agents for hastening the absorption of ethylene by sulphuric acid. He uses part of the spent acid for drying the gases and part for the manufacture of ammonium sulphate. Excess acid is reconcentrated by waste heat. Others have worked on the problem, but so far there has been no large recovery of ethylene from coke-oven gases. The chief difficulty seems to lie in the low efficiency (about 50 per cent) of methods and the relatively low concentrations of ethylene in the gases treated. Gas from Trent amalgam[3] contains much larger percentages of ethylene than does coke-oven gas, as will presently be shown, and if it should ever prove practical to treat industrial gas for alcohol, this gas would offer attractive possibilities.

Method Used in Carbonizing Trent Amalgams

The method used here to carbonize the amalgams differs from any now used for the commercial carbonization of coal. In ordinary practice, coal charges are distilled at all temperatures from the decomposition point of the coal to the highest retort temperature, and no definite temperature can be fixed on as the temperature of distillation. With the method here used, the distillation range was made narrow. This was effected by feeding the charge regularly into a retort kept at constant temperature—that is, the predetermined distillation temperature. Distillations were conducted at temperatures 400, 500, 600, 700 and 800 deg. C., and the gases evolved were measured and analyzed. Samples of the coal and oil used to prepare the amalgams were distilled under the same conditions as were the amalgams for purposes of comparison.

TABLE I—ANALYSIS OF MATERIALS USED

Big Muddy Coal

	Per Cent
Moisture	5.78
Volatile matter	31.87
Fixed carbon	52.42
Ash	9.93
Total	100.00
Sulphur	1.28

Fractionation of the Navy Fuel Oil

Temperature Range, Deg. C.	Per Cent Distilling
130	First drop
130 to 225	1.1
225 to 250	4.83
250 to 275	14.25
275 to 300	20.10
300 to 325	21.70
325 to 350	30.90
Residue	5.82
Loss	1.31
Specific gravity of the oil at 20 deg. C.	0.868

Experimental Results

The materials used in the experiments were Illinois coal obtained from the Big Muddy Coal & Iron Co., Herrin, Ill., and an asphaltic-base fuel oil. An analysis of the coal is given in Table I, also the fractionation results for the oil. Table II gives the analyses of gases evolved from amalgam, coal and oil at temperatures 400, 500, 600, 700 and 800 deg. C., together with total yields of gas and light oils scrubbed from the gas. Results for the 700 deg. amalgam run are not reported, owing to the fact that precipitated carbon clogged the mains and rendered the gas samples taken of doubtful value.

In general, the oils give higher yields and richer gases; the amalgams give somewhat less gas of poorer quality; and the coals give the lowest yields and the poorest gas. It is an interesting fact that the run at 800 deg. C. (with continuous feed) gave almost as much

TABLE II—ANALYSES OF GASES FROM TRENT AMALGAMS, COAL AND OIL

Charge	Temp., Deg. C.	CO_2	C_2H_2	O_2	CO	CH_4	C_2H_2	H_2	N_2	B.t.u. Per Cu.Ft.	Yield, Cu.Ft. Per Ton	Oil From Gas, Gal. Per Ton	Remarks
Amalgam	400	9.8	23.4	0.6	4.0	29.1	17.3	8.9	6.9	1,000	750	0.38	
Coal	400	17.9	0.5	0.4	11.7	46.7	0.0	17.4	5.4	550	980	1.5	
Oil	400	15.5	16.6	0.0	1.0	23.2	39.1	4.6	0.0	1,182	600	0.0	
Amalgam	500	3.0	17.0	0.0	5.3	37.4	12.0	25.0	0.3	937	4,470	3.0	
Coal	500	10.2	1.2	0.6	19.7	38.4	8.5	12.2	8.6	779	2,970	0.1	
Oil	500	0.6	39.6	0.4	0.5	29.3	24.1	2.9	2.6	1,353	5,300	2.6	
Amalgam	600	3.0	8.8	0.6	8.7	50.8	0.0	25.3	2.8	730	10,650	8.4	Continuous feed
Amalgam	600	3.3	13.6	0.6	7.5	49.4	0.0	23.9	1.7	794	5,550	3.6	Batch distillation
Coal	600	4.7	3.3	0.5	11.4	30.6	0.0	46.2	3.3	525	6,430	4.5	
Oil	600	1.3	31.0	0.5	1.8	46.3	10.8	5.0	2.8	1,167	16,900	11.1	
Amalgam	700	....	....	....	....	....	....	....	....	....	....	....	Gas samples uncertain
Coal	700	6.4	0.6	0.5	28.1	13.0	0.0	46.9	4.5	370	10,750	2.1	
Oil	700	0.4	23.2	0.5	0.5	63.6	2.0	8.3	1.5	1,056	19,320	7.0	
Amalgam	800	4.9	8.9	9.7	6.7	35.3	8.1	31.5	3.9	757	19,800	4.1	Continuous feed
Amalgam	800	4.7	6.1	0.0	7.5	52.9	5.4	36.9	3.4	654	3,400	20.2	Batch distillation
Coal	800	4.2	3.0	0.4	16.5	26.6	0.0	45.4	3.9	496	10,000	0.55	
Oil	800	2.1	2.2	0.0	1.6	63.7	0.0	28.2	2.3	710	20,050	2.1	

[1] Bury, Ernest, "Ethylene as Alcohol From Coke-Oven Gas," *Gas Journal*, vol. 148, Dec. 30, 1919, p. 718.

[2] De Loisy, M. E., "Sur un procédé industrial de fabrication synthetique de l'alcocl et de l'éther a partir des gaz de distillation de la houille," *Compt. rend.*, vol. 170, January, 1920, pp. 50-3.

[3] A paste consisting of approximately 2 parts finely pulverized coal and 1 part oil such as that obtained as a final product in the Trent process for cleaning coal. See Perrott, G. St. J., and Kinney, S. P., "The Use of Oil in Cleaning," *Chem. & Met.*, vol. 25, Aug. 3, 1921, p. 182.

gas for the amalgam as for the oil, and gave a gas of slightly better quality. At this temperature, it thus appears that Trent amalgam is just as good material for making commercial oil gas as the oil itself. The amalgam would of course be the cheaper, and further, it will be noted that under these conditions more oil was scrubbed from the amalgam gas than from the oil gas. Of course if a rich oil gas is wanted, the best procedure is to crack the straight oil at a lower temperature.

The percentages of oxygen-containing gases for the coals and amalgams are considered somewhat high. This is due partly to the method of feeding the retort and partly to the fact that the coal used was of high oxygen content. As for the first cause, the charge fed was finely divided, and must have carried into the retort a fair amount of adsorbed air.

Unsaturated Gases

The percentages of unsaturated gases are uniformly higher for the oil except with the run at 800 deg. C., where the amalgam gives the highest percentages. The coals give the lowest percentages of unsaturated gases, but slightly higher, perhaps, than would be obtained by commercial methods of carbonization. The amounts of these bodies found for the amalgams are intermediate between those for the oil and coal. Unsaturated gas is reported here as ethylene (C_2H_4), and it is probable that 95 per cent of it actually was ethylene. Especially is this true when it is considered that the gas had passed a charcoal scrubber, which would have a tendency to remove heavier gases.

Yields of Unsaturated Gases From Amalgams

Table III gives the yields of unsaturated gases from amalgams at the corresponding temperatures of distillation and their equivalents in alcohol, assuming complete recovery. Figs. 1 and 2 show the data graphically. As a basis of comparison of yields, we may take Bury's[4] figure of 1.6 gal. of absolute alcohol per ton of coal charged in byproduct ovens. Assuming a 50 per cent recovery, this would mean a possible yield of only 3.2 gal. of absolute alcohol per ton of coal from coke-oven gas, whereas from Trent gas there is possibly from 3 to 32 gal. per ton of amalgam charged. It would thus seem that Trent gas is ideal (second only to oil gas) for the application of an alcohol recovery process.

[4]Work cited.

TABLE III—YIELDS AND ALCOHOL EQUIVALENTS OF UNSATURATED GASES FROM AMALGAMS

Temp., Deg. C.	C_2H_4, Per Cent	Total Gas, Cu.Ft.	C_2H_4, Cu.Ft.	Alcohol Equiv. Gal. Per Ton
400	25.4	750	172	3.1
500	17.0	4,400	760	13.8
600	6.8	10,850	955	17.3
800	8.9	19,800	1,760	32.0

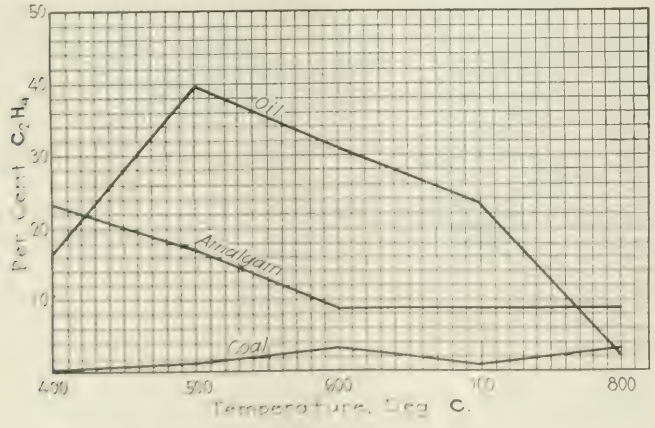


FIG. 1

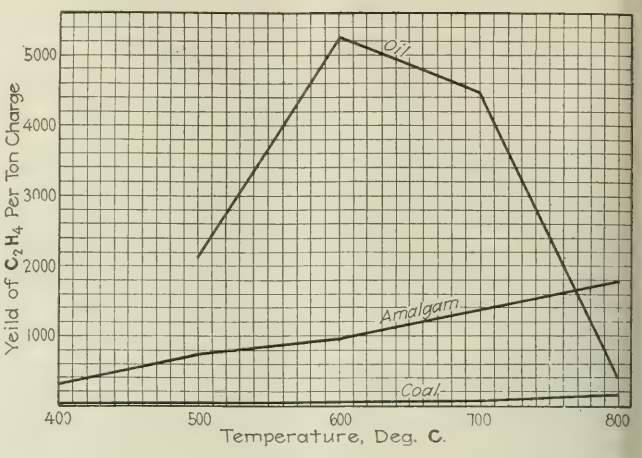


FIG. 2

Recovery of Ethylene as Alcohol

So far it has not been possible to recover from coke-oven gas more than 50 per cent of ethylene contained as alcohol, but it would undoubtedly be possible to improve this figure considerably by research. The problem offers possibilities, particularly in connection with the rich Trent gas. For example, De Loisy[5] found that he could increase considerably the speed of absorption of ethylene by sulphuric acid through the use of catalytic agents, and thereby increase the recovery of alcohol.

Loss of Heating Value Through Removal of Ethylene From Gases

Table IV shows that the loss of heating value suffered by Trent amalgam gages on removal of the ethylene is not an important consideration. They are rich gases to start with, and the removal of ethylene, although that gas has a high heating value, does not bring their heating value below that of the best industrial gases.

TABLE IV—EFFECT OF REMOVAL OF ETHYLENE ON THE HEATING VALUES OF TRENT AMALGAM GASES

Distillation Temp., Deg. C.	B.t.u. Per Cu.Ft. Raw Gas	B.t.u. Per Cu.Ft. Scrubbed Gas
400	1,000	798
500	936	795
600	726	639
800	757	671

It may be stated further that the ethylene in the composite gas has a market value much below that which it would have as pure gas. For example (see Table III), a 600 deg. distillation will yield 10,850 cu.ft. of composite gas, 955 cu.ft. of which is ethylene. The ethylene, if recovered commercially pure, would be worth 1 cent per cubic foot, or $9.55, whereas all the gas (at 50 cents per 1,000) would be worth about $5.40.

Conclusions

1. Trent amalgams yield gases intermediate between those from coal and oil in respect to both quantity and quality.

2. The high percentage of unsaturated gases from Trent amalgams offers a promising field for research.

Reports of Investigations,
U. S. Bureau of Mines.

[5]*Loc. cit.*

Book Reviews

METHODS OF THE CHEMISTS OF THE UNITED STATES STEEL CORPORATION FOR THE SAMPLING AND ANALYSIS OF PIG IRON. 40 pages, paper covers. Published by the Carnegie Steel Co., Bureau of Instruction, Pittsburgh, Pa. Price $1, cash with order.

This is a revision of a similar pamphlet published 10 years ago for use of the chemists of constituent companies of the United States Steel Corporation. Such a manual is evidently most useful in enabling chemists in distant laboratories to reach comparable results on a shipment of iron—even though this iron is sent from one subsidiary to another—from the vest pocket to the hip pocket, as it were. The present booklet is the work of W. B. N. Hawk of Lorain, William Brady of South Chicago, and H. E. Campbell of Clairton.

Accurate and accepted methods of analysis are also essential to prevent disputes with outside buyers. For this reason the American Society for Testing Materials has adopted many standards for sampling and chemical analysis. Both publications agree, for instance, that Drown's method for silicon is to be used—the Carnegie pamphlet appears to describe the manipulations which would be adopted in repetitive routine work.

It is advised that molten iron be poured into a chill mold. Granulation by water cools too rapidly, the sample cannot be used for combined or graphitic carbon, and sulphur (by evolution) is always low. Sand-cast samples, on the other hand, are likely to be contaminated by molding sand. While it is recognized that volumetric or evolution methods for sulphur do not give exact figures (two gravimetric methods are described for accurate work) it is the only one known "which can be made within the time limits fixed upon the laboratory," and in careful hands and on steady production gives very good figures for control.

Combustion methods and apparatus for total carbon are given in great detail. Analysis for titanium and copper are added to those other elements ordinarily determined. E. E. THUM.

CLAY PRODUCTS CYCLOPEDIA. First annual edition, 1922. 252 pages, illustrated. Published by Industrial Publications, Inc., 407 South Dearborn St., Chicago, Ill. Price, $3.

It is the aim of this book to present in readily available form information and data pertaining to all phases of the clay products industry. In an industry with so many ramifications this represents no small undertaking, and the editors are to be congratulated upon the success of their labors. In what is termed the definition section, covering 121 pages, will be found condensed information regarding more than 10 materials, processes or types of equipment. The arrangement is alphabetical and each item is numbered. Many items are supplemented and treated more fully in a statistical section of 75 pages. While much of the material has been compiled from various sources, there is also a great deal which is original. As the editors are in constant touch with the industry through their publication *Brick and Clay Record*, the correctness of such material is assured.

Alphabetical arrangement always presents the disadvantage of scattering items which may be closely related in considering a given subject or phase of a subject. This difficulty has been overcome in the "Departmental Index of Plant Equipment," which will be found extremely valuable in locating related information. The field is divided into general, pottery, and heavy clay products and under appropriate subheads will be found the numbers of all items to be consulted.

The remainder of the volume is devoted to a catalog section giving informative data regarding equipment and materials manufactured by different firms supplying the industry.

Because of its unusual reference value, this book should be indispensable to everyone connected with or interested in the manufacture of clay products. ALAN G. WIKOFF.

Recent Chemical & Metallurgical Patents

American Patents

Issued Nov. 14, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,435,211—Electric Furnace.
1,435,219—Coking Process.
1,435,361—Coke-Oven Decarbonization.
1,435,382—Sorting Materials.
1,435,471—Hydrogen Sulphide Process.
1,435,505 — Recovery of Metals From Fumes.
1,435,506 — Recovery of Metals From Fumes.
1,435,524—Treatment of Salt Mixtures.
1,435,650—Preparation of Cellulose Solutions.
1,435,652—Cracking Hydrocarbons.
1,435,727—Method of Concentrating Brine.
1,435,742—Production of Refractory Alloys.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Barium Chloride From Black Ash Waste—J. H. McMahon has assigned this patent to the Mathieson Alkali Works, Inc. The process consists essentially of producing soluble barium compounds from the residue left after the leaching of black ash with water. As the process stands now, barium sulphate (and other barium ores as barytes) is treated with coal and reduced at a high temperature, from which process barium sulphide or black ash results. This black ash is leached free from barium sulphide and the resulting residue contains a great deal of barium carbonate. The residue or exhausted black ash is well ground and reduced to a finely divided condition, then heated with a solution of ammonium chloride, from which a reversible reaction results in the partial production of barium chloride. This reaction would soon reach a definite end point due to the formation of ammonium carbonate along with the barium chloride, which compound would react to the original barium carbonate and ammonium chloride. To get around this difficulty, the solution is either agitated with air or boiled vigorously, which gets rid of the ammonium carbonate, and the process then goes to completion with the formation of barium chloride.

The mineral can either be treated according to the black ash process first, or it may be treated with ammonium chloride first and the remaining sulphate reduced with black ash. It is stated that the reaction with ammonium chloride will be 90 per cent completed after an interval of about 3 hours. The barium chloride thus formed is in solution and may be recovered by filtering, evaporating or crystallizing in the usual manner. (1,428,646. Sept. 12, 1922.)

The Manufacture of Acetic Anhydride—H. W. Matheson and G. E. Grattan have assigned to the Shawinigan Laboratories, Ltd., of Montreal, the following processes for making acetic anhydride. Glacial acetic acid is heated from 60 to 200 deg. C., according to the pressure under which the reaction takes place, and is violently agitated until the acetylene gas, which is blown into the liquid, is completely absorbed. Acetic anhydride is formed when these two materials react in the presence of a small quantity of finely divided mercury salt. Five hundred parts of pure acetic acid from 96 to 100 per cent are treated with 25 parts of mercury oxide and to this are added 12 to 13 parts of concentrated sulphuric acid, in order to precipitate mercuric sulphate. Acetylene gas is then passed into the reaction kettle under a pressure of 40 lb. per sq.in., above atmosphere pressure.

The temperature is permitted to rise to 130 deg. At the end of about 2 hours a mixture of acetic anhydride, together with ethylidene diacetate and a small amount of acetaldehyde, will be left behind. The reaction mixture must be agitated during the absorption. Mercury salts are filtered out and the product purified by distillation. (1,425,500. Aug. 8, 1922.)

Coke-Oven Construction—The horizontal transfer flue common to all coke ovens of the vertical flue regenerator type has long been considered a source of structural weakness. To overcome this drawback the type of construction shown in the accompanying figures has been developed. The principle is em-

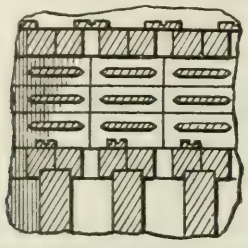


FIG. 1—LONGITUDINAL SECTION THROUGH HORIZONTAL FLUE

bodied in constructing the side walls of horizontal flue of what are called "notched brick." These brick are made with the ends of rectangular section, while the central portion is cut or notched until it has only a fraction of the cross-sectional area of the ends. In practice, brick of this type are laid so that the rectangular ends form the walls of the horizontal transfer flue, while the notched or cut-down parts form struts or braces between these two walls, thus serving to strengthen the structure.

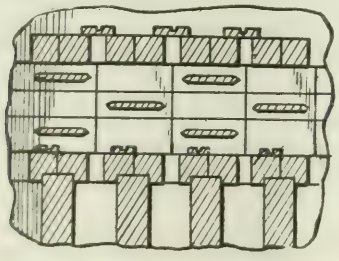


FIG. 2—ALTERNATE CONSTRUCTION

Fig. 1 shows a type of construction where every brick used is of this type. Fig. 2 shows an alternate type of construction which presents less resistance to gas flow but is not structurally as strong. (1,430,588. Arthur Roberts, assignor to the Chicago Trust Co. Oct. 3, 1922.)

Drying Apparatus Control—In the operation of the common type of drying apparatus which depends on the circulation of heated air for its drying effect, it is often desirable to maintain a predetermined humidity by controlling the amount of air which is re-circulated through the heating unit in relation to the amount of fresh air which is drawn in from the outside atmosphere. In this invention this is accomplished by locating in the air flues—on one side or the other of the fresh air inlet—a thermostatic diaphragm motor which operates a series of dampers regulating the openings in the various air passages. (1,431,145-1,431,146. J. E. Bolling, assignor to Drying Systems, Inc. Oct. 10, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Concentrating Coal—A process of separating coal particles of linear dimensions between 0.1 and 0.5 in. from shale or other gangue consists in submitting crude crushed or screened coal to treatment to coat the coal particles with a film of oil, and submitting the treated material to concentration by film flotation or subaëration flotation. The oiling may be effected by agitating a pulp of coal and water with an oil such as paraffine oil or fuel oil, or by immersing the coal in such an oil and then draining it. The coal may be first screened to separate out the particles of the size referred to, or the whole of the crushed coal may be treated together. In some cases, a frothing agent such as cresol may be added. (Br. Pat. 183,504. F. B. Jones and Minerals Separation, Ltd., London. Sept. 20, 1922.)

Artificial Silks—In the manufacture of artificial silk, films, etc., from viscose, an aqueous extract of certain plants is added either to the precipitating bath containing sulphuric acid and sulphates, or to the viscose itself. Salts of ammonia, triethylamine, pyridine, etc., may also be added to the bath. The materials used for making this extract may be the wood, stalks, leaves, needles, roots or fruits, particularly the needles, of conifers, and such roots or fruits as give mucilaginous extracts, such as mallow roots and linseed; and the extracting mediums may be water, solutions of acids or of substances having an acid reaction, or solutions having an alkaline reaction. The water extracts are obtained by boiling the material to be extracted with water under pressure, acidifying the extract, heating preferably to boiling point, filtering, and if necessary, concentrating preferably *in vacuo;* the salts necessary in the precipitating bath may be added to water during the extraction process, or they may be added to the extract. A similar procedure is adopted in the case of acid alkaline extractions; a suitable acid extracting medium is 5 per cent sulphuric acid, and as an alkaline extracting medium, solutions of sodium hydrate, soda or ammonia may be employed; "the dyes precipitated in the manufacture of viscose silk and soda-cellulose may also be used." The extracts may be rendered colorless by the addition of bleaching agents such as hydrosulphites, hydrogen peroxide or sodium peroxide or perborate, either during or preferably after the extraction process. From the needles of conifers is obtained "pine-needle extract," which extract contains terpene-like substances of particular value in the precipitation process; other extracts deficient in these substances may be improved by the addition of turpentine, turpentine oil, "pinon," dipentene, and the product obtained by reacting with acids on pinene, pinol, etc. (Br. Pat. 183,476; not yet accepted. Naamlooze Vennootschap Hollandsche Kunstzijde Industrie, Breda, Holland. Sept. 20, 1922.)

Synthetic Resins — Synthetic resins are formed by the direct action of acetylene on phenol or its homologs in the presence of acid and a mercury salt. Acetylene, preferably in excess, is passed into a mixture of the phenolic body with a little acid, such as sulphuric acid, or an acid salt to which mercurous or mercuric oxide or sulphate has been added; the temperature is preferably maintained at 50 to 120 deg. C.; increased pressure may be employed; a solvent for the phenol—for example, glacial acetic acid, an alcohol or acetone—may be present. Examples are given in which phenol and cresol are the starting materials, the resulting products being finally rendered infusible and insoluble by any method, such as treatment under heat and pressure with hexamethylenetetramine. (Br. Pat. 183,830; not yet accepted. Shawinigan Laboratories, Ltd., Montreal. Sept. 20, 1922.)

Wire Drawing — Dies for drawing tungsten wire, etc., are made from an alloy of tungsten and cobalt. The alloy may consist of 75 to 95 parts of tungsten to 25 to 5 parts of cobalt. The dies are made by producing the alloy by a thermo-aluminic process and then drilling and polishing. The alloy made may be sufficient to form a single die or a number of dies, in which case it is first sawed into pieces. In order to make the alloy, tungstic acid and cobalt oxide are first freed from moisture by heating at 400 deg. C. and are then mixed with fine-grained aluminum and fused in the ordinary way. (Br. Pat. 183,807; not yet accepted. Naamlooze Vennootschap Philips' Gloeilampenfabrieken, Eindhoven, Holland. Sept. 20, 1922.)

Soap—Soap, in a white and inodorous condition, is produced from soaps made from refined or unrefined oils, fats and fatty acids, or waste products of oil and fat manufacture, or from soapstocks obtained in deacidifying fats and oils, by spreading aqueous solutions of these materials over surfaces such as plates or rollers heated, for example, to 90 to 150 deg. C. By treating a thin film of soap at 100 deg. C., a dry product is obtained which on cooling takes the form of flakes. By using a lower temperature and a thicker layer of the solution, the amount of residual moisture can be regulated, and soap in pasty condition, suitable for making cakes or bars, is obtained. (Br. Pat. 183,837; not yet accepted. B. J. A. Nijdam, Wageningen, Holland. Sept. 20, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

More Tariff Rate Change Applications

Oxalic Acid Duty May Be Changed—Hearings to Begin in Two Weeks

Applications are continuing to pour in upon the tariff commission for changes in rates in the new tariff bill. Members of the commission declare that since the bill went into effect, only a few weeks ago, more than eighty applications have been filed for increases in rates for the protection of domestic manufacturers, reductions in rates for the benefit of importers, and for changes in classifications of commodities to lessen the burden of present rates on particular commodities.

Applications on Chemical Rates Numerous

The principal commodities represented by the applications filed to date, it was said, are chemicals and wool. In view of the comparatively large number of applications filed for changes in rates and the commodities agitating for these changes, officials do not consider the number of petitions filed as alarming.

Oxalic Acid Rate

The Advisory Board, supported by the report of the experts on chemicals, has filed data with the commissioners indicating that there is such a great difference in the comparative costs of oxalic acid in the United States and abroad and that a hearing well might be called to consider an increase in the rate on this chemical. A similar report has been filed on another chemical, which has not been identified.

It was learned upon good authority that the majority of the applications for changes in tariff rates, under the flexible provisions of the Fordney-McCumber act, represent chemicals and agricultural products.

Hearings in Two Weeks

The commission is having its commodity experts look carefully into the merits of the contentions before taking any definite action in the nature of open hearings, but officials are hopeful that the first hearings may be begun within the next two or three weeks, at which the commission may begin to take arguments on the accumulation of applications and decide the merits of the petitions.

Chairman Marvin of the commission is understood to be anxious to begin the hearings as soon as possible, and has urged experts of the commission to make every effort to this end. The difficulty met in obtaining the services of experts to investigate the applications as filed has slowed up the administration of the tariff measure and may yet delay the proposed hearings until the tariff machinery has been perfected.

Says Ford Will Get Muscle Shoals

That the disposal of Muscle Shoals to Henry Ford is but a matter of time was the announcement made by A. G. Patterson, president of the Public Service Commission, before the national convention of railway and utilities commissioners in Detroit last week.

When Muscle Shoals is completed, some of the vast amount of power developed there will be used for public utilities and, in that way, will come under the direct regulation of the commission.

"Never before have we been so certain that Congress will lease Muscle Shoals to Mr. Ford as we are today," said Mr. Patterson. "Muscle Shoals will go to Mr. Ford because no other party in the country has made, nor can make, an offer that compares with his. His nearest competitor is the Alabama Power Co., which is controlled by Wall Street capitalists. The South will never consent to have the destiny of its industries handed over to Wall Street control. The South trusts Mr. Ford because he does business on a conservative basis."

Physical Chemists Chosen as Editors of "Journal"

Announcement has been made of the selection of a board of editors for the *Journal of Physical Chemistry* to take over the burden of issuing that publication from Wilder D. Bancroft, of Cornell University, who has borne the entire responsibility of it for the past 18 years. The journal will be published in the future under the auspices of three societies, the Chemical Society of London, the Faraday Society and the American Chemical Society.

The following physical chemists have been named editors: By the Chemical Society of London, Professors T. M. Lowry, J. W. McBain and James C. Philip; by the Faraday Society, London, Prof. F. G. Donnan; by the American Chemical Society, Dr. A. L. Day, Prof. G. A. Hulett, Dr. Irving Langmuir and Prof. W. Lash Miller. Professor Miller is a Canadian member of the American society.

Trade Board Protests Alcohol Ruling

Urge Separation of Prohibition Enforcement and Industrial Alcohol Revenue Collection

Vigorous protest against the methods of the Treasury Department with regard to the legitimate commercial user of alcohol, who finds it almost impossible to keep abreast of the continuous stream of rulings emanating from Washington on the use of this chemical, was voiced at a meeting of the drug anl chemical section of the New York Board of Trade and Transportation in New York, last week.

In particular, the recent Treasury decision 3398 was condemned, since it is claimed that it is "an apparent attempt, without authority of law, to collect 25 per cent of the face value of a bond without resort to legal action, in addition to the penalties already provided for violations in the prohibition act itself."

Approval was given at the meeting to the protest of the committee on prohibition law enforcement and legislation of the board in this matter, which was stated in a letter to the Secretary of the Treasury, signed by Frank G. Starr, of Sharp & Doehme, chairman.

Urge Separate Enforcement

The committee also recommended a separation of the functions of the supervision of alcohol for industrial and other non-beverage purposes from the policing of violations of the prohibition law and urged the Commissioner of Internal Revenue to appoint a deputy commissioner to take over the industrial alcohol and chemical division of the prohibition unit.

University of Washington Offers Broad Course in Ceramics

The University of Washington, Seattle, Wash., announces the twenty-seventh annual winter mining session, to continue from Jan. 4 to March 21, 1923. No previous training is required for entrance. The expenses of the courses consist of laboratory deposits for material actually used and a university fee of $20.

The course in ceramics includes the study of clay testing, lime, plaster, cement, brick, stoneware, whiteware, refractories, glaze studies, clay technology and terra cotta manufacture. A postal card to the College of Mines, Seattle, will bring full details.

Agricultural Chemists Adopt Standard Methods

Value of Chemistry in Agriculture and Biology Stressed—Duplication of Scientific Work

During the deliberations of the Association of Agricultural Chemists in Washington last week, F. P. Veitch, retiring president of the association, made a plea for the elimination of waste in scientific work. In addition, he emphasized the importance which chemistry is playing in agriculture and in industry. In the course of these remarks Dr. Veitch, among other things, said:

"There are so many concrete things worth doing that the tendency to needless expansion and duplication is difficult to foresee or to check. Both are so wasteful of the people's funds, of time and effort that they should be guarded against at all times.

"Why has it been deemed necessary or even desirable for other organizations to repeat and duplicate much of the work done by this association? Why must three or perhaps more other organizations investigate the determination of the iodine numbers of oils? Why is it necessary for these organizations to do more than adopt these methods which are the outcome of many years of careful, thorough and impartial co-operative effort? What can be done to stop this waste of time and effort, and the doubt and conflict that result from the use of different methods?

Chemistry in Agriculture

"Years ago a distinguished member of this association remarked that no line of agricultural work progresses far before it is necessary to call in the chemist. This should be a more generally recognized fact. Take chemistry out of biology and nutrition and little but a name is left. Forget and abandon today's chemical knowledge in agriculture and industry, and civilization drops back two thousand years, because even two thousand years ago they were recognized as the rudiments of applied chemistry. In peace and in war it plays its major part."

Adopt Analytical Methods

With regard to boric acid in fertilizers, the association approved the following recommendation:

> That as boron compounds not soluble in water, but soluble in weak acids, appear to be as injurious to plants as the water-soluble compounds and since the Bartlett distillation method as now carried out determines the boron in such compounds, it is recommended that it be adopted as an official method in its present form to determine boron in mixed fertilizers and fertilizer materials.

Nitrogen Determination

With regard to nitrogen the following recommendations were approved:

> That the referee for 1923 be instructed to study the DeVarda method as applied to the nitrate of commerce.
>
> That the Moore method for nitrates be studied with collaborators next year.
>
> That the referee on nitrogen for 1923 be instructed to study the use of sodium thiosulphate as a substitute for sodium or potassium sulphide in precipitating mercury in the Kjeldahl method.

The association authorized the appointment of a referee to consider the determination of active acidity of hydrogen-ion concentration for agricultural chemical products.

Fertilizer Analysis Methods

With regard to potash, a recommendation to the effect that the investigation of the centrifugal method by Sherrill be discontinued was approved. The general referee on fertilizers was instructed to study the literature with regard to the use of alcohol, stronger than 80 per cent, for washing the potash precipitate with a view to ascertaining if collaborative investigation of the question is desirable.

A recommendation was approved to the effect that the determination of insoluble phosphoric acid in precipitated phosphates be carried out according to the present official method for the determination of insoluble phosphoric acid in fertilizers, with the exception that a 1-gram charge be employed.

Swedish Match Company Increases Capitalization

It is now definitely announced that the board of Svenska Taendsticks Aktiebolaget (Swedish Match Co.) has decided to propose that the present share capital be raised from 45,000,000 to 90,000,000 kroner. The new shares are to be issued at the rate of 120 per cent, thus bringing the total increase up to 54,000,000 kroner.

As the board of directors considers this amount too large for the Swedish market, an agreement has been entered into with a British company to place 40 per cent of the shares issued in England. It is expected that the company's shares will be quoted on the London Stock Exchange.

The new capital is to be used for the purpose of building match factories abroad, especially in India, this policy having proved advantageous. The company's exports of matches during the past few years have greatly increased and are now above the pre-war figure.

New York State Industrial Conference Considers Elimination of Waste in Industry

ELIMINATION of waste in industry was the watchword at the sixth annual New York State Industrial Conference which was held in Buffalo, N. Y., Nov. 21 to 24. Governor Miller, who had been expected to attend the opening session, wrote a letter that was read to the delegates.

"The limitation of waste in government is of equally great importance to the man of business and industry," the Governor wrote. "Industry and business, therefore, do well to meet and take counsel with government. The contracts made, the points of view acquired, cannot fail to be of service to the state, to business and to industry."

Welfare of Workers

Commissioner Henry D. Sayre reviewed the progress made in reducing the number of industrial accidents and said that with continued co-operation of industry itself further progress would be made, not only in reducing accidents, but in restoring injured to their full powers.

"The worker does not want to be coddled," said Mr. Sayre. "He does not want to be patronized. But he does want and is entitled to be protected from the effects of overfatigue and from the dull monotony of a constant repetitive process."

William D. Baldwin, of the Otis Elevator Co., spoke of better relations that exist between employers and employees now as compared with former times, for which, he said, much credit was due to workmen's compensation laws.

Wasteful Industrial Habits

Wasteful industrial habits are costing the nation billions of dollars anually, L. W. Wallace of New York City, executive secretary of the Federated American Engineering Societies, declared in addressing the convention. Lost production caused by ill health, physical defects and industrial accidents was a prolific source of waste, asserted Mr. Wallace, who said that the "42,000,000 men and women gainfully employed in the United States probably lose on an average more than 60 days yearly from illness or disability, including non-industrial accidents, or a total of more than 252,000,000 days."

The 12-hour day and the 7-day week were classed as wasteful industrial habits by Mr. Wallace, who cited the findings of the committee on work-periods in continuous industry of the Federated American Engineering Societies and the observations and experiences of John D. Rockefeller, Jr.

Management at Fault

Mr. Wallace held management responsible for conditions which slowed down production and produced increased cost, hardships and labor unrest. Cancellation of orders and the return of goods he characterized as vicious practices hindering stabilization. He commended Mr. Hoover's plan for an authoritative national information agency to aid managers of industry and commerce. High labor turnover he called another indictment of management. He advocated systematic and permanent study of the unemployment problem, ascribing to intermittent employment great waste. Labor difficulties in the clothing and building industries could be greatly reduced, he said, by the adoption of a more uniform production schedule.

Both management and labor, he charged, were guilty at times of criminal restriction of production, individually and collectively.

Paint Company Restrained on Charge of Misbranding of Goods

Charging methods of unfair competition in the misbranding of goods, the Federal Trade Commission has issued a formal complaint against John McQuade & Co., Inc., of Brooklyn, N. Y.

The concern is a manufacturer and seller of paints and similar products and is charged in the complaint with using on containers of certain of its products words and combinations of words which are not true descriptions of the contents of such containers. Among the words so used on labels, it is alleged, are the following: "French White Zinc," "Vieille Montagne Co., Paris," "Green Seal," "White Zinc" and "American White Lead."

Paint products so labeled, it is further charged, have definite meanings to the trade and others, in respective instances as follows: the words "Vieille Montagne" denote to the trade and to the purchasing public a zinc oxide commercially pure and one manufactured and sold by the Société des Mines et Fonderies de Zinc de la Vieille Montagne; that the term "Green Seal," when used to describe "White Zinc," signifies to the trade and to the purchasing public a high grade of white zinc; "White Lead," when used in labels placed upon commercial containers of pigments, signifies to the trade and to the purchasing public pigments composed wholly of commercially pure basic lead carbonate or basic lead sulphate. The commission's complaint alleges that the branding and labeling used by respondent is misleading and deceives the trade and the purchasing public because its goods so labeled do not conform with the above definitions.

Manufacturing Chemists' Association Protests Rate on Private Tank Cars

That the railroads should pay more for the use of privately owned tank cars is the contention set forth in a complaint filed with the American Railroad Association by the Manufacturing Chemists' Association. This action is taken largely in the interest of acid manufacturers. The American Petroleum Institute is taking similar steps with reference to privately owned oil tank cars.

Fertilizer Men Consider Protest on Freight Rates

Whether or not an attempt will be made to obtain an adjustment of the whole framework of fertilizer freight rates will be decided at a meeting of the traffic committee of the National Fertilizer Association which will be held in Cincinnati on Dec. 7. The fertilizer association contends that rates on fertilizers are higher than those charged on comparable commodities. It also is contended that lower rates will stimulate shipments and increase the profits of the carriers on this traffic.

Rarer Metals Symposium to Feature A.E.S. Meeting

Experts in Production and Applications of These Elements to Speak—Session on Electrode Potential

The growing importance of the so-called "rarer metals" is recognized by the American Electrochemical Society, which is planning an extended symposium on the subject at its forty-third annual meeting next spring. The convention will be held in New York, May 3, 4 and 5, 1923, headquarters being at the Hotel Commodore.

The symposium on "The Production and Application of the Rarer Metals" will occupy an entire day. Arrangements for this session are in charge of F. M. Becket of the Electrometallurgical Corporation, New York City. There will be papers on vanadium, tungsten, cobalt, molybdenum, zirconium, cerium, uranium, tantalum, calcium, magnesium and others.

Among the speakers will be: H. N. McCoy, president of the Carnotite Reduction Co. of Chicago; H. W. Gillett, of the Bureau of Mines, Ithaca, N. Y.; B. D. Saklatwalla, of the Vanadium Corporation; F. E. Carter, of the Baker Platinum Works, Newark, N. J.; H. S. Cooper (paper on zirconium metal); J. A. Holladay, of the Electrometallurgical Corporation (paper on analyses); M. A. Hunter, of the Rensselaer Polytechnic Institute, Troy, N. Y. (two papers; one on titanium); Mr. Clancy (paper on alloys as catalyzers); Mr. Cutter, of the Climax Molybdenum Co.; Russell Lowe, Bario Metal Corporation (paper on bario metal); Colin G. Fink, secretary of the society (paper on tungsten); C. E. Minor, Aravaipo Leasing Co., Klondyke, Graham County, Ariz.; W. R. Whitney, director of research laboratory, General Electric Co., Schenectady, N. Y.

Another session will be devoted to a discussion of "Electrode Potentials" headed by William G. Horsch, of the Chile Exploration Co., New York. The papers will cover studies on reversible electromotive force, overvoltage, ion activities and dissociations, electrotitration and p_H determinations.

Heavy Fire Loss at Plant of Duquesne Steel Co.

The plant of the Duquesne Steel Foundry Co. at Kendall, Pa., was threatened with destruction by a fire on Nov. 20, which destroyed one of the main shops of the plant. Shortly before midnight companies from five adjoining villages assisting the Kendall department apparently had the conflagration under control.

A preliminary estimate of the loss, made by an official of the company, was $350,000. The cause has not been ascertained, but the flames spread with great rapidity and threatened two oil tanks in the heart of the plant, which covers twenty acres. The company manufactures steel castings and locomotive cranes.

Photography to Feature Joint Meeting of Societies in New York

The monthly meeting of the Society of Chemical Industry, to be held at Rumford Hall in the Chemists' Club, 52 East 41st St., New York, has been postponed from Friday, Dec. 1, to Friday, Dec. 15. The evening will be devoted to papers dealing with some of the chemical or physical aspects of photographic science, with special reference to the uses of photography and motion pictures in the industries. A paper dealing with the last-named aspect—the application of photography and motion pictures to industry—by Dr. A. B. Hitchins, director of the research laboratory of the Ansco Co., Binghamton, N. Y., will open the proceedings, and this will be followed by an address on "Some Chemical Aspects of Photographic Science," by Dr. F. F. Renwick, director of the Redpath laboratory of E. I. du Pont de Nemours & Co., Parlin, N. J. The third paper will be by Dr. Herbert E. Ives, research engineer of the Western Electric Co., New York, who is to take for his subject "Color Measurement as Utilized in Color Photography." This paper will be illustrated by lantern slides.

The members of the Technical Photographic and Microscopical Society are invited to attend this meeting, which has been planned for their benefit as well as for the members of the American Section of the Society of Chemical Industry.

New Surgical Suture Invented in Wisconsin University

A skin suture for use in surgical operations that leaves no unsightly scars and combines all of the advantages of horsehair with none of its disadvantages has been recently invented by Prof. Louis Kahlenberg of the chemistry department of the University of Wisconsin and has come to be extensively used by surgeons in America, Europe and the Philippine Islands. This new suture, called "equisetene," is made by chemically treating silk so that tissue cells cannot penetrate the meshes of the silk. The treatment overcomes the disadvantages which surgeons had found in silk as a suture, and makes a smoother, more uniform material for use in surgical operations, it is said.

First Soda-Pulp Mill in Canada Planned by Smith Company

After a meeting of the directors of the Howard Smith Paper Mills in Montreal, Canada, it was announced that the company would proceed shortly to erect a plant for the manufacture of bleached soda pulp. So far Canada has imported what it needed.

The soda pulp will be used for mixing with sulphite pulp to go into the manufacture of certain grades of paper, the varieties produced by the company having grown to a marked extent in the past couple of years.

Domestic Tungsten Industry Slack

In Spite of Price Rise Due to Tariff, American Producers Cannot Operate Profitably

Due in part to natural economic pressure but largely to imposition of a tariff rate equivalent to $7.14 per unit, the price of tungsten has steadily risen in the United States from quotations of $1.85 to $2 per unit as late as last March to around $8 per unit. Even at the increased price, domestic mines remain idle, for the second year since 1899. Domestic production ceased after 1920, when the average price dropped to $7.86 per unit from the $18.02 average of 1919, which latter was the lowest average price over a course of years.

Despite the fact that reports to the Geological Survey indicate that there is 2 to 3 years' supply of tungsten in this country, there appears to be little prospect of a break in the market, as the supply is held in strong hands, willing to sell it only at favorable prices. Some steel makers are reported to have only a short supply remaining, indicating that demand will be stimulated before long.

Domestic Industry Cannot Compete

These factors favoring a price increase are offset, however, so far as domestic mining is concerned, by a study of figures compiled by Frank L. Hess, in charge of the rare minerals section of the Geological Survey, in a report covering 1921, which show that United States production of tungsten in 1918 was 5,061 short tons with an average price of $23.24 per unit and dwindled to 327 short tons in 1919, with an average price of $18.02; 216 short tons in 1920, with an average price of $7.86, and disappeared entirely after that year with further and drastic price declines. In 1915 the average price per unit was $29.30; in 1916, $33.98; in 1917, $18.40. Comparing the production table with the price table, it would appear that domestic mines do not find it profitable to produce tungsten when the price is below $20 per unit, and it is a long climb from the present range of $8 per unit to $20.

Most of the tungsten now on hand in this country came from China, where military operations have compelled continued working of the placer mines even at the very low price of $1.85 to $2 per unit, landed cost, which was paid here for some months. Although the price has risen to approximately $8 in the United States, Chinese tungsten still is being sold in England at around $3 per unit.

The new tariff rate is approximately four times the price at which tungsten was being bought here last spring. The old tariff act did not impose a duty on tungsten imports.

Vanadium Situation

The vanadium situation in the United States also is interesting. Produced here as a byproduct of radium, the output has ceased because of the radium market conditions. Imports, which have been principally from Peru, also have practically ceased. There is a supply in this country, however, equal to 2 to 3 years' normal demand for the product. The Ford Motor Co., which was the largest consumer of vanadium in its steel, no longer uses this alloy.

Corn Products Co. Called Monopoly

Charged With Price Fixing by Federal Trade Commission—President Denies Charge

Declaring that the Corn Products Refining Company, of New York, "makes the market," and through the medium of guarantees against price declines in table sirups has eliminated the competition of smaller companies, the Federal Trade Commission has issued a formal complaint against the company, which has a capitalization of $80,000,000.

In an extended statement, the Federal Trade Board explains that through the operation of the price guarantee system the Corn Products Refining Company has been able to force other competitors to lose their customers through lack of comparable resources.

Misinformed, Says Official

E. T. Bedford, president of the company, and Frank H. Hall, counsel for the company, have issued statements declaring that the charge has evidently been filed on misinformation of the facts existing in the table sirup and glucose trade.

"Guarantee against price declines is given by practically all large manufacturers who distribute their advertised package goods under their own label through the wholesale grocer," declared President Bedford. "It prevents speculation and effects uninterrupted distribution, resulting in economies in both manufacturing and cost of transportation, as well as the cost of selling, all of which are in the best interest of the ultimate consumer, who, by reason of the guaranteed price, gets a lower price and the immediate benefit of any decline in price."

Denies Price Control

"The Corn Products Refining Company controls neither the price of glucose nor of table sirups," said Mr. Hall. "The markets for both of these products are highly competitive. While it is true that the company has a larger capacity for producing glucose than any single one of its competitors, nevertheless the combined output of the competitors is considerably larger than that of the refining company. All of these competitors are substantial and aggressive.

Lively Competition

"It is quite true that the reports of sales of glucose and mixed sirups filed with the government show that if all our company's plants were closed down there would still be ample production of glucose and mixed sirups for all requirements."

Texas Potash Deposits Being Investigated

Geological Survey Making Analyses of Well Cuttings in Oil Fields

In conformity with the purpose of keeping the public fully informed regarding the progress of discoveries in the search for potash in western Texas, the director of the United States Geological Survey, Department of the Interior, has issued a statement of the results of the examination of samples of cuttings from two wells recently drilled there—the McDowell well No. 4, in Glasscock County, and the Texon Oil & Land Co.'s Santa Rita well, in Reagan County. The samples represent cuttings reaching depths of 2,550 and 4,426 ft. respectively in the two wells, but no samples representing a gap of 680 ft. between 1,010 and 1,605 ft. have been received from the McDowell well. There is also a gap of 2,205 ft. between the 1,683 and 3,888 ft. levels in the Santa Rita well from which no samples have been received.

The samples from the McDowell well ranged from 61.3 to 97.8 per cent soluble salts containing from 1.63 to 9.95 per cent K_2O. Those from the Santa Rita well showed from 47.4 to 93.7 per cent soluble salts containing from 1.86 to 10.78 per cent K_2O.

The samples thus analyzed, like those described in earlier announcements, were taken by standard tools from wells drilled primarily for oil. So many of the conditions attending the sampling are unknown that it is impossible to state whether the potash-bearing zones are a few feet or only a few inches thick. In the Santa Rita well, for example, the original sample taken from the bailer after the drill had cut the beds from 1,316 to 1,325 ft. showed 8.29 per cent of potash, equivalent to 10.78 per cent of the soluble salts, yet it cannot be safely inferred that there is a 9-ft. bed of potash salts of the stated richness at that horizon. Continuous sampling with core drills will be necessary before accurate data can be obtained.

Natural Indigo Production in India Falls Off

According to the first indigo forecast issued by the Department of Statistics of India, and based on reports received from six provinces, which contain practically the whole area under indigo in British India, the total area sown is estimated at 226,900 acres, which is 4 per cent below the estimate at the corresponding date of last year. As compared with the final estimate of last year (316,600 acres), the present estimate shows a decrease of 89,700 acres, or 28 per cent. The total yield of dye is at present estimated at 4,100,000 lb., as against 4,250,000 lb., the estimate at this time last year. As compared with the final estimate of last year, the present estimate shows a decrease of 33 per cent. Weather conditions at sowing time were not very favorable.

Cement Association Meets in Chicago

Officials of cement plants in all sections of the United States and Canada attended the sessions of the twentieth annual convention of the Portland Cement Association in Chicago last week. They brought optimistic reports as to improved conditions generally in the industry with bright prospects for the immediate future.

The convention opened Nov. 20, the various committees meeting in executive sessions to prepare reports which were submitted at the general sessions. L. T. Sunderland, president of the association, presided, and the program included the reading of papers on subjects pertaining to cement manufacture and mill practice. A. C. Tagge submitted a report of the special committee on accident prevention and insurance. C. H. Sonntag of the Cape Girardeau Portland Cement Co. read a paper on the waste heat installation in the plant of that company, and W. P. Gano, chief chemist, Pennsylvania Cement Co., read a paper explaining the different influences on the grinding of portland cement clinker.

A feature of the convention was the presentation by Secretary of Labor James J. Davis to the association of a concrete bust of Robert Whitman Lesley, the first president of the organization, which was modeled and cast by the boys of Mooseheart.

Wesson and Alexander at N. J. Chemical Society

Jerome Alexander and David Wesson were the speakers at the November meeting of the New Jersey Chemical Society in Newark, Nov. 13. The former chose as his topic, "The Importance of Impurities," and under this heading discussed a wide range of phenomena in industrial chemistry in which the presence of a small amount of "impurity" is essential for satisfactory results. It will be readily understood that the scope of such a subject is almost unlimited, and it was a fact that Mr. Alexander's remarks covered a miscellany of products and industries from electrodeposition to Welsbach mantles. The effect of varying quantities of cerium in the thorium impregnating solution used in incandescent gas mantles was described.

There followed two reels of motion pictures presented by Dr. Wesson, through the courtesy of the Kirkman Soap Co., showing the preparation of the raw materials entering into soap manufacture and the processes used in an up-to-date borax soap plant.

Dr. Wesson spoke on the subject of the color comparison of oils, describing the development of instruments used for this purpose from the first crude tintometer to the extremely accurate K. and E. spectrophotometer which measures the amount of light which passes through an oil for different wave lengths.

British Adhesives Research Committee Reports

Emphasizes Need for Systematic Investigation of Problems in Adhesive Manufacture

Early in 1918 it was estimated that within a year the shortage of glue would seriously limit the output of aircraft. In the latter part of 1917, however, the probability of a shortage had already been foreseen and the attention of the enginering war committee of the Royal Society was called, by a memorandum from one of its members, to the necessity for the scientific study of adhesives. This committee referred the matter to the Conjoint Board of Scientific Societies, which body called together an adhesives committee representative of the numerous aspects of the subject, both theoretical and practical.

Investigation Scope

Having in view the conserving of the existing supplies of raw materials for adhesives and cements, the committee set to work to devise improved and more economical methods of manufacture and to discover, if possible, new sources of supply. At the outset, the four following lines of inquiry were adopted:

1. An attempt to evolve physical and mechanical glue tests such as would differentiate between samples of tolerable merit. In this way it was hoped to obtain a closer knowledge of the characteristics of good adhesive cements and glues for wood.

2. To ascertain to what substance or substances and to what properties of such substances the adhesive strength of the gelatine base glues is due.

3. To discover whether and where wastage of raw material occurred in the course of the existing manufacturing processes and to suggest a remedy.

4. To examine, from the point of view of their adhesive power, the physical properties of substances obtainable from sources other than bone, hide or casein, and, if possible, from waste products of which supplies existed in England.

For several months the work of the committee proceeded along these lines and a number of useful results were obtained and are described in the first report. The experience already gained had shown that the need for a systematic investigation of the general problems of adhesives was very great and the results and experience already obtained gave hope of success.

Widespread Application

Adhesives are materials of very widespread application in industry; practically every branch of manufacture utilizes them in some form at some stage. Considerable progress has been made in the development of vegetable adhesives and in their industrial applications. Much work has also been done upon the chemistry of gelatine and gelatine glues, and in particular an attempt has been made to discover the nature of the changes occurring during the formation of gelatine from its precursors in animal tissues.

In the manufacture of glues and other adhesives there are very wide variations in the processes employed by different firms and in the character of their finished products. It would seem, indeed, that with a few exceptions the manufacturing processes employed in England are purely empirical, and without any real scientific basis. From this frequently follows an output of lower yield and grade than should be the case. It is hoped that the investigations of the committee will be of assistance in the evolution of a sound technology of glue manufacture. There exists a prejudice against adhesives, other than the common gums, derived from vegetable sources. It seems by no means improbable that valuable adhesives should be obtainable from such sources, and this expectation is strengthened by the results which have so far been gathered.

Experiments on Blast-Furnace Operation

Although the chemistry of iron blast-furnace reactions are fairly well understood, it has not been possible, due to the size of the commercial iron blast furnace and the loss involved when a furnace freezes, to operate a furnace experimentally except within those narrow limits which operating practice has proved not to be dangerous. Such being the case, the metallurgists of the Bureau of Mines have for some time past been carrying on experimental research work having for its ultimate object the construction of an experimental iron blast furnace of such dimensions as to be operated continuously and during the operation of which the conditions in the furnace would approximate those obtained in regular blast-furnace practice.

Based upon the data obtained from thirty-three different experiments, the bureau's metallurgists at its station at Minneapolis designed and constructed an experimental iron blast furnace. A 10-day test was recently made wherein no mechanical difficulties were encountered which materially hampered the operation of the furnace. The test also cleared up several metallurgical points concerning which considerable doubt had previously existed, such as the ability of a small experimental furnace to make "bosh gas" (35 per cent CO, 65 per cent N_2 in the combustion or tuyere zone); the size of the coke necessary; the number and size of tuyeres; amount of wind necessary; temperature of the blast, and temperature of the coke reaching the tuyere. It was likewise doubtful whether a small furnace would produce a gas sufficiently reducing in character to reduce oxides of iron and manganese; whether it would be possible to incorporate the proper amount of carbon in the metal produced; and whether the slag and metal could be removed from the crucible at the proper time.

Report of Canadian Chemical Industries

The gross value of chemicals and allied products manufactured in Canada in 1920 was approximately $122,000,000, according to a report published from the Dominion Bureau of Statistics at Ottawa.

The report states that the actual capital invested in the 456 plants operating in this group of industries in 1920 was $120.000,000. Pigments, paints and varnishes made in forty-eight plants were valued at $27,000,000 and with this output was first in the field. The report covers ten principal industries producing, respectively, coal tar and its products; acids, alkalis, salts and compressed gases; explosives, ammunition, fireworks and matches; fertilizers; medicinal and pharmaceutical preparations; paints, pigments and varnishes; soap, perfumery, cosmetics and toilet preparations; inks, dyes and colors; wood distillates and extracts; miscellaneous chemical industries.

Import Statistics

The imports of chemicals and allied products into Canada have gradually increased from $3,469,000 in 1895 to $24,000,000 in the 12 months ended March, 1922. The exports of Canadian products of the same class has risen from $760,000 in 1892 to $9,000,000 in the 12 months ended March of the present year. During the war the great production of explosives in Canada and the shipment of this commodity to the war zone raised the Canadian exports of chemical products to a grand total of $57,000,000 in the 12 months ended March, 1919. The present export figures show that much of the advantage gained in the war-time development has been retained, and the fact that the summary statistics for the calendar year 1921 showed that 444 plants were in operation as compared with 456 in the preceding year is further evidence that the chemical industries of Canada are more than holding their own.

Copies of the report on chemicals and allied products for 1919 and 1920 may be had on application to the Dominion Bureau of Statistics, Ottawa.

Illinois Industries Urged to Save Coal

Industrials in Illinois are urged to conserve and store coal by the Illinois Manufacturers' Association. In an effort to aid fuel economy the association has sent out hints based on a circular issued by the engineering experiment station of the University of Illinois. These hints deal particularly with fuel economy in the operation of hand-fired power plants and point out that practically the only fuel available for power plant use in Illinois under present conditions is bituminous coal from the central fields of Illinois, Indiana and western Kentucky.

"The care with which the coal is 'prepared' and separated into different sizes is an important factor affecting its value in the power plant," the circular states. "The B.t.u. value and the percentage of ash furnish a general guide to the relative values of Illinois coals. Generally the coals having the lowest ash content have the highest B.t.u. value."

The circular recommends the storage of bituminous coal, provided the prescribed precautions are observed. It also enumerates the conditions necessary for complete and smokeless combustion of bituminous coals.

Novel Government Guide to Latin America

The new revised edition of the "Commercial Travelers' Guide to Latin America" has just been released by the Department of Commerce. It is an encyclopedia of the countries south of the United States. It is the only complete and up-to-date "Baedeker" for the traveler. Everything that a foreign representative should know is included within its 698 pages; salesmen's equipment, steamship routes and railroads, connections and rates, schedules of sailings, postal and cable services and rates, hotel accommodations in the various cities, restrictions on travelers, duties on samples and advertising matter.

Everything a commercial traveler ought to know about the twenty republics and the many colonies to the south of us to make a trip profitable as well as enjoyable is encompassed within these 734 pages; steamship lines and railroads, time tables and connections, road routes, hotels and rates, taxes on travelers and restrictions, duties on samples and advertising matter; nothing essential is omitted. The traveler is told about the banks, postal service and postal rates, weights and measures, and all things that may obviate those vexatious delays which are especially troublesome to the uninformed and inexperienced traveler in Latin America.

Every city and market of importance in the Latin Americas is listed with information as to its characteristics, trade regulations, license fees, routes by which to reach it, etc., and the traveler is given abundant sound advice to be followed in canvassing each section.

This rather unusual publication is a decided novelty—quite a departure from the usual routine of official bulletins. Its attractive binding, with stout flexible covers, thin paper and convenient paragraph headings, is an unusual feature. One of the most important items in the guide is the series of more than forty maps which were specially drawn for this publication and are based upon the most recent authentic data regarding railway lines, commercial centers, etc. The guide may be obtained by applying to the Superintendent of Documents, Government Printing Office, Washington, D. C., or to any of the district or co-operative offices of the Bureau of Foreign and Domestic Commerce, price $1.25 prepaid.

Automobile Interests Finance Oil Refinery in Canada

Ground has been broken in Montreal, Canada, for one of the largest and most up-to-date oil refineries on the continent. It is being financed by prominent Canadians, associated with a group of Detroit automobile manufacturers, headed by Benjamin Briscoe, who since selling his Briscoe Motor Corporation interests in 1917 is now one of the principal stockholders in the Gray and the Durant motor companies. The new corporation, the Red Star Refineries, Ltd., with a paid-up capital of $6,000,000, controls the Ramage process for the refining of petroleum. It is claimed for this process that a much superior quality of gasoline is obtained from the crude oil.

The Red Star Refinery now under construction is on the St. Lawrence River, on deep water, where the company's tankers will bring the crude oil from Mexico and the Gulf ports. When finished, this refinery will have a capacity of 10,000 bbl. of "Super-Gas" per day.

Personal

C. F. Geiger, ceramic engineer of the Carborundum Co., Keasbey, N. J., was the principal speaker at the regular monthly meeting of the Rutgers Ceramic Club, Rutgers College, New Brunswick, N. J., Nov. 16. He gave an illustrated address on "Carborundum Refractories."

Ivar J. Moltkehansen, after 20 years practice in the United States, Norway and Belgium, has opened offices as a consulting electrochemical engineer at 44 Avenue Beau Séjour and 13 Rue Bréderode, Brussels, Belgium.

Arthur Rosenhain of England will deliver the second annual lecture before the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers on Feb. 19, 1923. His subject will be "Solid Solutions."

W. R. Shimer, metallurgist of the Bethlehem Steel Co., Bethlehem, Pa., addressed the Washington Chapter of the American Society for Steel Treating, Nov. 24, 1922, on "The Manufacture of Steel."

Victor Yngve has resigned his position with the Hydrol Co. of Niagara Falls, N. Y., to accept a research fellowship in cryogenic engineering at Harvard University, Cambridge, Mass.

Obituary

Spencer Kellogg, head of Spencer Kellogg & Sons, Inc., Buffalo, N. Y., producers of linseed, core and other oils, died at his residence, Nov. 14, at the age of 71 years, as a result of an attack of acute indigestion. He entered the linseed oil business in 1872.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

The Significance of the Stock Dividend

Many Companies in the Chemical and Allied Industries Are Capitalizing Their Accumulated Surpluses by Participating in This Record Distribution

DURING the past few weeks has occurred the largest distribution of stock dividends in the history of finance. The total issue announced by forty stock companies during the last 30 days amounts to $1,119,000,000, or slightly more this country's total national debt in 1914. The fact that the chemical and related industries have figured prominently in this movement may be regarded as convincing evidence of the widespread improvement occurring in these industries and also as an encouraging forecast of the earnings which these companies are likely to show in their annual reports for 1922.

A number of reasons have been assigned for the distribution of these dividends at this time, but it is believed that the principal motive may be found in the 1921 revenue law. That law differs from its predecessors in that it prescribes a flat rate of 12½ per cent on corporation profits. On the other hand the tax on individual incomes remains as in 1920 and 1921 on a sliding scale—the surtax steadily increasing from 1 to 65 per cent depending upon the size of the income. Another novel feature of the revenue law, known as the capital investment tax, makes it possible for large holders of securities, which have been owned for a period of 2 years or more, to liquidate their holdings and pay a straight tax of 12½ per cent on the profit from this sale, instead of paying the regular surtaxes.

Accordingly for some time there has been a tendency to forestall heavy outlays for taxation by allowing profits to remain in the business. This has brought about large accumulations of surplus accounts by many companies. In order to put this money to a more useful purpose, and guided perhaps by the rumors that Congress might attempt to impose a heavy tax on all accumulated surpluses, many concerns have found it advisable to capitalize their surplus accounts in the form of stock dividends.

An example may serve to show more clearly how the law operates. Suppose John Smith has a personal income of $75,000, on which he is required to pay the government a surtax at the rate of 35 per cent. Suppose, too, he owns a controlling interest in a corporation whose earnings would permit the payment to him of a cash dividend of $25,000. If he accepts that as cash, his income is increased to $100,000, and he must pay a surtax at the rate of 47 per cent. Naturally he does not want to accept such a dividend, for by leaving his profits in the business, only 12½ per cent need be paid in taxes.

Standard Oil and du Pont Dividends

The Standard Oil companies in New Jersey, New York, California, Kansas and Kentucky were among the first to announce stock dividends. That of the New Jersey company, which amounted to 400 per cent of its capital stock and corresponded to a distribution at par value of $395,517,000, was given wide publicity by members of Congress, who attempted to interpret the action as a tax evasion. Many other oil companies followed the example of the Standard companies, as may be observed from the accompanying compilation.

On Dec. 4 the directors of E. I. du Pont de Nemours & Co. will, with the approval of their stockholders, declare a 50 per cent stock dividend. The authorized capital stock was increased on Nov. 10 from $80,000,000 to $100,000,000 by the addition of 200,000 shares of $100 par value. The dividend rate for the new issue will be announced by the directors at their February meeting but it is generally believed that it will be the same as that on the old stock, namely $8 per share.

Since the du Pont stock was listed on the New York Stock Exchange in May, 1922, it has increased in value from $115 per share to $169.25 on Nov. 10. By Nov. 21 it had fallen off slightly to $154. In its annual report for last year the du Pont company reported that it had 10,579 stockholders, of whom 3,342, or 35 per cent, were employees.

Among the important industrials in the chemical, metallurgical and allied fields that have recently declared stock dividends are the following:

Company	Per Cent	Par Value Distributed (000 Omitted)
Standard Oil Co. of N. J.	400	$395,517
Standard Oil Co. of N. Y.	200	150,000
Standard Oil Co. of Cal.	100	100,971
Standard Oil Co. of Kans.	300	6,000
Standard Oil Co. of Ky.	33⅓	2,000
E. I. du Pont de Nemours Co *	50	20,000
Magnolia Petroleum Co.	50	58,675
Solar Refining Co.	100	2,000
Ohio Oil Co.	300	45,000
National Biscuit Co.	75	22,927
Vacuum Oil Co.	300	45,000
National Fuel Gas Co.	100	18,500
National Sugar Co.	50	5,000
U. S. Gypsum Co.	10	99†
Great Northern Paper Co.	200	16,800
Ingersoll-Rand Co.	100	15,000
Pan American Petroleum Co.	25	17,500
Scovill Mfg. Co.	200	10,000
Timken-Detroit Axle Co.	150	4,467
Union Natural Gas Co.	75	7,500
American Steel Foundry Co.	18	3,600
Hercules Powder Co.	100	10,000
American Mach. & Fdry. Co.	200	4,000
Gulf Oil Corp. †	200	72,290
Pure Oil Co.	75	1,568

*Pending stockholders' approval, Dec. 4, 1922.

†Not announced as a stock dividend but distributed to stockholders under a capital readjustment plan.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	162.45
Last week	162.83
November, 1921	146.82
November, 1920	240
April, 1918 (high)	286
April, 1921 (low)	140

The only items to show a change during the past week were caustic soda and linseed oil—both of which fell off slightly during the interval. The only effect on the index, however, was to lower it 0.38 of a point.

Taxes Claim One-Sixth of the National Income

In the fiscal year 1913-1914, taxes paid to national, state and local governments in the United States represented 6.4 per cent of the national income. By 1919-1920 the ratio had grown to 13 per cent and by 1920-1921 to 14.3 per cent. In the calendar year 1921, one-sixth of the current national income was diverted into tax channels for the support of governmental bodies in the United States.

This is one of the conclusions drawn by the National Industrial Conference Board after a comprehensive study of public expenditures and taxation in this country and abroad. "Under present conditions," the Conference Board's report concludes, "the tax bill in the United States is fast making inroads on the surplus necessary for economic progress and threatens materially to hamper our growth, especially in view of the uninterrupted rise in local government taxes. It is a question of growing importance whether a reduction in and wider diffusion of national tax burden may not be desirable, not only for the protection of the national surplus but in order to awaken a more general interest in the activities of the government."

Coal Problem Solved for This Winter (Except the Price)

The fuel situation has become stabilized to such an extent that the Chamber of Commerce of the United States recently notified its members that surveys and reports are no longer necessary, as the program adopted in September to equalize coal distribution, through co-operation among users in the period immediately following the strike, has been successful.

The resumption of large-scale industries such as steel plants and the relatively high operation of other plants show that industrial coal is adequately distributed and there is no apprehension about future supplies. The domestic user is clearly assured of domestic supplies, although individual preference as to kind and description may not always be met and may require some substitution of other coal.

Coal Production Up

The United States Geological Survey reports that bituminous coal production for the week Nov. 13-18 was 11,213,000 tons, as against 10,147,000 tons in the week preceding. Early returns for the week Nov. 20-25 indicate that 11,000,000 tons will be raised. Both bituminous coal and anthracite output in the week ended Nov. 18 were at high rates, and the total coal raised, 13,404,000 net tons, was the highest weekly outturn since the strike and was exceeded this year only in the week ended March 25, when the total outturn was 13,543,000 net tons.

Beehive Coke Output

Production of beehive coke continued to improve during the week ended Nov. 18. The estimated total output, based on the number of cars loaded, was 261,000 net tons, against 246,000 tons in the week preceding. Increased activity in the Pennsylvania-Ohio district was the principal factor in the improvement. According to the Contrict was the principal factor in the Connellsville region increased from 176,880 to 182,380 tons, the highest record attained since the beginning of the strike.

The cumulative output during 1922 to date stands at 6,310,000 net tons. In the corresponding period of the 4 years preceding it was as follows: 1921, 4,826,000 tons; 1920, 18,826,000; 1919, 17,376,000, and 1918, 27,627,000.

National Lead Pays Eight Per Cent

By declaring a quarterly dividend of 2 per cent on Nov. 23, the National Lead Co. placed its common stock on an 8 per cent premium basis as compared with the previous rate of 6 per cent. The dividend is payable Dec. 30 to stock of record on Dec. 15. The statement was made by President Cornish that the $4,000,000 in unissued common stock held by the company will remain as a reserve to be used for the extension of the business of the National Lead Co. and its subsidiaries.

The New York Market

New York, Nov. 20, 1922.

The chemical market continued along moderately active lines during the past week. Inquiries were quite abundant from various consuming industries for contracts over next year on some of the more important commodities, but as yet the producers have not shown any general inclination to accept this business. Resale stocks have been noticeably diminished and producers reported a sold-up condition for the remainder of the year on some products. Powdered white arsenic continued to be the feature of the week's trading and prices have reached new high levels. Actual transactions to the consuming industries have not been plentiful, but speculation among second hands on limited spot stocks has been the chief cause of the steady advance. Producers of acetate of lime announced another advance of ½c. per lb. Increased production costs and a stronger demand have been responsible for the new price.

The alkali market has also shown an appreciable improvement, especially for domestic consumption. Large producers seem well satisfied with the present volume of business and state that some new inquiries have recently been received from Japan and Italy for large tonnages. Red prussiate of potash is exceedingly strong on spot and sellers are asking top prices on limited stocks. Muriate of potash prices were advanced by leading importers. Formaldehyde retained its former strength without any quotable change.

General and Special Chemicals

Acetate of Lime—Producers advanced the market to $3.50 per 100 lb., for carload quantities, in bags. Higher production costs and better demand are responsible for the new price.

Arsenic—Quotations have again been advanced to 13½c. per lb. and the market during the latter part of the week was firmly established at this level. The insecticide industry has shown considerable activity.

Bichromate of Soda—Sales have been recorded at 7½@7¾c. per lb. for spot material and the market appeared firm at this level. Export business was fairly active.

Barium Chloride—The lowest figure heard for spot material was around $95 per ton, with the range at $95@$100, according to quantity. Shipments from abroad were held at $92 per ton.

Caustic Soda—The export market continued along moderate lines and prices were fractionally lower. The bulk of trading, however, is being done among domestic consumers. Contracts for the balance of the year are in very strong demand. Producers have not announced any prices for 1923. Spot quotations f.a.s. range around $3.50@$3.60 per 100 lb., with ex-warehouse goods held at $3.75@$4 per 100 lb.

Muriate of Potash—Quotations are somewhat higher on imported material at $35.75 per ton, basis 80 per cent.

Fluoride of Soda—Several sales of imported material were recorded at 9½c. per lb. Buyers are only purchasing for immediate requirements and the market showed some weak spots.

Oxalic Acid—Producers continue to quote 14c. per lb., f.o.b. works. Odd lots were heard around 14@15c. on the spot market. Foreign shipments were quoted at 13½c. per lb., duty paid.

Sal Ammoniac—White granular imported goods were much firmer during the week and prices ranged around 6¾c. per lb. The gray material continued firm at 8½c. per lb.

Soda Ash—Domestic demand has been quite strong and producers report heavy shipments at $1.75@$1.80 per 100 lb. for the 58 per cent, light, single bags. The export demand is moderate.

Vegetable Oils

Linseed Oil—Immediate shipment oil was quoted down to 85c. per gal., due to the unfavorable reports from the Argentine market. Late December delivery was reported at 82c. per gal., carload lots, in barrels. January-April oil was offered at 76@78c. per gal.

Coconut Oil—A good inquiry was reported for the Ceylon type oil, but the high figures restricted trading to a considerable extent. Prompt shipments held around 8c. per lb.

Corn Oil—The market for crude oil ruled steady at 8½c. per lb, f.o.b. Chicago, sellers' tanks. Spot oil in barrels was available in a small way at 10@10¼c. per lb.

Palm Oil—Foreign despatches reported a steady market, although spot prices remained quotably unchanged. Niger oil on spot was very scarce at 7¾c. per lb.

Peanut Oil—Domestic crude oil was purely nominal in the absence of any new crop offerings. The high cost of peanuts makes it almost impossible to produce any oil. Refined edible oil on spot was scarce at 13½@14c. per lb. in barrels.

Crude Rubber

General conditions in this market were somewhat easier during the past week and prices showed fractional declines for deliveries up to March, 1923. Trading was merely routine and buyers showed some disposition to hesitate at the present high levels. Smoked ribbed sheets and first latex were quoted at 24c. per lb. for December. January-March held at 24½c. and April-June at 25⅛c. per lb.

The Chicago Market

Chicago, Nov. 23, 1922.

But little change could be noticed in the condition of the industrial chemical market in this district. The tone of the market was firm, with both dealers and manufacturers reporting a very satisfactory volume of business. Its main feature has been the rapidly advancing prices on wood chemicals, which have risen nearly 100 per cent during the past 6 weeks. Imported chemicals are now at about the same price as domestic and in some instances higher.

Caustic soda maintained its firm posi-

tion and dealers report a good volume moving to the consuming trade. Prices were unchanged, with the solid 76 per cent quoted in ton lots at $3.50 100 lb. and the ground or flake in similar lots at $4.25. *Caustic potash* lacked quotable change and was reported as moving in a fair way at 7¼@7½c. per lb. *Soda ash* continued to be in good demand and supplies were available at $2.25 per 100 lb.

Potash alum was quiet, with mostly foreign material offered. The U.S.P. lump was quoted in small or moderate lots at 4½c. per lb. and the same grade in powdered form at 6½c. *Barium compounds* were unchanged in price and were rather quiet. The chloride was available in ton lots at $110 per ton and the carbonate at $90. *Barium hydrate* crystals were in limited request and spot goods could have been had at 6@6½c. per lb. *Ammonium chloride* moved in a routine way and the white granular was quoted at 7⅞@8c. per lb. *Ammonium carbonate* was quiet, with spot stocks of the lump held for 11c. per lb. *Copper sulphate* was unchanged in price and moved in a fair way at 6c. per lb. for small or moderate lots. *Carbon bisulphide* was scarce on spot and was held at 7½c. per lb. for single drums. *Carbon tetrachloride* was reported to be in good demand and spot stocks were quoted at 9@9½c. per lb. Following the advance on methanol *formaldehyde* was advanced to 15½c. per lb. in barrels. The advance was firmly maintained and dealers reported a very good volume of business at the new level. *Glycerine* was in a somewhat weaker position but the price of 18½c. per lb. for the c.p. material was maintained. *Lead acetate* was in fair demand and material on spot was quoted at 12½@13c. per lb. for the white granular.

Bichromates were firm and unchanged in price, with fair supplies reported to be moving to the consuming trade. *Potassium bichromate* was quoted at 12@13c. per lb., and the sodium salt at 9@9½c. *Potassium bicarbonate* was dull at 9½@10c. per lb. for the U.S.P. crystals. *Cyanide of potash* was very scarce and single-case lots were available from one source at 55c. per lb. *Red prussiate of potash* continued very scarce with only very small lots available at 95c.@$1 per lb. *Potassium permanganate* was rather quiet, with supplies of the U.S.P. small crystals quoted at 18½@19c. per lb. *Chlorate of potash* was very firm and small lots of powdered were quoted at 9c. per lb.

Linseed Oil and Turpentine

Turpentine is now so high priced that very little is moving and some of the consumers are taking up substitutes. Single-drum lots were offered for immediate acceptance at the opening of today's market at $1.69 per gal.

Linseed oil was firm in price, but the movement was reported as light. Single drums of the boiled was offered today at 95c. per gal. with similar quantities of the raw at 93c.

The Iron and Steel Market

PITTSBURGH, Nov. 24, 1922.

Steel mill operations seem to have had a slight further increase in the past week or two. Steel ingot production was at about 40,000,000 gross tons a year in October and may be estimated at a slightly higher rate this month. Cars are still in poor supply and from time to time there are various embargoes, but on the whole the current output is being shipped, together with some of the steel previously accumulated.

In wire products and tubular goods customers are exerting pressure upon the mills for heavier deliveries. In other lines there is no such pressure, but deliveries are evidently accepted freely, at as high rates as the mills can compass.

Finished Steel Markets Stagnant

As to actual sales and purchases, the finished steel markets on the whole are very quiet, practically stagnant, with certain important exceptions. Railroads continue to buy freely, orders reaching mills both direct from railroads and from car and locomotive shops, which are selling their product freely and have large inquiries before them. The automobile factories have formulated programs of production to April 1, and are in the market for the requisite steel. Although they are seeking as low prices as possible, they do not conceal their expectation of heavy operation. December is to be a light month in automobile production with the three succeeding months showing increases, the program involving heavier production in March than in any month of this year. The agricultural implement factories, while not operating particularly well, are doing better than formerly, and are buying some steel. The remarkable boom in garage and dwelling house construction causes pressure for delivery of nails and the smaller sizes of merchant pipe, and there is no little current buying of these.

Prices Barely Steady

In general, however, the finished steel market is quiet, and prices, far from advancing as they were doing for so many months, are barely steady. In view of certain long-range considerations, the ready acceptance of the present heavy deliveries is somewhat noteworthy. There is the general fact that steel prices advanced, on an average, rather sharply in connection with the coal strike, and the coal strike ended some time ago. The steel industry is left with higher costs than last March, but with the price level considerably higher still, and in the light of precedent the average buyer may be expected to seek lower prices before buying freely again. Another consideration is that production of steel since Oct. 1 has been at a rate more than 15 per cent greater than in the 6 months April 1 to Oct. 1. On account of the drastic liquidation in 1921, consumption April 1 to Oct. 1 could not have exceeded production, while now production is considerably greater and it is not the time of year for consumption to increase. This observation, noted in last week's report, applies with still greater force now and will apply probably until steel production begins to taper off, of which there is no visible premonition at present.

Steel Prices

Yesterday the American Sheet & Tin Plate Co. made its long-awaited announcement of sheet and tin plate prices for new periods. Contrary to expectations entertained very generally a month ago and still maintained in a few quarters, no advances are made, all prices being reaffirmed for the new periods. Tin plate is $4.75 per base box, 100 lb., for first quarter with jobbers and first half with manufacturing consumers, while sheets to all classes of trade for first quarter are 2.50c. for blue annealed, 3.35c. for black, 4.35c. for galvanized and 4.70c. for automobile. Independent tin plate makers had not been obtaining higher prices, although they insisted they ought to have higher prices. For a couple of months, all independents were obtaining higher prices for sheets, but lately there has been a recession to the Steel Corporation level, with the exception of automobile sheets, for which independents have still been trying to obtain 5c.

Bars, shapes and plates remain quotable at 2c., but the market is barely steady at that level, and no particular attempt is made to conceal the fact that on decidedly attractive orders slightly lower prices would readily be quoted by several sellers. Early deliveries are easily obtained. Delivery premiums on these lines disappeared recently.

Pipe remains quotable at 66 per cent basing discount, wire at 2.45c. and nails at $2.70. Hoops and bands are easier, desirable orders going at 2.75c., against 2.90c. formerly.

Coke and Pig Iron

The lack of coherence in market developments, or accidents, is illustrated by the fact that coal is down 50c. in the week, while coke, which is made from coal, is up 50c. and pig iron, which is made with coke, is down. Pittsburgh district steam coal is $2.75@$3, with byproduct at $3.50@$3.60 and high-grade gas coal at $3.60@$3.75. Connellsville furnace coke is $7.25@$7.50 for spot or prompt lots, and some of the best grades could scarcely be bought on contract to the end of the year at under $8.

Valley bessemer is quoted at $30 furnace, and it is not certain there would be any takers at that figure. Valley basic is offered at $27.50, without any inquiry. Single carloads of valley foundry have been going at $27.50. These prices are below those quoted a week ago by $2 on bessemer, 50c. on basic and $1 on foundry. The mere decline in prices is not remarkable, but the decline when there is so little inquiry to provoke active competition is distinctly notable.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.		$0.39 – $0.45
Acetone	lb.	$0.19 – $0.20	.20 – .22
Acid, acetic, 28 per cent	100 lb.	2.92 – 3.00	3.05 – 3.20
Acetic, 56 per cent	100 lb.	5.85 – 5.90	5.95 – 6.25
Acetic, glacial, 99½ per cent, carboys, 100 lb.		11.16 – 11.20	11.25 – 11.50
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.		.51 – .52
Hydrochloric, 18 deg.	100 lb.	.90 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg.	100 lb.	1.00 – 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech	lb.	.11 – .11½	.11½ – .12
Lactic, 22 per cent tech	lb.	.06 – .06¾	.06½ – .07
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg.	lb.	.05 – .05½	.06 – .06½
Nitric, 42 deg.	lb.	.06 – .06½	.06 – .07
Oxalic, crystals	lb.	.15 – .15½	.15½ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.		1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.		.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.		.30½ – .31
Tartaric acid, imported, powdered	lb.		.31 – .32
Tartaric acid, domestic	lb.		.32
Tungstic, per lb. of WO	lb.		1.00 – 1.20
Alcohol, ethyl (Cologne spirit)	gal.		4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.		.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.		.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03½ – .03¾	.03½ – .04
Alum, chrome lump	lb.	.05 – .05½	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07½	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06½ – .07½
Amylacetate tech	gal.		2.35 – 2.60
Arsenic, white, powdered	lb.	.13½ – .13½	.14 – .14½
Arsenic, red, powdered	lb.	.12½ – .12½	.13 – .13½
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	95.00 – 100.00	102.00 – 105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21¼ – .22
Barium nitrate		.08 – .08½	.09 – .09¼
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	
Blanc fixe, pulp	ton	45.00 – 55.00	
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)			
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.50 – 3.60	3.65 – 3.75
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.		1.40 – 1.50
Calcium phosphate, tribasic	lb.		.15 – .16
Camphor	lb.		.90 – .92
Carbon bisulphide	lb.	.07 – .07½	.07½ – .07¾
Carbon tetrachloride, drums	lb.	.10 – .10¼	.10½ – .12
Carbonyl chloride, (phosgene)	lb.		.60 – .75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	.04½ – .04½	
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	
Chalk, precip.—imported, light	lb.	.04½ – .05	
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05½ – .06	.06½ – .06½
Chloroform	lb.		.35 – .38
Cobalt oxide	lb.		2.10 – 2.40
Copperas	ton	27.00 – 28.00	29.00 – 30.00
Copper carbonate, green precipitate	lb.	.21 – .21½	.22 – .22½
Copper cyanide	lb.		.50 – .55
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.		.25½ – .26
Epsom salt (see magnesium sulphate)			
Ether, U. S. P. 100 drums	lb.		.14 – .15
Ethyl acetate com. 85%	gal.		.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.		.90 – .95
Formaldehyde, 40 per cent	lb.	.14 – .14½	.14 – .15
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	
Fullers earth—imported powdered	net ton	30.00 – 32.00	
Fuel oil, bbl	gal.		3.00 – 3.50
Fuel oil, crude	gal.		2.00 – 2.25
Glauber's salt (see sodium sulphate)			
Glycerine, c.p. drums extra	lb.		.18 – .18½
Iodine, resublimed	lb.		4.40 – 4.50
Iron oxide, red	lb.		.12 – .18
Lead acetate, white crystals	lb.		.12 – .12½
Lead acetate, powd.	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.		.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.		1.00 – 1.80
Methanol, 97%	gal.		1.00 – 1.07
Methanol, 97%	gal.		1.03 – 1.10
Nickel salt, double	lb.		$0.11 – $0.11½
Nickel salt, single	lb.		.12 – .12½
Phogene (see carbonyl chloride)			
Phosphorus, red	lb.		.40 – .45
Phosphorus, yellow	lb.		.30 – .35½
Potassium bichromate	lb.	$0.09½ – .10	.10½ – .10½
Potassium bromide, granular	lb.		.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06½	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07¾ – .08	.08½ – .09
Potassium cyanide	lb.		.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7.00
Potassium iodide	lb.		3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.16 – .16½	.16¾ – .17
Potassium prussiate, red	lb.		.90 – .95
Potassium prussiate, yellow	lb.	.39 – .39¼	.39½ – .40
Rochelle salts (see sodium potas. tartrate)			
Salammoniac, white, granular	lb.	.06½ – .07	.07¼ – .07½
Salammoniac, gray, granular	lb.	.08 – .08¼	.08½ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 – 27.00	
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07¾	.08 – .08½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04⅜ – .05½
Sodium chlorate	lb.	.06¾ – .07	.07¼ – .07½
Sodium chloride	long ton	12.00 – 13.00	
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09½ – .09¾	.10 – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.60	3.65 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09 – .09¼	.09½ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb		.18 – .21
Sodium prussiate, yellow	lb.	.21¼ – .21½	.21¾ – .22
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 – 1.30	1.35 – 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04¼	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03⅞ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 – 20.00	
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.		2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 – 40.00	
Talc—domestic powdered	ton	18.00 – 25.00	
Tin bichloride	lb.	.11 – .11½	.11½ – .11¾
Tin oxide	lb.		.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran	lb.	.07 – .07½	.07¼ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.90 — $0.95
Alpha-naphthol, refined	lb.	1.05 — 1.10
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.85 — .90
Benzidine sulphate	lb	.75 — .80
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Cresylic acid, 97%, resale	gal.	.90 — .95
Dichlorbenzene	lb.	.07 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.39 — .41
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.22 — .23
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.25 — .30
Dipnenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls	lb.	.06 — .06½
Naphthalene, flake	lb.	.06 — .06

Naphthalene, balls	lb.	$0.07 —	$0.07½
Naphthionate of soda	lb.	.58 —	.65
Naphthionic acid, crude	lb.	.65 —	.70
Nitrobenzene	lb.	.10 —	.12
Nitro-naphthalene	lb.	.30 —	.35
Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.85 —	.90
Ortho-nitro-toluene	lb.	.10 —	.12
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.50 —	1.55
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.37 —	.50
Phenol, U. S. P., drums	lb.	.34 —	.35
Pyridine, domestic	gal.	1.60 —	1.75
Pyridine, imported	gal.	1.40 —	1.60
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.29 —	.31
Salicylic acid, U. S. P	lb.	.35 —	.36
Solvent naphtha, water-white, in drums, 100 gal	gal.	.37 —	.40
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.20 —	.23
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.35 —	.37
Toluene, in drums	gal.	.40 —	.43
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.45 —	.50
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.40 —	.42
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

All prices remain same as previous report.

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.50 —	....
Rosin E-I	280 lb.	6.55 —	....
Rosin K-N	280 lb.	6.65 —	$7.10
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.57 —	1.58
Wood turpentine, steam dist	gal.	1.35 —	....
Wood turpentine, dest. dist	gal.	1.25 —	....
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.43 —	....
Rosin oil, second run	gal.	.51 —	....
Rosin oil, third run	gal.	.53 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
Blood, dried, f.o.b., N. Y	unit	4.60 —	....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.45 —	2.47½
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	35.75 —	38.50
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0 23½ —	.23¾
Upriver coarse	lb.	.17½ —	.17¾
Upriver caucho ball	lb.	.18½ —	.18¾
Plantation—First latex crepe	lb.	.24 —	.24¼
Ribbed smoked sheets	lb.	.24 —	.24¼
Brown crepe, thin, clean	lb.	.20 —	.20½
Amber crepe No. 1	lb.	.20 —	.20½

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12½ —	.12¼
Coconut oil, Ceylon grade, in bbls	lb.	.08¾ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
Corn oil, crude, in bbls	lb.	.10¼ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½ —	....
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.11 —	.11½
Linseed oil, raw, car lots (domestic) bbls	gal.	.85 —	.86
Linseed oil, raw, tank cars (domestic)	gal.	.81 —	.82
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.87 —	.89
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07½ —	.07¾
Palm, Niger	lb.	.06¾ —	.07
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10 —	.10¼
Peanut oil, refined, in bbls	lb.	.13½ —	.13¾
Rapeseed oil, refined in bbls	gal.	.77 —	.78
Rapeseed oil, blown, in bbls	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09 —	.09¼

Miscellaneous Materials

Prices remain quotably unchanged.

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225 00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	.10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, Atlantic seaboard	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	39 00 —	40.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	68 00 —	70.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.85 —	.90
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, c.i.f. Atlantic seaboard	ton	18 50 —	19 00
Coke, foundry, f.o.b. ovens	net ton	7.50 —	8 00
Coke, furnace, f.o.b. ovens	net ton	6.75 —	7 00
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19 00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	....
Manganese ore, chemical (MnO_2)	net ton	75.00 —	80 00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.11½ —	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.11½ —	12
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00 —	8 25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	7.75 —	8 00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1 75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2 50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	13¼

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.90
Aluminum, 98 to 99 per cent	20.00-21.00
Antimony, wholesale lots, Chinese and Japanese	6 60
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00-33 00
Nickel, ingot and shot, resale	30.00-31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	36.375
Lead, New York, spot	7.00-7.20
Lead, E. St. Louis, spot	6.875-6.90
Zinc, spot, New York	7.40
Zinc, spot, E. St. Louis	7.05-7.10

OTHER METALS

Silver (commercial)	oz.	$0.64⅜
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	52.00@55.00
Mercury	75 lb.	71.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

LEATHER—The Hiteman Leather Co., West Winfield, N. Y., has adopted an overtime working schedule at its local tannery. Maximum production is being maintained.

The Tunkhannock Tannery, Tunkhannock, Pa., is operating at full capacity, and has recently advanced the wage scale 10 per cent, making the second increase within the past few months. A full working force is employed.

The Standard Kid Co., Wilmington, Del., is advancing production at its tannery to a basis of 800 dozen daily, as compared with a former output of 600 dozen. The working force is being increased.

The Chain Leather Co., Peabody, Mass., operating on contract account, is maintaining active production at its tannery, and has recently placed a new hide house and other plant buildings in service. The working force is being held at close to normal.

RUBBER — The Republic Rubber Co., Youngstown, O., has commenced the manufacture of pneumatic tires at its local mill, and plans to develop a daily output of about 1,000 such tires at an early date. The company is also maintaining production at a high point at its mechanical rubber goods departments, and new monthly sales records are being established.

The mechanical rubber goods department of all mills at Akron, O., are running at full capacity, with full working forces. The majority of plants expect to maintain this schedule for an indefinite period. A number of tire-manufacturing plants are arranging for an increase in the present operating schedule.

The Lee Tire & Rubber Co., Conshohocken, Pa., is maintaining a high production program at its local mill, giving employment to a regular working force.

OIL—The Marland Refining Co., Ponca City, Okla., is advancing operations at its oil refinery. A new cracking plant is being completed with a capacity of about 1,800 bbl. of gas oil per day, and will increase the gasoline output about 25 per cent. It will be placed in service at an early date.

The Merritt Oil Co., operating in the Big Muddy Field, Wyo., a subsidiary of the Midwest Refining Co., Denver, Colo., has advanced production to a basis of 3,000 bbl. per day. The parent organization is taking a greater output from the Salt Creek Field, advancing capacity from 60,000 to 80,000 bbl. daily, gross.

IRON AND STEEL—The McKinney Steel Co. has blown in its blast furnace at Scottsdale, Pa., following a shut-down for about 24 months. The plant has a daily capacity of 350 tons and will be brought up to this point at an early date. Employment will be given to approximately 200 men.

The Pulaski Furnace Co., Pulaski, Va., has blown in its local blast furnace, following the reopening of its mines, quarries and coke ovens. Employment will be given to more than 250 men.

The American Steel & Wire Co. is preparing to operate at all of its Farrell mills in the vicinity of Sharon, Pa.

The Bourne-Fuller Co., Cleveland, O., has advanced production to a 100 per cent capacity basis at its mills.

All steel mills in the Birmingham, Ala., district are now running on a double turn, with extra working forces.

The American Swedo Iron Co., Danville, Pa., has inaugurated a night shift at its local mills, giving employment to a large increased working force. It is purposed to double the output.

Plants of the United States Steel Corporation in the Youngstown, O., district have advanced operations to better than 90 per cent of capacity. The majority of independent mills in this section are running in excess of 80 and 85 per cent.

A total of 230 blast furnaces are now operating in the eastern Pennsylvania district, the largest number for a year or more past.

At Joliet, Ill., 18 blast furnaces out of a total of 27 are now in operation. Independent companies in this section are running on a basis of from 70 to 75 per cent of normal.

The Gulf States Steel Co., Gadsden, Ala., is operating at 4 of its 6 open-hearth furnaces.

The National Tube Co., Lorain, O., has advanced operations to practically 100 per cent at its local mills.

The Trumbull Steel Co., Warren, O., is running at close to full capacity at its plant, with regular working force.

METALS — The Davis-Daly Co., Butte, Mont., is increasing production at its copper and silver properties, with monthly average totaling 21,000 tons to the smelter at East Butte. Employment is being to more than 300 men.

The Utah Copper Co., Salt Lake City, Utah, has commenced operations at the first unit of its Magna mill, which has been remodeled and improved. The unit will have a capacity of 1,000 tons, and will be supplemented by two additional units at an early date; the plant will have a total of 12 units, with rated output of more than 12,000 tons daily. The Arthur mill of the company is on the active list, running at 15,000 tons per day.

Foundries at Wrightsville, Pa., have advanced the wages of employees 5 per cent, effective Nov. 15, with a similar increase agreed upon at the first of the year. Among the plants affected are the Riverside Foundry Co., and the Susquehanna Casting Co., both running close to normal.

The United Engineering & Foundry Co. has resumed production at its Todd foundry, Youngstown, O., after a shut-down since May, 1918.

The Nevada Consolidated Copper Co. is running its McGill, Nev., smelter on the basis of 2,400 tons of copper ore per day, divided among 6 operating units. This will be advanced to 15 units in service shortly after the first of the year, with daily capacity of 6,000 tons.

Construction and Operation

Arizona

SUPERIOR—The Magma Copper Co. is perfecting plans for the erection of a new smelting plant at its properties. Other extensions and improvements will also be made.

California

MONOLITH—The Monolith Portland Cement Co. has inaugurated a program of extensions and improvements at its plant to increase the capacity to 3,000 bbl. per day. Additional equipment will be installed.

SIERRA CITY—E. C. Klinker and associates have taken over the Bigelow quartz properties, and plan for extensive production. Machinery will be installed, including equipment recently obtained from the Monarch Mine, in this same district. The Bigelow property has been inactive for some time past.

LOS ANGELES—The Shell Oil Co., San Francisco, has awarded a contract to the William A. Heitman Construction Co., 900 Merritt Bldg., Los Angeles, for the erection of the initial buildings for its new refining plant on a tract of land recently acquired at Wilmington, Los Angeles Harbor. The work will consist of a main refinery, pumping plant, stills, tanks, power house and a number of mechanical buildings, estimated to cost close to $5,000,000, with machinery.

Connecticut

WATERBURY—The Connecticut Brass Co., Watertown Rd., has plans nearing completion for the erection of a new 1-story brass foundry. Work will be commenced at an early date.

Georgia

AUGUSTA—The Hills Molasses Mixture Co., 19 Jackson St., recently organized, has obtained a local building and will soon commence the installation of machinery for the manufacture of insecticides for the destruction of the cotton boll weevil and other service. A list of equipment has been prepared. Frank H. Barrett is president.

GRIFFIN—Fire, Nov. 9 destroyed a portion of the fertilizer works of Gossett & Sons, with loss estimated at about $20,000. It is planned to rebuild.

Indiana

INDIANAPOLIS—The Republic Creosoting Co., 1614 Merchants' Bank Bldg., has plans in progress for the erection of two 1-story additions to its plant at Maywood, 82x107 ft. and 40x40 ft., respectively. A new still, condenser and other equipment will be installed. Batchelder & Scales, 426 Board of Trade Bldg., are architects. Peter C. Reilly is president.

INDIANAPOLIS—The Puritan Bed Springs Co., 902 Kentucky Ave., will rebuild the portion of its enameling works, destroyed by fire, Nov. 8.

Kentucky

LOUISVILLE—The Standard Sanitary Mfg. Co., 6th and Shipp Sts., has plans nearing completion for the erection of a 1-story addition to its plant, 55x325 ft., to be used for the most part for the enamel department at the works, estimated to cost about $75,000, including equipment. It will give employment to an increased working force of about 125 men.

OWENSBORO—The Bolger & Medley Co. has plans in progress for the establishment of a new local plant for the manufacture of face brick, hollow tile and other burned clay products. Work will begin at an early date.

Louisiana

NEW ORLEANS—The Atlantic Paint Co. has plans under way for the construction of a new 2-story brick plant, 30x140 ft., to replace its factory recently destroyed by fire. A general contract for the building will soon be let.

NEW ORLEANS—A. P. Orrick, 410 Chartres St., is making inquiries for machinery for the manufacture of soap and special soap shapes, to be installed in a local building.

SWARTZ—The Atlas Oil Co. has authorized the immediate preparation of plans for the erection of a new gasoline-refining plant, on the site of its former works, recently destroyed by fire with loss of about $100,000, including equipment. The new structure will cost approximately a like amount.

Maine

MILLINOCKET—The Great Northern Paper Co. has work in progress on a new 1-story building at its plant, 60x180 ft., estimated to cost about $25,000. C. P. Crowell and W. S. Lancaster, Exchange Bldg., Bangor, Me., are architects.

Maryland

SECURITY—The Security Cement & Lime Co., 116 West Washington St., Hagerstown, has commenced the erection of a new 1-story addition to its local cement mill for general increase in production. Other extensions will be made at the plant, including the installation of additional machinery. John Porter is general manager.

BALTIMORE — The American Oil Co., American Bldg., has taken title to the shipyard of the Henry Smith Shipbuilding Co., Curtis Bay, comprising about 10 acres of land, for a consideration of about $90,000, and will use the site for a new storage and distributing plant. Plans are under way for the initial buildings, including steel tanks with a total capacity of 2,500,000 gal. and which later will be increased to 10,000,000 gal. A factory will also be established for the manufacture of soaps, greases and kindred specialties. The new plant is estimated to cost approximately $500,000, including equipment.

CAMBRIDGE—The Dorchester Lime & Fertilizer Co., Trenton St., is completing plans for the erection of two new 1-story plant buildings, 100x150 ft. and 60x100 ft., to replace its plant recently destroyed by fire. A complete mixing and grinding unit will be installed, with capacity of about 20 tons per hour. The fire loss was approximately $65,000, and the new work will cost a like amount. Lloyd Webster is president.

Massachusetts

BROCKTON—The Brockton Gas Co., 40 Centre St., has foundations under way for an addition to its artificial gas plant on Grove St., estimated to cost about $100,000, including equipment.

EVERETT—The Beacon Oil Co., Beacham St., will commence the immediate erection of a 1-story building on Charles Court, 50x50 ft., for general operating service.

Michigan

PETOSKEY—The Petoskey Portland Cement Co. has tentative plans under consideration for enlargements in its plant for considerable increase in capacity. A number of buildings will be constructed, estimated to cost close to $500,000, including machinery. J. C. Buckbee, First National Bank Bldg., Chicago, Ill., is consulting engineer.

DETROIT—Fire, Nov. 15, destroyed the local distributing plant of the Huron Portland Cement Co., Atwater and Riopelle Sts., with loss estimated at about $250,000, including building, equipment and stock. Headquarters of the company are in the Ford Bldg.

BAY CITY—The City Council has commenced excavations for a new filtration plant at the municipal waterworks, estimated to cost about $1,500,000, with equipment. The Frazier-Elm-Sheal Co., Illuminating Bldg., Cleveland, O., is engineer.

Mississippi

MAGNOLIA—The Magnolia Cotton Oil Co. has plans under way for the erection of a new 1-story plant.

Missouri

HILLSBORO—The Apt Co., 3620 West Pine Blvd., St. Louis, Mo., will build a 1-story foundry in connection with its proposed local works for the manufacture of railroad specialties, castings, etc. W. E. Apt is president.

GRANITE CITY—The Union Starch & Refining Co., Edinburg, Ind., has taken title to the local plant of the Temtor Corn & Fruit Products Co., recently acquired for a consideration said to be about $1,000,000, and will take possession at once. Improvements will be made and operations commenced at an early date for the manufacture of glucose and other kindred products. The purchasing company will increase its working capital, and will establish headquarters at the local plant. It is purposed to discontinue operations at the Erinburg works.

Nevada

BATTLE MOUNTAIN—The Cortez Silver Co. has construction under way on a new mill with capacity of 100 tons per day, and plans to have the unit ready for service in the near future. The output will be increased to 150 tons with the installation of additional machinery shortly thereafter.

New Jersey

NEW BRUNSWICK—The Public Service Gas Co., Public Service Terminal, Newark, has acquired a tract of about 48 acres of property on the Raritan River, Raritan Township, as a site for a new artificial gas plant, with gross capacity of about 10,000,000 cu.ft. per day. It is estimated to cost in excess of $250,000.

NEWARK—The Essex County Highway Department is planning for the installation of a chemical laboratory for testing service. Space in a local building has been arranged for the purpose.

PISCATAWAY—The Middlesex Hollow Tile Co., 215 Rector St., Perth Amboy, recently organized with a capital of $100,000, has acquired the local plant of the Kelso Clay Products Co., and will use the works for the production of hollow tile. Operations will be placed under way at once. John G. Fritzinger, formerly connected with the National Fireproofing Co., heads the new organization. Other officials are John H. and C. E. Fritzinger.

GLOUCESTER CITY—The City Council is arranging a bond issue of $80,000, the larger portion of the proceeds to be used for the installation of a filtration plant at the municipal waterworks. A contract will be awarded in the near future.

New York

BATAVIA—The plant of the Batavia Rubber Co. has been acquired at a receiver's sale by the Taylor, Armitage & Eagle Co., 120 Broadway, and the Fred Stearns Co., 1832 Broadway, both of New York. The new owners have made a joint agreement to operate the plant for the manufacture of automobile tires, and will place the works in service at an early date. Improvements will be made.

RICHMOND HILL, L. I.—The Unique Leather Goods Co., 125th St. and Jamaica Ave., has filed plans for the erection of a new 2-story plant, 90x128 ft., estimated to cost about $85,000. William Higginson, 15 Park Row, New York, is architect.

BATAVIA—The United States Gypsum Co., 205 West Monroe St., Chicago, Ill., has taken title to a tract of gypsum property at Oakfield, near Batavia, totaling about 1,000 acres, and plans for the early development of the site. It is said that a new plant will be built at a later date.

NEW YORK—The Board of Trustees, Columbia University, Morningside Heights, has plans nearing completion for the proposed new chemical engineering and chemistry building at the institution. McKim, Mead & White, 101 Park Ave., are architects.

North Carolina

CHARLOTTE—The Aiken Mfg. Co., 728 East 7th St., recently organized with a capital of $100,000, has acquired a local plant for the manufacture of polishes and kindred specialties. The present factory will be enlarged and additional equipment installed at an early date. L. S. Sloop is president.

Oklahoma

SAND SPRINGS—The Mid-Chemical Co. has perfected arrangements for a local plant for the manufacture of chemicals and chemical byproducts. O. E. Oesterlie, Henryetta, Okla., is one of the heads of the company.

SAND SPRINGS—The du Pont Powder Co. has broken ground for the construction of a local plant for the manufacture of a line of powder specialties.

Pennsylvania

PITTSBURGH—The Metal & Thermit Corp., 120 Broadway, New York, manufacturer of metals, alloys, etc., is taking bids for the erection of a new 2-story plant, 40x100 ft., on Fayette St. H. D. Kelly, 801 Hillsboro Ave., is local representative.

PHILADELPHIA—The Abrasive Co., Tacony and Fraley Sts., manufacturer of grinding wheels and other abrasive products, has awarded a contract to the Pittsburgh-Des Moines Steel Co., 30 Church St., New York, for the erection of a 1-story addition.

WILKES-BARRE—A 1-story pressing and drying building at the plant of the du Pont Powder Co., Oliver Mills, near Wilkes-Barre, was destroyed by fire, Nov. 16, caused by an explosion.

FULLERTON—The Lehigh-Fuller Co., has tentative plans under way for the rebuilding of the portion of the foundry at its machinery manufacturing plant destroyed by fire, Nov. 13, with loss estimated at about $35,000, including equipment.

PHILADELPHIA—The American Insulation Co., Stokley St., manufacturer of asbestos products, has awarded a contract to the William Steele & Sons Co., 1600 Arch St., for the erection of a 1-story building at its plant to cost about $25,000.

CEMENTON—The Whitehall Portland Cement Co. will build an addition to its storage and distributing plant, and make other mill improvements.

PHILADELPHIA—The Pennsylvania Sugar Co., Delaware Ave., has plans under way for the erection of a new group of buildings at its local refining plant.

South Carolina

CLOVER—The Clover Cotton Oil & Gin Co. has been organized by J. F. Pursley, for the operation of a local mill for the production of cotton oil and fertilizer products. Plans are in progress for the plant, to total about 5,000 sq.ft. of floor space and to be equipped for a daily output of 100 tons of material.

Tennessee

CHATTANOOGA—The Gager Lime & Mfg. Co. is planning for the installation of additional equipment at its plant, including washing machinery, crushers, etc. M. P. Kenney is secretary.

Texas

CISCO—The local oil refinery of the Liberty Oil Co. has been acquired by new interests, headed by L. H. Christman, Dallas. The new owners plan for immediate enlargements, including the installation of additional equipment, estimated to cost approximately $50,000. The output will be increased to 3,000 bbl. daily.

SHERMAN—The Buffalo Refining Co., recently organized, has purchased the local oil refinery of the Buffalo Products & Refining Co., with capacity of 400 bbl. per day, and will take immediate possession. Improvements will be made and the plant placed in service. F. M. Thompson and D. L. Cooke head the new organization.

HUMBLE—Fire, Nov. 12, destroyed a large portion of the local tank farm of the Gulf Production Co., with loss estimated in excess of $300,000, including equipment.

West Virginia

NITRO—The Rubber Service Laboratories, Inc., is planning for the rebuilding of the portion of its local plant, recently destroyed by fire with loss estimated at about $75,000, including equipment. B. Carl Hand is general manager.

NITRO—The Charleston Paper Mfg. Co. has work under way on a new plant, comprising the remodeling of an existing building, for a new paper mill. It is planned to install equipment at an early date.

INWOOD—The Valley Evaporating Co. has tentative plans under consideration for the rebuilding of the portion of its plant recently destroyed by fire. An official estimate of loss has not been made.

Wisconsin

RACINE—The Belle City Malleable Iron Co., is razing an existing building on local plant site, preparatory to the erection of a new 1-story annealing works, 75x153 ft., for which plans have been completed.

New Companies

KAHLBAUM-KIRBACH, INC., New York, N. Y., care of C. S. Aronstam, 120 Broadway, New York, representative, has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are A. H. Appel, H. Pleus and F. R. Fox.

THE BARNES ZINC CO., Eighth and Union Sts., La Salle, Ill., has been incorporated with a capital of $100,000, to manufacture zinc and kindred metal products. The incorporators are C. B. O'Neil, Frank Page and Harold Beacon.

THE LITTLE FALLS CHEMICAL CO., Little Falls, N. J., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are E. C. Fox, Louis Van der Meer and Justus C. Herstein, Little Falls. The last noted represents the company.

THE GENERAL EXPLOSIVES CO., Wilmington, Del., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, has been incorporated under state laws to manufacture explosives, powder, etc., with capital of $1,000,000.

THE KEN OIL CORP., Binghamton, N. Y., has been incorporated with a capital of $50,000, to manufacture oil products. The incorporators are T. G. O'Brien, J. L. Weir and H. D. Ballard. The company is represented by Mangan & Managan, Binghamton.

THE STEVENS PAPER MILLS, INC., Rainbow, Windsor, Conn., recently incorporated, has been organized with a paid in capital of $50,000, to manufacture paper products. C. N. Stevens, New Rochelle, N. Y., has been elected president; and George C. Russell, Hartford, Conn., vice-president.

THE ATTOYAC OIL CO., Henderson, Tex., has been incorporated with a capital of $25,000, to manufacture petroleum products. The incorporators are O. S. Rogers, R. T. Forman and A. C. Wylie, all of Henderson.

THE NELSON PRODUCTS CO., Room 637, 111 West Washington St., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture colors, chemicals, etc. The incorporators are George C. Hager, R. D. Clay and H. C. McVeigh.

THE LIQUID LIGHTNING CO., Portland, Ore., has been incorporated with a capital of $5,000, to manufacture compounds for batteries and other purposes. W. A. Carter, 1212 Gasco Bldg., Portland, is the principal incorporator.

THE BUCKEYE COPPER CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $20,000,000, to produce refined copper and other metals.

THE SEPOY COLOR & CHEMICAL CO., Jersey City, N. J., care of the Corporation Trust Co., 15 Exchange Pl., Jersey City, representative, has been incorporated with a capital of 1,500 shares of stock, no par value, to manufacture colors, chemicals and chemical byproducts.

THE PURITY CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by Milton Ackerman and Ralph A. Bowen, 11 Stover St., Boston.

THE A. B. MASSA PAPER CORP., New York, N. Y., care of Knox & Dooling, 37 West 43rd St., New York, representatives, has been incorporated with a capital of $25,000, to manufacture paper products. The incorporators are A. B. and L. V. Massa.

THE ELECTRO-PLATING CO., Huntington, W. Va., has been incorporated with a capital of $5,000, to operate a metal-plating works. The incorporators are Louis and B. Klamer, Maurice Rosen and I. Benjamin Romer, all of Huntington.

THE EDWARDSVILLE CHEMICAL CO., Troy Rd. and 3rd St., Mahler Heights, near Edwardsville, Ill., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are Charles F. Scholl and Edward Koenig.

THE ARKANSAS-MARUCOPA OIL CO., Fulton, Ky., has been incorporated with a capital of $75,000, to manufacture petroleum products. The incorporators are W. E. Simmons, W. W. Gourley and J. T. Linton, all of Fulton.

THE BETHEL TANNING CO., INC., Bethel, Conn., recently incorporated, has been organized with headquarters at 146 Center St., to manufacture leather. Howard E. Mackenzie has been elected president; F. H. Judd, vice-president; and Charles H. Hart, secretary and treasurer.

THE COATING SPECIALTIES CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, has been incorporated under Delaware laws with capital of $50,000, to manufacture paints, varnishes and kindred products.

THE BERKSHIRE TALC PRODUCTS CORP., Newark, N. J., care of Harry Unger, 207 Market St., Newark, representative, has been incorporated with a capital of $125,000, to operate talc properties and manufacture refined talc products. The incorporators are Harold Shuster, Frederick G. Rose and George E. Ebehalt.

THE HUB CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture and deal in chemicals and chemical byproducts. The company is headed by John B. Lewis, 54 Thayer St., Boston.

WALTER SHUTTLEWORTH, INC., New York, N. Y., care of R. S. Nichols, 141 Broadway, New York, representative, has been incorporated with a capital of $150,000, to manufacture paper products. The incorporators are E. G. and W. E. Shuttleworth, and H. Comiskey.

THE R. L. GLASSON CHEMICAL CO., Seymour, Ind., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are Reuben Glasson and Charles F. Quade, both of Seymour.

THE STRATFORD CO., Morganville, N. J., care of James F. Farrell, Morganville, representative, has been incorporated with a capital of $1,000,000, to manufacture arsenic acid and other acids and chemicals. The incorporators are Julius Midas, Peter von der Hyde and James L. Ryan.

THE FIT FORM MFG. CO., New York, N. Y., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $1,250,000, to manufacture bottles and other glass containers. The incorporators are William F. Dermott, New York; Patrick M. Kelly, Jersey City, N. J.; and Theodore L. Harrison, Ridgefield Park, N. J.

THE INTERSTATE RUBBER CO., New York, N. Y., care of Nathan Permut, 82 Duane St., New York, representative, has been incorporated with a capital of $20,000, to manufacture rubber products. The incorporators are G., A., and J. E. Conklin.

THE AMERICAN ELECTRO-PLATING WORKS, INC., Somerville, Mass., has been incorporated with a capital of 100 shares of stock, no par value, to operate a metal plating plant. John J. Walsh, Ames Bldg., Boston, is treasurer and representative.

THE GREENWICH CHEMICAL CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws, with capital of $350,000, to manufacture chemicals and chemical byproducts. The principal incorporator is Samuel C. Wood, New York.

THE TILE PRODUCTS, INC., New York, N. Y., care of Delamarter & Morrison, 140 Nassau St., representatives, has been incorporated with a capital of $100,000, to manufacture ceramic tile and other kindred named clay products. The incorporators are F. Sellar, E. L. Hendrickson and H. A. [illegible]

Capital Increases, etc.

THE EGYPTIAN LACQUER MFG. CO., Passaic Ave., Kearny, Newark, N. J., has filed notice of increase in capital from $360,000 to $720,000, for proposed expansion.

THE UNION PAINT & CHEMICAL CO., Detroit, Mich., has filed notice of dissolution under state laws.

THE ALASKA CHEMICAL CO., 113 West 27th St., New York, N. Y., has filed notice of increase in capital to $500,000, for proposed expansion.

THE PENNSYLVANIA INDEPENDENT OIL CO., INC., Philadelphia, Pa., care of J. H. Sherman & Co., Bulletin Bldg., Philadelphia, bankers, is disposing of a stock issue of $440,000, a portion of the proceeds to be used for expansion.

THE VIRGINIA-CAROLINA CHEMICAL CO., Richmond, Va., has arranged for an increase in capital to $68,000,000, for general expansion and financing.

THE SOUTHERN PAPER CO., Moss Point, Miss., is arranging for a bond issue of $1,500,000, a portion of the proceeds to be used for expansion.

THE HARDY CHEMICAL CO., Norwalk, Conn., has filed a preliminary certificate of dissolution under state laws.

THE PETROLEUM OIL CO., Anderson, S. C., is arranging for an increase in capital to $100,000, for proposed expansion. Charles A. Gambrill is president.

THE MAGNOLIA PETROLEUM CO., Galveston, Tex., operating oil refineries, has called a meeting of stockholders, Dec. 2 to approve an increase in capital from $120,000,000 to $180,000,000, a portion of the proceeds to be used for expansion.

The referee in bankruptcy for the CHOAT OIL CO., South Robinson St., Oklahoma City, Okla., has arranged for the sale of the refinery of the company, rated at a capacity of 2,000 bbl. per day.

Manufacturers' Catalogs

THE CUTLER STEEL CO., Pittsburgh, Pa., in Bulletin 221 gives a general description of Duraloy, including the development, composition and characteristics, physical properties, strength at high temperatures, machining qualities, welding qualities, oxidation and heat resistance, and corrosion and abrasion resistance.

THE BRISTOL CO., Waterbury, Conn., has issued two new publications: Catalog 1401 contains 68 pages on Pyrometers, while Bulletin 311 contains 12 pages on Bristol's Class II Recording Wet- and Dry-Bulb Thermometers.

THE HOLDECK ENGINEERS CO., Marshall Bldg., Cleveland, O., has issued a bulletin on pulverized coal as applied to the malleable iron and air furnace iron industry.

THE CALORIZING CO. OF PITTSBURGH, PA., calls attention to Bulletin 2, on Calite Castings, for use in high temperatures. Calite castings are made under patents of the General Electric Co. at its Lynn, Mass., foundry and are sold by the Calorizing Co. of Pittsburgh. This 16-page booklet gives interesting illustrations and descriptive matter on the reason for Calite, the high-temperature range, why it lasts, resistance to corrosive gases, strength, physical properties, uses, etc.

B. F. STURTEVANT CO., Hyde Park, Boston, Mass., has published Bulletin 299, on unit driers. This type of drier consists of a motor-driven fan, the air from which passes over heater coils and is then discharged into a cabinet. Practically any desired temperature and velocity of air can be obtained for the correct drying of a particular material. These driers are made in various sizes, from the size which may be set on a bench to the size into which may be wheeled a number of trucks holding several trays of the material to be dried. Where the material is of such a nature that trays are not necessary, suitable methods of suspension are fitted into the cabinet accordingly. Copy of this bulletin will be sent on request.

THE VITREFRAX CO., Los Angeles, Calif., announces a new publication entitled "The Irreducible Volume." After a general description of Vitrefrax and the scope of the Vitrefrax process, there follows information on the nature and application of refractories in general and of Vitrefrax super refractories in particular.

THE CONNERSVILLE BLOWER CO., Connersville, Ind., calls attention to Bulletin 4, on rotary displacement meters.

THE LINK-BELT CO., Chicago, Ill., announces the completion of a new general catalog, No. 100, which embraces its entire line. It is the most complete book the company has ever issued, containing 932 pages, and is cloth bound. Copies can be obtained from any Link-Belt office. The catalog not only includes the complete Link-Belt line but also the products of the H. W. Caldwell & Son Co. plant of that company. The following is a brief summary of the contents covered in the catalog: Chains and wheels, power transmission machinery, bearings, hangers, take-ups, gears (machine molded or cut-tooth), clutches, pulleys, sheaves, elevator boots, buckets, casings, helicoid and other screw conveyor equipment, gates for conveyors, bins, hoppers, etc., steel apron conveyors, belt conveyors, Peck carrier, boiler plant equipment, coal tipple equipment, coal washeries, jigs, elevators, driers, coal storage, pockets, tramways, towers, locomotive coaling stations, car loaders and unloaders, portable loaders, portable belt conveyors, locomotive and crawler type cranes, grab buckets, wood grapples, etc., electric hoists, overhead cranes, telpherage, car pullers, friction hoists, power hoes, power shovels, cable haulage, sand and gravel washing equipment, revolving screens, sand separators, etc., lime-handling equipment, foundry conveyors, sand revivifiers, elevators and conveyors for glass plants, canneries, freight handling and sugar plantation and refinery machinery.

LEE B. METTLER CO., fuel efficiency engineers, Los Angeles, Calif., has issued a pamphlet entitled "In Response to a Demand." This pamphlet treats of the Mettler silicon-carbide refractory, surface-combustion burner, the surface combustion unit and the stack-damper indicator.

THE SEMENT-SOLVAY CO., Syracuse, N. Y., in a new publication tells of its progress of 30 years, of the byproduct oven and the manufacture of city gas, byproduct gas ovens, advantages of byproduct coke and gas ovens and byproduct recovery apparatus. Interesting photographs of actual plants are given, as well as the general arrangement of a byproduct gas oven plant, diagram of oven draft for single-pass regenerators and the Semet-Solvay gas flow chart

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9. Headquarters will be at the Hotel Jefferson.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

NEW JERSEY CLAY WORKERS' ASSOCIATION will hold its annual meeting at the Ceramics Building, Rutgers College, New Brunswick, Dec. 12.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20 — Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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CHEMICAL & METALLURGICAL ENGINEERING

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Strengthening Our Consular Service

THERE was a time when we looked upon consuls and diplomats as a queer sort of gold-braided courtiers or pompous supernumeraries that had somehow been forced upon our government by time and Old World customs. That youthful impression was soon dissipated, however, when we were given a chance to learn something of the multifarious duties of these men who represent us in foreign lands. In reality they constitute an active field force on which we are largely dependent for furthering and protecting our commercial interests abroad. In this way they perform a day-by-day service which in its aggregate importance to our country far outweighs this occasional but widely heralded accomplishments in the field of international politics.

As a government and as individuals the world war drew us into many new international relationships. The field of our commercial activities was greatly extended and with this came a need for a broader and better understanding of foreign affairs. The consular and diplomatic services assumed a rôle of new importance. And it was the greater demand for these services that called attention to the serious handicaps under which our representatives are laboring. Unfortunately their organization is largely on a pre-war basis—entirely inadequate to meet the pressing requirements of the government alone without giving any attention to private or commercial interests. Furthermore, the salary scales are pitifully low. For instance, diplomatic secretaries acting as counselors of embassies such as those in London or Paris receive a maximum annual salary of $4,000 and important secretarial positions are filled by men to whom the government can pay but $2,500 to $3,000. The result is that these officials, even down to the lowliest attaché, must be recruited from the ranks of men of independent means. It is a difficult task, therefore, to find a sufficient number of men who are qualified to carry out effectively the responsible and highly important work of these positons—and at the same time are willing to make so severe a personal sacrifice.

For some reason or other the law has separated the consular and diplomatic services into what has been described as "watertight compartments." Transfer from one branch to another has been made impossible: not even in an emergency could a well-qualified diplomatic secretary take over the responsibilities of a consular post. So it goes. Benefits to be derived from efficient co-ordinated administration must be withheld simply because of an antiquated law that has long since outgrown its usefulness.

These three defects in our present system—organization, personnel and compensation—can be remedied in a large measure by legislation now pending in Congress. The bills introduced by Representative J. J. ROGERS have been designed to strengthen and modernize the entire field forces of the Department of State. They provide for a reclassification and reorganization of the consular and diplomatic services. A co-ordinated plan of administration offers possibilities for flexible and efficient service and, finally, salaries have been raised to a respectable standard. The bills endeavor to do this without a radical extension of government service or an extravagant appropriation of government funds. Rather it is proposed to put these services on a directly business-like basis so that the foreign affairs of governmental and private interest may be completely and efficiently handled. Surely such a program is worthy of the support of all who are interested in furthering American business abroad.

Benjamin Silliman And Yale's New Laboratory

HISTORIC significance is given to the date that has been chosen by Yale University for the dedication of the new Sterling chemistry laboratory. It seems that on April 4, 1804, the first lecture ever given on chemistry in Yale College was delivered by BENJAMIN SILLIMAN, SR. In commemoration of that event Yale's magnificent new laboratory will be formally dedicated on April 4, 1923, during the spring meeting of the American Chemical Society in New Haven.

It is interesting to trace the influence of SILLIMAN on the development of American chemistry. For 51 years he held the chair of chemistry and natural philosophy in Yale. Probably more than any other one man in America he served to popularize science, particularly chemistry and geology, and to interest and instruct thousands of persons outside the college walls. He traveled all over the United States during a period of 20 years, lecturing on scientific subjects to large audiences. In Boston more than fifteen hundred persons paid admission to a series of evening lectures; and the capacity of the hall being exceeded by the demands, he gave a series of afternoon lectures as well.

Professor SILLIMAN was never known as a great investigator and researcher. What he did was thorough; but his great service was in bringing science to the people, in stimulating an interest in the subject in his students and in all who heard him lecture. Coming at the very beginning of our life as a nation, there was need for just such service. As founder and editor of the *American Journal of Science*, he laid the foundation for other journals devoted to the physical sciences. It is due more to Professor SILLIMAN than to any other man that the Sheffield Scientific School of Yale University was founded. Starting with scanty funds and two professors, both of whom were teachers of chemistry, the value of the institution brought forth the liberal contributions of JOSEPH E. SHEFFIELD, thereby insuring the future of this work. BENJAMIN SILLIMAN, on his retirement, turned over his work in

geology to the elder DANA, who was his pupil and who married his daughter. His chemistry courses went to his son, BENJAMIN SILLIMAN, JR., who maintained the high standards of his father and added his part in building up a strong department.

It is interesting to note that Professor SILLIMAN as a student in Yale College had no intention of becoming a scientist. Returning to New Haven at the age of 20, he took up the study of law and soon after was made tutor in Yale College. Near the close of his course in law President DWIGHT invited him to become professor of chemistry and natural philosophy, offering him time and assistance for the necessary study and preparation. SILLIMAN then spent two winters in Philadelphia as a pupil of Dr. JAMES WOODHOUSE. There he met PRIESTLEY and was an intimate friend of ROBERT HARE. Returning to New Haven, he took up his duties, his first lecture being on April 4, 1804. In his first class were several men who became famous, one of these being JOHN C. CALHOUN, afterward Vice-President of the United States. After teaching one year, SILLIMAN obtained a leave of absence and spent several months in London and Edinburgh, attending lectures. There he met HENRY, Sir HUMPHRY DAVY and DALTON. It was during his stay in Edinburgh that he became interested in geology, an interest which developed until he became as well known as a geologist as he is as a chemist.

For 15 years Professor SILLIMAN taught and carried out his experiments in a dismal basement room below the old Lyceum on the Yale campus. It is indeed fitting and appropriate that the great Sterling chemistry laboratory, now just completed at a cost of $2,000,000 and containing every facility for teaching and for research, should be dedicated on the anniversary of the first lecture given by the first professor of chemistry in Yale and in honor of a man who was a pioneer in American science.

Steel Production as A Business Index

THE time has not yet passed when business men need to be reminded of the difference between a barometer and a thermometer. The saying "Iron is the barometer of trade" is so old that it says "iron" when the trade designation of the great bulk of the ferrous product now made is "steel." Indeed, partly because the steel ingot, sound throughout, is not yet commonly made, but more generally because much scrap develops in making finished or commercial steel products, the weight of ingots cast, commonly called in the trade "the production of steel," has for 10 years past been running at considerably more than the weight of pig iron produced.

The particular point in the adage really is that steel is a barometer rather than a thermometer—that it foretells. As a thermometer showing the current condition, portland cement, of which we make something like three barrels to a ton of steel, is much better, for steel can be and is stocked by the dealer and consumer, while cement commonly is not. Storage is difficult and is generally by the producer. There are monthly statistics of shipments by cement producers, which are an accurate and prompt index of the volume of construction occurring at the time.

The barometric point about steel is that orders are placed in advance when industrial and construction activity is going to increase. It is the orders, rather than the production, that count as a barometric index. To illustrate, there was a great 3-year period of iron and steel and general industrial activity from late in 1904 to late in 1907. The difference between orders and production was striking. In the fourth quarter of 1904 the U. S. Steel Corporation's unfilled tonnage increased 1,668,767 tons, while in the third quarter of 1907 there was a decrease of 1,178,870 tons. In October, 1907, the month after that quarter and the month of the panic, production of steel made a new high record and was at a rate more than 50 per cent greater than the rate in the fourth quarter of 1904. In 1908 there was an industrial depression. The heavy buying late in 1904 was barometric of the industrial revival then on its way, while the record production of October, 1907, was not even thermometric in showing anything as to business and industrial conditions. The case is strictly typical, not exceptional, and is selected for citation because it was a particularly big case and being before the war may be regarded as normal.

Paradox—The Valley And Its Treasure

IT WOULD BE difficult to cite a topic from the news of the day which would cause the average citizen less concern than the prevailing price of radium. A drop of $30,000 per gram in the price of radium arouses far less jubilation in his breast than would a decrease of $1 per ton in the price of coal. Nevertheless, there is an interesting story back of the recent sensational drop in the price of radium; interesting because, as a result of it, all the radium plants in this country are shut down and because it gives the wiseacres such a beautiful opportunity for whispers of profiteering, cut-throat competition, price-cutting and other shocking practices. What is the real meaning of radium at $70 a milligram?

The answer involves the well-known partners who have been convicted so often of price-fixing—Supply and Demand. It is generally understood that the carnotite deposits of Paradox Valley, Colorado, constitute the largest known source of radium in the world. The average uranium oxide content of this ore is from 1.5 to 2.8 per cent, which means that it contains about 1 milligram of radium per 500 lb. of ore. Obviously, the extraction process is tedious and expensive. Recently there have been shipped to Belgium considerable quantities of very high-grade pitchblende ore from deposits in the extreme southern part of Belgian Congo on the property of the Union Minière du Haut-Katanga, a British-Belgian company operating large copper-bearing properties in Kantanga. An extraction plant has been erected at Oolen, Belgium, to work this ore. Undoubtedly, radium can be produced from this very rich ore at a much lower cost than from carnotite ore. Hence the suspension of extraction operations in this country is the best alternative, particularly since the several companies have been able to consummate working agreements with the Belgian producers for the marketing of their product in this country, thus preserving the identity of their distributing organizations.

In view of the production costs given by H. H. BARKER, on page 1114 of this issue, it is obvious that American radium producers have taken a loss on radium produced from Colorado carnotite and sold at $70 per milligram. Perhaps this was justified by the necessity of turning stocks into available capital, or by the advertising value of a large sale, or both. The

need for working capital in the industry was a consequence of overproduction. The financial depression did not really affect the radium industry until the early part of last year. At that time, when the demand began to slacken, the manufacturers were so unwise as to continue operations too long—a repetition of mistakes previously made in other industries. The result was the largest production in the history of the industry—over 36 grams—a large part of which remained unsold, much of it held by the banks as collateral.

Such are the circumstances that have brought about a reduction in the price of radium to an unprecedented level. Apparently $70 is to be the standard price for domestic and imported material until the Belgian ore gets "leaner" and extraction costs increase. The extent of the African deposits can be determined only by continued working, but it is generally believed by experts that the occurrence of the high-grade ore is limited to a few large pockets that will eventually be exhausted, so that Paradox Valley will come into its own again.

In the meantime, here is an opportunity for philanthropists and public institutions of large means to make radium available for the treatment of cancer and other malignant diseases. The State of New York and the City of Philadelphia have each bought 2 grams for the use of their citizens and the Province of Quebec has bought 1 gram. Surely, the opportunity to make radium and its emanation more readily available to sufferers, rich or poor, should be the most important "meaning" of cheaper radium.

Hunting for Woodchucks And Shooting the Cow

ON VARIOUS OCCASIONS we have commented on the activities of the prohibition enforcement authorities in a vein that has led some of our readers to charge us with failure to give moral support to the law. Perhaps it will be worth while making our position clear.

The Volstead act is the law of the land, and as long as it is, we stand for its impartial enforcement. But the very act which provides for the abolition of alcoholic beverages provides also for the use of alcohol in the industries, and even for its encouragement in this respect. Our protest is against the activities of prohibition enforcement officers that result in the crippling of legitimate industry without practically helping to destroy the drink evil. Failure of the prohibition authorities to perform their duty has become a national disgrace that has rightly caused grave apprehension in the Executive office at Washington. Bootleggers thrive. And simultaneously with the failure to curb these violators of the law, rules and regulations against legitimate industry are multiplied.

A little reflection brings up a related question, and this is whether morally, ethically or even legally the government has the right to introduce poisons into alcohol for the purpose of enforcing prohibition by killing the man who evades the law. This puts the whole principle of attempting to enforce prohibition on a square moral and legal issue, and it leads to the one right and available method of enforcement, which is to catch and punish the offenders.

The separation of denaturants from alcohol, like moonshine distilling, is a forbidden art no matter what the denaturant may be. It *is* moonshine distilling except that denatured alcohol is employed instead of corn or other mash. It is not practiced by law-abiding manufacturers, but it is a great game for the bootleggers. It is a dangerous game, but all illicit business is dangerous.

Changing formulas or the use of vicious poisons will not stop the practice, because there is plenty of money in bootlegging and there are chemists who are willing to conduct research for bootleggers and thus to circumvent any strategem. The question they ask themselves in regard to poisons is not how deadly they may be, but rather how robust they are in their chemical structure. It is mere child's play to try to circumvent the production of beverages by shifts of this kind. Illicit distilling is one occupation, and honest manufacturing is something entirely different. The law recognizes this. Prohibition enforcement officers should, but very often they do not. The chief prohibition enforcement officer lately boasted of the decreased production of tax-paid alcohol, and cited it as evidence of prohibition activity.

We shall not discuss the rum-runners doing business off our coasts with native craft, of which the latter are proper game for the authorities, or the great quantities of alcoholic beverages smuggled in under full authority and warrant from Canada, or the liquors and intoxicants withdrawn or made in secret. They do not come from legitimate makers of varnish, soaps, perfumery, fabrics and the like. Such manufacturers would not sell alcohol denatured or normal for beverages; they are engaged in other business. They do not hide or work in secret and the risk would be too great. The illicit producers and dealers are difficult to find, but it is nevertheless the business of the authorities to find them. The worst method in the world is to make the innocent suffer for the guilty. It is like hunting for woodchucks and shooting the cow.

Poisoning alcohol does not enforce prohibition. And again we ask, Is such denaturation legal or is it not? The man who manufactures or transports alcohol as a beverage or maintains it for drinking purposes commits a misdemeanor. It is not a capital crime. He is entitled to his day in court. Whether he drinks the stuff or not, it would be illegal to shoot him. Then by what right is he poisoned?

A Task for The Chemical Division

ELSEWHERE in these columns we have called attention to the need for adequately supporting the diplomatic and consular services—those governmental agencies that are effective for promoting our foreign trade. In this connection the chemical industry has a problem that is all its own. Much of the information on chemicals that is now being sent in by the government's foreign agents is of a more or less perfunctory character and does not deal with the specific problems or commodities in which the chemical exporter is interested. In order for our industry to profit to the fullest extent from this work it is essential that the consular agents be thoroughly acquainted with the problems of our export trade in chemicals. These men should be properly instructed as to what information is desired, about what commodities and from what particular countries or districts. In other words, there is a need for a consul's chemical manual—a sort of encyclopedia of world competition in chemicals. To prepare such a volume is a task for the Chemical Division of the Department of Commerce and an opportunity for constructive service in developing a healthy foreign trade in American chemicals.

Readers' Views and Comments

European Conditions as I Saw Them

To the Editor of Chemical & Metallurgical Engineering

SIR:—Readers of *Chem. & Met.* who are my personal friends have taken particular interest in the series of articles you have been publishing on "European Conditions as I Saw Them." I have had many conversations with them, and have sought to learn their views on the articles that have already been published. Their opinions are of interest; first, because some of them are somewhat familiar with European conditions, and, second, because of their frankness in passing criticism on my own views.

Permit me to pass in review here some of their criticisms, together with brief answers thereto. Perhaps by so doing, I shall reach other *Chem. & Met.* readers who may have had similar thoughts.

1. The German economic war idea is a *deus ex machina.* I can assure you it is not. In the latter part of March I heard the expression "Wirtschaftlicher Kampf" (economic fight) from a German intellectual, an expression which he used deliberately in the course of conversation on the abnormal discrepancy between the intrinsic and selling values of German finished products. The meaning and the scope of such a war have become clearer and clearer to me the more I have talked about it with intellectuals and average citizens of Germany. This has been reinforced by my observation of German industrial conditions as compared with those in other industrial countries. My conclusion, therefore, that the German economic war was used to create an atmosphere and undercurrent of opposition to the Versailles treaty, and that the cancellation of that treaty and the *status quo ante bellum,* 1914, were offered as a condition of truce, is a normal sequence to the observations made during my trip through Europe.

2. It is not conceivable that German industrials and merchants would be willing to sell at a loss. No, they personally did not lose. Stinnes and his type have constantly grown richer since the Versailles treaty was signed. On the other hand, the masses of the people working for wages and salaries have stood the loss, by getting only a small fraction of what they should receive were they paid the due reward of their labor. A wage of less than 1.5 cents per hour for girls in a German plant, mentioned in my article published Oct. 25, was considered a fair wage in the eyes of many German industrials, just as less than $1 per week for saleswomen in a Berlin shoe store was regarded as a fair wage in the eyes of many German merchants. As to the status of German salaried people, I shall reserve comment for a subsequent article.

3. It is not conceivable that German industrials should thus exploit their own workpeople. I grant that it seems inconceivable, but so was the war. The actual facts prove that it is so.

4. Writers of many sorts—politicians, bankers, economists, amateur students of European conditions, special correspondents and professional interviewers—have written a great deal about conditions in Europe, but none of them has brought forth even a hint as to a German economic war. This is quite true, but I regard it as being due to their individual limitations as observers. Not being in any of the above classes, I observed the industrial conditions closely; and when I looked at Germans at work, I saw clearly what is typified in the cartoon reproduced in our issue for Oct. 18.

5. What has all this to do with European industrial progress? My reason for emphasizing this subject is that it seems to me to be the outstanding cause of much of the distress in Germany, which prevails generally instead of the progress I expected to find. It seems to me a fitting subject to bring into the foreground, in order that American engineers may comprehend the situation and perhaps initiate a policy that will hasten the arrival of the day when everyone will have an opportunity to contribute to industrial progress and receive his fair reward.

6. What comment or reaction do I expect from Germany? It is impossible for me to give a direct answer to this question, but I should not be surprised if *Chem. & Met.* were to receive some protests and objections to various statements that have been made. I feel that I can substantiate with details all general statements that have been made; and, furthermore, I feel that the best refutation that could be given to my statements would be official German statistics of production and export, showing what has become of the products of her industries since the signing of the Versailles treaty.

New York City. J. S. NEGRU.

Wasn't This a Public Service?

To the Editor of Chemical & Metallurgical Engineering

SIR:—At Indianapolis the members of the local section of the American Chemical Society meet at luncheon every week, at the Chamber of Commerce. Usually someone is invited to address them, and whoever speaks may count on courteous and interested attention from an intelligent and scholarly audience. The members come from near enough to Missouri to want to be informed, and if anybody has anything to say or to offer that sounds interesting they are ambitious to know all about it. Then they ask questions.

There has lately been distributed in Indianapolis a little pamphlet, telling the good citizens how whoever will may achieve great wealth by getting it from the air. A remarkable invention is announced whereby "complete union of nitrogen of the air and lignite gas, forming sulphate of ammonia—direct" may be obtained. "The United States," says the circular, "annually imports $32,000,000 of nitrogen in its various forms, and $4,000,000 of sulphate of ammonia, from which is made nitric acid, hydrochloric acid, sodium nitrate (Chilean saltpeter), soda ash, caustic soda and all the ammonias." It declares that a $50,000 investment will enable the investor to reap a profit of $1,400 daily. It provides for "the complete gasification of coal, lignite, peat or shale, the ash being the only residue." Again, "A 1,000-ton plant will give the same results that are secured from a 4,000-bbl. oil well, all without drilling or dry holes." Again, "By the use of the new process . . . it would be possible for a 2,000-ton lignite plant to

recover more than four times as much nitrate as is secured from Muscle Shoals, or, to be exact, 146,000 tons, and the plant would not cost to exceed $2,000,000." In addition, "the new process plant would be capable of producing more electrical energy than Niagara Falls and Muscle Shoals combined." And finally, "This seems to be a sure money-making proposition for any investor," etc.

Who would not grow excited over such revelations as ammonium sulphate from nitrogen and "lignite gas"? Or again, the production from ammonium sulphate of hydrochloric acid, sodium nitrate, soda ash, caustic soda and more particularly *all the ammonias*, not to speak of the wealth that is offered?

So one of the inventors and the chief promoter were invited to join the section at luncheon and to tell all about it, which they did. The members listened politely and attentively, according to their habit. But after the speakers had delivered themselves of a description of all the wonders of their boon to humanity, the questioning period began, and without harsh or unkind words the whole scheme was carefully and logically analyzed. The promoter and inventor got deeper and deeper into contradictions and entanglements, until in the end there wasn't much invention left, and the chance to make squintillions of dollars evaporated right before their eyes.

You've been talking about chemists and public service, Mr. Editor. Wasn't this a public service?

MARTIN SEYT.

British Chemical Industries

FROM OUR BRITISH CORRESPONDENT

LONDON, Nov. 17, 1922.

IN SPITE of the political upheaval, the inevitable disturbance of normal trade due to a Parliamentary general election and a certain amount of depression in the textile trades, the chemical market continues in a fairly healthy state, particularly for heavy chemicals in home markets and also as regards export. Large forward contracts are still few and far between, but now that the "period of tranquillity" policy is to have its chance, competent observers predict a further revival of confidence, and this idea of an improved outlook is reflected by a rise in the quotations for shares in the principal chemical concerns. Acetone is still almost unobtainable and other wood-distillation products are also rising appreciably in price. Croesote is a good market, partly in view of an expected demand from American and British railways.

NEW WEEKLY JOURNAL

In club circles one of the principal topics of conversation has been occasioned by the common knowledge that the Council of the Society of Chemical Industry proposes from the beginning of next year either to publish the society's journal weekly or to discontinue the Review Section; in the latter case the journal would contain only transactions and abstracts and little advertising matter. Certain parts of the present Review Section will be embodied in the new weekly, for which the title *Chemistry and Industry* is suggested. This name was decided upon after some controversy and, perhaps unfortunately, is very similar to the French journal *Chimie et Industrie.* So far, the obvious course of hiring a trained journalist to edit *Chemistry and Industry* has not been adopted and there has been much speculation as to whether a continuation of the policy of amateur technical journalism would not spell failure for a paper which, in the long run, is dependent financially upon circulation and advertisements. The right man has yet to be found, but for the next few months the editorship will be, it is understood, in the hands of Dr. Stephen Miall. It is hoped to arrange for a more extensive circulation and generally to carry out the much-discussed intention of launching a weekly section. The crux of the matter is probably the attitude of advertisers and whether they will stand for the increased rates as compared with fortnightly insertions.

THE PARLIAMENTARY ELECTION

The cry of the trading community at the moment is undoubtedly "more orders," coupled with complaints as to lack of governmental support and understanding. During the war the development of the Department of Overseas Trade on practical lines was a step in the right direction and it is considered very unfortunate that the economy axe should have affected this means of obtaining early information as to opportunities for trade overseas. There is some prospect that the new government will restore the lost activities of this department, which in the past has proved of real use to chemical manufacturers. Chemists in Parliament have been few and far between and Mr. Woolcock, the general manager of the Association of British Chemical Manufacturers, was one of those who did not seek reelection. The results just to hand show that Sir William Pearce, a member of long standing, has been defeated, but C. S. Garland, managing director of Lighting Trades, has been elected, and this will no doubt be as welcome to the many friends he made during his visit to the United States last year as to his colleagues in this country. Dr. G. C. Clayton, a director of the United Alkali Co., succeeded in defeating Mr. Henderson, the well-known labor leader, and there are two or three other manufacturers and directors of technical concerns who will be able to voice the interests of the industry. Max Muspratt, managing director of the United Alkali Co., has just been created a baronet for his past services.

GENERAL NEWS AND NOTES

The Association of British Chemical Manufacturers has just published a new edition of its official directory and classified list of manufactures, which is again printed in six languages, with the notable difference that one of these is now German, to the exclusion of Russian. An amusing feature is the printed list of the officers and council, and it is something of a shock and seems somewhat unnecessary to see Herr Charles Carpenter, Herr E. F. Armstrong, etc., branded with German titles, while in the same list people like Sir William Alexander and Sir John Brunner go scot free. It might have been better to adopt the American habit and give them all the prefix Dr., but needless to say, this does not in any way detract from the usefulness of the publication. The ninth and last volume of the "Technical Records of Explosives Supply" has just been issued by the Ministry of Munitions and deals in a characteristic way with the subject of heat transmission. A memorial tablet to Sir William Ramsay was unveiled at Westminster Abbey last week in the presence of a large and distinguished gathering. Bronze medals struck in honor of this distinguished chemist are now obtainable.

Art and Science of Leather Manufacture—I

First of a Series Outlining the Modern Leather Industry—Kinds and Sources of Hides and Skins — Flaying — Preservation and Cure—Defects—Diseases—Skin Structure and Chemistry

By F. L. Seymour-Jones
Research Scholar, Columbia University

THE tanning industry is unique in that its raw material is a byproduct of agriculture and its finished product is again raw material for the manufacturer of shoes, harness, saddlery, belting, fancy goods and a host of other leather products. No farmer grows an animal for its skin, neither does the value of the skin play any part in the selling price of the animal. Consequently the tanner has as raw material a product variable not only in nature but in the state in which it is turned over to him, according to the care which has been given to it. This position has operated against that standardization which is so characteristic of many branches of American industry. On the one hand, it puts a premium on practical knowledge gained by long experience, a true empirical judgment; on the other, it has resulted in the preservation as trade secrets of processes which the proper application of modern chemical knowledge can often replace cheaply and effectively.

Tanning an Ancient Trade

Tanning cannot yet rightly be classed as a chemical industry. It is one of the most ancient of trades, for the prehistoric hunter certainly learned to dress skins for clothing before he settled down as a planter. But despite early spasmodic efforts at introducing chemistry into the trade—notably by Sir Humphry Davy in 1803—it is only in the last 50 years or so that real progress has been made. Friedrich Knapp, of Germany, in 1858 published his "Die Natur und Wesen der Gerberei und des Leders," dealing with mineral and fat tannages and a theory of tanning. Those interested will find an English translation in the *Journal of the American Leather Chemists' Association*, vol. 16, pp. 158-81 (1921). The late Wilhelm Eitner, in Austria, and Henry Richardson Procter, in England, were the chief among the pioneers in studying tanning processes from a scientific viewpoint. In the last 20 years the number of investigators has multiplied greatly; most countries now have tanning schools and several have research institutes. But there are still many tanneries which do not have a chemist at all. In many others his job is limited to the necessary but uninspiring work of analyzing raw materials (tanning extracts, oils, etc.) and exercising some form of analytical control over the processes.

The reasons for this state of affairs are twofold. Tanners, as a body, are innately conservative, and processes are handed down from father to son for generations, being kept as firm secrets. On the other hand, the problems which beset the leather chemist are among the most recondite of modern science. His raw materials include hides, mixtures of proteins of unknown composition, complicated by their biological origin; vegetable tanning materials, the chemical nature of which is only just beginning to be made clear by the researches of Emil Fischer, Karl Freudenberg and their pupils; mineral tanning agents, notably chromium compounds, perhaps the most unreasonable and complicated of any in inorganic chemistry. The solution to the chemist's problems lies in the application of modern physical and colloidal chemistry, but the chaos existing in the latter subject again hinders progress. In addition he has structural organic chemistry and also enzyme actions to study.

It is only in the last few years that the real fundamentals of the subject are being attacked. The pioneers cleared the ground ably and well, and those suitably qualified are now entering into their inheritance in an almost virgin soil.

There are many definitions both of leather and of tanning. The processes used, or capable of use, are so many and varied that it is impossible to give an entirely satisfactory definition. Broadly, tanning covers the conversion of the readily putrescible hides and skins of animals into a practically imputrescible and durable product known as leather.

The principal raw materials which the tanner has to deal with are hides and skins. The distinction between them is purely one of trade usage, and no hard or fast line can be drawn. The term hide is generally reserved for the larger animals, the ox, cow, heifer, bull, horse, walrus, etc., while the smaller animals provide skins—calf, sheep, goat, pig, seal, etc. Of intermediate size are kips, which strictly speaking are the hides of the small East Indian buffalo.

Sources and Kinds of Hides and Skins

Easily the most important hides are those of the ox or steer. These are obtained not only by local supply in all countries supporting oxen but also by export from cattle-raising countries. The United States ranks high in this respect, and hides from the packing houses have a well-deserved high reputation. Another large source is the Argentine and Uruguay, whence come the *saladeros*. Steer hides, properly flayed, and minus head, horns, etc., range from about 50 lb. to 90 lb. and even more. Their quality depends not only on natural and artificial damages (of which more will be said later) but also on their source. In general cattle from hilly districts furnish better hides than do lowland or plains cattle. Attempts to hasten fattening with oil cake and similar materials tend to produce a more greasy and poorer hide.

The portions of a hide are referred to as bends or butt, bellies, shoulders and cheeks. Except for the first, these terms are self-explanatory. That portion of the hide covering the back and sides of the animal forms the butt, divided into two bends by a line down the backbone. The butt is by far the most valuable portion. The rest is referred to in general as "offal." That side of the hide next the flesh is known as the "flesh," while that of the hair is the "grain."

A steer hide yields a stout, firm butt of close fibrous texture. The bellies are somewhat looser in texture. Younger oxen yield better hides than old ones. Those from beasts used as draught animals are inferior.

Bulls give coarser and more spongy hides, and are usually very thick in the neck and belly, with many wrinkles and folds. Cowhides are flabby, of little elasticity and of poor strength. Heifers yield nice, close-grained hides, which are not as stout or strong as those from the ox.

Horsehides are obtained both from local supply and from South America. They yield a very smooth leather of medium thickness, largely used for boot uppers. Walrus and hippopotamus hides are occasionally tanned, furnishing a very thick leather, chiefly used for burnishing implements and in brake linings.

Kips come from the 1- or 2-year-old cattle of India. They are considerably smaller than oxhides and vary greatly in quality. Prior to 1914 they were exported largely to Great Britain and Germany, either cured or tanned locally. The war, however, caused a great expansion of the Indian tanning industry, and, though it has been badly hit by the slump, a definite permanent advance in tanning more locally is likely to be the result.

Calf and Goat Skins

Calfskins are of variable supply, according to the demand for and the price of veal. In general the bulk is obtained within the country of tannage, and there is no great export and import. They furnish skins of very even, close and fine texture, the female being finer than the male. The finest skins of all are from those animals which have not been weaned. Almost as soon as the calf goes to grass, the extremely fine texture of the milk-fed animal disappears.

In goatskins the United States easily holds pride of place, importing largely from abroad, particularly from India, China, South America, South Africa, the Balkans and the Near East generally. The skin is of a characteristic grain pattern, boldly marked, and is extremely tough and strong. Goatskins furnish the true morocco leather, used for a great variety of purposes. Kidskins are not in great supply. They are of exceedingly fine texture, the same remarks as to sex and feeding applying here as for calfskins. They are dressed largely in France for glove leather, and also come into use for fine grades of shoes. "Glazed kid" is made chiefly from goatskins and is primarily a United States product.

The most important of skins is undoubtedly that of the sheep. Some form of sheep occurs in almost every country throughout the world. But sheep are grown either for mutton (as in New Zealand and the Argentine) or for wool (as in Australia), and it is those countries that are the chief exporters. The quality of the skins varies greatly. Those with fine wool are generally poor, thin and soft. Those grown for mutton are usually fattened with artificial feeding stuffs, and are in consequence exceptionally greasy and fatty. The ideal skin from the tanner's viewpoint is obtained from the mountain sheep; small in size, but of a firm fiber and texture, it yields a very high class of leather. The dewooled skin is technically known as a pelt. The uses of sheepskin are manifold; fancy leathers (including anything from a purse to a vanity bag), bookbinding, slippers, hat linings, cheap shoe uppers, and the imitation of other leathers (morocco, kid and pig).

FIG. 1—REMOVING CATTLE HIDES FROM BELLIES

Lambskins are of an exceedingly fine grain and delicate texture, these qualities rapidly disappearing with growth, especially after the first month. They are used for the finer leathers, notably for glove "kid." Dressed while they still have their short, curly wool, they furnish astrakhan, though this term was originally applied only to slink and pre-natal lamb skins.

Pigskins are of only limited supply, chiefly because in many countries it is customary to sell the skin with the meat, whence it appears on the breakfast table with the bacon as rind. They have a characteristic grain structure, with well-marked hair holes which, in genuine pigskin, also appear on the flesh side. They are used chiefly for saddlery, leggings, bookbinding and bags.

Kangaroo skins, obtained of course from Australia, are of smooth, close texture, and yield a good leather, used much for boot uppers. Sealskins come from the true seal, and not from the fur-bearing animal. They are obtained around Newfoundland, northern Europe and the Cape of Good Hope. The skin is very oily, but yields a very strong leather of compact texture, used for a special type of morocco leather and for japanning or enameling.

Of lesser important skins which come into the market the porpoise, deer, alligator and snake may be mentioned. Shark skin has been introduced in recent years, and other fish skins are sometimes tanned.

Flaying

The process of flaying is outside the tanner's province, but is nevertheless of great importance to him. The old method, still largely used, is with the knife. The danger of cuts, particularly with an unskillful operator, is considerable, and hides may easily be ruined in this manner. It is desirable that no fat should be left adhering to the hide, nor hide tissue to the meat. This requires skill and experience, and even then the best operators use the knife as little as possible, peeling off rather than cutting off the hide. Figs. 1 and 2 give an idea of the methods used by large packing houses.

Many mechanical devices have been suggested, of which two may be mentioned. In one air is pumped in between the skin and the flesh, forcing the skin away from the body, thus rendering its removal an easy matter. In the other the knife is used only for the necessary preliminary slits, the hide being then forced back from the flesh by an automatic hammer.

Of all "take-offs," undoubtedly the best are those from the packing houses in this country and from the large meat plants in South America. Municipal abbatoirs, particularly in large cities, frequently offer premiums for good flaying, which has improved matters somewhat. Hides from private slaughter houses,

FIG. 2—FLAYING HIND LEGS AND BACKS OF CATTLE

local butchers, etc., are often badly flayed. This was particularly the case with East Indian kips until during the war flayers were accorded extra pay for good work.

Once the hide or skin is flayed it is in a readily putrescible condition. Where a tannery is near enough to a local source of supply, fresh hides may pass into work immediately or at most receive a light salting, as is often the case with small country tanneries in England. Generally, however, preservation is necessary both for imported hides and for those collected in such great quantities at the packing houses. Further, the heavy leather tanner in this country usually keeps a reasonably large stock of raw hides on hand to meet emergencies. Thus, at the up-to-date sole leather tannery of the J. H. Ladew Co., Newark, N. J. (Fig. 3), South American hides are stored as shown in Fig. 4. It will be noted that spaces are left between the piles and that wooden frames are inserted about half way up. Sufficient ventilation is thus assured to prevent heating and decomposition. The temperature at the center of the pile can be determined at any time by simply inserting a thermometer through the space formed by the frame.

Salting

The usual method for hides is that of salting. The hides are first washed, to remove adhering dung, dirt and blood, and are piled on horses to drain. They are preferably salted in large cool cellars, maintained at a uniform temperature of about 55 deg. F. The hide is spread on a concrete floor, and salt is liberally applied from a shovel by a man, two shovelfuls being sufficient for a hide. The hides are piled in packs, these being made slightly higher at the edges than in the center, so that the brine will penetrate thoroughly. The salting and piling continue until the pack becomes too high for comfortable work. It is then leveled off and covered over with salt. A pack will be from 15 to 20 ft. long and about half as wide (according to the distance between the pillars on the floor). The pack stands about 2 weeks, which is usually sufficient for the cure.

In "taking up," the hides are stripped from the pack and thrown over a horse (a table with an open top) to shake off the surplus salt. They are then thrown flat on the floor for inspection and classification. Finally they are rolled up, with the shanks (legs) and necks inward, the sides folded over, and a neat roll, 15 to 18 in. wide, made, and tied with rope of the size of clothesline. They are then weighed and are ready for shipment. The salt brushed off is swept up and mixed with the next batch for salting. The salt used should be free from iron, as this gives objectionable stains. Consequently raw rock salt is inadvisable.

Another method of curing largely employed, especially in parts of South America, is dry salting. The hides are washed and then hung up in a cool room to permit excess moisture to evaporate. They are next spread on the floor, flesh side up, and the head, shanks and belly folded in. Salt is spread over the hide, and, as the brine cannot run off, the fibers are thoroughly impregnated. A second salting is frequently given, and the hides are hung up to dry to a slightly rubbery consistency. A final coat of salt is applied prior to export. While this method gives economy of shipping weights, such hides are far more difficult to soak back than the ordinary salted, and the crystallization of the salt may have a weakening effect on the fiber.

An analogous method is applied to East Indian kips. The salt used is an earth, found around Cawnpore, Agra, Delhi, Lucknow and Patna, and consists mainly of sodium sulphate with about 20 per cent sand. This is mixed into a thin paste and applied to the flesh side, the hide being permitted to dry over night. A second coat is given, and even a third and fourth to add weight for export, and the hide finally dried out.

Where salt is not available the method used is straight drying. The hides are hung up in the shade or in sheds, in a well-ventilated spot, until dried out. Where the drying is too slow, through stagnant air, the hide will putrefy and "weak grain" will result. Where it is too rapid, as in the sun, the outside will dry, leaving the inside moist; putrefaction sets in, and, on soaking back, the flesh and grain part company, or whole parts of the hide will dissolve, leaving gaping holes. As it is impossible to detect this damage before soaking, and as soaking back of flint dried hides is often difficult, this is the least satisfactory method of cure.

To withstand insect attacks in store or in transit, some preservative is usually applied to the hides. Sodium arsenite is a useful material for this purpose.

Dewooled sheepskins are frequently imported in the pickled condition. Pickling consists in treating the skins in a bath of salt and sulphuric acid, say 8 per cent and ¾ per cent respectively, and then putting them in a concentrated salt solution to bring down the swelling. One bath alone is frequently used, a concentrated brine bath to which a little acid has been added. Hydrochloric acid may be substituted for the sulphuric, and

FIG. 3—GENERAL VIEW OF MODERN SOLE LEATHER TANNERY

FIG. 4—HIDE STORAGE

organic acids, acetic and formic, have also been used with good effect. A well-pickled skin will keep indefinitely when kept out of water. In depickling some salt must be added to the water or liquor to prevent the acid exerting an undue swelling action as the salt diffuses out of the skin.

Defects of Hides and Skins

Hides and skins are liable to many defects, in addition to faulty flaying, improper drying and putrefaction, already mentioned. Branding of cattle, while a necessary evil, very greatly lowers the value of a hide. It is usual to keep it to one side of the animal only, so that one bend at least may be free. This evil reaches its height in East Africa, where a special brand is applied at each inoculation against the many tropical diseases, and in India, where the cattle are sometimes deliberately branded all over to prevent those castes which eat meat only from animals which have died (and not been slaughtered) from poisoning cattle for the sake of the meat and hides. Barbed wire scratches are also a common defect in close-farmed countries.

The warble fly is a source of considerable damage to cattle, and to a lesser extent to horse hides. It is only very recently that the life cycle of this fly has been discovered after much painstaking research. The fly lays its eggs on the hairs about the animal's hind quarters. From these the larvæ hatch out and burrow into the skin and along the body to the gullet, finally reaching the back, passing through various forms en route. Just beneath the skin the larva bores an air hole, through which it finally emerges on hatching. The loss through these holes to the tanner, and through "blown beef" to the slaughterer, is immense. A kip in the museum of the Leeds University (England) leather department has about 680 warble holes in it, and similar cases are well known to tanners. The British Ministry of Agriculture has a commission studying the question of prevention and cure at present. A final report is expected shortly. The most promising methods are squeezing out the grub by hand (laborious and impossible of general application) and the application of a nicotine-lime wash. By these means it is possible to exterminate the fly in a district in 5 or 6 years, provided the method be thoroughly carried out.

Salt stains arising from the cure are a frequent source of damage to hides. They arise from a variety of causes, chromogenic bacteria, bacterial action through insufficient salting, iron from the salt or from the blood, or from impurities in the salt, where, as on the continent of Europe, denaturants have to be used for commercial salt. The use of a pure salt, or, for a denaturant, of sufficient alkali (5 per cent sodium carbonate) to prevent the development of bacteria, is the best means of avoiding this source of damage.

Sheepskins are liable to many natural ills, of which two are most important to the tanner. Cockle consists of a disturbance of the pelt structure resembling a hard pimple of well-defined appearance, which becomes a deep brownish black in the tan liquors. It appears early in the year, but disappears immediately after shearing. It is largely caused by the intensive fattening of sheep with artificial foodstuffs (oil cake and the like), very common in England. Colt, or dead fat, is another trouble, probably due to the degeneration of the fat cells of the skin, leading to hydrolysis of the fat and crystallization of the fatty acids in the skin. It also is connected with artificial feeding.

The only definite occupational disease of the leather industry is anthrax, arising from infected hides in transit and in soaking. It is particularly prevalent in hides from the East. Various means have been suggested for disinfection, but unfortunately most disinfectants have a tanning action (e.g., formaldehyde, phenols, cresols, etc.) and it is difficult to obtain an efficient one which will not damage the hide. While it is easy to destroy the anthrax bacillus, the spore is highly resistant. A treatment in 1 per cent formic acid and 1 part in 5,000 of mercuric chloride, followed by a brine bath to complete the "wet-salting," has been tested with encouraging results. The use of mustard oil has also been suggested.

Skin Structure

The skins of all mammals have the same general structure, hence a description of one broadly covers all, allowing for particular variations. Some knowledge of this structure is essential for the proper understanding of the working of skins, especially for "splits"—i.e., where the hide or skin has been split horizontally. The skin consists of two principal layers, the epidermis, and the corium or dermis. They are of very different properties and even origin. The fertilized animal ovum rapidly separates into three layers, from the outer of which the epidermis is derived; the corium, together with bones and muscle, develops from the middle layer.

The epidermis is comparatively thin and is removed by the tanner in depilation. It consists of a lower, mucous layer, of living cells, and an upper layer, formed of dead cells, which are gradually worn away. The transition from one layer to the other is not abrupt, but really a series of successive stages of decay. To the epidermis also belong the hairs, sebaceous and sudoriferous glands; though these are deeply imbedded in the corium, they are surrounded by a thin epidermal sheath. The sebaceous glands resemble a bunch of grapes, and serve to lubricate the hair. They are squeezed by the *erector pili* muscle, running from the hair root sheath to the epidermis. This muscle is an involuntary one, and is the cause of "gooseflesh" and of making the hair stand on end. The sudoriferous or sweat glands are connected with the epidermal surface by a spiral duct. Other epidermal structures include horns, nails, claws, etc.

The corium is that major part of the skin which is made into leather. It is composed in the main of a densely interwoven mass of white fibers. Close to the grain surface, and to a lesser degree on the flesh, yel-

low elastic fibers also occur. These serve to bind and support the white fiber bundles, and to draw the skin back to its original shape when stretched. Toward the flesh side groups of fat cells are to be found, and the whole is nourished with fine blood capillaries. The upper layer of the corium is the grain membrane, very thin, and bounded on top by the hyaline surface, which, if damaged, will result in uneven coloring. Below the grain membrane lies the compact fiber-bundle layer of the *pars papillaris*, so called from the projecting papillæ which form the characteristic grain pattern of the skin. Below this layer are the more open-fibered sebaceous and adipose layers (*pars reticularis*), in which the sebaceous glands and hair roots are imbedded, together with fat cells. The corium is connected to the body by a network of connective tissue (*panniculus adiposus*), frequently filled with fat cells. Many animals also possess a thin voluntary muscle (*panniculus carnosus*) just beneath the corium, used for twitching the skin to drive off flies, etc.

Chemical Nature of the Skin

The skin regarded chemically is a very complex body, built up mainly of proteins. Such mineral salts as occur are mainly phosphates and calcium compounds, in addition to those arising from the blood. The proteins belong to the unclassified group—i.e., scleroproteins. The epidermis consists mainly of keratins, the "old keratin" of the outer layer being more resistant to acids and enzymes than the "young keratin" lying next the corium. Keratins are insoluble in water, but are easily hydrolyzed by alkali and sodium sulphide solutions, a property used in unhairing. They are characterized by a comparatively high sulphur content.

The white fibers composing the bulk of the corium are formed of collagen, the parent substance of gelatin. Indeed, it is generally regarded as an anhydride of gelatin. It is insoluble in cold water, but is hydrolyzed in hot water to form gelatin. It swells readily in acids and alkalis, and is eventually hydrolyzed thereby. It is readily dissolved by pepsin, and less readily so by trypsin, unless previously reduced to a powdery state. Freed from keratins and elastin, by liming and bating, the collagen of the hide when ground up forms hide powder used in tanning analysis and experimental work. Far more work has been done on gelatin than collagen; the fibrous structure and insolubility of the latter render it less suitable for experimental work, and results obtained with gelatin usually closely parallel those with collagen. The collagen is the leather-forming substance of the skin, and its combination with tannins, chrome salts, etc., forms leather.

The elastin of the elastic fibers is the most resistant of all the hide proteins to reagents. It is, however, readily hydrolyzed by trypsin, and this property is used in bating. Mucins occur in the cementing substance joining the white collagen fibers together; they appear to be a degradation product of the fibers themselves. The grain membrane is of unknown composition; it is not collagenous, since it does not yield gelatin on boiling. Very little is known of the skin fats, though they appear to be mainly lecithins and cholesterols.

Acknowledgment

Illustrations for this article were made available through the courtesy of Armour & Co. (Figs. 1 and 2), and the J. H. Ladew Co. (Figs. 3 and 4).

(This article will be followed by others on this subject, to be printed in subsequent issues.)

What Is the Meaning of Radium at $70 per Milligram?

Is It "Cutthroat" Competition, Overproduction or Attempt to Put Industry on Stable, Co-operative Basis?

By H. H. Barker

THE public was somewhat surprised when it was announced, a few months ago, by one of the leading producers of radium that the price had been reduced from around $120 to $90 per milligram, but quite astounded when a further reduction to $70 was announced a few weeks ago by still another of the large producers. Who will be next to knock off another $20 to $30? Surprise at this matter is not amazing when we consider that for the past 5 to 10 years there has been an attempt to educate the public to the belief that radium was cheap at the current prices, and that the price must eventually rise. However, there are still those (perhaps they are not apace with the times) who still believe that the time is not far distant when radium will cost twice the sum of $70 per milligram.

In connection with this matter a few facts and some figures may be of interest. Anyone familiar with the radium-bearing ore deposits of the United States is cognizant of the fact that practically all of the ore comes from one section of the country which could be surrounded by a circle 200 miles in radius, and that the condition of mining, quality of ore, etc., are about the same throughout this region except for a few undeveloped deposits of virgin ore. It might therefore be assumed that no one concern has the "drop" on the others when it comes to obtaining the virgin ore at a ridiculously cheap figure.

Production Costs

It has been estimated by quite reliable authorities, who are familiar with the type of mining involved in the production of radium ore, that even under the most favorable conditions for mining a fair group of claims, the cost to produce a ton of 2 per cent uranium ore, containing 5.3 mg. of radium element, will be at least $150. To say the least, this figure is conservative and allows for only a small proportion of development work. As pointed out by George Kunkle,[1] as time goes on and the readily available ore is used up, more and more money will have to be expended in exploration work, with the result that the cost of ore will rise. Mr. Kunkle conservatively estimates the cost of radium in ore delivered to the railroad at $28 per milligram under present conditions.

The cost of processing a ton of ore is somewhat problematical and difficult to estimate unless put on a tonnage basis, where a certain quantity of ore is treated per month, 12 months of the year. However, it is probably safe to estimate that the cost may range from $100 to $150 per ton, depending upon the quantity of ore treated, overhead expense, methods used, cost of chemicals, labor, etc. The cost of recovering the uranium and vanadium is not taken into account here.

Taking the average of the figures given for the cost of processing, plus the cost of the virgin ore, we find that we have invested in the radium recoverable from 1 ton of 2 per cent uranium ore a total of $275. In the event that a recovery of 85 per cent is obtained (which

[1] *Eng. Mining J.-Press*, vol. 114, No. 12, p. 503, Sept. 16, 1922.

is undoubtedly higher than any company now producing can boast of over its entire period of production), the cost per milligram will be approximately $61, while on the basis of 80 per cent recovery the cost will be approximately $65. Add to this the cost of selling, plus the cost of maintaining the service which certain companies have established, and the total cost is easily $75 per milligram.

The average merchant feels that he is entitled to from 20 to 50 per cent profit on the commodities which all of us must of necessity buy. Certainly a radium manufacturer is entitled to a profit comparable to this, and it is questionable whether his margin should not be much greater when we consider what a risky undertaking the production of radium is and what opportunities for losses are involved. However, let us assume that the manufacturer is entitled to a profit of one-third the cost of production. On this basis the minimum price which radium should sell for is $100 per milligram.

In other words, it would seem that concerns which are selling radium produced from American ores at a price much under $100 are losing money and will ultimately face a deficit. A fact that further substantiates the statement that there is no profiteering in radium at $100 is that only one of the large producing concerns has ever paid any dividends, and in its case it is also a well-known fact that its radium has netted it well above $100 per milligram. What industry is able to go on indefinitely without paying dividends? Sooner or later those who have been doing their financing will become impatient and discouraged, unless they realize some returns in the way of real money.

Possible Significance of Cheap Radium

There appear to be four possible solutions to account for $70 radium, which will be briefly presented:

1. This reduction in price may be a means of discouraging competitors and in some instances putting the smaller fellow out of business. It might also serve to discourage new capital which may be contemplating entering the industry. Provided the position of some of our American manufacturers is so strong financially that they can afford to do this, it may be very effective, but it is a question whether they will not impair their own financial condition before they do that of some of their competitors. The fellow who is viewing the situation from the spectators' bench has nothing to lose but his time.

2. This reduction in price may be a bargain sale on radium, used as a means of raising real money on a large inventory of finished product. In the long run this would seem to be rather poor business, as it upsets the market, which, in the handling of a commodity such as this, is apt to slow up buying and create certain obstacles which may be difficult to surmount when the readjustment time comes. Then too, these firms are sacrificing their product at a price below cost of production, and eventually will have neither radium nor money.

3. This reduction in price may be the result of prospective importation of radium. From good authority, it has been ascertained that there was received in Belgium a few months ago 60 tons of 50 per cent uranium ore, from which 6 to 7 grams of radium can be obtained. The extent of the deposits in the Belgian Congo from which this ore was obtained is unknown, but it is quite improbable to conceive of their having a mountain of such ore. It might be well in this connection to call attention to the fact that several tons of very high-grade ore (perhaps not 50 per cent) have been taken from pockets on some American claims, but it did not follow that the entire region was permeated with such ore or even the entire claim from which the high-grade ore was obtained. It is logical to assume that one of these high-grade pockets was struck in the Belgian Congo deposit and that the ore has been pretty well removed. It is possible, of course, that there may be a tonnage of fair ore available, and again there may not be any appreciable quantity of ore of a commercial grade. What the total production of such a find will amount to time only can determine.

4. Have recent advances in X-ray therapy made some producers of radium fear for the stability of their industry? On this point the writer has no definite data, but he feels that this factor has had no material influence in the present slump in the price of radium.

Effect of Slump on Industry

However, let us assume that the 60 tons has been processed and the radium is ready for marketing. It is easy to realize that the cost per milligram will be nominal on such a grade of ore, and a handsome profit can be realized selling for $70 even allowing a $20 commission. It is quite possible that some of our American organizations have the agency for this material and are thus able to put radium on the market at this low figure.[2] Such a price for radium, in small quantities, is not only demoralizing to the other producing concerns but it is also demoralizing to the customer. He immediately assumes an attitude of suspicion, for, as stated before, he has been educated to expect an increase in price, and, contrary to his expectation, comes a decline. It is considered good business never to buy on a declining market, and presumably many persons will look at this situation in such a manner. Equally true, it is considered good business to buy on a rising market provided you get in shortly after the price starts to mount. Perhaps we are just preparing for a rise in price by getting right down to rock bottom as a basis.

When all is said and done, we must come to the conclusion that even in the event that the market for radium is somewhat demoralized at present on account of imported material, we shall eventually have to get back to the consumption of our own product, and with such consumption an advance in price is inevitable.

What is to be the outcome of all this "cutthroat" work in the marketing of radium? Undoubtedly, the survival of the strong—and possibly the fit—who are able to weather the storm and after the "fly-by-night" concerns have passed by will have a legitimate industry whereby they may realize a fair return on their money invested. When such time comes we shall undoubtedly see more co-operation among the producers than there has been in the past, and we shall not have such large variations in the price of radium as quoted on a recent order of fair size. The prices quoted ranged from $77 to $120 per milligram. Some such a co-operative agreement would undoubtedly prove to be of benefit to the large as well as the small producer, and can be most efficient in helping to establish the future of radium both in the professions and as an industry.

Columbia, Mo.

[2] Editor's Note. It has recently been announced by the Radium Company of Colorado that since July last members of the executive and technical staffs of the Radium Company of Colorado have been in Belgium working out details of the new radium enterprise, and that the Radium Company of Colorado, with main offices in Denver, which is to market the Belgian product in America, has formed a joint corporation with the Société Générale du Radium to market radium throughout the world.

A Method for Determining The Rate of Sulphation Of Storage Battery Plates

Experiments Which Have Been Made to Develop a Speedy and Accurate Method for Measuring the Effect of Impurities in Storage Battery Electrolyte—The Fundamental Theory of the Method, and Measurements of the Rate of Sulphation of the Lead Plates in Pure Solutions

By G. W. Vinal and L. M. Ritchie
Bureau of Standards, Washington, D. C.

THIS investigation was undertaken to establish if possible a speedy and accurate method for the measurement of the effect of impurities in storage battery electrolytes. Preliminary experiments in which small cells were "poisoned" by the addition of the substances to be studied showed that accurate and consistent results were difficult to obtain. The capacity of the negative plates is ordinarily greater than that of the positives and the effect of such impurities as affect the negative plate is therefore masked, in part at least, when determinations of the capacity are made. It is difficult also to insulate the small cells so perfectly that leakage current during the periods of standing will not affect the measured capacity. It is often necessary to permit several weeks to elapse in order to determine the loss in capacity resulting from the impurities which are added. Because of the inaccuracies of this method and the time required, it was decided to determine the effect of the impurities in terms of the rate of the reactions taking place at the plates. This may be accurately determined in a short time by successive weighings of the plates immersed in solutions which are maintained at a constant temperature.

In the present paper it is desired to present only the fundamental theory of the method and the results which have been obtained for the rate of sulphation of positive and negative plates in solutions of pure sulphuric acid of various concentrations. According to Dolezalek[1] measurements of the rate of self-discharge of the plates in varying concentrations of the electrolytes have not been made. The method here described affords a simple and accurate means of obtaining this information. The changes taking place at the negative plate are most readily studied by this method, but the interpretation of the results obtained on positive plates presents greater difficulties. The method is not immediately applicable to the study of such impurities as serve as oxygen carriers between the plates of different polarity. In a subsequent paper the effects of impurities will be discussed.

Arrangement of the Apparatus

The general arrangement of the apparatus is shown in Fig. 1. Twenty-four plates were suspended by glass hooks and entirely immersed in the electrolytes, which were contained in six rectangular glass jars, four plates to each jar. These jars were carried on a revolving frame in the thermostat bath which permitted the plates in any jar to be brought to a point directly underneath the left-hand arm of the balance. The balance was mounted on a marble slab over the thermostat tank as shown in the illustration. By this arrangement it was possible to weigh each plate while immersed and without exposing it to the air. The thermostat tank was filled with water to within 1 in. of the top of the jars. The temperature of the water could be controlled by a thermo-regulator at any desired point within the range 20 to 40 deg. C. The variation of the temperature of the water from a fixed point was within 0.01 deg. The water was stirred continuously. Each jar was provided with a wood cover impregnated with paraffine.

The plates selected for the experiments were those made for starting and lighting batteries by two manufacturers. Small sizes of plates were selected to avoid overloading the balance, which was of high quality having a nominal capacity of 200 grams. The plates of maker A were $5\frac{5}{8}$x$4\frac{1}{8}$x$\frac{3}{32}$ in., those of maker B were approximately $5\frac{5}{8}$x$4\frac{3}{4}$x$\frac{3}{32}$ in.

To adapt plates to the conditions of our experiments, the lug was cut off and burned on again in the middle of the top edge in order to balance the plate when suspended in the liquid. Two holes were drilled in the lug. One of these was used for the glass hook which suspended the plate from the balance during weighings and the other for a second glass hook which supported the plates when weighings were not in progress.

Experimental Results

Weighings of the plates were made daily and the results computed as the increase of weight per hour. Three sets of weighings extending over a period of 48

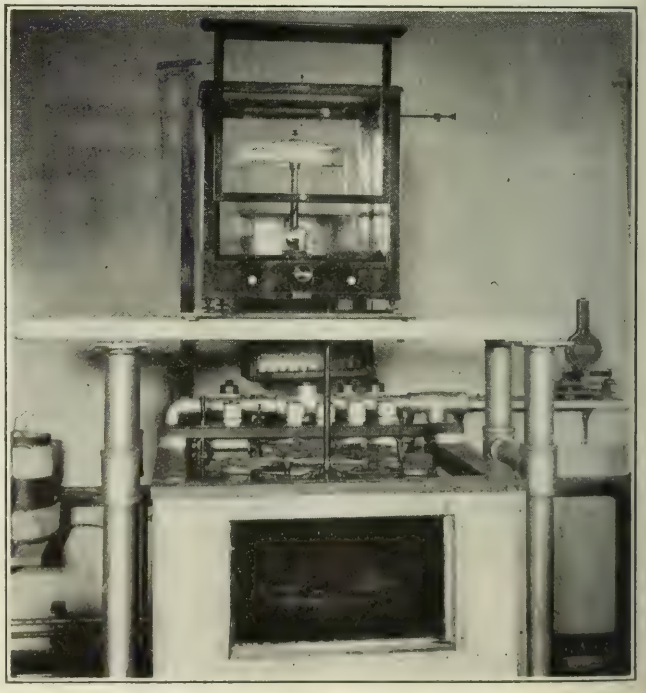

FIG. 1—APPARATUS FOR DETERMINING RATE OF SULPHATION OF STORAGE BATTERY PLATES

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[1] "Theory of the Lead Accumulator," p. 139.

hours were sufficient to give two determinations of the rate of change in weight of the plates. These two determinations in nearly all cases were in good agreement. Four weighings at 25 deg. C. were made, giving three determinations of the change in weight. The mean of these is given in the table below. Since the weighings were made in the electrolyte, a buoyancy correction was necessary. This correction has been calculated on the assumption that the materials have the following densities:

Lead	11.3
Lead sulphate	6.3
Lead peroxide A plates	8.7
Lead peroxide B plates	8.8

Since the values for the density of lead peroxide found in the literature differ widely, determinations of the density of the active materials of the positive plates in the fully charged condition have been made by Mr. Peffer at the Bureau of Standards with the results given above. Analysis of the active materials by Mr. Altrup shows 97 per cent lead peroxide in the positives of each manufacturer, 97 per cent lead in the negatives of manufacturer A, and 91.5 per cent lead in the negatives of manufacturer B. The expanders in the negatives were carbon in each case. The buoyancy corrections are applied to a small difference of two weighings, and hence a slight error in the density of either the solutions or the active materials produces a negligible error in the final result.

The densities of the solutions were determined directly by the use of calibrated hydrometers.

The chemical reactions during discharge at the plates are generally assumed to be:

$$Pb + SO_4 = PbSO_4 \qquad \text{Negative plate}$$
$$PbO_2 + H_2 + H_2SO_4 = PbSO_4 + 2H_2O \qquad \text{Positive plate}$$

Since the molecular weight of lead is 207.20 and of lead sulphate 303.26, the gain in weight during the transformation of 1 mol of lead to lead sulphate is 96.06 grams and the relative gain in weight (96.06 ÷ 207.20) times the weight of lead acted upon. There is of course a large amount of lead which does not take part in the reaction and decreases the sensibility of the weighings, but in spite of this fact and the heavy damping resulting from the viscosity of the electrolytes the balance was sufficiently sensitive to permit an accuracy of a few tenths of a milligram to be obtained.

From the rate of change in weight of the plates the equivalent loss in ampere-hour capacity can be computed. The valence is 2 and hence a gain in weight of the negative plate of 96.06 grams is equivalent to 2 × 96,500 coulombs. From this the change in weight is computed to be 1.79 grams per ampere-hour.

Both chemical and electrochemical reactions are possible at the negative plate, but the former are probably predominant over the latter during self-discharge. This is indicated by the results for the A plates in 1.150 and and 1.400 acid. The gain in weight per hour in the stronger acid is twenty-three times that in the more dilute. The change in potential of a lead plate as the concentration of the electrolyte is changed from 1.150 to 1.400 sp.gr. is less than 0.1 volt, according to the measurements of Gladstone and Hibbert.[2]

The resistivity of the more concentrated electrolyte is higher than for the 1.150 sp.gr. electrolyte. On the basis of Ohm's law, therefore, this marked increase in the extent of the reaction cannot be readily accounted for as an electrochemical reaction.

[2] *J. Inst. Elec. Eng.* (British), vol. 21, p. 430 (1892).

TABLE I—GAIN IN WEIGHT, GRAMS PER ECUR, OF NEGATIVE PLATES IN SOLUTIONS AT 25 DEG. C., SATURATED AND UNSATURATED WITH LEAD SULPHATE.

Sp. Gr. $\frac{25° C.}{25° C.}$	Gain in Weight for Plates of Manufacturer A, Sat. Sol.	Manufacturer A, Unsat. Sol.	Manufacturer B, Sat. Sol.	Manufacturer B, Unsat. Sol.
1.150	0.0022	0.0031	0.0048	0.0058
1.200	0.0026	0.0071	0.0118	0.0120
1.250	0.0036	0.0098	0.0178	0.0290
1.300	0.0060	0.0115	0.0283	0.0394
1.350	0.0151	0.0270	0.0385	0.0558
1.400	0.0460	0.0480	0.0906	0.0960

The measurements on the negative plates at 25 deg. C. are given in Table I. Each figure is the mean of six observations (three measurements on each of two plates). Buoyancy corrections have been made.

These results show that the rate of sulphation is decreased appreciably in the saturated solutions of concentrations corresponding to those ordinarily used in storage batteries. The solutions were saturated with chemically pure lead sulphate when hot and were permitted to cool before the plates were immersed. The electrolyte in a lead storage battery is ordinarily saturated with lead sulphate, although the electrolyte is initially a solution of pure sulphuric acid. In the unsaturated experiments the ratio of the mass of acid to the mass of the plates was so large that saturation could not occur in as short a time as is ordinarily the case. Each jar contained 4.5 liters of solution and four negative plates.

The question has been asked, Why it is injurious to permit a discharged cell with low gravity of electrolyte to stand when the results of this paper show that the rate of sulphation is less in the solutions of low gravities? The answer is that the low gravity of electrolyte in the discharged cell is merely incidental and the state of charge of the plates is the controlling factor. The plates for these experiments were initially fully charged.

The rate of sulphation decreased as time progressed. This is especially noticeable in the case of the plates of manufacturer B in the unsaturated solutions of higher concentration, as is shown in Table II.

TABLE II—DECREASE IN RATE OF SULPHATION WITH TIME, NEGATIVE PLATES IN UNSATURATED SOLUTION.
(Measurements on Plates of Manufacturer B.)

Date	Gain in Weight, Grams Per Hour, for Each of Six Concentrations: 1.150	1.200	1.250	1.300	1.350	1.400
Feb. 19	0.0059	0.0132	0.0304	0.0416	0.0574	0.0976
Feb. 20	0.0053	0.0110	0.0289	0.0414	0.0560	0.0964
Feb. 21	0.0061	0.0121	0.0275	0.0352	0.0535	0.0942
Feb. 22	0.0050	0.0118	0.0260	0.0369	0.0484	0.0818
Feb. 25	0.0052	0.0110	0.0247	0.0359	0.0498	0.0819
Feb. 27	0.0053	0.0113	0.0236	0.0332	0.0470	0.0769

It can easily be computed that the capacity of the plates would be exhausted in a relatively short time if the initial rate of sulphation were to continue indefinitely. The decrease in the rate of sulphation is probably to be attributed to the protection which the lead sulphate affords to the underlying active material and also the increasing amount of lead sulphate present in the solutions which were initially unsaturated. The effect of the presence of lead sulphate in decreasing the rate of sulphation of the plates has been shown in Table I, but the effect of saturating the solution in holding the rate of sulphation constant for a few days during which measurements of the effect of impurities can be made is of fundamental importance in establishing the validity of this method. This is made clear in Table III, in which comparative results for the plates of manufac-

turer A are given for a period of 3 days for both the saturated and unsaturated solutions. The results with the minus signs express the decrease in rate of sulphation during this time. Inconsistent results are to be observed for the solutions of 1.150 and 1.200 sp.gr., but this is not surprising, since these solutions are in the region of the minimum solubility for lead sulphate according to the curve given by Dolezalek.[3] In this region there can be but little distinction drawn between saturated and unsaturated solutions. The measurements made on the plates of manufacturer B were not as consistent as those for manufacturer A because of a tendency for the active material to scale off, which produced an error in the results.

TABLE III—EFFECT OF SATURATING THE ELECTROLYTE WITH LEAD SULPHATE ON THE CONSTANCY OF THE RATE OF SULPHATION OVER A PERIOD OF 3 DAYS

(The minus signs indicate a decrease in the rate and plus signs an increase. Plates of manufacturer A)

	Change in the Rate of Sulphation, Grams Per Hour, in Solution at 25 Deg. C.					
Solution	1.150	1.200	1.250	1.300	1.350	1.400
Unsaturated....	+0.0017	+0.0013	—0.0031	—0.0045	—0.0029	—0.0037
Saturated.....	0.0000	+0.0005	0.0000	0.0000	—0.0009	—0.0014

The effect of temperature on the rate of sulphation is important. In Table IV are given the measurements made on the negative plates of both manufacturers when the solutions were maintained at constant temperatures of 22, 25 and 30 deg. C. The increase in the rate of sulphation from 22 to 25 deg. is proportionately greater than from 25 to 30 deg.

TABLE IV—EFFECT OF TEMPERATURE ON THE RATE OF SULPHATION OF NEGATIVE PLATES

Sp.Gr. 25° C. / 25° C.	Gain in Weight, Grams per Hour, Saturated Solutions for Plates of — Manufacturer B —			— Manufacturer A —		
	22°	25°	30°	22°	25°	30°
1.150.....	0.0031	0.0048	0.0056	0.0012	0.0022	0.0022
1.200.....	0.0073	0.0118	0.0118	0.0016	0.0026	0.0027
1.250.....	0.0111	0.0178	0.0196	0.0028	0.0036	0.0051
1.300.....	0.0183	0.0283	0.0325	0.0046	0.0060	0.0082
1.350.....	0.0270	0.385	0.0420	0.0122	0.0151	0.0198
1.400.....	0.0614	0.0906	0.1027	0.0350	0.0460	0.0544

Local action at the positive plate is essentially electrochemical, resulting from the difference in potential between the oxide and the lead-antimony alloy of the grid. Metallic impurities are not precipitated by the oxide, and Dolezalek and Finckh[4] have stated that no solubility of the peroxide in solutions of the specific gravities ordinarily used in storage batteries can be detected. The reaction at the positive plate in these experiments is therefore to be regarded as the general expression for the discharge of a cell, with the qualification that the negative electrode may be lead or lead-antimony alloy depending on the construction of the plate.

$$PbO_2 + Pb + 2H_2SO_4 = 2PbSO_4 + 2H_2O$$

The lead sulphate formed appears on both the peroxide and the grid.

The gain in weight of the positive plates is not as simply related to the total amount of sulphate formed as in the case of the negatives. The sulphate which forms on the grid or the underlying lead is equal to 96.06 grams for 2 × 96,500 coulombs, but the change in weight of the positive plates because of the formation of sulphate on the peroxide is 64.06 grams for the same quantity of electricity. The difference is accounted for by the formation of 2 mols of water at the peroxide.

[3] "Theory of the Lead Accumulator," p. 145.
[4] *Z. anorg. Chem.*, vol. 51, p. 320 (1906).

TABLE V—GAIN IN WEIGHT, GRAMS PER HOUR, OF POSITIVE PLATES IN SOLUTIONS AT 25 DEG. C. SATURATED AND UNSATURATED WITH LEAD SULPHATE

Sp.Gr. 25° C. / 25° C.	Plates of Manufacturer A		Plates of Manufacturer B	
	Saturated Solution	Unsaturated Solution	Saturated Solution	Unsaturated Solution
1.150.....	0.0128	0.0111	0.0077	0.0138
1.200.....	0.0121	0.0096	0.0077	0.0090
1.250.....	0.0069	0.0060	0.0047	0.0051
1.300.....	0.0053	0.0022	0.0050	0.0061
1.350.....	0.0050	0.0019	0.0048	0.0062
1.400.....	0.0047	0.0031	0.0049	0.0088

This means that 160.12 grams of sulphate would be formed on the positive plate if the quantity of electricity flowing were 2 × 96,500 coulombs. The ampere-hour equivalent for the gain in weight resulting from local action, is, therefore, 2.99 grams for each ampere-hour. The experimental results for the positive plates in solutions of varying concentration at 25 deg. C. are given in Table V for solutions saturated and unsaturated with lead sulphate.

It will be observed from the results given in Table V that the gain in weight of the positive plates decreases as the concentration of the solution increases. This suggests that the plates contained some soluble constituent, the solubility of which increased as the concentration increased, but the data which are available on the solubility of lead peroxide and lead oxide fail to offer an explanation. In the solutions which were saturated the gain in weight of the plates was more for manufacturer A but less for manufacturer B than in the unsaturated solutions. The difference in behavior may be attributed to the different methods used in preparing the paste for these plates, but no exact explanation can be given now.

Petroleum Laboratory List Being Compiled

The Bureau of Mines is revising its list of commercial laboratories to which correspondents are referred when they wish to have chemical analyses made. This is necessary because the policy of the Bureau of Mines does not permit making analyses for private individuals unless such analytical work forms a part of a larger project which is being carried out by the bureau in the public interest. Due to an unforeseen delay the formal questionnaires which were to be sent out in connection with the revision of this list have been held up. They are now being forwarded to the various laboratories, however, and a prompt response is hoped for. Laboratories which are not on the present list are invited to communicate with the Bureau of Mines relative to their ability to carry out the various tests on petroleum products. The bureau reserves the right to limit the list to laboratories that appear to be qualified to do the work.

Gummy Substances in Gasoline

A study of various methods of evaporation and oxidation of cracked gasolines made by the Bureau of Mines leads to the conclusion that gummy and resinous deposits are caused by oxidation and have no direct relation to unsaturation as determined by solubility in sulphuric acid. In the investigation made by the bureau a new and convenient method was developed for determining "gum" in gasoline. The study of gums and their formation leads to the conclusion that they are polymerized aldehydes, which probably are formed by the oxidation of olefins, etc. Storage tests confirm the above conclusions. Details of the investigation made by the Bureau of Mines are given in Serial 2394, "Gum-Forming Constituents in Gasoline," just issued.

The Protective Action of Copper in Case Carburizing

By James C. McCullough (Associate Professor) and H. A. Holden Pray
Severance Laboratory of Oberlin College, Oberlin, Ohio

ONE of the common methods of preventing action on certain parts of a piece of steel that is being carburized by the cementation process is to cover these parts with a plating of copper. Even though this is common practice, it fails at times in a way that is not understood. Illustrating this, we quote a few sentences from a discussion following a paper on "Case Carburizing" by C. G. McFarland, as published in the *Transactions* of the American Society for Steel Treating, vol. 1, page 305:

Mr. Stenger: "I would like to ask if you can give us an explanation of just why copper plating prevents carburization."

Mr. McFarland: "I cannot."

Chairman: "Maybe somebody here would like to ask the question why it does not at times."

The literature records some work along this line by Giolitti, Habec, Guillet and Bernard, Zimmerli, and others and is contradictory to a degree. We have been studying the matter at some length, and in this communication, which is in the nature of a progress report, we give the ideas we have so far acquired. If any readers have had experiences which bear upon the problem we should very much appreciate hearing from them.

Good Plates Easily Made on Good Steel

Of course our first assumption was that the commonly accepted theory of carburization is correct and that CO gas is the active carburizing agent. It also seemed probable from published data that CO does not diffuse through copper to any appreciable degree even at 950 or 1,000 deg. C. We assumed that this failure of the copper protection in certain cases was due to holes in the plating and we tried to prove this assumption.

None of our copper platings on clean, uniform steel failed to protect unless we scratched through the copper. In some cases the copper seemed to diffuse over the scratches or file marks and the sample emerged from the furnace without any sign of carburization. This seems to have been noted by others but not explained. We do not attempt to explain it.

Since all of our first platings from a cyanide bath gave adequate protection, we began to look for some that would not protect even when considerable care was used in plating. A low-carbon steel with slag and ghost lines gave this erratic behavior, and we consequently confined our attention to it in an effort to show at least one reason why copper fails to protect.

Imperfect Results on Low-Grade Metal

The latter material was of low carbon content and in the form of round rods or pieces cut from steel bar ¼ in. thick and 2 in. wide. These pieces were cleaned in hydrochloric acid containing 1 per cent by volume of 40 per cent formaldehyde solution (Holmes patent) and then plated over part of their length in a copper cyanide bath of the following composition: water 10 qt., sodium carbonate crystals 8.5 oz., sodium hydrogen sulphite crystals 7 oz., copper carbonate 7 oz., and potassium cyanide (98 per cent) 8.5 oz. The pieces were then carburized by packing in a sheet-iron box 3x4x6 in., the mixture being 3 parts wood charcoal and 2 parts barium carbonate. The temperature, measured at the center of the box, was held at 1,000 deg. C. for 75 minutes and then permitted to drop with the electric furnace.

Cross-sections of these rods were then examined under the microscope to determine the degree of carburization and the condition of the copper plating. Great care was necessary to prepare these sections without damage to the copper. The method finally chosen was to mount the sample in a type metal composed of lead 8 parts, antimony 2 parts and tin 1 part. Standard pipe caps for ¼-in. gas pipe make convenient cups for this mounting. A harder alloy than type metal would be desirable, but they have higher melting points and dissolve part of the copper. There was a marked tendency for the copper to tear loose from the iron and be carried out into the alloy during the grinding of the sample and even the edge of the iron seemed to flatten out into the type metal mounting. Successful grinding was obtained only by coating the carborundum papers with paraffine, avoiding much pressure during polishing and holding the sample in one position during the entire process instead of changing direction with each change of paper. By this method the one edge of the iron rod where the direction of motion was from type metal to iron could be successfully examined. A new grinding was necessary for each edge examined.

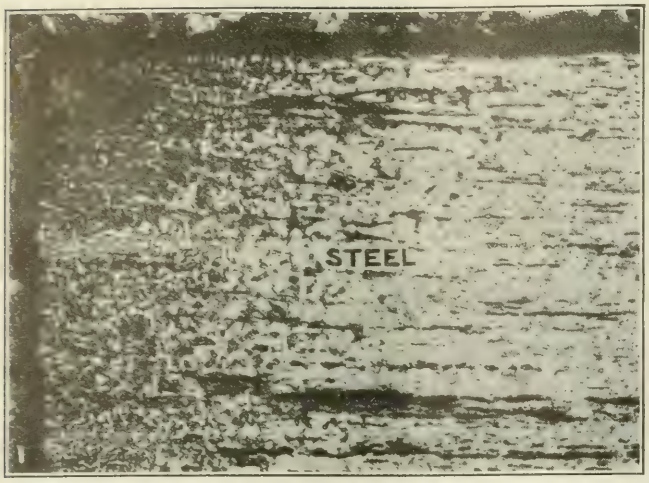
Microscopic examination of such samples was very satisfactory even with the highest power oil-immersion lens, the red color of the copper being very apparent. Photomicrographs were also prepared (some of which are reproduced), but with considerable difficulty. The type metal always ground away to a lower level than the iron and copper, making a sloping junction that was very hard to adjust for clear focusing over much of the field at one time. Photographs were all made on Wratten M plates using Wratten light filters. With the blue (C) filter copper shows in the print as black, while with the red (A) filter the copper prints white and may be distinguished from slag or structure lines in the steel.

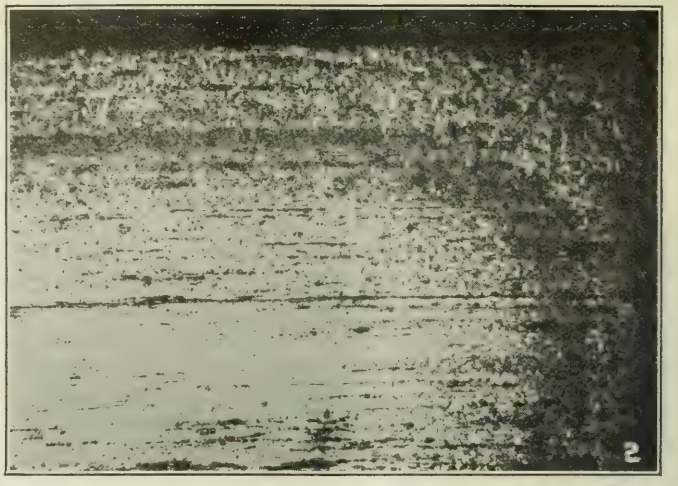
Copper 0.004 mm. Thick Protects Iron

Without exception the samples examined showed no carburization under copper plating, except when there were holes in the copper. Carburization was always in proportion to the number of such holes.

Copper plates perfectly from a cyanide bath on to clean, pure iron or steel providing a low current density is used. We got complete protection with a plating of 0.004 mm. thick deposited at a current density of 0.08 amp. per square decimeter, while a plating 0.006 mm. thick deposited at the rate of 0.6 amp. afforded very little protection and showed many holes. Copper will not deposit on spots of slag or oxide that come to the surface of the iron. Breaks in the copper and consequent carburization always seemed to accompany such structural marks in the steel unless the copper deposit was made very thick.

Figs. 1 and 2 show the conditions at corners at opposite ends of the same sample of low-grade steel bar. One end had been copperplated, the other was bare and clean. After carburization, the clean end (Fig. 2) was seen to be carburized about the same depth inward from the sides and from the ends. This indicates that penetration was no deeper one way than the other, even though the slag lines might have afforded open channels for the gas. We do not believe that CO followed these slag lines to any marked degree, but we are sure that





FIGS. 1 AND 2—CORNERS ON OPPOSITE ENDS OF SAME BAR.
ETCHED WITH 5 PER CENT HNO_3, 95 PER CENT ALCOHOL
Fig. 1—Copper plated end. × 50. Fig. 2—Bare end. × 25.

these slag lines cause holes in the copper plate through which the gas does enter and diffuse into the steel in all directions. This is plainly shown in Fig. 1.

Fig. 1 has a copper plate 0.004 mm. thick (too thin to show at this magnification). Owing to the difficulties in polishing and photographing, the edge of the sample is marked by a black streak, beyond which appear the large crystals of the white-metal mounting. The plating across the "fiber" was quite defective, while it was much more perfect around the sides. Consequently gas penetration was from the ends only. Much of the pearlite in the carburized zones has been divorced, and fairly large masses of carbide may be seen. This occurrence is to be expected in such impure steel, as shown by McQuaid and Ehn in several recent papers.[1] This structure, and breaks in the copper plate, are shown more clearly at higher magnification in Fig. 3. It shows the edge, normal to slag lines, of the same piece of steel photographed in Fig. 1.

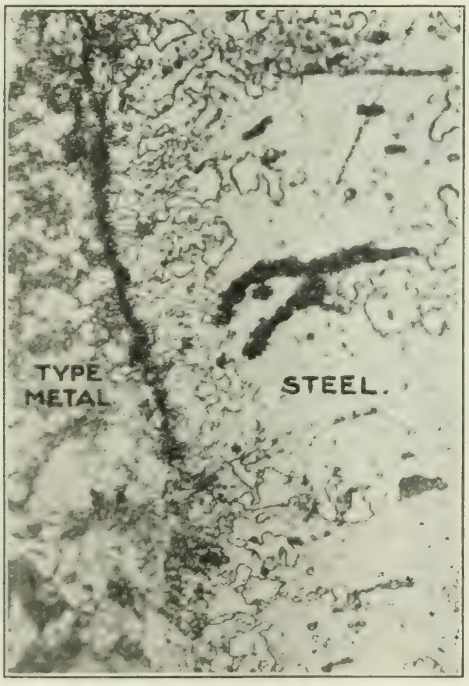


FIG. 3—SAME AS FIG. 1. × 500
Etched with 5 per cent HNO_3, 95 per cent alcohol. Blue filter. A portion of the edge normal to slag lines shows breaks in copper plate and divorced cementite beneath.

[1] American Institute of Mining and Metallurgical Engineers, N. Y. meeting, February, 1922. British Iron and Steel Institute, May, 1922, meeting. American Society for Steel Treating, Detroit meeting, October, 1922.

Conclusion

Our work strongly supports the following view of the theory of case carburizing and its prevention by plating with copper. It shows the cause of failure in at least some cases and points to a reliable remedy. When soft iron is heated in a charcoal pack, the carbon monoxide gas penetrates into the iron and gives up some of its carbon to the iron to effect the desired carburization. Carbon monoxide gas does not dissolve easily in copper and hence cannot pass through it unless there are cracks or holes in the copper. A thin copper plating over iron should, therefore, prevent carburization unless there are flaws in the copper. We found such flaws in every plating examined that had failed to prevent carburization and we found no breaks in the effective platings.

Treatment of Oil Field Emulsions

D. B. Dow, chemical engineer of the petroleum experiment station of the Bureau of Mines at Bartlesville, Okla., who is making a study of oil field emulsions, recently interviewed a number of operators at Tulsa, Okla., and obtained information on methods of dehydration that are being used by different companies. It was found that most companies are using chemicals for treating oil field emulsions, although in a number of fields the centrifugal process is in rather general use. An extended series of laboratory tests has been made to determine the effects of large amounts of water when produced with the oil. It was found that with 10 per cent oil and 90 per cent water, only a small percentage of B.S. was formed and that about 98 per cent of the water separates on standing. By decreasing the amount of water and increasing the amount of oil, the percentage of B.S. increases and the amount of free water decreases. The laboratory experiments coincide with the information that has been obtained from field men to the effect that in a well producing excessive amounts of water there is less trouble from emulsions than in one that produces a comparatively small amount of water. Additional laboratory tests will be made to determine the effect of finely divided material on the formation of oil field emulsions.

The Donnan Program of Investigation for the Chilean Nitrate Industry

The Present Method of Caliche Treatment Is Outlined and a Critical Examination Is Made of a Recent Suggestion That the Operation of the Shanks Process Should Be the Object of Intensive Scientific Research

By A. W. Allen
Assistant Editor, *Engineering and Mining Journal-Press*

Between December, 1918, and July, 1919, Dr. F. G. Donnan made an extensive investigation on methods of treatment in vogue and results being obtained at a number of nitrate oficinas[1] in Chile. The ultimate sequel to the visit was the publication of an elaborate report,[2] issued by the Chilean Nitrate Committee in London.

Dr. Donnan, who is professor of general chemistry at the University College of the University of London, is well known as one of the leading authorities on many important phases of chemistry. His researches, apart from a brilliance that places him among the front rank of present-day scientists, indicate an originality above the normal. His writings are usually constructive and helpful. He has been an outstanding figure among those who are attempting to solve the many problems connected with colloidity and adsorption; in 1910 he propounded what is now known as the Donnan theory of membrane equilibria, support and elaboration of which is to be found in Dr. Jacques Loeb's recently published monograph on "Proteins and the Theory of Colloidal Behavior."

Dr. Donnan writes fearlessly of conditions on the pampa. The most striking fact revealed by the inspection was the "great dearth of exact quantitative data" and the absence of results of "detailed scientific investigations. The time has come," it is averred, "when these defects must be remedied as rapidly as possible." Investigation work is recommended as the panacea, the report under review being concerned mainly with its organization, direction and control.

In a preliminary section the distinguished chemist deals with the general economic conditions affecting the Chilean industry, discusses the possible competition of synthetic products and emphasizes the fact that "no great industry can progress without keeping a vigilant watch on the progress and development of its competitors." Discussing process control, Dr. Donnan draws attention to the deplorable conditions observable on the pampa. Like many others who have gone before, he found that "no proper means of determining the essential data existed, and such as were determined and reported were often either erroneous or falsified."

Causes Behind Deplorable Conditions Existing on the Pampa

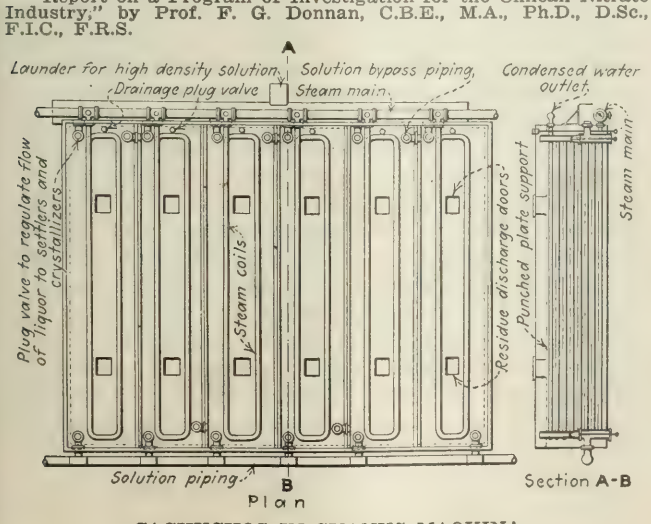
Among the causes of the present state of affairs are mentioned (1) inadequate technical staffs; (2) want of close technical control of the processes of manufacture; (3) the tendency to be satisfied with present profits, regardless of the technical inefficiency of the processes and the wasting of material; (4) the control of the industry by men of business, men unpossessed of any chemical or engineering knowledge. "A clean cut must be made with the methods of the past . . . The highest possible premium must be placed on accuracy and moral and intellectual honesty . . . Only really well-trained men must be appointed—men who have already demonstrated their capacity for technical and scientific investigation."

Verily a "clean cut" will be needed to separate the industry from those who have hitherto had control of technical operations—who have derided the efforts of independent engineers to obtain recognition of fundamental principles—who have systematically discredited scientific fact by the contention that all that could be tried has been tried, "back in the '70s or thereabout" —who discourage initiative by camouflaging the results of inefficient operation so that they appear presentable—who are helping to squander Chile's resources by a determination to ignore the wastage caused by the selective mining of the highest grade of caliche. Dr. Donnan's suggestions as to the need for "moral and intellectual honesty" are especially applicable. If the "clean cut" proposed be made it will mean the elimination of much that is reprehensible in the operation of the industry.

The technical side of Dr. Donnan's report is confined almost entirely to a consideration of the results—actual, possible or problematical—of continuing the present method of operation known as the Shanks process. He maintains that "we must thoroughly control and understand the existing process before we attempt to improve it." The personnel of the proposed research department

[1] Glossary: **Agua feble**—solution obtained by refrigeration of **agua vieja**, which is the mother liquor remaining after the fractional crystallization of high-density nitrate solution to atmospheric temperature; **batea**—crystallization vat; **borra**—sludge found underneath punched-plate support in vat, also in solution and clarifying tanks, also used (incorrectly) to refer to slime in caliche; **cachucho**—boiling tank in Shanks plant; **caldillo**—any liquor with more nitrate than mother liquor and less than **caldo**, which is of the highest density and temperature; **caliche**—nitrate-bearing material containing, in addition to nitrates, soluble impurities in a number of forms and in varying proportions; **chullador**—an open, flat-bottomed vat used to settle the slime and salt in the solution before crystallization; **cancha**—place where nitrate is dried and sacked; **costra**—material of low nitrate content usually found near caliche; **crinolina**—perforated-plate false bottom in treatment vat on which charge of caliche rests; **maquina**—nitrate plant; **oficina**—nitrate property equipped with plant; **relave**—weak nitrate liquor; **ripio**—residue, usually only referring to that portion that comes from above the punched-plate support in the treatment vat; **salitre**—commercial nitrate.

[2] "Report on a Program of Investigation for the Chilean Nitrate Industry," by Prof. F. G. Donnan, C.B.E., M.A., Ph.D., D.Sc., F.I.C., F.R.S.



CACHUCHOS IN SHANKS MAQUINA

is to consist of four research chemists, one research physicist, one geologist, one mineralogist, four analytical chemists, one mechanical engineer, one chemical engineer, one mining and metallurgical engineer, two draughtsmen, et al. The technical staff will be chosen, other than in exceptional cases, from among those who have attained "the D.Sc. or Ph.D. standard of the best European and American universities." An ambitious program of work is proposed, involving heavy expense. The candidates should preferably be between 25 and 35, and an "adequate pension scheme" is recommended. The task of finding out what is wrong with the Shanks process is to be tackled in no hasty, commercial spirit.

So little has been published about the Shanks process that it will not be out of place to preface my comments on Dr. Donnan's conclusions by a brief description of its fundamental features. The caliche (nitrate-bearing material), after hand sorting, is reduced in swing-jaw rock breakers to about 3 in. The wearing plates of these abrade at a maximum in the center; and many or few large lumps, according to the condition of the plates, escape proper reduction. The crushed material then goes by conveyor or gable car to the vats, which are rectangular and of iron, six generally forming a nest; each is equipped with steam coils. A perforated-plate support with ⅜-in. holes is fixed a few inches above the bottom of the vat. The caliche is tipped into the upper section and usually segregates into coarse and fine, the steam pipes, acting as a grizzly, aiding the classification that occurs. An even distribution of the material in the vats is looked upon as entirely unnecessary. Large dividends have been paid for years by companies whose technical staffs have followed the original plan.

Operation of the Shanks Process

The arrangement of piping to, from and around a typical cachucho (boiling tank) is shown in the accompanying line drawing. Provision is made for the passage of solution from vat to vat; but as all of these are on the same level, no upward or downward percolation is possible. For the most part the solution passes from underneath the perforated-plate support into the side of the adjoining vat. Enrichment of the solution is achieved by submerging the caliche with liquor from a nearby charge, followed by boiling or high-temperature maintenance. During this phase of operations the liquor becomes thoroughly contaminated with slime; when a high density is reached it is laundered to a settler, where dung or flour is added to assist sedimentation. The clear liquor is then decanted and sent to crystallizing vats, the slimy dregs from the settler going to waste. Owing to the ease with which the nitrate content of the solution can be augmented by evaporative concentration in the cachuchos there is no difficulty in obtaining a high-grade crystal after ordinary cooling to atmospheric temperature. Broadly speaking, the industry is confronted with no problem of a chemical nature directly connected with the manufacture of a high-grade nitrate product from caliche.

After an imperfect displacement treatment in the cachucho, the material is finally washed with water and discharged. The mud that collects underneath the crinolina, or punched-plate support, shares the same fate as that which is discharged from the clarifying vats: it is treated as waste.

Such are the essentials of the Shanks treatment. Various modifications have been proposed or put into practice. Fine grinding has been attempted; but the boiling or high-temperature maintenance in the vat involved the freeing of too much slime. In some oficinas the sludge from below the perforated plates has been removed from a discharging vat and placed on top of one undergoing treatment, with results not difficult to imagine. At some plants an attempt has been made to treat this mud by decantation or filtration, but unsuccessfully. In a few cases the fine constituents of the dry charge have been isolated and treated separately, but the scanty data available have shown that the problem has been only partly solved.

Large Losses on the Pampa Due to Neglect of Fundamental Principles

I do not find myself in agreement with Dr. Donnan's general program. The Shanks process, he admits, has been a miserable failure, as judged by present-day requirements. "We may assume," he says, "that 40 per cent of the nitrate contained in the material arriving at the works is at present lost." This confirms my own opinion that, "although optimistic figures have been given at various oficinas as to the amount of nitrate extracted, it is improbable that the actual recovery in crystal form and ready for shipment exceeded, on the average, 55 per cent of the nitrate originally in the caliche; and it is certain that in very many cases the amount was considerably below this estimate."[3]

Scientific workers are paid little enough, but there is another type of investigator who often gets nothing for his labor. I refer to the person who thinks several times before he acts. A little analytical and constructive thought on the problems of the pampa will do more to bring prosperity back to the industry than will the expenditure of vast sums of money to determine the precise physicochemical happenings in a Shanks maquina. The failure to improve results has been due to a neglect to appreciate the fundamentals of any process employed for the removal of a soluble salt from an insoluble gangue. The technical men in control of the industry apparently refuse to realize the importance of simple and fundamental facts.

Inefficient Extraction in Shanks Process

Dr. Donnan remarks that "Providence has so arranged that in the cycle of the Shanks maquina the unwanted constituents are usually purged with the final boil of the caldo" (liquor of highest density and temperature). But Providence is equally kind to those who have no faith in the Shanks scheme as applied to the extraction of nitrate from caliche, for any solubility curve will show that boiling temperature is not necessary for the selective absorption of nitrate and the release of salt and other impurities. This leads to one of the fundamental weaknesses of the prevailing method of treatment: the evaporation of water from solution in contact with the caliche. "Such concentration," Dr. Donnan remarks, "works against the leaching, and for this reason alone the evaporation, if it be necessary, should be conducted after and not during the leaching." This confirms my own conclusion that "the inefficiency of nitrate recovery—the lengthy time of treatment to obtain even moderately low ripios [leaching-vat residues]—is due largely to the enrichment of the charge by the evaporative concentration of high-grade

[3] "Recovery of Nitrate From Chilean Caliche." Charles Griffin & Co., Ltd., London.

solution and by the addition of caldillo [weak nitrate liquor] and aqua vieja [mother liquor]. These high-grade nitrate solutions have low dissolving powers. Caldo is formed mainly by evaporative concentration, and not by the abstraction of nitrate from the caliche; and this involves the augmenting of the nitrate in the cachucho, resulting in a proportionately high ripio. The boiling or high-temperature maintenance disturbs the equilibrium of the charge, causing the borra [sludge] to circulate with the solution and finally to find its way underneath the crinolina and thence to the surface of other charges or to the relave [weak nitrate liquor] tanks."[4]

The Borra Bogey an Illegitimate Excuse for Poor Yield

In reading Dr. Donnan's report one is constantly reminded of the fact that he has been duly impressed by the borra bogey. When the rotos, or workmen, of the Chilean pampa become fractious at the high cost of beans and carry their grievances to Santiago, the government counters their complaints with a scare: "Peru is about to attack us." "Viva Chile!" they all shout, and prepare to defend their beloved country with the last drop of their Araucanian blood. And the price of beans is forgotten. Similarly, on the Chilean pampa, an inquiry as to the reason for the pitiable results usually obtained by the Shanks process invariably elicits a tale of woe about borra. This bogey should be laid reverently to rest, for it has worked hard and long to deflect attention from one of the principal causes of technical failure in the nitrate industry. A thousand and one ideas have been proffered to solve the problem of what to do with the layer of sludge found underneath the crinolina and deposited during clarification in the chulladores (settling vats) and in the relave tanks. Dr. Donnan has an elaborate program prepared for his research department. An amazing fact again emerges: that investigators fail to realize that the process ceases to be leaching as soon as a portion of a charge is removed with the percolating liquor. The effluent is no longer a solution, and the material left in the vat does not represent the residue. Further, the abstraction of slime from the vat connotes channeling; the equilibrium of the charge is disturbed, making regular percolation impossible.

Assuming that other conditions are correct, the deposition of borra, or slime, from the leach liquors resulting from downward percolation is due to inadequate support for the charge. If the pioneers in cyanidation had practiced bulk treatment of comparatively coarse, dry-crushed material by leaching in a vat with a "filter" bottom of ⅜-in. holes, failure would have resulted in the same way as it has on the pampa. A proportion of the slime would have washed through, channeling would have resulted and extraction would have been poor.

The borra bogey has served to obscure an important fundamental fact—that physical considerations must be given primary attention. The first thing is to see that the process is working as such. If it be leaching, then percolation must be even; the effluent solution must be free from insoluble. Physical conditions must be arranged so that this is possible; consideration can then be paid to the question of efficient extraction. In Chile little or no attention has been given to physical considerations. Much finer grinding of the caliche has been suggested as a logical departure, in order that a charge may consist of particles of a size permitting even percolation, even dissolution of the nitrate and even drainage; but operators have pooh-poohed the suggestion, because, forsooth, more borra would be formed or released! Thus it is seen that the bogey crops up at every stage; it is used at every opportunity to frighten the interested visitor.

The borra in Chilean caliche of average composition is easily and inexpensively treated, provided (1) it is held in position throughout all stages of submergence, leaching and drainage; and (2) that adequate support is provided for the charge, permitting regular percolation and low moisture content in residue. Fineness of grinding must be such that there is no appreciable movement of borra in the direction of the percolating solution. Muddy liquors in Shanks-maquina operations are caused "(*a*) by the disturbance of the equilibrium of the charge by boiling or high-temperature maintenance in the cachuchos, and the freeing of an unnecessary amount of borra; (*b*) by uneven resistance to flow of solution through the charge, resulting in short circuiting; and (*c*) by the incomplete and unsatisfactory support for the charge by means of punched plates, leading to local collapse at numerous small areas and the washing through of borra and sand."[5] No investigation should be started until agreement is reached that muddy solutions are incompatible with correct physical conditions for leaching. Dr. Donnan, after summarizing the action in the chullador, says that "clarification presents a number of problems . . . very careful and scientific attention must be paid to these operations." A better, cheaper and safer plan would be to consider the production of solutions free from borra.

"If boiling and evaporation are to be prevented in the boiling tanks," suggests Dr. Donnan, "probably the best way to do this would be to close the tops and

SORTING CALICHE ON THE PAMPA

BRINGING CALICHE FROM THE PAMPA

MECHANICAL CAR TIPPING AT A PLANT

[4]Ibid., p. 6.

[5]Ibid., p. 10.

preheat the liquor between each leach." The removal of the steam coils and the avoidance of the external heating of solutions between vats was put in practice on an operating scale over 2 years ago. No investigation is necessary on the part of the proposed research department to determine the practicability of the step. As to closing the tops of the vats, I do not understand what is meant, although I have suggested[6] the use of float insulators on the surface of the solution to prevent heat losses from radiation.

Donnan Fails to Mention the Possibility of the Use of Grainers in Crystallization

Under the subject of crystallization, Dr. Donnan touches lightly on batea practice, dwelling primarily on the time factor. The heat loss during crystallization cannot be considered important, but I think that emphasis might well be laid on the fact that, because of large areas needed, the cooling of solution en route to the more distant bateas is inevitable. "Most of the heat available for evaporation is dissipated by conduction losses and direct contact with excess cold air. When the solution has reached such a temperature that evaporation is slight, the deposit of crystals on the sides and bottom of the batea prevents or delays the chilling of the liquor to low temperatures. Excessively large installations are needed to counteract the inefficiency of operations at every stage of the process."[7]

I was disappointed not to see some comment by Dr. Donnan on the possible use of grainers in Chile. The apparent advantages of their adoption would include "(1) reduction in area of plant required; (2) ability to grade product, from high-grade crystals containing caldo (with low salt percentage) as moisture, to the ordinary commercial nitrate; (3) elimination of all hand labor and the continuous and automatic delivery of crystals of varying grades, from pure nitrate to a commercial product; (4) avoidance of launder delivery of caldo for long distances, with reduction of radiation losses, prevention of formation of small crystals and high moisture percentage in product; (5) ability to control heat losses during the earlier stage of cooling, so as to obtain maximum evaporation of water; and ability to hasten the later stage when evaporation is slight."[8]

The Donnan Report Also Omits the Large Economy of Atmospheric Evaporation

The extended use of vacuum-pan evaporators in the nitrate industry is desirable and logical; but to my mind a serious omission from the recommendations for research is in connection with what is usually referred to as solar evaporation. I am still of the opinion that "Primary consideration must be paid to the possibility of utilizing the extraordinarily favorable atmospheric conditions prevailing at all seasons of the year on the Chilean nitrate pampa—the heating effect of the sun, the abnormal dryness of the atmosphere, the persistence of high winds and the almost entire absence of rainfall. These advantages indicate conditions that are highly favorable to solar evaporation. The feasibility of utilizing the evaporative powers of the air in conjunction of the sun-heating of thin layers of liquor at a negligible expense offers advantages that cannot well be disregarded. The problem confronting the industry as soon as the present high-grade deposits are nearing exhaustion will be in connection with the recovery of a commercial nitrate from a comparatively low-grade brine. The fractional crystallization of such a solution by solar evaporation and the production of an impure crystal must inevitably be an important phase of any scheme suggested."[9]

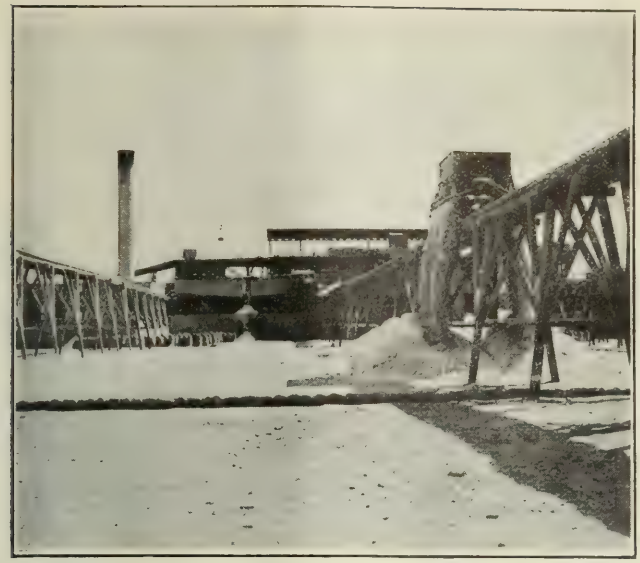
I carried out in Chile, on three separate occasions, tests on the evaporation of water from aqua vieja by natural means. At the time I had access to an unusually complete series of weather reports on another pampa, from which I judged that the favorable conditions I observed were not merely local. The evaporation amounted on an average to 9 liters of water per square meter of surface exposed per 24 hours. One test indicated that the evaporation amounted to 146 in. per annum. In another test it was found that the exposure of 1 sq.m. of aqua vieja resulted in the deposition of a heavy crop of crystals containing 89 per cent nitrate ($NaNO_3$). Other experiments proved that a considerable amount of commercial nitrate is obtainable from aqua vieja by this method, provided the evaporated water is replaced at the same time by more aqua vieja. At a certain stage, however, an impure crystal is deposited, after or just before which the brine might be returned to the treatment plant.

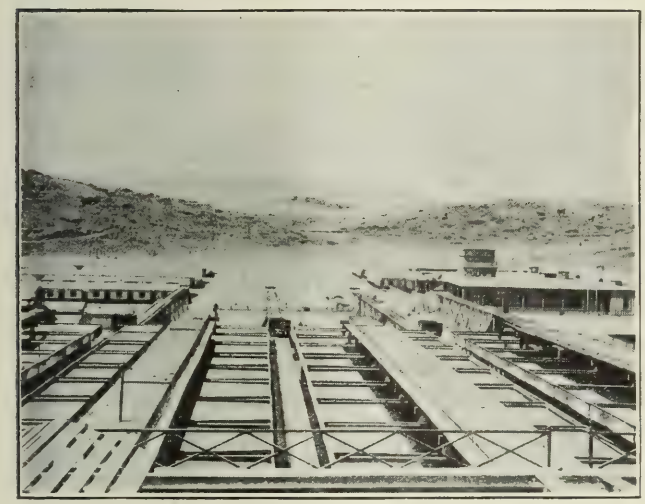
If the caliche is of high enough grade, and so long as an expensive method of evaporation is feasible, it appears impossible to interest pampa operators in a cheaper and equally effective alternative. Other saline industries have gone through the same experience; but, so far as I know, the technical men of the pampa and their advisors represent the only group determined to ignore the possibilities of natural evaporation. In Utah, an important brine deposit was a commercial failure when quadruple-effect evaporators were used; but by adoption of solar evaporation it was transformed into a technical as well as a commercial success. In the district in question the rainfall is about 3 in. per annum, the net evaporation being 36 in. In many parts of the Chilean pampa there is no rain, and the evaporation amounts to over 100 in. per annum.

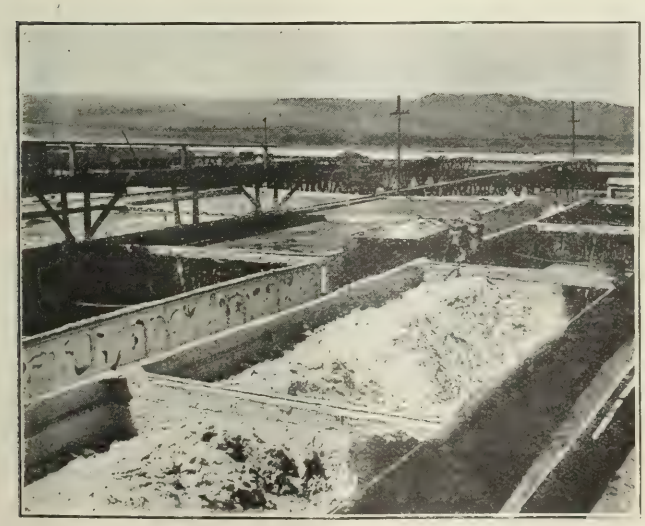
Questionable Value of Separate Treatment of Fine Material

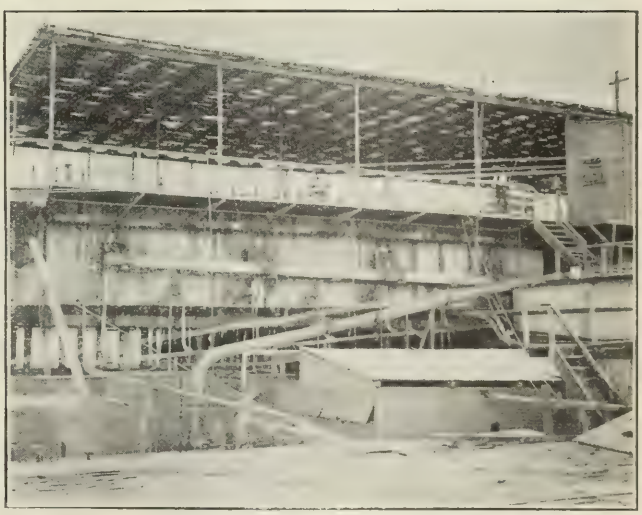
Considerable investigation is proposed to determine the advisability for the separate treatment of fine material subsequent to its isolation from the caliche. Expecting a gradual diminution in grade of caliche treated, I see no prospect for the ultimate adoption of any of the schemes proposed. If the removal of fines from ordinary caliche gives improved results, it is obvious to me that the methods in vogue for the extraction of soluble are at fault; for, in leaching, much of the fine material is needed to maintain the texture of the charge, to insure even percolation and to prevent channeling around the larger lumps. Segregation of fines involves heavy expense and waste of nitrate, or it necessitates the application of pressure or vacuum filtration. Paul F. Holstein, whose experience in this connection in Chile has been unusually complete, stated recently: "The past 10 years has seen much, on the whole, unprofitable experimentation with new processes, most of them attempts to apply bits of knowledge snatched from milling practice without any great understanding of the applicability of the methods. The use of filters of various types is an example of one of these unfortunate efforts. While the nitrate man has gained costly knowledge, his

[6] Ibid., p. 27.
[7] Ibid., p. 15.
[8] Ibid., pp. 47-48.
[9] Ibid., pp. 37, 38.









Nitrate cancha at an ordinary oficina

Crystallizing vats

Nitrate in crystallizing vats

Passenger electric car at a plant

Nitrate plant

Boiling vats (cachuchos)

enthusiasm has become much dampened as each heralded 'invention' went the way of its predecessors into the scrap heap."[10] I still think that "There is no justification for the extra expense involved in the classification of the small amount of slimy material found in normal crushed caliche and the treatment of the fines by any system of pressure or vacuum filtration. Owing to the refractory nature of the slime after the absorption of the nitrate solution and the difficulty if not impossibility of thickening or filtering a borra pulp by any known method, it is highly inadvisable to separate this from the sandy material, either purposely or as an unavoidable phase of any scheme of treatment adopted."[11]

Bouquets for the Gibbs Process Unwise

Dr. Donnan singles out the Gibbs process, now defunct, as forming probably "a genuine and courageous attempt to break away from the bonds of traditional practice"; investigators unconnected with names to conjure with in the recent technical history of the industry are apparently grouped as "would-be inventors or authors" who "fail to justify their ideas or suggestions by means of the publication of exact quantitative investigations. There seems little doubt," the professor continues, "that the vast majority of the so-called 'new processes' are simply paper propositions."

Visitors to the Chilean nitrate pampa should distribute bouquets with caution, for it may be possible that a genuine and intelligent attempt may best be made by the pampa technician to improve methods and processes by adopting an attitude of moral and intellectual honesty toward the researches of others and by a toleration of the views of "authors and would-be inventors" from divers phases of industry. Dr. Donnan's commendation of the Gibbs process at oficina Celia, "which he was unfortunately prevented from visiting owing to preoccupation with other matters," indicates an apparent divergence from a rule he has laid down for the guidance of others, to wit, that "on no account must the research department take any figures or data on trust. It is absolutely essential that they themselves should determine the data." Consistency is a jewel, especially among scientists.

The Recovery of Nitrate from Ripio Is a Promising Field

The problem of re-treating the ripio dumps of the Chilean pampa, we read, is one "which the research department must not leave untouched or unconsidered. They would feel very foolish if somebody came along some day and solved it over their heads." Dr. Donnan suggests that "Good systematic counter-current leaching in the cold, followed by recovery of the nitrate by refrigeration, might offer a solution or part solution of the difficulty."

Ripio might be described as caliche that has been impoverished of nitrate and enriched with salt and other compounds. Ordinary cold leaching would produce an exceedingly impure liquor, so far as nitrate was concerned; it would offer no opportunity for the selective solution of the nitrate to the exclusion of salt—an advantageous feature of the hot process. Dr. Donnan could find no reliable survey of the average percentage of nitrate in any dump in Chile, and hundreds of millions of tons of this so-called residue is scattered over the pampa. One can only conclude from this reticence that it will be voted bonanza material at some time in the future, when the industry has finished "picking the eyes" out of the deposit. I should say that the average nitrate content of the dumps of residue in Chile is about 9 per cent. It may be more or it may be less. I have heard many asservations of low ripio, but the absence of convincing data on total loss leaves me skeptical.

"In any case," states Dr. Donnan, "the result would only be the recovery of a dilute liquor." I see no reason for this conclusion. I found no difficulty in treating a typical ripio, with the following results: nitrate in charge, 7.8 per cent; nitrate in residue, 0.4 per cent; nitrate extracted, 95.5 per cent; time of treatment, about 24 hours. The ripio was crushed to about ½ in. The solutions used were aqua feble, relaves and the customary water wash. The first effluent showed that the abstraction of nitrate from the ripio amounted to over 100 grams per liter. The residue contained 13.3 per cent moisture.

Although some dumps may contain sections in which there is an excess of borra, it is probable that an aggregate taken over any considerable length of dump face would provide an excellent product for treatment. As a rule the average ripio is so clean that it might well form the body of a charge that included a proportion of refractory, high-borra caliche.

Alternative Methods of Operating the Shanks System

Advantages of Upward or Downward Displacement

Dr. Donnan asks whether "it would be an advantage or disadvantage to give up the original idea of a continuous slow downward displacement of denser liquor, and to circulate the liquor in each separate tank by pumps or other means." This question indicates an incomplete appreciation of the imperfections of Shanks-maquina operations. I maintain that: "Efficient displacement of solutions during leaching must take place either in an upward or a downward direction. This involves (*a*) pumping from vat to vat on any system of solution concentration; or (*b*) the erection of the vats at different levels. The latter practice would present obvious disadvantages. In the Shanks system an effort is made to secure displacement from vat to vat without recourse to pumping or variation in vat level. The result is that operations are considerably simplified, but at the expense of efficient displacement. . . . Caldo where formed is largely diluted with incoming caldillo . . . no true displacement takes place."[12]

The concentration of solution by pump circulation in individual cachuchos is already in practice in many maquinas, but in this case nitrate is removed by the solution to be put again in contact with the charge. It may be taken as an axiom that in all efficient leaching operations a progressive impoverishment of the charge is accompanied by a progressive diminution in nitrate content of the solution in contact with it.

Circulation of Liquor Produced Thermally

Dr. Donnan also asks: "Could external heating of the liquors be so arranged that upward circulation in each tank was produced thermally (after the well-known principle of thermal circulation) and not by pumps?" The "liquor" circulating from cachucho to cachucho in

[10] *Chem. & Met. Eng.*, May 17, 1922.

[11] "Recovery of Nitrate From Chilean Caliche," pp. 11, 12.

[12] Ibid., pp. 6, 7.

an ordinary Shanks maquina is so muddy that I do not know of any type of heater that would prove reliable for the purpose. However, if the fundamental principles of leaching are to be recognized, it may be mentioned that upward percolation is not only practicable but highly desirable, especially during the earlier stage of treatment. As a general rule, however, I am opposed to the use of pumps for the delivery of solution underneath the bed of caliche. The pressure fluctuates and often rises above the normal, thus disturbing the equilibrium of the charge, causing short-circuiting and poor average extraction. Gravity flow from a definite head is preferable, arranged so that the difference in density between the incoming and outgoing solutions is a little more than balanced. The great advantage of upward percolation is that the denser liquor resulting is delivered from the surface, thus obviating crystallization troubles in piping or other inclosed parts of the apparatus.

Desirability of Using Homogeneous Charge

Dr. Donnan has drawn attention to one of the weakest features of present practice when he calls for an investigation on the advantage of homogeneity of the material comprising the charge, both in regard to size and nitrate content. The nitrate, as a general rule, is not finely disseminated through the caliche. In a 20 per cent charge I have often seen masses of 60 per cent crystalline matter alongside 2 per cent costra. Thorough mixing of the various types of caliche usually treated is an essential preliminary to operations on an adequate unitary scale. A homogeneous charge, in so far as nitrate is concerned, is only possible after the adoption of much finer crushing than is practiced in a Shanks maquina.

Machinery Necessary in Finer Grinding

It is pertinent that attention should be drawn to the question of machinery suitable for the purpose. I am averse to rolls for the secondary reduction of caliche; they were tried at Chuquicamata and thrown out in favor of disk crushers. There is a great deal more minus 150-mesh material in average caliche than there is in Chuquicamata ore, so that consideration of the problem of the avoidance of unnecessary sliming should be more thorough on the nitrate pampa than it need be at the famous copper mine. Any earthy raw material—if crushed coarse, thrown into a "leaching vat" equipped with steam coils and a perforated-plate bottom support, submerged with solution, which is boiled—might be termed refractory; for it is certain that the disturbed slime would clog the space below the support and foul the solution abstracted for precipitation or crystallization, or sent forward to vats charged more recently. This is precisely what happens in the Shanks maquina. The trouble is due to the methods followed and the apparatus used; the borra is responsible for the resulting inefficiency because it is improperly handled. The cheap and efficient removal of soluble by gravity leaching necessitates the preparation of a mass that is evenly permeable. This condition can be obtained only by adequate crushing, thorough mixing and proper distribution; the permeability is obtained by the selection of suitable machinery, by the avoidance of overcrushing and the release of an excessive amount of slime.

Suggested Use of Cottrell Precipitators for Settlement of Dust Unnecessary

In discussing the question of the settlement of dust, Dr. Donnan suggests that it might be possible "to arrange the crushers in closed wind-channels or wind-passages, and to precipitate and catch the dust by Cottrell or Lodge electrostatic precipitators."

The accompanying photograph of a disk-crusher plant in operation was taken at an oficina commended by Dr. Donnan for its progressiveness. The escaping dust, which was of higher grade than the average of the caliche being treated, was distributed everywhere by the prevailing wind. I see no need for electrostatic precipitation. I think that the trouble could be lessened by the use of aqua vieja as a spray on piles of caliche, either on the pampa or in the bins. Incidentally, the evaporation of water resulting would save fuel. Dusting from a primary crusher is inevitable with small-scale operations. With large gyratory crushers, however, the dust problem is seldom insistent, even with the most refractory material. As far as secondary crushing is concerned, disk-crushers are especially suitable for arrangement so that no dust escapes into the atmosphere in or in the vicinity of the crusher building. If an attempt were made to solve the dust problem in the maquinas of the pampa, it would be found that one of the principal causes of damage to machinery, of dirt and general discomfort would be removed. Health and interest in the work cannot persist for long under the conditions obtaining in the majority of the oficinas.

Criticisms of Methods of Calculating Results Suggested in Donnan Report

If one thing is needed more than anything else in the Chilean nitrate industry it is the simplification of operations at every stage. Much depends on a quick and

NITRATE CANCHA WITH BELT-CONVEYING EQUIPMENT

SECONDARY CRUSHING PLANT

easy and comprehensible method of stating quantitative results which constitute an important check on operations. Dr. Donnan has incorporated some valuable mathematical calculations in his report, but unfortunately he has beclouded the application of them by the introduction of phrases that need considerable clarification. Thus we have the "nitrate extraction efficiency of the leachers" and the "tank efficiency," the latter being defined as "the percentage of the nitrate contained in the raw material which is obtained in the strong liquor run from the leachers (boiling tanks)." In the first place, "efficiency" is a word that should be used with caution on the Chilean nitrate pampa; in the second place, the amount of nitrate in the "strong liquor run from the leachers" is greatly in excess of that originally in the caliche. What is needed in the technical operations of any process such as caliche treatment is a recognition of the difference between theoretical extraction and actual recovery. The former indicates the amount of nitrate removed, as shown by analyses of caliche and residue; the latter is based on the yield of nitrate in cancha (drying and sacking platform) as compared with the amount sent to the maquina. The best indication of a satisfactory process is evidenced when actual recovery closely approximates theoretical extraction and when it is obvious that accurate sampling is feasible by ordinary methods.

Sampling Methods in Vogue on the Pampa

Dr. Donnan contends that the sampling methods noticed in use on the Chilean pampa usually were unworthy "of the time of Noah's Ark." Personally I think that this is a reflection on the care with which that gentleman selected his cargo. If he followed instructions, the result must have been a creditable example of early sampling, although it is possible that a number of smaller beasts escaped being counted when they rode in that famous two-by-two procession.

The average methods of sampling in vogue in a nitrate oficina operating the Shanks process are such that no reliance can be placed on the accuracy of the results. Many different types of ripio may be discharged to the dump, the nitrate in the portion coming from above the crinolina plates in the cachucho being used invariably as an index to the efficiency of operations. "Because of the difficulty of sampling so unhomogeneous a mass as the material fed to the cachuchos, the impossibility of estimating the tonnage of the various ripios discharged and the wide variation in nitrate content in the individual pieces . . . the actual yield of nitrate usually indicates a loss amounting to twice or even three times as much as the estimate of nitrate in ripio would seem to indicate."[13]

Quantitative Control a Practical Impossibility on the Pampa

In formulating an extensive program of investigations for the research department, Dr. Donnan maintains that every process, "be it good or bad, is under *accurate quantitative control.*" I repeat the italics, but I maintain, in the Shanks process, that though this may be possible theoretically, it is impracticable when considered as an everyday phase of routine duties. Take, for instance, the question of the estimation of nitrate in borra, which is correctly described as a semi-liquid sludge with 16 to 25 per cent of nitrate. The nitrate may occur in small lumps of untreated caliche, as a strong solution, as original or redeposited crystals, as adsorbed salt or associated moisture in contact with colloidal clay and granular sand. This sloppy though valuable mess is usually shoveled into dump cars placed below the discharge doors of the cachuchos. To avoid undue spilling, the cars are loaded only about half full; the borra consists mostly of coarse sand and nitrate crystals in the bottom, with slime pulp and fine sand of varying densities at different levels. Correct sampling and tonnage estimation is impossible. The mass is of varying nitrate content and the car is usually caked with old ripio. The conditions of dumping are dirty and unsatisfactory; if the research department evolves during the day a scheme for the correct estimation of nitrate so discharged, it will be disregarded during the first night shift. To expect intelligent men to maintain enthusiasm over such a job connotes a disregard of the fundamental fact that a so-called leaching process which delivers a residue (*sic*) in such a condition is either being operated badly or is entirely unsuitable for the purpose.

A glance through Dr. Donnan's report will convince one that standardization of weights and measures is unknown on the Chilean pampa. Not only does this involve a pitiable waste of time and labor, but many of the results are valueless for comparative purposes. In few other industries are the advantages of adopting the metric system so obvious; if a research department be formed, the members should be permitted no personal latitude in this respect. Opponents to the metric system often maintain that it is seldom practicable to displace entirely the older units. In Chile it is mentioned that though the metric system may be used for control work, the final record of salitre (commercial nitrate) must be given in terms of the Spanish quintal of 45 kilos. This anomaly, one is glad to note, has now been overcome and the association is quoting all prices per metric quintal of 100 kilos.

Field for Scientific Research

I am, and always have been, a vigorous supporter of scientific research, not hit-or-miss experimentation; but I also believe that much depends on the careful selection of a promising field for investigation in the first instance. The prospective group of doctors of science and philosophy proposed by Professor Donnan might well spend their lives, until the pension age was reached, and their children and grandchildren after them, in obtaining scientifically accurate information about the working of the Shanks process under the varying conditions obtaining in the two hundred odd oficinas on the Chilean pampa, only to confirm existing knowledge—that, in nine cases out of ten, it is hopelessly inefficient.

Thanks to the initiative of the sponsor of the Shanks process in Chile, James (Santiago) Humberstone, the method has well served its purpose; it has enabled the industry to reach a high state of prosperity; and it has been responsible, in no small measure, for Chile's present-day position in the front rank of progressive nations. Conditions, however, are changing rapidly. The beds of caliche remaining untouched must be classed, for the most part, as either too low grade or too refractory for successful treatment by existing methods. In my opinion the best thing that could happen to the industry, except possibly in a few isolated instances, would be for everyone concerned to forget the Shanks process.

[13] Ibid., p. 3.

Improved Automatic Regulator for Pressures Below Atmospheric

By W. A. Jacobs and P. A. Collins*

In the examination of crude petroleum and some of its products, it is frequently necessary to obtain high-boiling fractions that cannot be distilled without decomposition ("cracking") at atmospheric pressure. Dean and his co-workers[1] state:

> The separation of the residue boiling above 275 deg. C. (527 deg. F.) or 300 deg. C. (572 deg. F.) into further fractions of various ranges of volatility can be made without cracking either by a steam or a vacuum distillation. Distillation in the presence of a current of open steam is almost universally used in commercial refining and frequently in the laboratory. In connection with a quantitative analytical method, however, there are numerous complications and it seems preferable to use the scheme of vacuum distillation. Either of these methods accomplishes the same fundamental purpose of reducing the boiling point of the oil. Boiling occurs when the vapor pressure of the oil slightly exceeds the pressure of the atmosphere above it. The temperature at which a liquid boils can be lowered either by balancing part of this atmospheric pressure with the vapor pressure of a current of steam, or by reducing the atmospheric pressure by means of an evacuating pump. The latter method permits easier control and is more suitable in the laboratory.

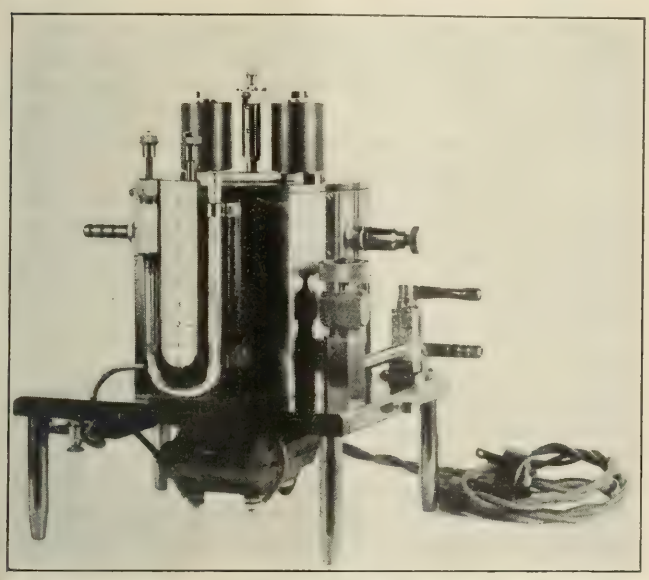


FIG. 1—PRESSURE REGULATOR DEVELOPED BY BUREAU OF MINES

This same bulletin describes the apparatus and methods used in making vacuum distillations, and describes two types of manually operated and one automatic pressure regulator for maintaining a constant "vacuum." The actual pressure used for this class of distillations in the bureau laboratories is 40 mm. absolute, which corresponds at sea level to a "vacuum" of about 28 in.

The automatic regulator described by Dean was entirely successful and has been in use for over 2 years in one of the bureau laboratories. It has, however, been necessary to build additional regulators from time to time, and a number of improvements have been incorporated in each one, so that the latest model is considered much more simple to construct, more compact and neater in appearance, more sensitive and more foolproof than any of the earlier models.

The principal parts of this regulator are a cylinder 4 in. high made of 5-in. brass tubing with sealed ends, which serves as a reservoir, two electromagnets which operate the air inlet valve, a main valve, supplemented by a needle valve, on the tube connecting with the vacuum pump, a 110 to 6-volt transformer, a fixed condenser to prevent "sparking," outlets for connecting to the distillation system and to the vacuum pump, and an adjustable regulating manometer equipped with a movable scale. The adjustable manometer makes it possible to carry on distillations at different pressures at will.

Working drawings of this apparatus have been completed, and its manufacture will probably be undertaken by several of the apparatus supply houses. Fig. 1 shows practically all parts of the apparatus.

Published by permission of the Director, U. S. Bureau of Mines.

*Chemical Engineer, and Instrument Maker, respectively, Pittsburgh Experiment Station, U. S. Bureau of Mines.

[1]Dean, E. W., Hill, H. H., Smith, N. A. C., and Jacobs, W. A., "The Analytical Distillation of Petroleum and Its Products," Bull. 207, Bureau of Mines, page 19.

Patenting Process for Wire

A paper recently read by R. C. Helm before the American Iron and Steel Institute entitled "Use of Liquid Fuel in Metallurgical Furnaces," contains some interesting information on the so-called patenting process used to soften and toughen wire before drawing it through dies, and the kinds of furnaces usually installed for performing the operation.

"Old process" patenting is effected in a continuous furnace in which the rod or wire is heated to 1,700 deg. F., then cooled in air. In "double lead patenting" the rod is passed through a lead bath heated above the critical, and immediately passes into another at a temperature just below the critical. The latter scheme gives the strict temperature control necessary for high-carbon material.

Older coal-fired furnaces were made of massive brickwork to act as a heat reservoir so that variations in firing would have less effect on the metal. Long narrow furnaces were used; the flame passed lengthwise from end to end, then back through an upper compartment, escaping at the fire end. Wire or rod was threaded through small perforations in the fire arch, as shown in the sketch, Fig. 1.

Less coal is burned if the wire passes through the upper compartment, bathed in the waste gases. When using oil fuel the lower compartment may be flared out from the burner, and the hottest portion of the furnace is then at the end discharging the wire.

Double lead patenting is done in furnaces of the same general type. The high-temperature pot is placed over a perforated arch at the end of the furnace farthest from the burner. Spent gases travel back again above the fire arch in opposite direction to the cold wire as it enters, giving it a preheat before it enters the pot. The second or cooler pot is placed just beyond the furnace and is heated largely by the hot wire entering it. A quenching furnace has a bath of cold oil in place of the second lead pot; hardened wire then passes into a separately heated oil bath to draw the temper.

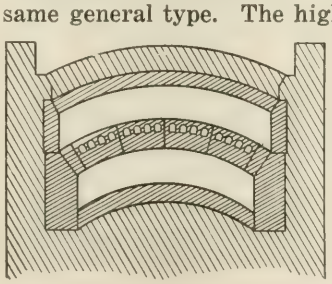


FIG. 1—CROSS-SECTION OF COAL-FIRED PATENTING FURNACE

Trademarks

What Is a Trademark?—Brand Marks Versus Names of Products—Why Select a Word for a Trademark Which Cannot Be Exclusively Appropriated?—Why Undermine One's Business Good Will by Using a Trademark as the Name of a Product?

By Clayton L. Jenks
Patent Attorney, New York City

STRANGE customs are growing up in the advertising field which unless checked will either store up future trouble or require a modification of our trademark laws and a reversal of our court precedents. The difference between a trademark and a name of a product seems to be misunderstood not only by chemists who should know how to protect their marketed discoveries but even by many advertising and sales men who originate trademarks and are supposed to be their foster-parents. How many people can analyze and define the trademark rights involved in the following well-known words: Aspirin, Bevo, Castoria, Cascarets, Celluloid, Coca Cola, Coffee, Colgate's, Corn Flakes, Elgin, Fatima, Featherbone, Ivory, Kodak, Linoleum, Lux, Lysol, Mazda, Mazola, Pantasote, Postum, Pyrex, Pyroxylin, Quaker Oats, Resinol, Sapolio, Shredded Wheat, Singer, Vaseline? What is a trademark?

A tribe of Indians acquired a fancy for a certain brand of cove oysters put up in cans which bore on the label a picture of a dog's head. Being uneducated denizens of the prairie and unfamiliar with the taste of sea food near its native habitat, they have always believed that this particular delicacy was canned dog, and woe unto anyone trying to palm off other brands for their beloved dog!

Absurd as such an interpretation seems, a large number of educated people are similarly using trademarks as names of products and deliberately undermining their own businesses. Why did "linoleum" change from a valuable exclusive trademark asset to a mere common name of doubtful value? In the average popular magazine, on the street cars, everywhere, one sees advertising built around some special word which either is inherently unfitted for use as a trademark or, originally being a good trademark, is improperly used. Why is it that many a business good will is built upon quicksand when rock foundations are freely available? There is a surprising amount of ignorance as to the function of a trademark, and yet the whole subject is based upon a few simple fundamental principles which should not be ignored.

Origin and Function of Trademarks[1]

From the time of the Neolithic age there has been a strong necessity for identifying particular manufactured goods. The stones of the walls of Pompeii and pottery found in Egypt, dated from 6000 to 1200 B.C., have borne crude illustrations of horns, trees, jugs, bees, animal heads, etc., which were used as trademarks. It is interesting to note that similar trademarks found in Greece, Upper Egypt and Hungary have indicated a common civilization around the Mediterranean long before Egypt acquired a civilization of its own. A jar of fish sauce found in Pompeii bears the inscription "Scaurus' tunny jelly, Blossom Brand, put up by Eutyches, slave of Scaurus." Note the use of the proprietor's name as well as the special trademark "Blossom."

As that particular tunny jelly sold in Pompeii, or the Damascus sword blade or a clay brick made in Moses' time became known for especial merit, naturally the purchasing public demanded some identification mark on the goods so as to know whether the salesman was trying to substitute something "just as good" for the original satisfactory product. Likewise, the maker of the jelly, the sword or the brick realized the advertising value in getting the public to look for his mark and ask for his goods; hence from the beginning of trade, other than in local bartering, there has always been a reason for using a trademark.

Use of Marks Explained

In early times the maker could not write his name and customers could not read it, hence the peculiar mark put on the sword blade or the brick served as his signature for identification purposes. Moreover, it indicated that goods so marked were of his best workmanship and that he was not ashamed of them. Naturally, if he were making poor products he would attempt to sell them by surreptitious methods.

We today have the same method of branding, particularly on goods such as nails and small tools, which are not capable of carrying long names or elaborate picture designs. However, the main difficulty with wordless marks is that the purchaser has no ready name for the mark and so must see the goods for identification and point them out to the salesman. Obviously, this tongue-tied system has its drawbacks. Hence such symbol marks are more ordinarily used in association with words, such as the peculiar mark found on the end of the cracker package put out by the National Biscuit Co. which is labeled "In-er Seal." Similarly the brand of evaporated milk which bears the picture of a bird carries the name "Eagle" so that one may not mistake its identity.

Ordinarily a word is used without illustration and it is in this use of words alone that our modern difficulties largely arise. The purchaser of Eagle condensed milk knows that he is obtaining the milk of cows. Similarly a buyer of Star soap knows that it is not of stellar origin. On the other hand the average person may not know that Aspirin is not the chemical name of the product and that the material is in reality "acetylsalicylic acid." It is this use of the trademark as the name of the product, due to the manufacturer's failure to provide a satisfactory name or to the public's indifference or its inability to understand correct trademark usage, that works the greatest harm.

A trademark is a part of the intangible good will which the public holds toward a business person,

[1] These historical data were derived from Rogers on Good Will, Trade-marks and Unfair Trading, published by A. W. Shaw Co. of Chicago. This book gives a clear non-technical exposition of the subject and is well worth reading.

whether individual or a company, who makes or sells a branded product. It is the first and main duty of an advertising man to build up and safeguard this good will. The owner of the business should know whether that good will is being injured or fostered. The prime purpose of advertising is not to obtain an order here and there, but it is to educate the public as to the use and advantages of a new article and the manufacturer's business service, to arouse a popular interest in both the company and its goods, and to create a potential friendliness or good will which ultimately results in prosperous business. A trademark from this viewpoint should be the most prominent part of the advertising, which is meant to remain clear in the mind of a potential purchaser. The latter is not supposed to remember all the virtues of a particular trademarked article, but if he acquires a good impression from reading the advertisements, he subconsciously carries that good impression intertwined in his mind with a word which is prominently displayed, whether it is the trademark or some other word. That word should be the trademark.

Haphazard Choice of Mark

When a patented article is first put on the market, and particularly a chemical product, the organizers of the company may appreciate dimly the advantages in having a good trademark; yet they may carelessly select some word which cannot be registered or they may deliberately misuse a registrable word as a mere trade name under the delusion that the name will always be their exclusive property. Unless a careful preliminary study of the trademark situation is made, many and serious difficulties may arise in later protecting the business good will.

It is a common occurrence for a new trader in the field to go to the expense of adopting a trademark only to find that he is infringing another's rights and is subject to an injunction stopping his business and to an accounting of his profits. Not only should the utmost care be taken to insure having a proper word which does not infringe and using it correctly, but one should, as far as possible, test the psychological effect of the use of the word upon a large number of persons representing the purchasing public and otherwise endeavor to determine its advertising advantages.

As a serio-comic illustration of the possibilities for trouble inherent in a trademark, the American name of an automobile proved unpopular in Spanish countries during the early days of the industry, when automobiles were both a novelty and a menace. Upon investigation it was found that the translated name meant "criminal"!

It is a common error for a new trader to choose a word which describes the article or its advantages. If the product is a new shaving soap, he may decide to call it "Heavy Lather," or if a razor, "Fast Shaving." Or, weakly following the custom in his particular art, he may mall a floor covering "Baboleum," indirectly suggested by the popularity of "Linoleum." In the latter case, thinking possibly that Baboleum is the name of his floor covering, because Linoleum is a name, he sticks a blue label on the back of the rug and misguidedly advertises for the public to "look for the blue label," totally failing to realize that there is little trademark value in any such spot of color and that whatever the public retains from reading such advertisements or seeing such labels is centered, not around the blue color, but around the main word "Baboleum."

Such a manufacturer is headed toward trouble. Some competitor, realizing the strides of this first man's business, may decide that he too must market a "heavy lather soap" or a "fast-shaving razor" and he puts out competing products and so uses the same words to describe his goods as to draw a share of the trade. The first man, taking his aggrieved feelings into court, finds to his surprise that he cannot monopolize any such description as "Heavy Lather" or "Fast Shaving"; and the court merely mildly enjoins the competitor from unfair practices, but leaves him open to the free use of such descriptive words. Then all that is left to the first man is his own business name, which may not have been emphasized in the advertising and which will now cost a large sum to get it properly before the public.

The word "Aspirin" as found on a drug used to mean that the material so labeled was made by the Bayer Company. The court has, however, recently decided that the trademark word was a common name so far as concerned the retail trade, so that a druggist might sell "Aspirin" of any company's make under that name. As a result the original users of the mark were obliged to undertake a campaign to advertise the name "Bayer" and ask the public to "look for the Bayer Cross" made up of the two words "Bayer" arranged in a cross shape on each tablet. Why was this trademark "Aspirin" thus thrown into the public domain?

Trademark—A Common Law Right

It is difficult to understand why the originators and users of a trademark do not appreciate the value of a word mark capable of being monopolized or why they are so shortsighted as to build up a trademark only to lose it. A trademark should last as long as the business lasts. Perhaps such people have vague dreams that a descriptive word such as "Fast Shaving" for razors or a mere dictionary name might be retained exclusively in their business, but common sense considerations should teach them otherwise. Trademarks are founded not so much on a large body of laws and decisions, which indeed there are, as upon ordinary everyday common sense, and the function of the court in the average trademark dispute is merely to apply that same judicial common sense.

A patent is a right granted by the government under which a monopoly for 17 years is obtained for excluding others from making, using or selling the product of an inventor's brain. The monopoly ceases at the end of the period and the public thereafter has full rights to the invention. Similarly, an author or artist may obtain a copyright monopoly giving him the sole right to publish or make copies of his work for a limited time. Patents on inventions and copyrights on writings and paintings are monopolies created by law. A trademark, however, implies that there is no monopoly and that the mark is used to distinguish the goods of one maker from similar goods of a competitor. There is no monopoly except in whatever rights a user has to the trademark itself.

A trademark is a designating symbol or word which stands as a short signature of a manufacturer, as a means of indicating the origin or ownership of goods, as a memory guide to which the public attaches its good will for a particular make of goods, and at times as a sign of quality and guarantee of the trader's good will toward the public. One chooses a trademark, therefore, to identify his own goods and differentiate them from those of his rivals.

A trademark is not a government-granted right. It

is a common law right. It is a squatter's right, an explorer's right. He who first penetrates a new land unclaimed by others, under the law of all time, is entitled to that land. This is a fundamental principle embodied in the very make-up of the human being. Similarly, when a person adopts a trademark, he is pre-empting and claiming exclusive rights to a field never before occupied; but let him see that there are no adverse claims to his field when he enters it and that the public be not allowed to trespass later. Therein of course lies his danger.

Two Classes of Trade Words

With these principles in mind, it is now seen that a partial answer to our main question is that there are two classes of words used as trade symbols: (1) technical trade or brand marks; and (2) trademark names.

A genuine technical brand mark is easily picked out. These are the words which truly indicate the origin of the goods and stand as a short signature for the manufacturer's or trader's name. For example, Old Dutch Cleanser, Eagle milk, Quaker oats, Lysol disinfectants and soaps obviously comprise strong brand-marks.

The term "trademark name" is used herein in a narrow sense to indicate that class of trade words which are used as names of products, but which have trademark functions and indicate the manufacturing or sales origin of the goods. A name of a product, unless it has trademark qualities, is not registrable, or if it has been registered may be later removed from the official records, when it no longer serves as an exclusive designation of origin. Originally, linoleum was a trademark. It was used as a trademark name. Now it is a mere common dictionary name without trademark value.

A further class of words relate to a business and its good will rather than to a particular commodity. Such trade names as company names may become of great value, but unless they are registrable as exclusive trademarks, they serve but poorly to protect one's business. If the company name has been arbitrarily coined, it may ordinarily be maintained as an exclusive mark; but if it is a common name like Baker or Rogers, the difficulties involved in keeping all other Bakers and Rogerses out of the same field are formidable, as has been the case in connection with the use of these names in the chocolate and silver industries, respectively.

When a new chemical is discovered, it is given a name, like the name of a basic element, and this name is necessary for the public to use in referring to that particular material. Everyone has full rights in using that name and no one may use it as an exclusive trademark. On the other hand, a trademark is supposed to identify a particular business and certain goods of a trader, and not to apply to similar goods made by one's competitors. Unfortunately, many chemical manufacturers in marketing a new and unnamed product do not provide both a name and a trademark but economically try to make one word do for both. It will not do! Remember that a trademark is the signature of a person and not the name of an inanimate object. A trademark name has not all the characteristics of a trademark; hence the public or a competitor may some day tear down whatever good will lies in that word and use it merely as a common dictionary word descriptive of a product made by anyone.

We shall not attempt to point out the strong as distinguished from the weak trademark names, as the distinctions are very fine, and some of the weak ones may yet be reclaimed before it is too late. How this can be done after one has let competitors into his trademark field is not the purpose of this article. Suffice it to say that the way is rough and stony.

Trademark names should be considered from two viewpoints, depending on whether they are applied to patented or unpatented products.

Patented Products

When the original makers of "Linoleum" floor covering marketed this product, they coined an arbitrary word to designate it and theoretically had a good trademark. They had, but they did not use it as a trademark exclusively. This floor covering was a new product, and patented so that no one else could make it. Instead of adopting a separate descriptive name by which the public might differentiate it from all other flooring materials, the makers chose to use their exclusive trademark "Linoleum" as a trademark name and the sole name of the product. When the patent expired and others had a right to make the flooring material, they had no other name for this material and naturally adopted the same word "Linoleum," merely stating that this was "Smith's" or "Jones'" Linoleum instead of the product made by the original Linoleum company. The court upheld this state of affairs, holding that since there was no common name for the material which the public could use, it had a right to take the name which had heretofore been considered a trademark by its owners and use such name in a descriptive sense to name the flooring material; but competitors of course were obliged to make it clear to the public that they were not the original company.

Following this decision the courts have thrown into the public domain such trademarks as "Castoria," "Singer," "Featherbone," "DeLong" (hooks and eyes), "Webster" (dictionary) and "Aspirin."

In the Castoria case, the court held that the name Castoria as first used by Dr. Pitcher may have been indicative of the manufacturer—i.e., have trademark functions—during the life of the patent, yet when the right to manufacture and sell the compound became universal anyone might call his compound of the same formula by the name Castoria. It should be particularly noted that "Castoria" was used by Pitcher for 10 years after his patent expired before the second man adopted it, nevertheless the court held that this matter of time made no difference. Since the word had become the name of the thing and public property, it could not thereafter be reclaimed as a trademark.

In connection with the Singer Sewing Machine, it was decided in an opinion rendered by the late Chief Justice White that the name "Singer" indicated to the public a class and type of sewing machines and so was generally descriptive. The court, however, held that while others might use the name Singer if they made the identical Singer machine, nevertheless this right was subject to the condition that the name must be so used as not to deceive the public into mistaking the second manufacturer for the original Singer company.

Similarly, copyrighted names are subject to seizure by the public; as decided in the famous Webster Dictionary case. During the term of the copyright the proprietor has a monopoly of the book as well as the name, but both name and book pass into the field of public right when the copyright expires. However, it is to be emphasized that the court endeavored to protect

the G. & C. Merriam Co., the original publisher of the Webster Dictionary, by holding that the word had acquired a secondary trademark meaning by the public's acquiescence; hence *prima facie*, the second man was not entitled to use the word except under rights which were secondary to those of the Merriam company. That is, he must neutralize any false impressions which might be created and unmistakably inform the public that the book is of his own publication and not that of the Merriam company. The courts therefore place the burden upon the second man and not upon the first user of the trademark to distinguish between the two makes of goods.

It may, however, be stated as the law of the English-speaking nations that a trademark which is used as the name of a patented article will become public property when the patent expires, if such word is the sole name by which the public has come to know the patented article. It is of vital importance that manufacturers understand this theory of trademark usage. Anyone checking up the advertising in the average popular magazine or cards in the cars will find a great many trademarks which are going headlong into the public domain. Some advertisers are so kind to the public as to place their patent dates on the trademarks, telling when the patents expire! The failure of advertising managers and salesmen to understand this danger is appalling, considering the immense sums of money which they are expending in building up such trademarks, merely to have them taken away by a competitor when their patent rights are gone.

Unpatented Articles

As to the unpatented products, the courts have attempted so far to protect the trademark names applied thereto, but Lord Kay in his famous summary of the law of names has stated that if the maker of an unpatented article has slept upon his rights and permitted the name to be used by others until it has become public property, the court will not interfere. Moreover, it is difficult to say how far away is the day of reversal of the former lenient attitude of our courts and legislatures. Attempts have already been made to destroy many valuable trademark rights. For example, as a result of the German chemical situation, a bill was introduced in Great Britain in November, 1917, to amend the trademark laws. This bill, which was sponsored by such prominent men as Lord Parker, a leading judge, and Sir Albert Stanley, President of the Board of Trade, provided that a word trademark used as the name of an article should be removed from the Register of Trademarks. The chief reason underlying this bill was that if a trademark were used as a name it thereby gave a perpetual monopoly of a business so that it would be impossible for competitors to get on the market unless they could use these same household trademark words. In their panic the British misconstrued the nature and function of a trademark and proposed to go back to harsher rules than ever before applied and they even extended their ill will to cover well-known American trademarks. The protests from this country and the final calm judgment of British business men and attorneys ultimately killed that portion of the bill. It was considered that, with due regard to business ethics and fair play, every new man in the field should build up his own trademark and not attempt to profit by the advertising good will of the earlier competitors. We have, however, no guarantee that such a hostile theory of trademark usage may not some time be enacted into law. Small manufacturers are likely to back trademark legislation which penalizes any large manufacturer, and anti-trust laws may go to the extent of declaring our well-known trademark names to be public property.

This British belief concerning the monopolistic nature of a trademark business—this does not refer to the monopoly in the word itself—seems to be echoed in the minds of many American advertising men—i.e., if they use a trademark word as the sole name of a product, they thereby acquire a perpetual monopoly in that product without regard to their short-lived patents. But in their overzealousness they defeat their own ends. Peculiarly, they do not appreciate the fact that a trademark properly used is a perpetual right, and they strive to attain something even greater than a trademark, which will give them not only a trademark monopoly but a perpetual quasi-patent monopoly as well. The fallacies underlying their beliefs are clear. First, there is no perpetual monopoly in a trademarked business, since obviously if the original makers should change their product and put out an inferior grade, or, as is more likely, if some new product appears which tickles the popular fancy, then competition must be faced and new trademarks will rapidly come to the front and undermine the original business. In the second place, the use of the trademark as a name negatives the idea of monopoly, since a name belongs to the public and does not primarily indicate the origin of the goods. As the advertising of a trademark name progresses, the more familiarly the public uses it; hence the more popular the mark the more insecure are the trader's rights in it.

It must not be understood from the above discussion that trademark names will not be protected by the courts. On the contrary, our courts will go a long way toward helping a man out of his difficulties by ascribing a secondary trademark meaning to a trade name. Moreover, one may perfectly properly decide to use a trademark as a name and he will be protected from unfair competition and the unethical practices of competitors trying to capitalize for their own benefit the advertising good will which the first man has built up. Many well-known trademark names are so valuable that it would be a harsh court indeed which would throw such words open to the public; yet we have the "Aspirin" and "Linoleum" cases as warnings that a trademark name, however popular it may be, may under certain circumstances be legally held to be a part of the public domain.

An analysis of the trademark situation for a manufacturer about to enter the chemical field may resolve into the question as to whether he can obtain greater commercial advantages by using his trademark as a name or by using it purely and solely as a brand mark for a described product. The answer should come easily. Merely by describing his product, giving it a name and using his trademark as a brand mark, he can protect the business good will. Why, if it is so easy to do the thing right, should one wish to take chances? It is not ordinarily difficult to describe a product, however complex its composition and structure may be. The public does not demand and in fact does not want a detailed description of the goods it purchases. For example, "Pepsodent" tooth paste bears the phrase "pepsin-bearing tooth paste" as the name of the material. This undoubtedly is sufficient description, since a chemical analysis of the actual ingredients present is

of no interest to anyone but competitors, who can make their own analyses.

The point is: Use some kind of a descriptive name to describe your goods so that the public will not think that the trademark is a mere name and so seize it for its own use. Surely, one's advertising campaign is as effective and the popularity of the goods as easily assured if the goods are identified by a proper trademark instead of a trademark name. No one can gainsay the popularity of such well-known brand words as Ivory and Fairy for soaps, Gold Dust for washing powders, or Fatima for cigarettes. These are proper trademark words and are clearly not the names of products.

If one but remembers the customary usage of trademarks as built up from the beginnings of trade and use the words as brand marks which specifically identify and distinguish one man's goods from another's, he cannot go far wrong. To furnish such identification, the trademark word must be carefully selected so as to be capable of exclusive use and then its user should fight with all his powers to keep competitors out of his domain, and to educate the public to know that such trademark always stands for a particular line of goods and as a synonym for the trader's name.

RÉSUMÉ

A trademark is a brand mark, a short signature, a mark serving to identify the maker and the origin of the goods. It is not the name of a product. It is one trader's brand of that product and should be used to distinguish his goods from another's. A trademark implies competition, not monopoly. It distinguishes between competing goods. Why try to use a personal signature as the name of an inanimate object?

Legal Notes

BY WELLINGTON GUSTIN

Decision on Chemical Control Act Not Reviewable

In a recent case the Court of Appeals of District of Columbia has upheld the ruling of the Secretary of the Treasury of the U. S. on his interpretation of the dye and chemical control act, approved May 27, 1921, saying that the Secretary has the implied authority to interpret the act because that is necessary to the performance of his administrative duty. This act operates to extend a privilege to manufacturers of certain chemicals and their substitutes, and Congress rightfully fixed the conditions under which the privilege should be enjoyed, one of which was that the Secretary of the Treasury should administer the act.

FUSEL OIL HELD NOT TO COME UNDER ACT

The provision in dispute was title 5 of the act, which reads: "No synthetic organic drugs or synthetic organic chemicals shall be admitted to entry or delivered from customs custody in the United States. . . . unless the Secretary [of the Treasury] determines that such article or a satisfactory substitute therefor is not obtainable in the United States . . . in sufficient quantities and on reasonable terms as to quality, price and delivery," etc.

The Secretary issued an order on Sept. 30, 1921, that fusel oil should not be considered to be a synthetic organic chemical within the meaning of the act and that permits for its release from customs custody were not required.

Exception to this order was taken by the Commercial Solvents Corporation. This company manufactures, at its plant in Indiana, butyl alcohol, which it claimed could be used, and was in fact being used, by practically all of the former users of fusel oil as a satisfactory and efficient substitute for that oil. It contended that fusel oil is a synthetic organic chemical and that its entry into the United States is prohibited by the act, since the corporation's plant had ample capacity to manufacture a satisfactory substitute for it and is able to supply all the needs and demands for such oil, and offers the same for sale at a reasonable price, and on even and equal terms with all purchasers, having regard for the quantities of their purchases, any difference in price being merely sufficient to equalize the difference in the cost of selling in large or small quantities. It also alleged that, if the Secretary of the Treasury should permit the importation of fusel oil in accordance with the order mentioned above, the company would sustain great loss and damage. Hence the company came into court to obtain an injunction forbidding the Secretary to give any instruction to any Collector of a Port of the United States permitting the importation of fusel oil except in the special cases provided for in the act. The Supreme Court of the District of Columbia refused the injunction and the Commercial Solvents Corporation appealed.

SECRETARY'S DECISION NOT REVIEWABLE

The corporation alleged that various importers and would-be importers made representations to various bureaus and officials of the Treasury Department to the effect that such oil is not a synthetic organic chemical; that these representations were considered by such officials as Chief of the Dye and Chemical Control Section, Chief of the Customs Division and Secretary of the Treasury. Further it alleged that the Secretary decided that fusel oil was not a synthetic organic chemical and that its importation was not prohibited by the act. It also alleged that this decision, made after the consideration just mentioned, was not correct and asked its reversal on the assumption that the court has the right to exercise its independent judgment with respect to the facts set forth in the bill and decide the case on its merits—in other words, that the court has a right to substitute its judgment for that of the Secretary, if it thought he was wrong, even though he was acting within his jurisdiction when he rendered his decision.

The Court of Appeals upheld the lower court in its holdings. The authority given to the Secretary by the dye and chemical control act to administer that act carries with it the implied authority to interpret it, because interpretation is necessary to the performance of his administrative duty. Nor can the courts review, by mandamus or by injunction, a decision of the Secretary of the Treasury, made within his jurisdiction, to interpret the chemical control act, if he did not act in a capricious or arbitrary manner. The Chemical Solvents Corporation did not charge or contend that the Secretary acted in a capricious or arbitrary manner, and it has been established in other cases that whether the Secretary's decision be right or wrong, that is not the question. It is his duty to decide as he thought the law was and the courts have no power whatever under those circumstances to review his decision.

Determining Combined Nitrogen in Iron and Steel

By Louis Jordan and F. E. Swindells
Chemist and Assistant Chemist, Bureau of Standards

THE only form of nitrogen ordinarily determined in steel is that combined as nitride, either of iron or of some of the other constituents. Tests for the presence of hydrocyanic acid or cyanogen on solution of steel in acid have been negative[1] and all the combined nitrogen is generally regarded as being present as nitrides. It is readily conceived, however, that part of the nitrogen present is not combined, but is either dissolved, adsorbed, or mechanically held. Iron, manganese or silicon nitride may be present in an ordinary steel; others are possibilities in alloy steels.

Allen Method for Combined Nitrogen

The usual method for the determination of combined nitrogen in steel is a modification of that employed by A. H. Allen[2] in 1880. Allen dissolved the sample of drillings or millings in hydrochloric acid of specific gravity 1.11. When solution was complete, it was made alkaline with lime, the ammonia distilled off and determined with Nessler solution. H. Braune[3] employed this same method, but specified that the solution should be filtered before distilling. He also used caustic soda in the distillation instead of lime.

In the 1918 edition of Blair's "Chemical Analysis of Iron and Steel" the Allen method is given with several modifications made by Langley, chiefly in the treatment of the caustic soda solution with a copper-zinc couple to remove nitrates and nitrites. Boussingault[4] had called attention to the fact that nitrates and nitrites during distillation were partly reduced to ammonia by the ferrous hydroxide present.

Another method for the determination of the ammonia in the distillate was proposed in 1907 by Petren and Grabe.[5] This consisted in collecting the distillate in standard sulphuric acid, the excess acid being determined by the addition of potassium iodide-iodate solution and titration of the liberated iodine with standard sodium thiosulphate solution. Hurum and Fay[6] have recently recommended the iodide-iodate modification of the Allen method for nitrogen determination.

In 1915 Tschischewski[7] studied the Allen method and made several improvements. He used standard sulphuric acid to collect the distillate containing the ammonia and titrated the excess acid with standard alkali. He had previously objected to the use of the Nessler method for the determination of the ammonia in the distillate because of the probable presence of amines.[8] He also pointed out the probability of error from alkali dissolved from glass condensers, and warns against unprotected rubber stoppers in the distillation apparatus if the Nessler method is employed.

As has been stated by Tschischewski, the size of the blank correction in this method is greatly influenced by the kind of condenser tube employed. Tests made at the Bureau of Standards with glass condensers have given after blank runs an amount of alkali in the distillate equivalent to 0.0001 to 0.0002 gram of nitrogen. The same solutions used in blank determinations with block tin condenser tubes have given only 0.000015 gram of nitrogen. The high blank with glass condensers is, however, quite constant and satisfactory duplicate results are obtained by carrying out two determinations on a given steel using a glass condenser for one and block tin for the other.

However, the correction for glass condensers is larger than is desirable when it is considered that the combined nitrogen found by this method in a 5-gram sample of steel lies between 0.0002 and 0.0007 gram.

Errors From Nessler Solution

A series of bessemer steels was analyzed for combined nitrogen and the ammonia determined by both the acid-alkali titration and by the Nessler colorimetric methods. Except in the case of the 0.1 per cent carbon steel, the Nessler method gave lower results than the titration method. The difference between the two values—i.e., the error in the Nessler determination—became greater the higher the carbon. Results of these analyses are shown in Table I.

TABLE I— OMPARISON OF TITRATION AND NESSLER METHODS

Bessemer Steel Samples

Approximate Per Cent Carbon	Per Cent Combined Nitrogen — Titration	Titration Average	Nessler	Nessler Average	Excess Titration Over Nessler
0.1	0.0133				
	0.0126		0.0132		
	0.0123	0.0127			
0.2	0.0105		0.0090		
	0.0107	0.0106	0.0097	0.0094	0.0012
0.4	0.0112		0.0100		
	0.0115	0.0114	0.0098	0.0099	0.0015
0.6	0.0094				
	0.0095	0.0095	0.0076		0.0019
0.8	0.0120				
	0.0117				
	0.0111				
	0.0117	0.0116	0.0093		0.0023

Many texts on the analysis of iron and steel give the Allen method with the Nessler solution, but these results indicate that in steels containing 0.2 per cent carbon or over titrimetric methods should be used.

Solution of Samples

Solution of the steel or iron is effected in a small covered beaker heated on a steam bath. A number of determinations were made in which the solution was carried out in a closed vessel and the evolved gases led through a bubble-tube containing hydrochloric acid, a procedure often recommended. Both portions of acid were then combined and the ammonia determined in the usual manner. No higher results for nitrogen were obtained than when the sample was dissolved in a beaker (Table II).

TABLE II—COMPARISON OF METHODS OF SOLUTION

Sample	Evolved Gases Not Washed in HCl. Per Cent Nitrogen	Evolved Gases Washed in HCl. Per Cent Nitrogen
Bessemer steel.....	0.0121	0.0123
	0.0125	0.0126
Electric arc weld-metal		
A- 8	0.135	0.132
A-10	0.122	0.119

Low results for nitrogen are, however, often obtained if solution is made in a beaker heated over a gas burner,

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[1] H. Braune, *Stahl und Eisen*, vol. 26, p. 1359 (1906).
[2] A. H. Allen, *J. Iron and Steel Inst.*, vol. 40, p. 181 (1880).
[3] H. Braune, *Chem. Centralblatt*, 1904, II, p. 1167.
[4] Boussingault, *Z. anal. Chem.*, vol. 1, pp. 112-4 (1862).
[5] Petren and Grabe, *Stahl und Eisen*, vol. 27, pp. 1700-1 (1907).
[6] T. Hurum and H. Fay, *Chem. & Met.*, vol. 26, pp. 218-22 (1922).
[7] N. Tschischewski, *J. Iron and Steel Inst.*, vol. 92, II, pp. 47-90 (1915).
[8] N. Tschischewski, *Stahl und Eisen*, vol. 28, I, p. 397 (1908).

on a hot plate, or on a sand bath instead of on the steam bath as described above.

METHOD USED BY THE BUREAU[9]

It was at first thought necessary to prepare special ammonia-free hydrochloric acid for dissolving the sample, but it was later found that a fresh bottle of concentrated acid of the c.p. grade diluted with ammonia-free water to a sp.gr. 1.11 usually gave a sufficiently low blank determination. The sample of steel or iron 5 grams in weight (unless known to be very high in nitrogen[10]) is dissolved in 50 c.c. of this acid. While the solution is taking place, 30 c.c. of sodium hydroxide solution, prepared as directed by Blair and Langley,[11] one or two pieces of mossy zinc and 400 c.c. of distilled water are placed in the distilling apparatus. This distilling apparatus consists of a 1-liter Erlenmeyer flask connected with a condenser whose block-tin inner tube is bent downward at its upper end as shown in Fig. 1. The alkaline solution in the flask is then boiled until 200 c.c. has distilled over. This distillate is discarded, the contents of the distilling flask are permitted to cool slightly and the solution of the steel sample is introduced through a separatory funnel in the stopper of the distilling flask. The solution of the sample is not filtered. The beaker in which the solution of the sample took place and the separatory funnel are rinsed into the distillation flask with three 50 c.c. portions of ammonia-free water. The contents of the flask are then boiled until 200 c.c. of distillate is collected in 25 c.c. of 0.01 normal sulphuric acid. The adapter at the end of the condenser should dip into the acid or be connected with a receiver of a type which causes any escaping gas to bubble through it.

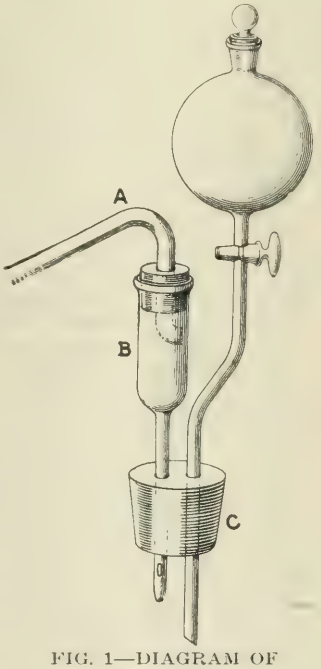


FIG. 1—DIAGRAM OF CONNECTIONS
A—Block tin tube.
B—Carbon filter funnel.
C—Flask stopper.

After distillation is complete, the excess of sulphuric acid is titrated with 0.01 normal sodium hydroxide, using as an indicator one drop of a 1 per cent aqueous solution of sodium alizarine sulphonate. The end point is the complete disappearance of the clear green color or the first indication of brown. This method of determining the ammonia in the distillate is much superior to the method involving the use of Nessler solution, and probably as convenient and accurate as the iodide-iodate method.

A review of the properties of some of the nitrides possibly present in the steel indicates that iron nitride is readily and completely decomposed by dilute acids with the formation of ammonia.[12] Aqueous acids and alkalis have little effect on silicon nitrides[13]; fusion with alkali is required to convert their nitrogen to ammonia. Manganese nitride is decomposed slowly by water and more readily by acids[14]; it is rapidly decomposed by hot caustic alkali solutions with the formation of ammonia. Aluminum nitride is completely decomposed by hot alkaline solutions.[15] Titanium nitride is insoluble in dilute acids but is decomposed in boiling potassium hydroxide solutions.[16]

Therefore, the nitrogen determined by the solution method is probably chiefly that present as iron and manganese nitrides. If the solution of the sample is not filtered before distillation, it is possible that nitrogen present as aluminum or titanium nitrides is also converted to ammonia by the boiling alkali solution during distillation. Nitrogen dissolved, adsorbed, or mechanically held in pores or blowholes will not figure in the result.

Removal of Sulphur From Illuminating Gas

The use of coals of the central coal-mining district for gas manufacture, owing to their relatively high sulphur content, makes the purification of gas for domestic and industrial uses an increasingly difficult problem. In fact, with the gradual exhaustion of the choice low-sulphur coal beds, gas purification is becoming generally more of a problem to the gas industry. Commercial hydrated oxide of iron, the commonly used purifying agent, varies widely in its quality as a gas purifier.

No completely satisfactory laboratory methods for the evaluation of oxides now exist. The Bureau of Mines is co-operating with the American Gas Association in the effort to perfect testing methods and to learn more concerning the effects of different chemical and physical conditions on the properties of hydrated iron oxide in use for gas purification. Among the conditions affecting the use of oxide studied during the present year are moisture temperature, iron content and sulphur content of oxides, and hydrogen sulphide content of the gas to be purified. A report covering the results of these studies is now in preparation.

American Fertilizers Popular in Italy

The use of chemical fertilizers in Sicily has shown a marked increase during the past few years, and American products of this class have always enjoyed a ready sale and a good reputation, according to a report to the Department of Commerce from Consul Nathan. Approximately 140,000 tons of sulphate of ammonia is consumed annually, of which 50 per cent is supplied by domestic manufacturers (north of Italy), and the remainder is imported from the United States, Great Britain and Canada.

Nearly 180,000 tons of superphosphates is used. Italian manufacturers, enjoying a large advantage in the matter of competition because of their close proximity to the sources of raw material at Tunis and Algiers, supply three-quarters of the total, and America, Belgium and Egypt supply most of the remainder.

The price of citrate of lime in Italy has been fixed for the seasons of 1922 and 1923 at 600 lire per 100 kilograms.

[9] Essentially the Allen method with modifications, chiefly those by Tschischewski (See Note 7).

[10] For alloys containing 0.1 per cent nitrogen 2-gram samples are used. With still higher nitrogen content, as in nitrogenized iron, the acid solution of the metal is diluted with ammonia-free water to a known volume and aliquot samples are taken which contain nitrogen equivalent to not more than 25 c.c. of 0.01 normal acid.

[11] A solution of 300 grams of sodium hydroxide in 500 c.c. of water is digested at 50 deg. C. for 24 hours over a zinc-copper couple.

[12] J. Fowler, *J. Chem. Soc., Trans.*, vol. 79, pp. 285-99 (1901).

[13] L. Weiss and T. Engelhardt, *Z. anorg. Chem.*, vol. 65, pp. 38-104 (1909).

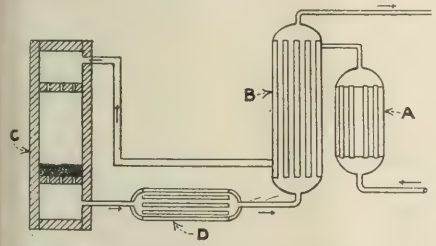
[14] G. C. Henderson and J. C. Galletly, *J. Soc. Chem. Ind.*, vol. 27, p. 387 (1908).

[15] S. A. Tucker and H. L. Read, *Trans. Am. Electrochem. Soc.*, vol. 22, pp. 57-65 (1912).

[16] O. Ruff and F. Eisner, *Ber. deuts. chem. Ges.*, 41, p. 2252 (1908).

Recent Chemical & Metallurgical Patents

Production of Nitrogen Oxides From Ammonia by Catalysis—A cut is herewith reproduced, showing an apparatus in which this process is carried out. The ammonia-oxygen mixture passes through heat exchangers *A* and *B*, where the incoming gases are heated to approximately 200 deg. C. They then enter a reaction chamber of considerable size before the hot gases come in contact with the catalyst. This space is usually as much as a meter long. The contact mass in chamber *C* then oxidizes the mixture and the gases leave at a temperature approximately 750 deg. C.



They are cooled off in chamber *D* to about 400 deg. C., and then are used to heat the incoming gases in the first heat exchanger. The essential features of this process are, first, the use of the gases produced in the reaction to preheat the incoming gases, and second, the large capacity of the reaction chamber linings of the preheaters and reaction chambers are of such materials that they will not induce a premature catalytic action. Such metals as copper, iron and magnalium are avoided. The author seems to prefer non-metallic linings, such as fireclay, heavy magnesia and the like. The advantages of this apparatus are, first, the more complete oxidation, due to the elimination of inhibiting action before the catalyst is reached, and second, a very efficient use of the heat generated in the reaction. (1,426,952. Karl Bosch, of Ludmigshafen, Germany, assignor to the Badische Anilin und Soda Fabrik. Aug. 22, 1922.)

Apparatus for Washing Insoluble Powders—P. W. Prutzman, of Los Angeles, assignor to the General Petroleum Corporation of California, has developed a washer for insoluble powders which embodies the following principles: First, the powder is placed in a conical bottom tank and solvent is pumped up through the tank. Near the top of the tank is a screen, through which the solvent is permitted to go, but which in turn keeps back the particles of solid material. The solvent, after passing through the screen at the top of the tank, overflows and is pumped back into the tank again, entering at the bottom of the cone. Thus the solvent circulates upward through the powder to be washed. The solvent may be replaced by another portion of clean solvent, the old solvent being used in another similar washer on unwashed material. Finally, after successive portions of solvent have been used, the mass is dropped into a pulp tank, where it settles out. (1,426,099. Aug. 15, 1922.)

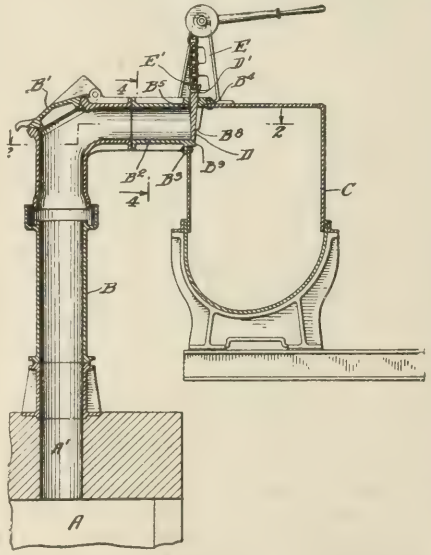
American Patents
Issued Nov. 21, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,435,930—Production of Sodium Sulphate.
1,436,094—Coke Oven.
1,436,095—Coke Oven.
1,436,096—Coke Oven.
1,436,097—Coke Oven.
1,436,098—Coke Oven.
1,436,164—Titanium Pigment.
1,436,179—Production of Cyanamid.
1,436,180—Converting Cyanamid to Urea.
1,436,196—Gas Purification system.
1,436,230—Separation of Magnesia From Lime.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Collecting Main for Coke Ovens—The invention shown in the accompanying drawing consists of a new design for a cut-off valve between an individual ascension pipe from a coke oven and a gas-collecting main serving a battery of ovens. This consists of a slide or damper valved as used on many types of ovens, but located to operate in a vertical plane instead of in a horizontal plane, as was formerly the practice. Due to the construction of this valve



and its seat, as shown in the drawing, it tends to cut away the deposits of hardened pitch and carbon which always form at this point, thus insuring the proper seating of the valve when it is hammered home. (1,433,634. Charles V. McIntire, assignor to Louis Wilputte and Alice A. Wilputte. Oct. 31, 1922.)

Improved Sulphite Pulp Process—A modified sulphite cooking liquid for which is claimed the advantages of producing a finer fiber and one which is capable of being easily bleached and easily hydrated and from which the waste liquor can be easily recovered is described in a specification taken out by George A. Richter, of Berlin, N. H., and assigned to the Brown Co. A cooking liquor is prepared by passing gaseous sulphur dioxide through a 3 to 5 per cent solution of sodium sulphate until the resulting acid solution contains free sulphurous acid from 2 to 7 per cent. The sodium sulphate is reduced by this treatment to sodium sulphite and sulphuric acid is formed. The inventor assumes that as the cooking progresses sodium sulphite is used up in neutralizing free organic acids formed by the hydrolysis of the cellulose. This unbalances the reversible reaction and brings about the formation of more sodium sulphite, which is in turn able to react with more free organic acids. Thus progressive decomposition continues until the cooking operation is complete. In this way the sodium sulphate present in solution acts as an available source of sodium, which may be transformed into an active constituent represented by sodium sulphite. Experience has demonstrated that the concentration of sulphuric acid resulting from this progressive supply of sodium sulphite is not sufficient to injure the cellulose fiber resulting from the cooking process.

The waste liquor from the process is collected in a suitable tank and is neutralized with sodium carbonate and is then evaporated and concentrated and then burned in an oxidizing atmosphere so that the sulphate is recovered in the same form in which it was previously used and is thus ready to be used again.

The advantages claimed for the process are that it is possible to produce a cooking liquor by passing the sulphur dioxide through a clear solution rather than through a milky suspension, thereby eliminating the trouble encountered in handling such suspensions; its advantage over calcium bisulphite liquor lies in the fact that any sulphate formed by the action of sulphur trioxide in the burner gas will not produce insoluble calcium sulphate. It is also claimed that the process produces a pulp of better color and greater strength than the average unbleached pulp by the calcium bisulphite process. The ease of recovery of the sulphate from the waste liquor is of course an added advantage. (1,427,125. Aug. 29, 1922.)

Desulphurizing Gas—A process which consists in first passing the gas through charcoal, then adding to it at least the required amount of oxygen for oxidizing the hydrogen sulphide and passing the mixture through active charcoal is patented by Alwin Mittasch and Max Schumann, of Badische Anilin und Soda Fabrik. (1,430,920. Oct. 3, 1922.)

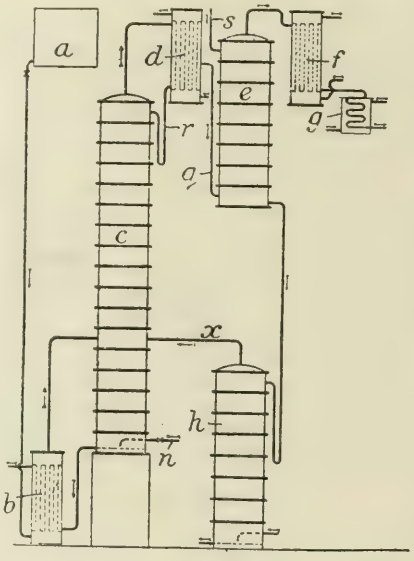
Complete Gasification Apparatus—Sir Arthur McDougall Duckham in this patent describes a complete gasification process which consists in a combined vertical retort and water-gas machine. Several of the retorts are superimposed on a single water-gas generator so that the coke is discharged directly from the retorts into the water-gas generating space. The retort is heated externally during the blow period by the blast gases and during the gas-making period by burning a small portion of the water gas in the heating flues around the retort. The remainder of the water gas made passes through the coal which is being coked, also contributing to the heat for carbonization. (1,428,421. Arthur McDougall Duckham, London, England. Sept. 5, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Inks and Paints—Inks and other pigmenting and like compositions for printing, duplicating, etc., comprise as the vehicle for the coloring matter an emulsion or emulsoid in the form of a plastic solid, of which the yield value (defined as the finite pressure it is necessary to apply before any flow through a capillary orifice takes place) is materially greater for the emulsion than for its components, the yield value of the components being, for example, zero. The composition may have the property of breaking down when brought into contact with paper or other porous material, one of the components being absorbed thereby. One of the components may be an oleaginous material, such as Yorkshire grease, wool fat, wool wax or adeps lanæ, a wax such as Japan wax or beeswax, or a soap insoluble in water, and the other component may be water, the components being emulsified with or without the use of emulsifying agents. The water forms the internal phase, and preferably acts as the sole solvent for the coloring material, which must be of such a nature as not to break down the emulsion or reverse the relationship of the phases. Pigments such as graphite, which are selectively wetted by the external phase, may also be used. The oleaginous material may be mixed with a thinning agent. A thickening agent such as gum or starch may be dissolved in the water, but the addition of a substance to delay evaporation is unnecessary. A salt of a polyvalent metal may also be added. Three examples are given, as follows: (1) Yorkshire grease is dissolved in a light mineral oil and the solution incorporated with a 10 per cent solution of nigrosine in water; (2) aluminum stearate is treated with a light mineral oil and emulsified with a 5 per cent solution of nigrosine in water; (3) a mixture of turkey red oil, glycerine, and castor oil, with a pigment such as graphite, lamp-black or hydrated alumina, is emulsified with water. (Br. Pat. 183,513. A. de Waele, London. Sept. 20, 1922.)

Dehydrating Alcohol—In preparing alcohol of 98 to 99 per cent strength, alcohol vapors are brought into contact with glycerine, which acts as a dehydrating agent. The glycerine preferably flows down a rectifying column up which alcohol vapors are passed. In a continuous apparatus, alcohol of 92 to 93 per cent strength passes from a tank *a* through a preheater *b* to a column *c* heated by steam injected through a pipe *n*. The vapors from the top of the column are partly condensed in a condenser *d*, the liquid condensate from which is returned by a pipe *r* to the column *c*. The uncondensed vapors pass by a pipe *q* to the base of a column *e*, down which glycerine admitted by a pipe *s* passes. The vapors pass from the top of the column to condensers *f*, *g*. Glycerine passes from the base of the column *e* to a column *h*, in which it is treated



with steam to remove alcohol, which is passed as vapor by a pipe *x* to the column *c*. The glycerine is finally treated to separate water and used again. A second specification, 184,129, covers the use of an anhydrous or hygroscopic salt such as calcium chloride, zinc chloride or potassium carbonate as the dehydrating agent. (Br. Pat. 184,036. J. van Ruymbeke, Marseilles, Sept. 27, 1922.)

Fatty Acid Esters—Organic acids, other than polyoxy fatty acids, are converted into esters by the aid of zinc, tin or other metal of the periodic group of which tin is a member. Particular reference is made to the esterification of fatty and resin acids. Fats containing free fatty acids can be neutralized by heating at ordinary or reduced pressure in the presence of tin with the necessary quantity of glycerol or of the mono- or di-glycerides of such acids as caprylic, lauric, myristic, stearic, oleic or erucic acid. According to the example, a mixture of copra oil waste and copra fat acids is heated with glycerine in the presence of tin until the acid value of the fats becomes practically nil, the reaction taking place with exclusion of air first at normal pressure and then under reduced pressure. (Br. Pat. 183,897. P. Haddan, London. Sept. 27, 1922.)

Viscose—To avoid the necessity for the ripening process in the manufacture of viscose and to obtain directly a high molecular product, cellulose, or a near conversion product of cellulose, associated with caustic alkali in a concentration of 15 per cent and upward, preferably 20 to 50 per cent, and in a quantity of not more than two molecules of caustic alkali, preferably one molecule or less, per molecule of cellulose, is treated with carbon bisulphide in a quantity of not more than one-half molecule—for example, one-fifth to one-half molecule—per molecule of cellulose. The treatment with the reduced proportion of carbon bisulphide is conveniently carried out in the presence of benzol or other solvent or diluent for carbon bisulphide. In an example, cellulose is treated with a 20 to 50 per cent caustic soda solution, and the surplus liquid separated so as to leave one molecule of caustic soda to one molecule of cellulose; either immediately or after standing, one-half to one-quarter molecule of carbon bisulphide diluted with benzol is added, and the mixture kneaded; the diluent is eventually separated by evaporation *in vacuo* or by the addition of water. The viscose is soluble in water or in alkali, and may be spun without ripening. When used for the spinning of artificial silk or in the manufacture of films, etc., the following coagulating baths may be employed—bisulphates or mineral acids, or weaker acids such as acetic or formic acids, or stronger acids such as oxalic acid alone or together with such weaker acids, or alkali bicarbonates; in the case of these weaker acids or alkali bicarbonate baths, the temperature of these is preferably raised to 30 to 40 deg. C. (Br. Pat. 183,882. H. Dreyfus, London. Sept. 27, 1922.)

Tungsten—Tungsten powder suitable for the production of lamp filaments is obtained by reducing (in hydrogen) materials called "complex tungstic acid." The materials mentioned are compounds of tungstic acid with silicic and boric acid respectively and are prepared by boiling sodium tungstate with water glass and acetic acid or with silicic acid or boiling tungstic acid and ammonia with silicic acid; or by boiling sodium tungstate with boric acid. In each case the treatment is continued until strong hydrochloric acid does not precipitate tungstic acid. The reaction mixture is in some cases poured into strong hydrochloric acid and an oily layer is separated from which the complex tungsten acid is crystallized. Specification 155,851 is referred to. (Br. Pat. 183,816; not yet accepted. Naamlooze Vennootschap Philips' Gloeilampenfabrieken, Eindhoven, Holland. Sept. 20, 1922.)

Synopsis of Recent Chemical & Metallurgical Literature

Investigation of Soil Absorption

As a rule, considerably less than 5 per cent of the absorptive capacity of a soil is in the unaltered mineral particles, and 95 per cent or more is due to what is known as the colloidal material, says the U. S. Department of Agriculture in a professional paper, "Absorption by Colloidal and Non-collodial Soil Constituents," recently published as Department Bulletin 1,122.

The results given in the bulletin are at variance with some of the older but still prevalent conceptions regarding soil absorption. According to the old notion, the more highly absorptive soils were supposed to contain some specially absorptive mineral called zeolites, but it is now very generally recognized that if definite crystalline zeolites are present at all they are there in extremely small amounts. It was also thought that aside from the absorption caused by organic matter, most of the absorptive capacity was due to the fineness of the mineral particles, and not to the relative amount of surface exposed by these particles. It is now coming to be realized that the highly absorptive inorganic material is not crystalline zeolites but amorphous material such as iron hydroxide, aluminum hydroxide, silicic acid and aluminum silicate gels. The investigations tend to confirm the more modern view of soil absorption and give for the first time an estimate of the amount of absorption due to the colloidal material and to the non-colloidal particles.

Ethyl Chloride in Refrigeration

That ethyl chloride is a very convenient material for commercial refrigeration is the conclusion one draws from a paper by Prof. C. F. Jenkin recently presented before the British Coal Storage and Ice Association. Commenting on this paper in its issue of Oct. 21, 1922, *The Chemical Age* (London) lists the various advantages of ethyl chloride, among which are the following:

It did not attack metals, but it did contaminate mercury. It attacked india rubber, but vulcanized rubber tubing and corks could be used, though they leaked a little. They swelled considerably, but returned to their original size when the ethyl chloride dried off. Pure rubber tape was softened almost to solution. Vulcanite swelled moderately. It caused most woods to swell, but lignum vitæ could be used for valves, etc., when a non-conductor of heat was required. Bakelite was also useful as a non-conductor; it swelled only very slightly.

Liquid ethyl chloride dissolved a small quantity of water, but could be dried by passing it through calcium chloride drying tubes. With water it formed very remarkable ice crystals. Similar crystals formed at the throttle valve in a refrigerating machine if there was any water dissolved in the ethyl chloride, and quickly choked the valve. Ethyl chloride was also a convenient cooling material for use in laboratories; when sprayed on to any object, the temperature is quickly reduced to —20 deg. C. or lower.

For mechanical refrigeration ethyl chloride was very suitable. The vapor compression cycle was the one used. The pressures corresponding to the ranges of temperature commonly required were very low—for example, for a range of ±20 deg. C., the pressures were 19.4 and 3.5 lb. per sq.in. absolute. The type of compressor generally used was a rotary pump. To avoid air leaks all valve spindles, compressor shafts, etc., had to be sealed with glycerine, so that any leakage was of glycerine.

The flammability of ethyl chloride was its most serious drawback. To get over this, various "non-flam ethyl chlorides" had been put on the market in Great Britain. These were mixtures of ethyl chloride with large proportions of ethyl bromide. The mixture was not only non-flammable but could be used as a fire extinguisher. Its properties as a refrigerator were not very different from those of ethyl chloride, but as it was heavier than glycerine special separators were necessary.

Book Reviews

JOURNAL OF THE IRON AND STEEL INSTITUTE, 1922, No. 1. (Volume No. 105). Edited by *George C. Lloyd*, Secretary. Published by the Institute, 28 Victoria St., London, S. W. 1, England. (American Agents: Spon & Chamberlain, 123 Liberty St., N. Y. City.) Price, $9.50.

A great variety of papers is contained in this, as in all recent volumes of the *Journal* of the British Iron and Steel Institute, ranging from the operation of a blast furnace to X-ray studies of crystal structure. Perhaps half the volume could be classed as "practical," the other half as "theoretical."

Blast-furnace practice was discussed in its broad commercial aspects by the president, Francis Samuelson, in his address. D. E. Roberts also presented details of various methods of getting ore, coke and flux from the stockyard to the top of the blast-furnace shaft in a paper entitled "Notes on Blast-Furnace Filling." Another voluminous paper, "Recent Developments in Power Production," excited a deal of discussion, as did also a study of "British Siemens Furnace Practice," by Fred Clemens. The latter comprised a thorough analysis of the operations of a new 60-ton open-hearth furnace; all the observed data are included on log sheets, and the derived conclusions should undoubtedly be studied by all furnace superintendents and designers.

Reactions between gases and the constituents of steel are discussed in three papers by Carpenter and Elam, Austin, and Ehn. The latter restated his views on the influence of dissolved oxides on carburizing and hardening qualities of steel. Several members, while admitting that Ehn had discovered a connection between microstructure and defective carburizing properties, doubted that he had proved trat the trouble was due to dissolved oxides. On the other hand, Portevin was able to duplicate Ehn's "abnormal structures" when carburizing overblown bessemer steel.

Microscopical and thermal studies of austenite and its decomposition products were presented by Hallimond, Honda and Kikuta, Yamada, Belaiew and Whiteley—forming in all a mass of extremely interesting metallographical data on hardened and annealed steel. Westgren and Phragmén also presented a contribution on "X-Ray Studies on the Crystal Structure of Steel." In view of the opinion Dr. Westgren presented in *Chem. & Met.*, vol. 25, p. 641, when discussing the "Slip Interference Theory of Hardening," it is interesting to observe that he now presents evidence to show that martensite has the crystallographic structure expected of extremely minute crystals of alpha iron. He thinks these crystals are of the order of 20 A.u. in diameter, containing only a few hundred atoms, and are on the verge of being totally amorphous. Furthermore, the cubic lattice of both gamma and alpha iron is slightly distended by the carbon in austenite and martensite in a way to suggest that carbon is uniformly distributed as atoms in both constituents. Cementite has also been found to crystallize in the orthorhombic system.

About 150 pages at the end of the book are devoted to notes on current literature. Perhaps 750 references are noted—many of them of course are quite perfunctory, but on the other hand, excellent digests of many important papers can be noted on even a hurried examination. E. E. THUM.

A HANDBOOK FOR ELECTROTYPERS. By *John F. Locke*. 35 pp. Published by the author, Cincinnati, 1922. Price, $1.

The introduction states that this booklet served as a basis for a series of lectures to electrotypers. There is today a large field for the application of the principles of science in both the electroplating and electrotyping industries, and the author is to be commended for his efforts in this direction. It is unfortunate, however, that, perhaps through the desire for simplification, he has made several misleading or inaccurate statements, such as the following: "The internal resistance [of a bath] is reduced by . . . a lowering of the temperature." "The higher its conductivity [of an acid copper bath] the lower the *amount of current* needed." "Boric acid is being used [in a nickel solution] to increase the conductivity of the bath." The presence of these and other errors reduces greatly the value of the book to those who are in need of an accurate presentation of scientific facts and theories in simple language.

WILLIAM BLUM.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

War Department Appoints Chemical Advisory Board

Asks Co-operation of Prominent Representatives of Industry as Aid in Carrying Out National Defense Act

The Assistant Secretary of War, J. M. Wainwright, has addressed a letter to twenty-two prominent representatives of the chemical industry and of technical educational institutions requesting their individual co-operation in an advisory capacity in matters pertaining to the chemical industry which present problems difficult of solution by the layman. The letter points out the desirability of co-operation between the War Department and the industrial interests of the country in preparing for the future defense needs of the nation in carrying out the provisions of the national defense act.

Desirability of Co-operation

The letter is reproduced below:

In carrying out the provisions of the national defense act, with respect to the question of preparation for mobilization of national industries in time of war, I very often find myself confronted with matters regarding the broad field of chemical industry difficult of solution by laymen.

I have conceived the idea of asking fifteen or twenty gentlemen connected with the various activities of the chemical field (industrial, academic and research) to co-operate with me in such matters, assuming that they ought to know what the War Department is doing, or would be interested to the extent of assisting in an advisory capacity.

You, of course, will realize that in carrying out the provisions of the national defense act in the way of preparation for the future defense needs of the nation, there should be co-operation between the War Department and the industrial interests of the country, and I trust that you may see your way clear to permit me to call upon you for advice when the occasion demands.

The representatives of the industries, educational institutions, associations and publications who have been asked to serve on the advisory committee are as follows:

Prominent Men on Advisory Committee

Edgar F. Smith, president American Chemical Society; Henry Howard, vice-president of the Grasselli Chemical Co.; Edward W. Washburn, chairman, division of chemistry and chemical technology of the National Research Council; R. A. Milliken, research professor of physics, California Institute of Technology; V. C. Vaughan, National Research Council; Julius Stieglitz, professor of chemistry, University of Chicago; S. W. Wilder, Synthetic Organic Chemical Manufacturers' Association; C. L. Reese, chemical director, E. I. du Pont de Nemours & Co.; C. P. Townsend, Union Carbide & Carbon Corporation; J. George Lehman, vice-president, Bethlehem Foundry & Machine Co.; H. N. Ott, president, Spencer Lens Co.; John E. Teeple, consulting chemist; M. C. Whitaker, vice-president, U. S. Industrial Alcohol Co.; H. C. Parmelee, editor, *Chem. & Met.;* C. S. Miner, consulting chemist; Charles H. Herty, president, Synthetic Organic Chemical Manufacturers' Association; A. B. Lamb, professor of chemistry, Harvard University; Charles A. Meade, E. I. du Pont de Nemours & Co.; F. G. Cottrell, Nitrogen Research Laboratory; Charles L. Parsons, secretary, American Chemical Society; H. E. Howe, editor, *Journal of Industrial & Engineering Chemistry;* R. B. Moore, chief chemist, U. S. Bureau of Mines.

Engineering Council to Consider Important National Problems

A number of important problems of national as well as technical interest will be considered by the American Engineering Council, the executive body of the Federated American Engineering Societies, at its meetings in Washington, Jan. 11 and 12, 1923. The 12-hour day in industry, topographic mapping, government reorganization, types of government contracts and a wide range of other engineering, political and economic topics will be discussed. The plan for an engineering investigation into the Muscle Shoals situation will also receive consideration.

Tear Gas Effective for Dispelling Mobs

A highly effective method of spraying tear gas has been developed by the Chemical Warfare Service. The new device recently was tried out before police officials in Washington and was so effective that the observers, supposedly at a safe distance, inadvertently went through the experience of receiving a very thorough application of the gas. The representatives of the Police Department are very ready to testify as to its effectiveness in controlling mobs or rioters.

Sugar Refiners Protest Tariff Rate

Extensive Investigations Will Be Necessary to Bring Tariff Commission Data Up to Date

Acting under the flexible section of the new tariff act, an application for a reduction in the duty on sugar has been filed with the Tariff Commission in the name of the United States Sugar Association, an organization said to include in its membership a number of independent refiners in this country who have interests in Cuba. Cuban sugar interests are raising a fund of $70,000 to assist the effort to reduce the duty.

The application was filed by Edward Schoenech, of the law firm of Bond, Schoenech & King of Syracuse, N. Y., as attorneys for the United States Sugar Association, of which H. S. Rubino, of New York, is executive chairman and counsel.

While no specific reduction is asked, the application is understood to set forth that the duty fixed by the new tariff act is fully 1 cent per pound more than is necessary to equalize the differences in costs of production of sugar in the United States and Cuba. The flexible tariff section authorizes the President, after investigation by the Tariff Commission, to change rates of duty not more than 50 per cent to equalize costs of production.

The sugar duty in the new tariff is 2.20 cents per pound, and as Cuba enjoys a 20 per cent preferential on imports into the United States, the effective duty on Cuban sugar is 1.76 cents per pound. Under the emergency tariff, which the 1922 tariff act supplanted, the general duty on sugar was 2 cents per pound, with 1.60 cents per pound on Cuban sugar.

Investigations Necessary

As the data of the Tariff Commission regarding sugar are out of date, considerable preliminary investigation will be necessary before this application is reported to it for action. It probably will be necessary to send an agent to Cuba, and possibly elsewhere abroad, before a report can be compiled. It is not probable that there will be any definite action regarding this petition for several months, and even then the commission might decide that there had been no change in conditions since enactment of the tariff bill with its rates expressing the will of Congress which would justify an investigation.

Students Keep Busy During Vacation

Chemical Engineering Students at University of Michigan Establish Record for Industry During Summer

Statistics compiled by the department of chemical engineering at the University of Michigan show that the policy of encouraging undergraduates to obtain summer employment is approved by the students. Tabulations representing a digest of the survey of summer employment of the present junior and senior classes of chemical engineers at the university show that outside of those who attended summer school, 94 per cent obtained employment of some nature. Of the eighty men who obtained employment, 11 per cent worked in industrial laboratories, 35 per cent engaged in plant work outside of the laboratories, and the remainder obtained employment of a miscellaneous nature.

The university points to this record with pride, as proving a spirit of industry and earnestness on the part of the students and indicating that a great majority of them are paying at least a portion of their college expenses. It is also interesting to note that there appears to be no difficulty for a student to obtain useful employment during the summer months.

Variety of Occupations

A great variety of occupations are represented by the report of the seniors, ranging from specialized engineering work in chemical plants to common laborers and railroad ticket agents. Among the different types of laboratories represented in the report are highway laboratories, dye works laboratories, locomotive works laboratories and automobile plant laboratories. The industries which furnished employment to the students include gas plants, automobile plants, food product plants, metallurgical plants, foundries, telephone companies, alkali plants, condensed milk plants, boiler plants and oil companies.

Not only does this report speak well for the co-operative spirit of the undergraduate but it shows that such efforts by educational institutions will have the support of industrial establishments. Among the names of the companies co-operating to the extent of giving summer employment to these undergraduates are dozens of well-known manufacturers of highly specialized technical products.

Seek Substitute for Carbon Bisulphide as Grain Fumigant

The use of carbon bisulphide as a fumigant of grain has been discontinued by the railroads of the country, except at certain points, particularly Baltimore and New Orleans. The Department of Agriculture is working on a series of tests looking to the development of a more suitable fumigant for grain.

May Distribute Byproduct Gas for Industrial Fuel

The proposed developments by the Alabama Byproducts Co., operating a large coking plant near Birmingham, to lay a pipe line through which byproduct gas could be transported to a number of industrial plants in the eastern section of the city is being watched with interest by the other operators of similar plants in the district. The city commission of Birmingham has been requested to grant a permit for the construction of this pipe line, and it is thought it will grant the request as soon as it has made an investigation.

Every byproduct plant in the Birmingham district is located near an active industrial section. Should the Alabama Byproducts Co. be permitted to lay the gas main to serve industrial plants, it would establish a precedent and make the path clear for the other companies to do likewise.

It is proposed to lay a 12-in. main from the plant to the East Birmingham section, a distance of about 2 miles, along the streets of Birmingham and the roads of Jefferson County. The gas is to be furnished to the Stockham Pipe & Fittings Co. and several other industries. The gas will not be purified and will not be connected with the mains of the Birmingham Railway, Light & Power Co., which takes gas from the Sloss-Sheffield Co. for public service distribution.

Morris W. Bush, president of the company, stated that the gas would be furnished to industrial plants only, and would be furnished them only when a surplus is available.

Progress Made in Reduction of Varieties of Fertilizers

Meetings of fertilizer salesmen with the state agronomists to agree on a policy of pushing a reduced number of high-analysis grades of mixed fertilizers are being arranged in the five states which recently reached an agreement with manufacturers of the Middle West to reduce from fifty-seven to fifteen the analyses being offered for sale in those sections.

Each state, through its authorized soils representatives, is selecting from the list of fifteen the special high-analysis fertilizers best suited to the varying conditions within its own borders. Ohio has selected twelve and Missouri ten. The selection will be explained to the salesmen, with the uses for which each analysis is best suited. The meeting in Ohio has been held, and those in Indiana, Minnesota, Michigan and Missouri, the other states represented in the agreement, will be held soon.

The soil improvement committee of the National Fertilizer Association is preparing stickers and other forms of advertising to make known the selected list for each state, giving the analyses selected by the college station of each state with the proper use for each major crop.

To Investigate Scarcity of White Arsenic

Cotton-Belt Congressmen Ask Action to Insure Farmers Supply of Insecticide

Aroused by complaints of constituents that the price of calcium arsenate has advanced rapidly and that the supply is short at any price, members of Congress from the cotton belt, where the compound has proved to be the most effective insecticide for combating the ravages of the boll weevil, are attempting to launch an investigation.

Two Resolutions Presented

Senator Harris of Georgia has written both the Department of Justice and the Federal Trade Commission asking them to investigate whether there exists a combination to control the price of white arsenic, the base of the insecticide. Representative Wise of the same state has introduced a resolution in the House directing the Federal Trade Commission to report the cost of manufacturing and producing calcium arsenate and whether the production and prices are controlled by any unlawful combination. Senator Smith of South Carolina has drawn a Senate resolution declaring that a crisis exists for agriculture because of the difficulty of obtaining arsenical insecticides and directing the Department of Agriculture, through the Bureau of Entomology, and the Department of the Interior, through the Geological Survey, to investigate the supply of white arsenic and possible development of new sources of supply.

The Secretary of Agriculture has reported informally that the production of white arsenic in the United States last year was below normal and that reports indicate that Australia has contracted for much of the Canadian supply.

There is no tariff duty on white arsenic, this chemical having been continued on the free list at the insistence of Southern Senators.

Georgia Buys Arsenic

The State of Georgia has taken the matter of combating the boll weevil in its own hands and has taken steps to obtain such supplies of calcium arsenate as may be necessary to cover the cotton acreage of the state in the coming season. Negotiations are under way between the Georgia State Department of Agriculture and the Salt Lake Insecticide Co. for these supplies. It is said that the state is planning to take the entire output of this company on contract during the coming season.

Some authorities have been counting on this new production to prevent an extremely high price for calcium arsenate in the spring, but if the entire production is taken out of the market by the State of Georgia alone, there is little chance that prices of calcium arsenate will be depressed to any extent by this production.

Management Problems Before Taylor Society

Papers on Application of Scientific Control to Various Industries Are Read at the Annual Fall Meeting

On Nov. 23 and 24 the Taylor Society held its annual fall meeting in the rooms of the Federated American Engineering Societies, New York City.

The annual business meeting was held on Nov. 22, in connection with an informal dinner at the Café Boulevard. In addition to the election of officers, plans were outlined at this meeting for the work of the society during the ensuing year, including the promotion of the use of budgets for control of sales and production.

The technical meetings occupied two daily and one evening session on Nov. 23 and 24. These meetings covered very thoroughly the application of scientific management and control to various industries, showing how the industry should be organized, how the data should be obtained and how the budgets made up from these data could be applied to effective operation of the industry. Examples were drawn from effective industries such as the Corona Typewriter Co., the Lewis Manufacturing Co., the Joseph & Feiss Co., Day & Zimmerman, Inc., the Hood Rubber Co., the Dennison Manufacturing Co., the United States Rubber Co., the Union Carbide Co., and the Tidewater Oil Co.

The following topics were covered in developing the scheme of the program: The organization and the management of a medium sized plant; statistical compilation and its uses; shaping management to meet developing industrial conditions; master budgets of sales and production; reduction of waste, and the supervision of personnel.

Sales Problem of the Future

The paper on "Shaping Management to Meet Developing Industrial Conditions," given by H. S. Person, managing director of the Taylor Society, was particularly noteworthy. Mr. Person pointed out that the market before industry today and probably for the next decade is a buyers' market. Under this condition the sales problem will be the most critical problem which industry must meet. In the solution of this problem two important phases will stand out: First, the market must be thoroughly analyzed and second, precise co-ordinated schedules of sales, production and finance must be made on the basis of this analysis. After these two phases of the problem have been satisfied, the most complete co-operation within the organization will permit successful operation.

To Study U. S. Potash Plants

The Bureau of Mines has assigned Dr. Andrew Stewart to the work of making a survey of the present conditions of the 88 potash permits outstanding. Dr. Stewart has been studying potash production in this country and its possibilities.

Expect Bill to Authorize Crediting of Reparation Dyes to Army Expense

A joint resolution will be presented in Congress in the near future authorizing acceptance of German dyes and chemicals from the Reparations Commission to be charged against the bill of the United States for maintaining troops on the Rhine, and setting up an agency to distribute these products, according to report in Washington.

The resolution probably will limit the quantity which may be accepted for this purpose and also throw further limitations about the action which will protect domestic producers of chemicals and dyestuffs.

The State Department has retained F. S. Dickson, who was chief of the Dye and Chemical Control Board established to operate the dye licensing system, or embargo, as its adviser in handling this question of reparation dyes.

Dye Strength Regulations

The Treasury Department has under advisement the issuance of temporary regulations for the importation of coal-tar products pending determination of questions of comparability and standard strengths toward which a board is now working. Dye importers have pointed out that until these questions are determined there is danger of confiscation under the new tariff act through erroneous declarations of value and have urged that temporary arrangements be made.

The State Department is considering three plans for the handling of reparation dyes. Each of the plans under consideration contemplates the formation of a board or a commission to be representative of manufacturers, importers and consumers of dyes.

One of the plans contemplates the setting up of this board as a part of the State Department to distribute the dyes. Another would make the board, or commission, independent of the State Department, to which the department would assign its equity in these dyes. Still another plan is that the State Department sell outright to the board, or commission, the dyes allotted to this country.

It is believed that one of these plans will be used as a basis for a draft of a joint resolution which will be submitted to Congress as soon as the necessary consideration has been given the proposals.

Washington and Baltimore Chemists Visit Sugar Refinery

On Nov. 24 about forty Washington chemists joined an equal number from Baltimore and visited the Baltimore plant of the American Sugar Refining Co. This largest and most up-to-date sugar refinery of the world was explained in detail by special guides. At a meeting the same evening an address on the economics and the engineering problems of sugar refining was given by C. L. Huettinger, superintendent and chief engineer of the plant.

Nobel Chemistry Prizes for Soddy and Aston

Two British Physical Chemists Awarded Prizes for Most Important Work in Chemistry During 1921 and 1922

The Nobel chemical prizes for 1921 and 1922 have been awarded to Prof. Frederick Soddy of Oxford, and Dr. F. W. Aston of Trinity College, Cambridge. The Nobel prizes, which are probably the best-known honorary awards for scientific achievements, were founded by A. B. Nobel, the Swedish inventor of dynamite, for the encouragement of men and women who work for the interests of humanity. They are awarded annually for the most important work during the year in physics, chemistry, medicine, physiology, idealistic literature and service in the interest of peace. The prizes average $40,000 each.

Professor Soddy's Activities

Curiously enough, the two recipients were born within a day of each other, Dr. Aston on Sept. 1, 1877, and Professor Soddy on Sept. 2 of the same year, and both have studied under Sir Ernest Rutherford. Professor Soddy, whose name is particularly associated with the study of radio-activity, was educated at Eastbourne College, University College of Wales, and Merton, Oxford. In 1900 he was appointed demonstrator in chemistry at McGill University, Montreal. He was appointed lecturer in physical chemistry and radio-activity at the University of Glasgow in 1904, a post which he retained until 1913, when he left to take up the professorship of chemistry at Aberdeen University. In 1919 he was appointed Lee's professor of inorganic and physical chemistry at Oxford. Among his other distinctions, Professor Soddy has been president of the Röntgen Society and was the recipient of the Cannizzaro prize (Rome) in 1913. He was made a foreign member of the Swedish Academy of Sciences in 1919. He is the author of numerous scientific publications, chiefly on radio-activity, some of his works being "The Interpretation of Radium," "Chemistry of the Radio-Elements," and "Science and Life."

Aston Holds Many Honors

Dr. Francis William Aston's work on electric discharge in gases, mass spectra, isotopes and other physical and chemical subjects is well known. He was educated at Malvern College, Mason College, Birmingham University and Cambridge University. In 1909 he was appointed assistant lecturer in physics at Birmingham University. The following year he entered Trinity College, Cambridge, and studied under Sir J. J. Thomson and Sir Ernest Rutherford at the Cavendish Laboratory. He was awarded the MacKenzie Davidson medal of the Röntgen Society in 1920, and has been secretary of the Cambridge Philosophical Society since 1920. He was recently elected a Fellow of the Royal Society.

Manufacturers Collect Data on Refractory Brick

Questionnaires to Be Sent to All Users of Refractory Brick to Summarize Properties Demanded in Practice

An industrial survey which has for its purpose the uncovering of a mass of information with regard to the furnace conditions which refractory brick must meet in actual service will be conducted by the Refractories Manufacturers' Association in co-operation with committees which have already been appointed in associations of users of refractory brick and with individuals, firms and corporations to whom refractory brick is an industrial necessity. Up to the present, research in refractories, particularly in connection with the manufacture of refractory brick, has been largely confined to laboratory work.

This survey will consume the better part of 2 years and it is hoped that preliminary reports will be made at the end of the first 3 months, the first half year and so on, until the survey is completed. These reports will cover the information which will be gathered by using a rather elaborate questionnaire which will be distributed to consumers of refractory brick in the thirteen industries to which the bulk of this material goes. These include blast furnaces, stoves and connections; open-hearth furnaces and metal mixers; heating, puddling and forge furnaces; cupolas; malleable furnaces; oil refineries; gas plants; glass houses; by-product coke ovens; zinc, copper and lead refineries; boilers; cement, lime and plaster kilns, and kilns for burning ceramic products.

The questionnaire covers temperature and combustion conditions found in the typical furnace, abrasion, slag action, the presence or absence of uncommon furnace gases, spalling conditions, loads, insulation, character of draft, etc. This information will be sought in the industries named and the answers to the questionnaires will be sent to the Mellon Institute of Industrial Research, at Pittsburgh.

When enough information has been received to warrant the issue of a progress report in any single industry, this report will at once be made; it will include a statement of the more general and possibly typical conditions, with data relative to conditions which would properly be considered exceptional in that industry. Meager as these progress reports may be, they will be an important addition to present knowledge.

Conditions Rapidly Changing

Attention has been called to the rapidly changing conditions in many industries, caused by the necessity of obtaining greater production from each unit. To meet these conditions, brick of entirely different characteristics have been developed. In a great many cases no attempt has been made to co-ordinate the changes in requirements with the changes in the refractory material. This has resulted, in many cases, in the use of refractories which, while seemingly well suited for the purpose, did not and could not live up to their reputation. A study of furnace conditions often develops the cause of the trouble; so it is thought that a similar study will develop these conditions in advance of expensive failures.

Every consumer of refractory brick will derive a certain benefit from the successful prosecution of the work described. Wastes will be eliminated, which cannot help but reduce production costs. Intelligent service will follow authentic knowledge of requirements. The whole movement augurs well for the industry which is launching it and for every industry which finds refractory brick a necessary part of its plant equipment.

War Department Offers Sodium Nitrate for Sale

The War Department has called for bids on 25,000 tons of sodium nitrate, stored at Jacksonville, Tenn. Sealed bids will be received at the New York office of the Ordnance Salvage Board, Army Building, 39 Whitehall St., New York, until noon, Dec. 15. The material is offered in lots of 100 tons or more. It is packed in bags.

Week of Practical Instruction in Water Purification Planned in Texas

Arrangements are being completed for a short course of practical instruction for water and filtration plant operators at Dallas, Tex., during the week of Jan. 15, at which time the opening of the new White Rock filtration plant will be celebrated. The course will be under the joint direction of the State Health Department and the Dallas Health Bureau. Such subjects as storing, purification and distribution of water will be discussed by authorities on the topics during the course, and one day will be given over to a complete inspection of the White Rock plant. W. T. Davidson, director of public health, Dallas, will preside at the different sessions. The speakers will include Helman Rosenthal, chemist in charge of the Turtle Creek filtration plant; Robert T. Hill, geologist; C. M. Adams, city chemist and sanitarian; Major W. J. Powell, engineer to the supervisor of public utilities; John W. Everman, supervisor of public utilities; and David Morey, engineer in charge of construction of the White Rock filtration plant.

Personal

H. L. Blackmer has been elected chairman of the board of the Midwest Refining Co., Denver, Colo., manufacturers of refined petroleum products. T. A. Dines, senior vice-president, has been elected president.

Eversley Childs, formerly head of The Barrett Co., has resigned from the Allied Chemical & Dye Corporation and has been succeeded by Charles Robinson Smith, who was long an attorney for and vice-president of the General Chemical Co. Clinton S. Lutgens has been made vice-president of the corporation. Mr. Casey, formerly of the General Chemical office staff, has been made treasurer and Mr. Crisp has been made secretary. J. M. Weiss and C. R. Downs, lately honored by the Franklin Institute for their achievements in research, more particularly for the catalytic oxidation of benzene, and long connected with The Barrett Co., have also resigned.

Albert A. Heimrod, formerly with the Research Corporation, has been appointed chief engineer for the Federal Phosphorus Co. and other Swann interests in Alabama.

P. M. McHugh, of the Dorr Co., has gone to Hawaii on a business trip. He expects to be gone about 6 weeks.

Bernard L. McNulty has been elected president of the Marblehead Lime Co., Chicago, Ill. He was formerly general manager of the Lehigh Lime Co.

W. G. Moncrieff has been elected chairman of the board of the Swan & Finch Co., New York, manufacturer of refined oils, succeeding Henry Fletcher, resigned.

Frank Nickerson, for 9 years connected with the San Francisco office of the Midvale-Cambria Steel Co., has severed his connection with that company to accept the position as southern California manager for the Bethlehem Steel Corporation. About the first of January he will open an office in the Washington Building, Third and Spring Sts., Los Angeles, Calif., for the Bethlehem Steel Corporation, covering all of southern California and Arizona.

Prof. Frederick Soddy, of Oxford, England, and Dr. F. W. Aston, research fellow of Trinity College, Cambridge, England, have each been awarded a Nobel prize, for 1921 and 1922, respectively.

The board of governors of the Synthetic Organic Chemical Manufacturers' Association of the United States has elected H. F. Wilmot technical adviser to the association in matters involving administration of customs duties under the present tariff act. Mr. Wilmot was president and a director of the Tinc Tura Laboratories, Brooklyn, N. Y., and has severed his connection with that organization in order to devote his entire time to his new duties with the association. His office will be Room 1648, Equitable Building, 120 Broadway, New York City.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

In the Upward Swing of the Business Cycle

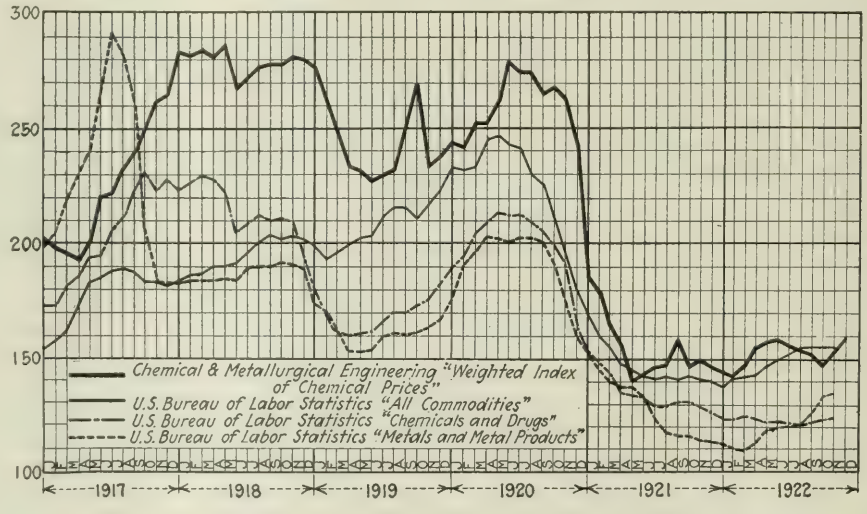
Basic Industries Continue to Gain as Commodity Prices Rise and the Volume of Manufacture Shows Substantial Increase

Forecast: *The outlook for the remainder of 1922 and the first half of 1923 is for rising wholesale prices and an expansion of business activity, with the strong probability of a continuation of the upward swing during the second half of next year. The recovery of business has been very substantial, as shown by the marked rise of the business curve of our index chart since January.*—Harvard Economic Service.

A BROAD SURVEY of present industrial conditions reveals abundant evidence that we are in the upward swing of the business cycle. Ever since the beginning of the year there has been an advancing level of prices together with a substantial increase in productive activity. Starting at first with the basic industries of iron and steel, fuel, building materials and agricultural products, this movement has broadened until at the present time practically every line of business activity has been favorably affected by it. October and November marked almost complete recovery from the labor troubles that had threatened to tie up the transportation and coal supply of the country. Production in the bituminous mines has so far exceeded current consumptive requirements that now we are practically on an even footing with 1921. Car loadings during October were at a maximum and by Nov. 1 the shortage of railroad cars was the largest on record. An expected seasonal decline in revenue freight loadings, however, during the week ended Nov. 8 reduced this shortage to 174,498 cars, a decrease of 4,000 cars. Additional relief during the week ended Nov. 15 reduced the shortage to 153,291 cars, but the transportation situation is still a serious obstacle in the path of further business expansion.

Rising Prices

Following the decline in September there has been a sharp rise in wholesale prices that has affected practically all commodities. The Bureau of Labor Statistics' general index had increased from 138 to 155 during the period January to August. In September lower prices for coal caused the index to drop to 153, but October marked a recovery to 154. Especial strength was shown in the textile, hide and leather, chemical and metal groups. From Oct. 1 to Nov. 1 Bradstreet's index rose from $12.5039 to $13.3482, a gain for the month of 6.7 per cent. This marks the highest level since December, 1920, and is the fourteenth month in the past seventeen that this index has advanced.



THE TREND OF CHEMICAL AND METAL PRICES

During the early months of 1922 the commodities on which *Chemical & Metallurgical Engineering's* weighted index of chemical prices is based showed a more striking increase than was evident for most commodities. The result was that some readjustment took place during the summer months and from its high level of June this index fell steadily during July, August and September. In October it stood at 153.10 and the effects of the tariff had just begun to be felt. During November there was substantial increase and the average for the month was 159.77, the highest point reached since early in 1921.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

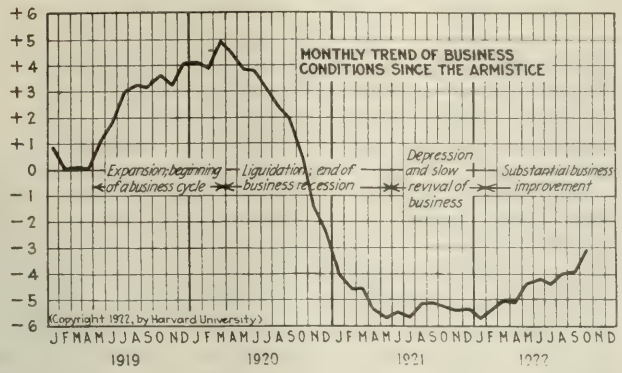
This week	160.60
Last week	162.45
December, 1921	145
December, 1920	245
April, 1918 (high)	286
April, 1921 (low)	140

Included in this index are acetic, citric, hydrochloric, nitric, and sulphuric acids, ethyl and methyl alcohols, anhydrous ammonia, ammonium sulphate, barium chloride, bleaching powder, borax, caustic potash, caustic soda, copper sulphate, formaldehyde, glycerine, potassium carbonate, salt cake, soda ash, sulphur, benzene, aniline, and cottonseed and linseed oils.

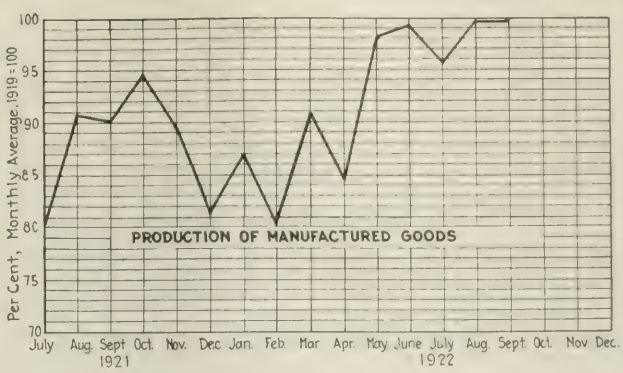
The expanding volume of manufacture has been accompanied by increased employment in industrial establishments. Gains in the total amount of the payrolls in October as compared with September indicated larger earnings for the individual workers. The Department of Labor reports are based on 3,064 establishments in 43 different manufacturing industries employing 1,525,785 workers and paying out $47,051,229 per week in wages. Comparing the figures for October, 1922, with those for identical establishments for September, 1922, there were increases in the number of employees in 29 of the 43 industries. Glass, foundry and machine shops, textiles, iron and steel and chemicals show increases ranging from 5.9 to 4.6 per cent. Strikes in the pottery industry caused a decrease in employment in that industry of 30.9 per cent. Fertilizers, largely because of seasonal character, showed a decrease of 6.8 per cent. Thirty-four of the 43 industries reported increases in their payrolls for October as compared with September. Since the increase in payroll accounts are greater than the increase in numbers employed, it is evident that wages have been advanced or that hours of work have been extended.

The output of pig iron and steel

Trend of business conditions in the United States based on Bradstreet's price index and bank clearings outside of New York as computed by Harvard Economic Service.


MONTHLY TREND OF BUSINESS CONDITIONS SINCE THE ARMISTICE
Expansion; beginning of a business cycle
Liquidation; end of business recession
Depression and slow revival of business
Substantial business improvement
(Copyright 1922, by Harvard University)
+6
+5
+4
+3
+2
+1
0
−1
−2
−3
−4
−5
−6
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1919
1920
1921
1922

Index of the volume of manufacture of steel, lumber, paper, petroleum, textiles, leather, food and tobacco compiled by Federal Reserve Board.



ingots, the consumption of cotton and silk and the output of portland cement all exceeded in October any previous month since 1920. The production of pig iron for October was the largest for any month since December, 1920, and exceeded by more than 200,000 tons the production for July, which was the record month for 1922.

The total production of newsprint in October was 130,682 net tons, as compared with 101,884 tons in October, 1921. This brings the total for 10 months of 1922 up to 1,200,301 tons, or about 188,000 tons more than for the same period of the preceding year.

Stocks of hides and skins at the end of September, the last month for which statistics are available, showed another increase and were the largest since last March. The production of sole and belting leather increased, although less upper leather was made than in August.

Cement production during October was 12,287,000 bbl., a new high record. This compares with 10,506,000 bbl. in October, 1921.

Meltings of raw sugar were somewhat less than in September (280,003 long tons, as compared with 321,909 tons), but nevertheless exceeded those for October, 1921.

The Stock Market Reaction

After security values had a phenomenal rise and the *Wall Street Journal* average for twenty industrials had reached a new high value for the year of $103.43, a sharp decline set in, affecting the common stock of a wide range of companies. Various reasons have been assigned for this reaction, but the one most generally held is that it represents the accumulation of a number of disquieting economic developments. Prominent among these is the situation in Congress and the threatening passage of class legislation such as the ship subsidy, farmers' loans, governmental financing of plans for the distribution of farm products, proposed re-enactment of the excess profits tax, reduction of freight rates and amendments to the Federal Reserve Act. Should such radical measures be enacted into law at this time it is evident that a fatal blow would be dealt to the future improvement of business.

The St. Louis Market

St. Louis, Mo., Nov. 29, 1922.

The firmness of the heavy chemical market during the past few weeks has been further exemplified by several important advances. These have tended toward inducing large buyers to anticipate their future requirements, resulting indirectly in a very active market. Stocks of most important items are very limited and on some items spot stocks are not to be located, while producers report having sold up their production for several months ahead. An easier feeling is observed for imported material, prices having fallen appreciably in some cases. Transportation facilities are somewhat better but are still below normal. It is evident that buyers should give this condition their serious consideration when placing orders.

Alkalis

Only routine business is being transacted in *caustic soda* and prices remain the same. The same may be said about *soda ash*, though more small purchases of ash are being made. Prices on ash are generally steady, though in a few instances they have been slightly shaded. *Bicarbonate of soda* has shown more life recently and prices are firmer than when we last reported. *Sal soda* has been fairly active recently and a number of good-sized less than carload lots orders have been placed. Quotations are as follows: Barrels, $1.65 per 100 lb.; kegs, $1.85; packages, $2 per case.

General and Special Chemicals

The heavy *mineral acids* have not been displaying unusual activity since our last report; however, the demand has been very good for this time of the year. No change in prices has been reported for some time, but the market is firming up quite a bit. Producers of *acetate of lime* have made a further advance in price which has also made a corresponding increase in *acetic acid* and *formaldehyde*, with quite a heavy demand for the latter, particularly in small lots. Supplies of *citric acid* are apparently adequate to meet the present demand, which is only moderate. Large quantities of imported material can be had, but domestic goods are not so free. *Oxalic acid* is reported very active, and the competition from imported goods has been keenly felt by the domestic manufacturers. *Aqua ammonia*, 26 deg., is very quiet, which is not unusual for this time of the year. *White arsenic, powdered*, is quoted at 14c. f.o.b. New York, with no spot goods available, and a further advance in price would not prove surprising. There is no relief looked for for some time, as the domestic production is very limited due to many of the American smelters having curtailed their operations. There has been very little change in the *copperas* situation, the demand still far exceeding the production. Prices have been very firm and no change is looked for in the immediate future.

Sales of moderate quantities are being made on *cream of tartar*, and while *tartaric acid* is generally active, the average sale involved is comparatively small. *Glycerine* has not changed; for some time the price has been firm at 18½c. in drums with a large volume of business being transacted. The market for *yellow prussiate of potash* is apparently devoid of any spot stocks, and for future shipment from abroad prices are being quoted at around 38@38½c. f.o.b. New York. The demand for *sodium benzoate* has kept up unusually well considering the fact that the preserving and canning season has come to a close. *Zinc sulphate* remains very strong, with an extremely large demand. Prices are reported at 3⅝c. per lb. in carlots f.o.b. St. Louis, and at 3¾@4c. per lb. in less than carload lots f.o.b. St. Louis. The *zinc dust* market is very much improved, the product being quoted at 10c. per lb. in carloads, f.o.b. New York.

Vegetable Oils and Naval Stores

Castor oil, after declining to 13½c. in drums, has steadily held its own, and a present active demand would indicate no further decline for some time. Today's quotations for *linseed oil* do not differ greatly from recent reports. Single-barrel lots are being quoted at $1 basis raw oil; 5-bbl. lots at 92c., with the usual differential of 2c. for boiled over raw. *Turpentine* is slightly weaker than previously reported, the market today being $1.52 in 5-bbl. lots; $1.58 in single barrels, a decline of 10c.

On Nov. 20 a general advance in prices on *barytes, blanc fixe* and *whiting* became effective in this market. The largest producer here quotes as follows: *Barytes*, $26@$28 per ton for water ground and water floated material. Water ground and water floated *whiting* sells for $17@$19 per ton. *Blanc fixe* is being sold at $90 per ton. A good volume of business in these items is being reported. *Zinc oxide* is very firm and an advance in price is daily expected. An active market is reported, with prices as follows: Carloads in barrels, lead free, 7¼c.; 5 per cent lead, 6¾c.; 8 to 10 per cent lead, 6¼c. Carloads in bags, ¼c. less. Less than carload lot prices, barrels, ¼c. over carload lots. These prices are ex-warehouse St. Louis.

The Iron and Steel Market

PITTSBURGH, Dec. 1, 1922.

There is no evidence of any decrease in the rate of steel production, which was, in ingots, at the rate of 40,000,000 tons a year in October and probably ran a trifle above that in November. There is an increase of fully 15 per cent over the average rate April to September inclusive, when production was less than the demands of buyers, although it is not certain that buyers would have been as anxious to obtain heavy deliveries if the coal strike had not occurred.

Shipping conditions are far from good, but they permit of shipments fully equal to current production, while only a few producers desire greater facilities for moving coal and coke than have been at their command in the past few weeks. Some consignees are affected by the many embargoes.

The finished steel market as a whole is very quiet in point of tonnage turnover, and indeed has been very quiet for more than a month. Mill operations are based very largely on old orders and interest centers mostly on the question of how long old orders will carry the mills. The Steel Corporation is booked many months ahead in most of its lines. Among the independents, there are heavy order books in tubular goods and a fairly large tonnage in wire products, with a moderate tonnage in merchant bars. In plates, shapes, tin plate and sheets there is not so much business, and in the case of some mills not enough to support the present operating rate fully through December.

STEEL PRICES

A motion is prevalent that finished steel prices are destined for declines in the not distant future. The distinction is not made as clearly as it should be between bars, shapes and plates, in normal times the market leaders, and pipe, wire, sheets and tin plate. The former group, if the market be taken as really established at 2c., are distinctly high, their low point having been 1.35c., early in March. The other products have advanced less in dollars per ton and much less in percentage. The effect of wage advances since March, counteracted in part by reductions in freight rates, represent a net increase in cost of something like $5 a net ton upon finished steel products as a whole.

As to prospective declines, while 2c. is the commonly quoted market on bars, shapes and plates, attractive orders have been going at less in recent weeks, so that a readjustment might not really mean much after all. In sheets and tin plates, the independents have not fully recovered from their disappointment that the price announcement of the Steel Corporation 8 days ago did not involve advances, so that it is no time to predict declines in those quarters. In pipe, there is still great pressure upon mills for deliveries, particularly in the smaller sizes, and the same is true to an extent of nails. Tubular goods may be considered very strong marketwise and wire products moderately strong. Markets are: Wire, 2.45c.; nails, $2.70; blue annealed sheets, 2.50c.; black sheets, 3.35c.; galvanized sheets, 4.35c.; automobile sheets, 4.70@5c.; merchant pipe, 66 per cent basing discount.

The sheet bar market is poorly defined and will not be well established until business comes to be done on a large scale for the first quarter of next year. The usual contract price for the current quarter was $38 Pittsburgh or Youngstown. For a time prompt lots brought $40 readily. Recently there have been sales at various prices, particularly sales by Cleveland producers to Cleveland consumers, at less than $38, but from such sales one cannot compute a market price at the usual basing points Pittsburgh and Youngstown from the awkward circumstance that one does not know whether adding or deducting the freight would be the proper thing. Probably some tonnage of fourth quarter business will have to be carried over on account of buyers not being able to specify in full. A fair guess seems to be that the first quarter market will not be under $33 nor over $35. Billets, which are but lightly traded in, are commonly quotable at the same price as sheet bars.

COKE AND PIG IRON

A week ago it was noted that coke was not running with coal, coke having advanced, while coal had declined. This week coal is at variance with itself. Pittsburgh steam coal is quotable at $2.75 and Connellsville steam coal, probably chiefly Sewickley vein, at $2.25@$2.50, whereas reasonably good byproduct coal is all of $3 and good grades run up to $3.50 at least, Youghiogheny gas coal is at approximately the same range. In normal times the differences between grades are relatively very slight. Connellsville furnace coke for spot or prompt shipments is $7.25@$7.50, but with $8 or more quoted for regular shipment over December, and $8 quoted for first quarter, prices which do not interest furnacemen.

Valley pig iron has continued to decline. Transactions do not run into tonnage, and there are variations between prices in actual sales, suggesting either that buyers do not cover the market ground carefully or consider other circumstances than price, such as quickness of delivery. Some carload sales of foundry iron have required instant shipment. Bessemer iron is offered at $28.50, with scarcely any takers, against $30 quoted a week ago. Basic seems to be available now at about $25.50. There was a sale early in the week at $26 and report, apparently authentic, of a sale at $27.50. Foundry iron can be picked up at $26.50, but some furnaces are getting $27.50 on single carloads, chiefly, no doubt, from consumers accustomed to a certain brand. Prices mentioned are f.o.b. valley furnaces, freight to Pittsburgh being $1.77.

The New York Market

NEW YORK, Dec. 4, 1922.

The chemical and allied markets showed only moderate activity during the past week, due probably to the intervening holiday. The outstanding interest of the week was again centered around the arsenic market and new high levels for the year were recorded. Producers of acetic acid advanced all grades, because of the recent rise in the price of acetate of lime and they report a steady demand from consumers for fair-sized packages. American refiners announced a second advance of 3c. per lb. in camphor, bringing present figures around 96c. per lb. Manufacturers of bleaching powder report a heavily sold up condition at the works and are quoting high prices for early shipments. Prussiate of soda has shown some tendency to ease and prices were somewhat lower during the late trading. Prussiate of potash, on the other hand, was scarce, with the demand very strong for the yellow and red varieties. The alkali market continued along steady lines at the same levels as previously recorded. Export demand was for moderate quantities and came chiefly from Italy and Japan. The domestic demand continued exceptionally active and contracts over 1923 were recorded among leading producers. Barium chloride, formaldehyde, permanganate of potash, bichromate of potash and soda, sodium acetate and cyanide continued along steady lines, with very little selling pressure in any direction.

GENERAL AND SPECIAL CHEMICALS

Alcohol—Leading producers report a fairly active demand from consumers and state that supplies are sold ahead for the remainder of the year. Second-hand stocks have been greatly diminished and competition was less noticeable. Producers quote denatured 188 proof No. 1 formula at 37@39c. per gal. Methanol continued at $1 per gal. in drums for the 95 per cent and $1.03 per gal. for the 97 per cent.

Arsenic—Commercial material recorded a new high record for the year when spot material sold at 15c. per lb. Domestic producers are heavily sold

ahead and importers are experiencing some difficulty in obtaining any appreciable tonnages from Japan or Germany. Shipments have sold up to 14c. per pound.

Bleaching Powder—Producers have been unable to offer any prompt shipments and prices have advanced to $2.25 per 100 lb. f.o.b. works. Consuming demand is quite satisfactory and several contracts over 1923 were reported around $1.90@$2 per 100 lb. in large drums, f.o.b. works.

Carbonate of Potash—Calcined 80-85 per cent was quoted around 6c. per lb. Shipments were held at 5½c. per lb., duty paid. Hydrated 80-85 per cent was very scarce at 8c. per pound.

Caustic Potash—Imported 88-92 per cent material was steady at $6.50 per 100 lb. on spot. Shipment prices were at the same levels as spot goods.

Caustic Soda—Export demand has not shown any noticeable change and leading sellers quoted the market around $3.50@$3.60 per 100 lb., f.a.s. N. Y. The domestic inquiry continued exceedingly strong at $3.75@$4 per 100 lb., ex-store. Contracts over 1923 were recorded at $2.50 per 100 lb., basis 60 per cent, carload lots, f.o.b. works.

Copper Sulphate—Producers reported a very good demand and stated that November, 1922, business was more than double that of November, 1921. The insecticide and agricultural industries are showing inclinations for future requirements. Standard 99 per cent large crystals were quoted at $5.75 per 100 lb., in carload quantities.

Prussiate of Potash—Yellow material was very strong during the early part of the week, but later reacted somewhat. Prices opened around 40c. per lb. and declined to 39½c. Red material was scarce at 95c. per pound.

Prussiate of Soda—The general tone of the market was barely steady and prices recorded a fractional decline. Consumers showed very little desire to purchase any round quantities and resale merchants quoted down to 21c. per lb. for spot goods.

Coal-Tar Products

Dealers in crudes and intermediates reported a steady tone to the market, with supplies in several items heavily sold ahead for the remainder of the year and well into 1923. Among the most important were benzol, cresylic acid, solvent naphtha, salicylic acid and phenol. Producers of salicylic acid announced another increase of 5c. per lb. on the U.S.P. and technical grade.

Benzol—There has been no material relief in this market, even though producers announced increased production. Spot goods remain in very limited supply at 38@40c. per gal. for 90 per cent.

Cresylic Acid—Spot goods are in limited supply and prices are quite firm. Sales of 97-99 per cent material were recorded around 85c. per gal., with 95 per cent goods at 80c. Producers quote unchanged prices for contracts, but report a heavily sold up condition.

Phenol—The market exhibited signs of weakness, due to the sudden advance in quotations. Consumers showed little inclination to purchase at the present high levels and second-hand dealers were eager to book business as low as 32c. per pound.

Aniline Oil—The demand continued along steady lines and sellers' quotations were firm around 16@17c. per lb. Aniline salts also showed a tendency to maintain current figures and were held at 24@26c. per pound.

Beta Naphthol—The technical material is held firm among leading factors at 25@26c. per lb. Consumers have shown greater interest and purchases were for larger packages. The general range is around 24@26c. per pound.

Salicylic Acid—Producers announced an advance of 5c. per lb., bringing present levels for U.S.P. to 40c. per lb. Demand is fairly active and producers report a satisfactory volume of business at the works. Higher costs of raw material were responsible for the late advances.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	.....	$0.39 – $0.45
Acetone	lb.	$0.21 – $0.21½	.21½ – .22
Acid, acetic, 28 per cent	100 lb.	3.50 – 3.60	3.65 – 4.00
Acetic, 56 per cent	100 lb.	7.00 – 7.15	7.20 – 7.50
Acetic, glacial, 99½ per cent, carboys,	100 lb.	14.00 – 14.25	14.30 – 14.50
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	.....	.51 – .52
Hydrochloric, 18 deg	100 lb.	.90 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg	100 lb.	1.00 – 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11¾ – .12
Lactic, 44 per cent tech	lb.	.11 – .11½	.11¾ – .12
Lactic, 22 per cent tech	lb.	.05 – .05½	.05¾ – .06
Muriatic, 20 deg. (see hydrochloric)		.....	.....
Nitric, 40 deg	lb.	.05½ – .05¾	.06 – .06½
Nitric, 42 deg	lb.	.06 – .06½	.06½ – .07
Oxalic, crystals	lb.	.15 – .15½	.15½ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	.....	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	.....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	.....
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	.....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	.....	.....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	.....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	.....	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	.....	.30½ – .31
Tartaric acid, imported, powdered	lb.	.....	.31 – .32
Tartaric acid, domestic	lb.	.....	..... .32
Tungstic, per lb. of WO	lb.	.....	1.00 – 1.20
Alcohol, ethyl (Cologne spirit)	gal.	.....	4.75 – 4.95
Alcohol, methyl (see methanol)		.....	.....
Alcohol, denatured, 188 proof No. 1	gal.	.....	.37 – .39
Alcohol, denatured, 188 proof No. 5	gal.	.....	.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03½ – .03¾	.03½ – .04
Alum, chrome lump	lb.	.05 – .05½	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07½	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.09 – .09½	.09¾ – .10
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07¼
Amylacetate tech	gal.	.....	2.35 – 2.60
Arsenic, white, powdered	lb.	.15 – .15¼	.15½ – .15¾
Arsenic, red, powdered	lb.	.13½ – .14	.14½ – .15
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	95.00 – 100.00	102.00 – 105.00

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate		.08½ – .08¾	.09 – .09¼
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	.....
Blanc fixe, pulp	ton	45.00 – 55.00	.....
Bleaching powder	100 lb.	2.25 – 2.35	2.40 – 3.50
Blue vitriol (see copper sulphate)		.....	.....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		.....	.....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.50 – 3.60	3.65 – 3.75
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	.....	1.40 – 1.50
Calcium phosphate, tribasic	lb.	.....	.15 – .16
Camphor	lb.	.....	.93 – .95
Carbon bisulphide	lb.	.07 – .07¼	.07½ – .07¾
Carbon tetrachloride, drums	lb.	.10 – .10¼	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	.....	.60 – .75
Caustic potash (see potassium hydroxide)		.....	.....
Caustic soda (see sodium hydroxide)		.....	.....
Chalk, precip.—domestic, light	lb.	.04¼ – .04½	.....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	.....
Chalk, precip.—imported, light	lb.	.04½ – .05	.....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05½ – .06	.06½ – .06½
Chloroform	lb.	.....	.35 – .38
Cobalt oxide	lb.	.....	2.10 – 2.40
Copperas	ton	27.00 – 28.00	29.00 – 30.00
Copper carbonate, green precipitate	lb.	.21 – .21½	.22 – .22½
Copper cyanide	lb.	.....	.50 – .55
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.	.....	.25½ – .26
Epsom salt (see magnesium sulphate)		.....	.....
Ether, U.S.P. 100 drums	lb.	.....	.14 – .15
Ethyl acetate com. 85%	gal.	.....	.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.....	.90 – .95
Formaldehyde, 40 per cent	lb.	.14 – .14½	.14½ – .15
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	.....
Fullers earth—imported powdered	net ton	30.00 – 32.00	.....
Fuse oil, ref	gal.	.....	3.00 – 3.50
Fusel oil, crude	gal.	.....	2.00 – 2.25
Glauber's salt (see sodium sulphate)		.....	.....
Glycerine, c.p. drums extra	lb.	.....	.18½ – .18¾
Iodine, resublimed	lb.	.....	4.40 – 4.50
Iron oxide, red	lb.	.....	.12 – .18
Lead acetate, white crystals	lb.	.....	.12 – .12½
Lead arsenate, powd	lb.	.14 – .14¼	.14½ – .15
Lead nitrate	lb.	.....	.15 – .20
Litharge	lb.	.07¾ – .08	.08¾ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07¼
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.	.....	1.00 – 1.80
Methanol, 95%	gal.	.....	1.00 – 1.07
Methanol, 97%	gal.	.....	1.03 – 1.10

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Nickel salt, double	lb.	..... –	$0.11 –$0.11½
Nickel salt, single	lb.	..... –	.12 – .12½
Phosgene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35½
Potassium bichromate	lb.	$0.09½ – .10	.10½ – .10½
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.06 – .06½	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07½ – .08	.08½ – .09
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7.00
Potassium iodide	lb.	..... –	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06½	.07 – .08
Potassium permanganate	lb.	.16 – .16½	.16½ – .17
Potassium prussiate, red	lb.	..... –	.93 – .95
Potassium prussiate, yellow	lb.	.39½ – .39¾	.40 – .41
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .06½	.07 – .07½
Salammoniac, gray, granular	lb.	.08 – .08½	.08½ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07½	.08 – .08¾
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07½	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04½ – .05¼
Sodium chlorate	lb.	.06½ – .07	.07¼ – .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09½ – .09¾	.10 – .10¼
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.60	3.65 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contract	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.08½ – .09	.09½ – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.21 – .21¼	.21½ – .22
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 – 1.30	1.35 – 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04½	.04¾ – .05
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03½ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	..... – .....
Talc—domestic powdered	ton	18.00 –25.00	..... – .....
Tin bichloride	lb.	.11 – .11½	.11½ – .11¾
Tin oxide	lb.	..... –	.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07¾ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.95 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.90 — $0.95
Alpha-naphthol, refined	lb.	1.05 — 1.10
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00½
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70½
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.85 — .90
Benzidine sulphate	lb	.75 — .80
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Cresylic acid, 97%, resale	gal.	.90 — .95
Dichlorbenzene	lb.	.07 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.39 — .41
Dinitrobenzene	lb.	.20 — .22
Dinitrochlorbenzene	lb.	.22 — .23
Dinitronaphthalene	lb.	.30 — .32
Dinitrotoluol	lb.	.32 — .34
Diphenylamine	lb.	.22 — .24
Dipropyl, 97%, car lots, in drums	gal.	.25 — .30
Hexamethylenetetramine	lb.	.54 — .56
H-Acid	lb.	.75 — .80
Naphthylenediamine	lb.	.90 — 1.00
Nitrobenzene	lb.	.08 — .10
Nitronaphthalene	lb.	.95 — 1.10
Nitrotoluene, crystals, in tubs	lb.	.06 — .06
Naphthalene, flake	lb.	.06 — .06
Naphthalene, balls	lb.	$0.07 — $0.07
Naphthionate of soda	lb.	58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12½
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.15 — .17
N-W acid	lb.	1.20 — 1.30
Ortho-amidophenol	lb.	2.25 — 2.30
Ortho-dichlor-benzene	lb.	.17 — .20
Ortho-nitro-phenol	lb.	.85 — .90
Ortho-nitro-toluene	lb.	.10 — .12
Ortho-toluidine	lb.	.12 — .14
Para-amidophenol, base	lb.	1.20 — 1.25
Para-amidophenol, HCl	lb.	1.25 — 1.30
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .80
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.50 — 1.55
Para-toluidine	lb.	.85 — .90
Phthalic anhydride	lb.	.37 — .50
Phenol, U. S. P., drums	lb.	.34 — .35
Pyridine, domestic	gal.	1.60 — 1.75
Pyridine, imported	gal.	1.40 — 1.60
Resorcinol, technical	lb.	1.50 — 1.55
Resorcinol, pure	lb.	2.00 — 2.10
R-salt	lb.	.55 — .60
Salicylic acid, tech., in bbls.	lb.	.35 — .37
Salicylic acid, U. S. P.	lb.	.40 — .42
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.37 — .40
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.20 — .23
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.35 — .37
Toluene, in drums	gal.	.40 — .43
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.45 — .50
Xylene, pure, in tank cars	gal.	.45 — ....
Xylene, commercial, in drums, 100 gal.	gal.	.40 — .42
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.28 — $0.30
Beeswax, refined, dark	lb.	.30 — .32
Beeswax, refined, light	lb.	.34 — .35
Beeswax, pure white	lb.	.36 — .40
Candelilla, wax	lb.	.34 — .35
Carnauba, No. 1	lb.	.39 — .40
Carnauba No. 2, North Country	lb.	.23 — .24
Carnauba, No. 3, North Country	lb.	.17 — .18
Japan	lb.	.15 — .15½
Montan, crude	lb.	.03½ — .04
Paraffine wax, crude match wax (white) 105-110 m.p.	lb.	.04 — .04½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ — .02¼
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼ — .03½
Paraffine waxes, refined, 125 m.p.	lb.	.03¼ — .03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04¾
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ — .04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05¼
Stearic acid, single pressed	lb	.09 — .09¼
Stearic acid, double pressed	lb.	.09½ — .09¾
Stearic acid, triple pressed	lb.	.10 — .10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$6.35	— .....
Rosin E-I	280 lb.	6.45	— .....
Rosin K-N	280 lb.	6.55	— $7.00
Rosin W. G.-W. W	280 lb.	7.75	— 8.25
Wood rosin, bbl.	280 lb.	6.25	— .....
Spirits of turpentine	gal.	1.52	— 1.53
Wood turpentine, steam dist.	gal.	1.35	— .....
Wood turpentine, dest. dist.	gal.	1.25	— .....
Pine tar pitch, bbl.	200 lb.	.....	— 6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	— 12.50
Retort tar, bbl.	500 lb.	.....	— 11.00
Rosin oil, first run	gal.	.43	— .....
Rosin oil, second run	gal.	.51	— .....
Rosin oil, third run	gal.	.53	— .....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist.	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pine wood creosote, ref.	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55	— 3.60
Blood, dried, f.o.b., N. Y.	unit	4.60	— .....
Bone, 3 and 50, ground, raw	ton	42.00	— 44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10	— 3.20
Nitrate of soda	100 lb.	2.47½	— 2.50
Tankage, high grade, f.o.b. Chicago	unit	4.50	— 4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50	— 4.00
Tennessee, 78-80%	ton	7.00	— 8.00
Potassium muriate, 80%	ton	35 75	— 38.50
Potassium sulphate	unit	1.00	— .....

Crude Rubber

Para—Upriver fine	lb.	$0.23½	— .23¾
Upriver coarse	lb.	.17½	— .17½
Upriver caucho ball	lb.	.18¼	— .18¼
Plantation—First latex crepe	lb.	.25¾	— .26
Ribbed smoked sheets	lb.	.25½	— .26
Brown crepe, thin, clean	lb.	.21	— .22
Amber crepe No. 1	lb.	.21½	— .22

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls.	lb.	.12½ —	.13
China wood oil, in bbls.	lb.	.12½ —	.12¾
Coconut oil, Ceylon grade, in bbls.	lb.	.08¾ —	.08¾
Coconut oil, Cochin grade, in bbls.	lb.	.09 —	.09¼
Corn oil, crude, in bbls.	lb.	.10½ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08¼ —	.....
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.11 —	.11½
Linseed oil, raw, car lots (domestic) bbls.	gal.	.85 —	.86
Linseed oil, raw, tank cars (domestic)	gal.	.81 —	.82
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.87 —	.89
Olive oil, denatured	gal.	1.12 —	1.15
Palm, Lagos	lb.	.07½ —	.07¾
Palm, Niger	lb.	.06½ —	.07
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10 —	.10½
Peanut oil, refined, in bbls.	lb.	.13½ —	.13¾
Rapeseed oil, refined in bbls.	gal.	.77 —	.78
Rapeseed oil, blown, in bbls.	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09 —	.09¼

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$650 00	$700.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	60 00 —	80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	16.00 —	20.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24 00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	14.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	14.00 —	20.00
China clay (kaolin), imported, powdered	net ton	40.00 —	45.00
Feldspar, No. 1 pottery grade	long ton	5.50 —	7.00
Feldspar, No. 2 pottery grade	long ton	4.00 —	5.50
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	20 00 —	21.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal.	per ton	40.00 —	.....
Kieselguhr, f.o.b. N. Y.	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00 —	15.00
Pumice stone, imported	lb.	.03 —	.05½
Pumice stone, domestic, lump	lb.	.05 —	.05
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.74 —	.75
Shellac, orange superfine	lb.	.76 —	.77
Shellac, A. C. garnet	lb.	.75 —	.77
Shellac, T. N.	lb.	.72 —	.73
Silica, glass sand, f.o.b. Indiana	per ton	1.75 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2 50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	17 00 —	17.50
Silica, building sand, f.o b. Pa	per ton	2.00 —	2.75
Soapstone, coarse, f.o.b. Vermont	ton	7.00 —	8.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00 —	17.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	net ton	50
Chrome cement, 40-50% Cr_2O_3	net ton	23–27
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	43–46
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	39–41
Magnesite brick, 9-in. straight (f.o b. works)	net ton	70–75
Magnesite brick, 9-in. arches, wedges and keys	net ton	85–90
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	50–53
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	45–47
Silicon carbide refractory brick, 9-in.	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11 —	.11½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.11½ —	.12
Ferromanganese, 78-82% Mn, Atlantic seaboard	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	36 00 —	37.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	70 00 —	72.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.90 —	.95
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, c.i.f. Atlantic seaboard	ton	18 50 —	19.00
Coke, foundry, f.o.b. ovens	net ton	7.50 —	8 00
Coke, furnace, f.o.b. ovens	net ton	7.25 —	7.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	45 —	.....
Manganese ore, chemical (MnO_2)	net ton	75.00 —	80.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	lb.	.06 —	.08
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.11½ —	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.11½ —	.12
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00 —	8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	7.75 —	8 00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 —	3 75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent.	22.00–23.00
Antimony, wholesale lots, Chinese and Japanese	6.50
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	36.00
Lead, New York, spot	7.10
Lead, E. St. Louis, spot	6.95
Zinc, spot, New York	7.30–7.35
Zinc, spot, E. St. Louis	6.95–7.05

OTHER METALS

Silver (commercial)	oz.	$0.64¼
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent.	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	52.00@ 55.00
Mercury	75 lb.	71.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	16.75
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	24.75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@ 8.75
Lead, heavy	4.50@ 4.75
Lead, tea	3.25@ 3.50
Brass, heavy	5.50@ 5.75
Brass, light	5.00@ 5.25
No. 1 yellow brass turnings	5.50@ 5.75
Zinc	2.25@ 2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	$2.90
Soft steel bars	2.80	2.80
Soft steel bar shapes	2.80	2.80
Soft steel bands	3.40	3.40
Plates, ¼ to 1 in. thick	2.90	2.90

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

California

OAKLAND—The Rhodes-Jamieson Co. has commenced the operation of a new plant on the Oakland estuary, near High St., for the manufacture of composition tile products. It is proposed to develop an output of about 10,000 tiles per day. The company has a 5-acre tract to provide for future expansion.

SAN FRANCISCO—The San Francisco Sulphur Co., 624 California St., has filed plans and will commence the immediate erection of its proposed 1-story sulphur-refinery, 137x138 ft., on West Grant Ave., to cost about $35,000. The equipment installation will be arranged at an early date.

FRESNO—The Zellerbach Paper Co., Kern and H Sts., has awarded a contract to Minard & Casteel, 319 Abbey St., for extensions and improvements at its local works to cost about $12,000.

Connecticut

WATERBURY—The Gulf Refining Co., 364 Railroad Hill, will construct a new storage and distributing plant on South 5th St., with oil tanks, etc., to cost approximately $25,000.

Delaware

WILMINGTON—J. C. Rhoades & Sons, 11th St. and the Baltimore & Ohio R.R., manufacturers of leather products, are taking bids for the erection of a 1-story addition.

Florida

TAMPA—The Sulphur Springs Chemical Co. has preliminary plans in progress for the construction of a new plant in the Sulphur Springs section. James Langdon is president.

TAMPA — The Imperial Oil Co., 6006 Branch Ave., recently formed with a capital of $100,000, has plans under way for the construction of a new storage and distributing plant on local site, comprising a number of buildings, tanks, etc. A. M. Allen is general manager.

Iowa

WEST DAVENPORT—The Marquette Cement Mfg. Co., 140 South Dearborn St., Chicago, Ill., is taking bids for the erection of a new building at its local mill to cost about $100,000.

Louisiana

MONROE—The Keystone Carbon Co. has plans in progress for the erection of a new 2-unit carbon black plant on local site. The equipment installation will be arranged at an early date.

ELIZABETH—The Calcasieu Sulphur Co., recently organized under Delaware laws with a capital of $2,000,000, has plans in progress for the erection of a new local mill for the manufacture of kraft and other papers from pine and forest waste. A byproduct plant will be established for the production of turpentine, pine oil, rosin, etc. The initial unit will cost in excess of $150,000. J. F. Carter is general superintendent.

NEW ORLEANS — The Louisiana Celotex Co., manufacturer of fiber board products from sugar cane waste, has plans under way for the erection of two new plant units, to double the capacity of the present mill. The work is estimated to cost about $1,000,000, including machinery. E. G. Dahlberg is president.

Maine

SABATTUS—The Pine Tree State Rubber Heel Co., recently organized with a capital of $200,000, has acquired a local brick mill, and will commence the immediate installation of machinery for a new plant. The initial equipment will provide for a working force of about 40 persons, and this will be increased at an early date to about 150 operatives. Frank W. Hodges and Theodore D. Cowen, both of Malden, Mass., formerly connected with the Converse Rubber Co., of this place, are president and treasurer of the new organization, respectively.

BATH—The Texas Co., 17 Battery Place, New York, N. Y., manufacturer of petroleum products, is reported to have acquired the local shipyard of the Emergency Fleet Corp., and will use the property for a new oil storage and distributing plant.

Maryland

BALTIMORE—The Crown Oil & Wax Co., Pratt and 8th Sts., has plans in preparation for the construction of two new 1-story additions to cost about $13,000. Work will be commenced at an early date. The structures will replace the portion of the plant recently damaged by fire.

BALTIMORE—The Air Reduction Co., 342 Madison Ave., manufacturer of industrial oxygen, acetylene, etc., has plans in progress for the erection of a new plant on East Fayette St., near 11th St.

BALTIMORE—The Colonial Concrete Products Co. has awarded a contract to the John Waters Building Co., 28 East Centre St., for the construction of a 2-story plant addition, 15x100 ft. Theodore W. Pietsch, American Bldg., is architect.

BALTIMORE — The Baltimore Brick Co., Maryland Trust Bldg., will construct five additional kilns at its plants, three to be located at Highland Ave. and Monument St., and two at Loney's Lane and Monument St., estimated to cost about $15,000.

Massachusetts

WATERTOWN — The Hood Rubber Co., Nichols Ave., manufacturer of automobile tires and other rubber products, will soon commence the erection of a 4-story plant addition, to be known as Factory No. 53, estimated to cost approximately $60,000. F. C. Hood is general manager.

NORTH BROOKFIELD—The Asbestos Textile Co. will commence the immediate construction of a new addition, 30x50 ft. J. J. Lang is superintendent.

ACTON — Fire, caused by an explosion, Nov. 18, destroyed two of the mills at the local plant of the American Powder Co. An official estimate of loss has not been announced.

ANDOVER—The Tyer Rubber Co., recently reorganized, is planning for enlargements in its local plant for the production of additional lines of rubber goods, continuing in the manufacture of automobile tires, druggists' goods, etc. Stock has been issued for $530,000. Myron H. Clark is president, and Walter E. Piper, treasurer.

Michigan

MUSKEGON—The Central Paper Co. has commenced excavations for a new mill addition to cost about $200,000, including equipment.

Minnesota

DULUTH—The Universal Portland Cement Co., 210 South La Salle St., Chicago, Ill., is planning for the construction of a new 1- and 2-story mill at its plant in the Morgan Park section, estimated to cost about $235,000, including equipment. R. S. Huey is local superintendent.

Missouri

KANSAS CITY—The Kansas City Oxygen Gas Co., 1805 Grand Ave., is taking bids for the erection of a new 2-story ammonia and nitrate plant, 20x48 ft., at Centropolis Station.

ST. LOUIS—The Brauer Mfg. Co., manufacturer of leather products, has acquired a building at 817-19 North 17th St., for a new local plant. The structure will be remodeled and improved, and equipment installed at an early date.

Nevada

FALLON—The Board of Education will install a chemical laboratory in the new Churchill County High School, for which plans have been completed. Erection will be commenced at an early date.

BELLEHELEN — The Bellehelen Merger Mines Co., operating on a tract of about 75 acres, is perfecting plans for the construction of a new mill, with capacity of 50 tons per day, estimated to cost approximately $125,000. A. E. Strong, Denver, Colo., is consulting engineer.

New Jersey

TRENTON—The Maddock Pottery Co., 3rd St., manufacturer of chinaware, will make extensions and improvements in its local plant. The contract has been awarded to the Karno-Smith Co., Broad St. Bank Bldg.

TRENTON—The Semple Mfg. Co., recently organized to take over the assets of the Semple Rubber Co., defunct, will operate at the former mill of the Sanhican Rubber Co., in the Brookville section. Equipment from the former Semple works will be installed, and production concentrated on rubber tubes and tubing. C. H. Semple is president, and W. B. John, treasurer.

TRENTON—The Empire Tire & Rubber Co., Clinton Ave., will build a 1-story addition 50x90 ft.

BOUND BROOK — The Fischer-Sweeny Bronze Co., 312 Adams St., Hoboken, N. J., manufacturer of bronze, aluminum and other metal castings, has acquired a 1-story building at Bound Brook, totaling about 16,000 sq.ft. of floor space, and will use for a new foundry. It is purposed to concentrate operations at this location, and the present plants at Hoboken and Newark will be removed here.

New York

DUNKIRK—The Atlas Steel Corp. is perfecting plans for extensions and improvements at its local plant, and at its branch works at Charleroi, Pa., to cost in excess of $250,000, including equipment. L. J. Campbell is chairman of the board.

Ohio

SANDUSKY—The Diamond Fertilizer Co., Market St., is planning for the erection of a new 1-story addition to its plant, 100x140 ft.

CLEVELAND — The Cleveland Waterproof Paper Co., 2033 West 106th St., has acquired property on the Berea Road, N.W., near the line of the New York Central R.R., as a site for a new plant for the manufacture of waterproof and mothproof papers. Plans have been prepared and work will proceed at once.

CINCINNATI—The Cincinnati Galvanizing Co., McMicken St., has authorized plans for the erection of a new 2-story plant at Chickering and Spring Grove Aves., estimated to cost about $150,000, including equipment. C. J. Hiefer, 810 Fourth National Bank Bldg., is engineer.

WARREN—The Alloy Electric Steel Casting Co. has work nearing completion on a new foundry for the production of alloy steel castings, and plans to have the structure ready for operation early in the coming year. The equipment installation will include a 15-ton furnace.

SPRINGFIELD—The Fairbanks Co., manufacturer of piano plates and other castings, plans for the rebuilding of the portion of its plant destroyed by fire, Nov. 13, including pattern shop, with loss approximating $50,000, with equipment.

RITTMAN—The Ohio Match Co., Wadsworth, O., has authorized the preparation of plans for the construction of a new plant on local site. Details and estimates of cost will be made at once. Christian, Schwartzenburg & Gaede, 1900 Euclid Ave., Cleveland, are engineers.

Oklahoma

OKLAHOMA CITY—The Kenyon Brick & Tile Co., 2700 West 10th St., has plans in progress for the erection of additional units at its plant to increase the output to about 40,000 bricks per day. At a later date, further extensions will be made to advance the capacity to close to 100,000 bricks daily, with departments for the manufacture of face brick and ceramic tile. Considerable new equipment will be installed. A. W. Kenyon is president.

PERRY—G. T. Braden, Tulsa, Okla., has acquired a local site for the construction of oil refinery, with department for gas production from residual oils. Plans will be prepared at an early date.

PICHER—The Buffalo Mining Co. has tentative plans under consideration for the rebuilding of its milling plant, recently destroyed by fire with loss of about $100,000, including equipment.

Oregon

SALEM—The Oregon Pulp & Paper Co. has awarded a contract to Van Patten & Son, Salem, for the erection of a 4-story,

reinforced-concrete plant addition, to cost about $50,000.

OREGON CITY—The Hawley Pulp & Paper Co. is completing plans for the erection of a complete new plant unit to practically double the capacity of the present mill. It is estimated to cost close to $1,500,000, including machinery. W. F. Hawley, Sr., is president.

GRESHAM — The Columbia Brick Works have plans nearing completion for the construction of a new addition, consisting of a number of buildings, designed to double the present plant capacity. New kilns will be built and new machinery installed.

Pennsylvania

YORK—The Gilbert Wall Paper Co., 728 Linden Ave., Paul C. Gilbert, president, has rejected bids recently received for its proposed new plant, and will have revised plans prepared at an early date. The plant will be 2-story and basement, 85x325 ft., located at State St. and the Pennsylvania Railroad. A power house will also be built. New bids will be called late in January. J. A. Dempwolf, Casset Bldg., is architect.

PHILADELPHIA—The Department of Water, City Hall, is arranging an appropriation of $90,000 for the purchase of chemicals for the waterworks during the coming year.

MARS—The Velte Foundry & Machine Co. has tentative plans under consideration for the rebuilding of the portion of its foundry and pattern shop, destroyed by fire, Nov. 23, with loss estimated at about $40,000, including equipment.

LEWISTOWN—The American Refractories Co., Union Arcade, Pittsburgh, has acquired a large tract of property near Lewistown Junction, and plans for the development of the site for refractory production at an early date.

PHILADELPHIA — The Keystone Chemical Co. has leased property at 24th South Front St. for a local works.

South Carolina

EASLEY—The Easley Oil Mill Co. is said to be planning for the rebuilding of the portion of its local plant, destroyed by fire, Nov. 16, with loss estimated at $30,000, including equipment.

Tennessee

CHATTANOOGA—The Odorless Refrigerator Co., West 1st St., near Pine St., has construction in progress on a 2-story and basement addition, 80x125 ft., to be equipped as an enameling plant. W. H. Sears, 905 James Bldg., is architect. Gaston G. Rauol is president.

Texas

PIONEER—The American Oil Co., Tulsa, Okla., has completed plans for the construction of a new local oil refinery. The first unit will have a capacity of about 2,500 bbl. per day, and will be supplemented with a second unit of like size at an early date. T. J. Ryan is president.

STAMFORD—The Rule-Jayton Cotton Oil Mill Co. has completed plans and will break ground at an early date for its proposed new oil mill, estimated to cost in excess of $80,000.

Virginia

CLIFTON FORGE—Eugene Mathews & Co. are planning to purchase machinery for local clay mining operations, including grinding equipment, driers, etc., for preparing the material for market. Inquiries are being made.

West Virginia

CHARLESTON—The St. Albans Glass Mfg. Co., Massillon, O., has acquired a local plant for a new works. Extensions and improvements will be made to cost close to $30,000. Operations will be inaugurated at an early date. Louis P. Mauger is president.

CHARLESTON—The Owen Bottle Co., 1401 Nicholas Bldg., Toledo, O., is completing plans for its proposed new 1-story plant on local site, 120x200 ft., estimated to cost about $150,000, and will commence work at an early date. It will be an addition to the present plant now operated in this section. The Devore Co., Nicholas Bldg., Toledo, is engineer. E. D. Libbey is president.

PARKERSBURG — The Blackwood Electric Steel Co., recently organized with a capital of $150,000, has plans practically completed for a new local foundry for the manufacture of alloy steel castings, and will break ground at an early date. The installation will include an electric melting furnace. F. S. Blackwood, head of the Farrell-Cheek Foundry Co., Sandusky, O., is president and general manager of the new company.

Industrial Developments

RUBBER—The Goodyear Tire & Rubber Co., Akron, O., has increased production from 20,600 to 21,000 automobile tires per day, and plans to advance this to 26,000 casings daily at an early date.

Stockholders of the Smith Tire & Rubber Co., Passaic, N. J., are perfecting plans to take over the plant from the receiver, William L. Brunyate, at an early date, and will place the works in immediate operation.

The B. F. Goodrich Co., Akron, O., has increased production 2,000 tires a day since the early part of November.

The Boston Woven Hose & Rubber Co., Boston, Mass., is maintaining active production at its plant, with regular working force.

The Carlisle Tire Corp., Stamford, Conn., has closed its local plant, throwing about 135 men out of employment. Lack of orders, owing to the winter season, is said to be the cause

The Firestone Tire & Rubber Co., Akron, O., is arranging for increased production at its local mill. The Miller Rubber Co. and the General Tire & Rubber Co., in this same district, are also advancing their outputs and adding to the working forces.

The Lee Tire & Rubber Co., Conshohocken, Pa., is maintaining full production at its local mill, with regular working quota.

METALS—The United States Smelting, Refining & Mining Co., Salt Lake City, Utah, is increasing operations at its local properties and adding to the working force.

The Keystone Foundry Co., Lebanon, Pa., is placing a new plant addition in service, recently completed, and will develop maximum output in the line of machine molded soft gray iron castings.

The Miami Copper Co., Miami, Ariz., is operating five sections of its concentrating plant, only one section being idle. The plant is now running on about 5,000 tons of ore per day, the production of the local mines.

The American Smelting & Refining Co. has placed its four copper furnaces at Matehaula, San Luis Potosi, Mexico, in full operation, with a total daily capacity of 950 tons of ore.

The Success Mining Co., Wallace, Idaho, is operating with two shifts at its mill, and plans to advance to a full three-shift basis in the near future. Production at the mines is being increased.

The Anaconda Copper Mining Co., Great Falls, Mont., is operating its local electrolytic plant at maximum capacity. It is reported that extensions will be made in the plant for greater output.

The Callahan Zinc-Lead Co., Cœur d'Alene, Idaho, has placed its local mill on a full time, capacity basis.

The Calumet & Hecla Mining Co., Calumet, Mich., is increasing the working forces at its mines and mill. Increased capacity is being developed at the smelter. More than 3,600 men are now employed.

IRON AND STEEL—The Falcon Steel Co., Niles, O., has resumed production on a full time basis at its local bank of 8 mills.

The Replogle Steel Co. has placed the second furnace in blast at its Wharton, N. J., plant, and is operating at the mill at its Scrub Oak mines. Mining operations at the latter point will be commenced at an early date.

The Reading Iron Co., Reading, Pa., is arranging to resume operations at its puddle mill at Birdsboro, Pa., early in December. The plant has been idle for about 24 months past. It is also expected to resume at the Birdsboro sheet mill at an early date.

The A. M. Byers Co., Pittsburgh, Pa., is operating its blast furnace in the Youngstown, O., district, with 70 puddle furnaces, two turns at the bar mill, and one turn at the plate mill.

The Thomas Iron Co., Dover, N. J., has recently completed a new concentrating mill at its Richards Mine, electrically operated, and will have the unit in full service in the near future.

The Inland Steel Co., Chicago, Ill., is advancing production to better than 75 per cent of normal at its local mills, the highest since the coal and railroad strikes.

The United States Steel Corp. is holding at 100 per cent capacity production at its Youngstown, O., plants.

The Weirton Steel Co. has placed its Clarksburg, W. Va., plant on a full capacity basis, with full working force, following a two-thirds output schedule, as operative for some time past.

The National Tube Co., Pittsburgh, Pa., has resumed operations at its local Riverside plant on a full capacity basis, giving employment to approximately 3,000 men.

The Republic Iron & Steel Co., Youngstown, O., has increased operations at its mills to approximately 80 per cent of normal.

MISCELLANEOUS — The General Chemical Co. is operating at its sulphuric acid plant at Pulaski, Va., and plans for the establishment of a new plant unit at an early date.

The Snyder Brick Co., Ottawa, O., is arranging to continue operations throughout the entire winter, for the first time in the history of the plant. An order has been taken for 1,000,000 hollow tile blocks.

Practically every paper mill in the New England district is running on a full-time basis, with full working forces. Newsprint plants are particularly busy, and have adopted an overtime schedule.

The Pittsburgh Plate Glass Co., Pittsburgh, Pa., is operating its plants at maximum capacity with full working forces.

The Forest Paper Co., Yarmouth, Me., has reopened its soda fiber mill, following a resumption in other departments. The wages of employees have been advanced. It is expected to develop full capacity at an early date.

All cement mills in the Lehigh Valley section of Pennsylvania are continuing operations at maximum capacity. A number of plants are arranging to maintain this schedule throughout the winter.

The National Carbon Co. has resumed production at its Clarksburg, W. Va., plant, after a shut-down of more than 24 months. Employment will be given to about 100 men, and this force will be advanced to the maximum of 250 men in the near future.

England, Walton & Co., Philadelphia, Pa., operating leather tanneries, is maintaining full production at its Chilhowee extract plant at Newport, Tenn., under 24-hour service. The output is devoted to tanning extracts.

Three out of four oil refineries at Brownwood, Tex., are now in operation, these being the plants of the Blue Ribbon Refining Co., 2,000 bbl. capacity; and Brownwood Producing & Refining Co., 400 bbl. daily capacity. The refinery of the Baney Refining Co., now idle, has a rated production of 400 bbl. per day.

The Corn Products Refining Co., New York, N. Y., has adopted a production schedule of 85 per cent of maximum at its Argo, Ill., plant, on a six-day week basis.

The Texas Farm Bureau Ribbon Cane Growers' Association, Lufkin, Tex., has commenced operations at a new local sirup mill, to be run on a co-operative basis. Following the installation of additional copper coils and other equipment, the output will be advanced.

Capital Increases, etc.

THE GENERAL PAPER CO., 411 5th Ave., New York, N. Y., has filed notice of increase in capital from $100,000 to $500,000 for expansion.

LEAS & MCVITTY, INC., 303 Vine St., Philadelphia, Pa., manufacturer of leather, has filed notice of increase in capital from $3,400,000 to $5,400,000 for proposed expansion.

THE DYE PRODUCTS & CHEMICAL CO., 200 5th Ave., New York, N. Y., has filed notice of increase in capital from $75,000 to $200,000 for general expansion.

THE NATIONAL TILE CO., Anderson, Ind., has filed notice of increase in capital from $545,000 to $872,000 for expansion.

ENGLAND, WALTON & CO., INC., Third and Vine Sts., Philadelphia, Pa., manufacturer of leather, is disposing of a bond issue of $1,500,000, a portion of the proceeds to be used for financing, expansion, etc. Spencer K. Mulford is president.

THE JOVA BRICK WORKS, INC., Roseton, N. Y., has filed notice of increase in capital from $56,000 to $500,000 for proposed expansion.

Property of the THURLOW STEEL WORKS, INC., Chester, Pa., including machinery and equipment, will be sold by E. Wallace Chadwich and Howard M. Lutz, receivers.

THE WHITAKER PAPER CO., Cincinnati, O., has disposed of a bond issue of $1,500,000, a portion of the proceeds to be used for general operations and expansion.

Property of the NIANTIC & MENHADEN OIL & GUANO CO., East Lyme, Conn., manufacturer of fertilizer products, including real estate, plant and equipment, will be offered at a public sale by a stockholders' committee, headed by Frederick P. Latimer, on Dec. 12.

New Companies

THE MERCURY TANNING CO., Newark, N. J., has been incorporated with a capital of $125,000, to manufacture leather. The incorporators are E. Roth Fast, Jacob and Louis Schrenzel. Newark. The last noted represents the company.

THE L. B. ABEL CO., INC., Waterbury, Conn., has been incorporated with a capital of $50,000, to manufacture rubber products, leather specialties, etc. The incorporators are Frank E. and Louis B. Abel, 118 North Main St., Waterbury.

THE TAYLOR PRODUCTS CO., New York, N. Y., care of M. H. Briggs, 342 Madison Ave., New York, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical by-products. The incorporators are J. E. Taylor and J. D. Peckner.

THE EMPIRE FLUORSPAR CO., Golconda, Ill., has been incorporated with a capital of $100,000, to operate fluorspar properties, refine lead, zinc, etc. The incorporators are Frank H. Stanbitz, Walter R. Pierce and Henry B. Pierce, all of Golconda. The last noted represents the company.

THE PACIFIC STRAW & PAPER BOARD CO., Vancouver, Wash., has been incorporated with a capital of $500,000, to manufacture strawboard, paper board and other composition products. Charles F. Schaub, care of the Chamber of Commerce, Vancouver, is the principal incorporator and represents the company.

THE CLEO MFG. CO., New York, N. Y., care of Rosett & Deutsch, 198 Broadway, New York, representatives, has been incorporated with a capital of $100,000, to manufacture chemicals and affiliated products. The incorporators are C. C. Bleakley, F. Brek and R. Eskin.

THE CELLULOSE CO., Newark Ave., Bloomfield, N. J., has filed notice of organization to manufacture celluloid products. The company is headed by P. Edward Koester, 58 Prospect St., Bloomfield.

THE MICA CERAMICS CORP., Philadelphia, Pa., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws, with a capital of $3,000,000, to manufacture mica products and affiliated specialties.

THE DEARBORN GLASS CO., 1426 West Harrison St., Chicago, Ill., has been incorporated with a nominal capital of $5,000, to manufacture window glass and other sheet glass products. The incorporators are Arthur R. Levisohn and Herman R. Paulick.

THE ALLDAY OIL CORP., Eldorado, Ark., has been incorporated with a capital of $250,000, to manufacture petroleum products. The incorporators are M. L., D. H. and R. E. Allday, all of Eldorado.

THE TUNGSTEN PRODUCTS CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated with a capital of $525,000, under state laws, to manufacture tungsten products and conduct metallurgical operations.

THE CONSUMERS BRICK CO., 607 West 66th St., Chicago, Ill., has been incorporated with a capital of $350,000, to manufacture brick, tile, sewer pipe and kindred burned clay products. The incorporators are Thomas Bisch, Fred C. Rathje and W. L. Woods.

THE HAR-LO PRODUCTS CO., INC., Bridgeport, Conn., has been incorporated with a capital of $50,000, to manufacture varnishes, paints, etc. The incorporators are Harry T., Charles and James E. Logan, and Frederick W. Wren, all of Bridgeport.

THE PREMIER PAPER CO., New York, N. Y., care of S. S. Kogan, 299 Broadway, New York, representative, has been incorporated with a capital of $50,000, to manufacture paper products. The incorporators are S. Greenberg, J. and J. G. Gold.

THE REFUGIO GLASS WORKS, INC., Refugio, Tex., has been incorporated with a capital of $75,000, to manufacture glass products. The incorporators are W. M. Stephenson, W. L. Napier and J. K. Naylor, all of Refugio.

THE EASTERN STEEL CASTINGS, INC., Newark, N. J., has been incorporated with a capital of 10,000 shares of stock, no par value, to manufacture steel and semi-steel castings. The incorporators are John B. Brown, Robert D. Reynolds and William D. Sergent, Ave. L and Edward St., Newark. The last noted represents the company.

THE CHEMICAL ELECTRO PROCESS CORP., Seattle, Wash., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. H. D. Horton, 6022 12th Ave., South, Seattle, is the principal incorporator and represents the company.

THE BON-LAC CORP., 1602 Continental Bldg., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture shellac, varnishes, etc. The incorporators are James S. Bond, Oliver R. Loomis and W. Fairfield Peterson.

THE BEEBE-TUNNELL CORP., New York, N. Y., care of Newman & Joseph, 291 Broadway, New York, representatives, has been incorporated with a capital of $150,000, to manufacture silicon, aluminum and kindred products. The incorporators are H. Beebe, H. E. Tunnell and B. Simon.

THE ROYAL REFINING CO., care of the Corporation Trust Co. of America, duPont Bldg., Wilmington, Del., has been incorporated under Delaware laws, with a capital of $750,000, to manufacture refined petroleum products.

THE MICHAEL MARX GLASS CO., New York, N. Y., care of Potter & Potter, 305 Broadway, New York, representatives, has been incorporated with a capital of $25,000, to manufacture glass products. The incorporators are I. Sherman, M. Wolfson and N. J. Schumer.

THE STANDARD PAPER CO., San Francisco, Calif., has been incorporated with a capital of $20,000, to manufacture paper products. The incorporators are Charles Gross, David Morris and George R. Perkins, Chronicle Bldg., San Francisco. The last noted represents the company.

Industrial Notes

THE CHEMICAL EQUIPMENT CO., Chicago, Ill., has opened a new office in New York at 109 Broad St., which will be under the supervision of G. M. Hickley, formerly of the Celite Products Co.

THE AMERICAN ANILINE PRODUCTS, INC., has acquired control of the American Vat Color Co. of Chicago and has reorganized it under the name of the American Vat Color Manufacturing Co., with main offices at 80 Fifth Ave., New York City. Ample working capital has been provided. Algol and indanthrene colors are being manufactured.

THE LINK-BELT CO., Chicago, Ill., which for many years has been issuing a large calendar, has just advised that the 1923 Link-Belt calendar will be ready for distribution early in December and that a number of extra copies are available. They can be obtained by addressing the Link-Belt Co., 910 South Michigan Ave., Chicago, on the letterhead of your firm. The calendar measures 15½x24 in., and contains twelve separate full sheets. Each has an illustration of Link-Belt machinery and equipment. Underneath each month's large calendar are shown the previous month and the succeeding month. The company also announces the promotion of W. W. Sayers to the position of chief engineer of the company's Philadelphia works and Eastern operations. Mr. Sayers was for many years a representative of the company in its Chicago territory, in the lines related to power house machinery, coal storage, Peck carriers, crushers, etc., and later in charge of the locomotive crane department. His headquarters will be at the Philadelphia office.

THE STANDARD TURBINE CORP., of Wellsville, N. Y., announces the appointment of E. E. Maher as district sales manager in Chicago, with offices at 2237 Insurance Exchange Bldg. The Chicago office will handle business for the greater part of Indiana, Illinois and Iowa. The Standard Turbine Corp. is incorporated under the laws of New York and manufactures steam turbines exclusively. J. Y. Dahlstrand, formerly associated in engineering capacities with the Allis-Chalmers Mfg. Co., the Westinghouse Electric & Mfg. Co. and the Kerr Turbine Co., is chief engineer and manager of the corporation.

THE FLORANDIN EQUIPMENT CO., 110 West 40th St., New York City, who is New York representative of the Conveyors Corp. of America, Chicago, is also representing the Perfection Grate & Supply Co., Springfield, Mass., manufacturer of hand stokers and soot cleaners.

JENKINS BROS., New York, announce the appointment of William G. LeCompte as sales manager in charge of their New York territory. Mr. LeCompte has been a member of the sales organization of this company for a quarter of a century.

THE NATIONAL FOREIGN TRADE COUNCIL, of India House, Hanover Sq., New York, announces the completion of a Selected Bibliography of Foreign Trade, 1922, in which are listed the leading authorities on various aspects of International Commerce. This 5-ft. bookshelf of foreign trade contains fifty titles dealing with training for foreign trade, the history and geography of foreign trade, the practical administration of an export business, and with all phases of ocean transportation. "We receive many requests for the titles of books on foreign trade which may be termed the leading authorities," says O. K. Davis, secretary of the National Foreign Trade Council. "To meet this demand, we have consulted a large number of representative economists, editors, educators and practical export executives in order to obtain a consensus of opinion as to which are the best books in the English language on foreign trade. The American literature of foreign trade, which was little better than nothing 10 years ago, has now grown to such proportions that a full list of titles would include several hundred books. It is obviously impossible for business men or those other than academic students of the subject to make practical use of such a list, but there is a desire and a need among those actively engaged in one or another of the different branches of overseas commerce for a brief list of authoritative references. It is primarily to meet that need that this list has been prepared. It has been impossible to include many books of recognized value; but failure to include them indicates only that other works were preferred by those consulted. Should this Selected Bibliography prove of value, the National Foreign Trade Council plans to republish it annually with such changes and additions as further investigation and the publication of new books may necessitate."

THOMAS J. KEENAN, secretary-treasurer of the Technical Photographic and Microscopical Society, has moved from 251 West 19th St., to a more central and convenient location in Room 710, Bar Bldg., 36 West 44th St., New York City.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1913.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9. Headquarters will be at the Hotel Jefferson.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

NEW JERSEY CLAY WORKERS' ASSOCIATION will hold its annual meeting at the Ceramics Building, Rutgers College, New Brunswick, Dec. 12.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
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On the Merit of Being In Business for One's Health

"WE ARE NOT in business for our health," said a man of affairs, as he turned a mean trick and offended against his obligations.

Now this notion was his misfortune. The poor devil thought he was in business only for profit; he did not know that if a business establishment is operated solely for the profit of its owners, it cannot endure. It has a liability that does not show on the balance sheet. It may seem but a phantom, but it will soon take on shape and substance. A business concern is patronized in the measure that it satisfies the needs or wants of other persons than its owners. Its very life is in its fulfillment of its obligations to its customers, to the trade. The human demands upon a business organization are as great and insistent as those upon a household. The point is obvious, but many stockholders miss it.

If we succeed and are surrounded by men of good will toward us, we are doing more for our health than we can get out of all the watering places and health resorts in the country. It is fighting and quarreling, and worrying over the fear that we may lose out, that is the killing pace.

Imagine two men engaged in producing and distributing merchandise. One has the interests of the users of his products constantly in mind. He prosecutes research for their benefit—and they buy more. He has no desire for every last penny. He wants purchasers to do well with what he sells them and is pleased when they are beholden to him for their success. If there is a squeeze in the market, he is as easy as he can be with his old customers. Then, when a slump comes along, many of them will stand by him. He has chosen his walk of life not only for his financial welfare but also for his health. He wants to live an agreeable life. Having established good will, his worry is decreased to a minimum, and this preserves his health. It is a pleasure to work for such a man.

The other has an eye only for what he can see in his balance sheet. His philosophy of trade is that if he can beat his competitors in prices the trade will belong to him. His advantage he believes to consist in cutting down production costs by the elimination of such overhead charges as research and service, and the reduction of salaries and wages. He thinks his customers are as mean as he is, that they too are not in business for their health, and that they are out for every last cent.

The last cent is the most expensive of all earnings. He who would gain it destroys his personnel, because his competent men will leave him as soon as they can. The lame ducks will stay on. He destroys his best means of reducing costs, which follows in the wake of a contented and loyal staff, anxious to improve methods. And the worry that comes from being without friends is likely to undermine his health.

The elder ROTHSCHILD once said that he accounted for his fortune by his willingness to buy at prices above the bottom and to sell at those below the top. Some hopeful rothschildettes of today have not mastered this principle.

Research Is the Plow of Industry

> Behold the days come, saith the Lord, that the plowman shall overtake the reaper, and the treader of grapes him that soweth seed; and the mountains shall drop sweet wine and all the hills shall melt.—*Amos*, ix., 13.

THAT is our text. Now follows the sermon. Observe, please, the diligence of the plowman and the wealth and prosperity which accompany it.

Research in Germany under present conditions costs about one-tenth of that for the same work in America. It is again being prosecuted with vigor by leading chemical companies. There is also such stress of need there as to make Necessity conceive many inventions. These are being brought to fruition in the various German industrial research laboratories. They provide materials and goods that are needed, short-cuts in manufacture, improvements in yields and in qualities. The American people will want them. A tariff wall will not keep them out after it becomes known that such novelties and improvements are available. The rights to produce may or may not be purchased, according to the attitude of the inventors or owners. If they are purchased, only one manufacturer will profit by them. And in patent cases the United States courts are increasing their frown at those who evade protected rights by trickery.

The only way to meet research is to catch up with it, and the only way to catch up with it is to get a gait on; to have a good, long running start. This takes time, a long time, and energy and patience and character to deal with negative results; and above all things intelligent direction from an understanding mind. It is sheer lunacy to attempt to organize an industrial research laboratory without these exceptionally rare qualities, or even to expect results until, like KIPLING'S ship, the research organization has found itself.

With such an organization achieved, however, it is the most precious possession of an industrial establishment. It insures the future. It is evidence that the directors are not stock-jobbers who want to sell out, but rather true manufacturers who want to maintain the organization as a monument to their wisdom. That is, after all, the right and, indeed, the only way to protect stockholders. Research is more important than dividends, because it provides for them. What the pseudo-business man can not see—and by this we mean one who is a speculator, whose principal interest is to buy

and sell shares, who gets control and operates with a view to selling out—is the time factor in the sequence. Dividends follow research with such sureness that, under proper organization, one can fairly predict dividends to come by the number of men engaged at research. It is merely a matter of time, under good administration.

Art is long, but life is brief. Most of us learned this at school, with our early Latin. But science also is long. It will not work under snap judgments. It requires understanding and continuous study.

Large corporations are cumbersome, and it is difficult to make changes in them. The balance sheet does not show the reserve assets of research or the threatening liability of its lack. Without sound research in science to guide them, they are riding for a fall. Research is the plow of industry.

The Greater Vision Of Chemistry

"FOR we like sheep" we used to sing in the oratorio; "for we like sheep; like sheep have gone astray-hay-hay; like sheep have gone astray! Have gone astray!" And without doubt we have; every mother's son of us. But that is not the end of the simile. Like sheep also we follow on without much thought.

For many years we have entered into the great pasture of chemistry by the Gate of the Elements, and we think the question fair whether, in the light of present study, this is the proper portal. We miss a wonderful road by making for that entrance with all our might.

Just because we used to think the elements were the alphabets of matter we cling to the familiar expressions and bring in the dull phraseology of tradition whenever we talk about chemistry. That makes the language of chemistry dull. As proof of this, pray imagine yourself in a company of intelligent persons and the lively attention that would be paid if you were to say, "I have a story to tell of human reactions." Or if you offered to speak of a new note in architecture or of any of the fine arts. But if you commence, "Here is a chemical story," most persons will breathe a sigh of regret and hope that your discourse will not be long. Matter doesn't begin with the elements, and the elements are not eternal and everlasting, as we used to declare, although many of us were never completely convinced of it. Then why should chemistry begin with elements and acids and bases and salts? These are specifications. What the non-technical but interested public wants is a bigger picture.

The dogma that elements are eternal is discredited. It isn't so any more. It doesn't do us any good or make us better chemists to believe it. Elements are in the making in the sun and in the stars. They are in disintegration in the earth and in planets and moons. There is no sign of a beginning and no sign of an end. Elements are mere stages in the cosmic history of matter. Some are very short-lived and others long-lived, but it appears that not one of them can withstand cosmic time.

There is poetry in this vision of the great cycle of creation, if we can arouse our imagination and cease to be like sheep for a little while. True, our own lives are very short, and we sense but little of what is all around and about and beyond us. But the life of humanity is long, and our living places are in the very heart of this great and enduring life of humanity. What are we doing for it?

The Irreducible Minimum

DAILY papers last week carried more or less news about the President's message transmitting the budget. He pointed with pardonable pride to the great achievement in reducing the estimated expenditures for general and civil functions from $1,330,000,000 to $1,130,000,000. This saving of two hundred million dollars is certainly due in greatest measure to the President's own insistence upon rigid economy in all the executive and departmental activities; it has been materially helped by the recently inaugurated budget system common to all modern enterprises except government.

Expenditures for military functions remain constant at 1¼ billion dollars. Refunds and losses for the next fiscal year are estimated at 125 million less, and fixed charges have been reduced 135 million. Thus, two of the principal items responsible for the reduction in total estimated expenditures from $3,700,000,000 to $3,200,000,000 have come about by a shrinkage in our inherited obligations—the real reduction has been in the current governmental expenditures, other than for war. Certainly a reduction of 15 per cent in administrative expenses is a notable achievement. Maybe some day we can do as much to the army and navy.

But that contingency does not seem to be favored by the President. In casting about for further means of curtailing expenses he says:

"There is, however, another field of governmental operation—a rapidly broadening field of government expenditure—which may be discussed with profit to us all. I refer to expenditures which are being made from appropriations for federal aid in lines of research, improvement and development which, while having no direct connection with the operations of the business of government, have grown to become a recognized part of its activities. It is not easy, therefore, to divorce from our minds the fact that considerable of the moneys appropriated for the government are spent for those things which do not pertain to the normal functions or operations of the business of government. There is question as to how far the government should participate in these extraneous activities, and I am frank to say that an answer to the question as to whether we can look forward to any further material reduction in the expenditures of the government in future years depends largely upon whether or not there will be a curtailment or expansion of these activities."

Not wishing to indorse wasteful expenditure in any governmental activity, we cannot help but be reminded that most of the governmental activities for research, education and development are at present in crying need of funds for executing the work they have been commanded to do by the law which established them. It is a difficult if not an impossible task to segregate the cost of these operations, but as a matter of fact all of them certainly total to less than 75 million dollars. More than half of this money is spent by the Department of Agriculture in studying plant and animal diseases and in educating the farmer. Knowing how the farm bloc dies but never surrenders, the President would apparently direct the next cut in appropriations toward such activities as center in the Bureau of Standards, Bureau of Mines, the Coast and Geodetic and Geological Surveys.

What would be the result?

Two years ago, the late Dr. ROSA of the Bureau of Standards analyzed the first budget and discovered that the country was then (after two years of peace) spend-

ing a dollar for war to a penny for progress. Even then the scientific services were seriously undermanned and scandalously underpaid. Comparing the items of Dr. ROSA'S list with those from the budget ending June, 1923, and listed in the right hand column of the attached table, it is found that the current appropriations call for about the same amount of money as was spent in 1920, except only that the Bureaus of Education and Vocational Education have together been increased 6 million dollars, Farm Management 3½ million, and the Bureau of Mines ½ million.

COMPARATIVE BUDGET ESTIMATES

	1924	1923
Agricultural Experiment Stations	$1,743,600	$1,748,600
Extension and Co-operative Services	7,388,730	7,345,600
Weather Bureau	1,946,235	1,925,235
Bureau of Animal Industry (less meat inspection)	5,819,426	6,076,896
Bureau of Plant Industry	3,096,470	3,632,910
Forest Service (less receipts)	5,723,582	5,732,302
Bureau of Chemistry	1,339,031	1,277,631
Bureau of Soils	310,775	371,775
Bureau of Entomology	1,772,880	1,803,080
Biological Survey	840,625	870,565
Bureau of Standards	1,742,360	1,547,360
Coast and Geodetic Survey	2,236,015	2,213,135
Bureau of Fisheries	1,244,090	1,262,090
Bureau of Education	3,196,560	3,122,960
Geological Survey	1,576,090	1,450,940
Bureau of Mines	1,782,700	1,580,900
Howard University	283,000	190,000
Total	$42,102,169	$42,151,979

Obviously, the investigative and educational activities of the government have not been overextended in the last three years. Perhaps, in view of the great pressure which has been brought to curtail governmental activities, it should be a matter for congratulation that these budget items have not been sharply reduced. As noted in the above table, which compares the proposed expenditures for next year with those allowed for the current fiscal period, the chief governmental activities looking toward progress and improvement have so far been able to deflect the axe of the terrible General DAWES. It is now incumbent upon all of us to let our representatives understand that the present budget represents the very minimum. Most of the money now goes for overhead. For real utility the appropriations must be increased; if further decreased, they might as well be eliminated entirely.

Volume and Kind Of Business

ALL of us are interested in "How's business?" Some of us show a sordid spirit in asking the question. Others do not, but all are interested. There are innumerable trade reports, the number constantly increasing. There are the trade papers, the circulars of banks, trust companies and stock exchange houses and the studies of economic institutions, while finally the United States Government itself, through the Department of Commerce, circulates very comprehensive statements, all on the subject of "How's business?"

We are studying, or at least talking, economics at a great pace these days and we are also developing psychology. The two go together in considering the individual. Take, then, the case of the individual in connection with this matter of how is business. Judging by what one hears and sees, the common conception as to the state of business is a quantitative conception. It is a question of how much business there is. The form of speech used betrays the mental concept of quantity being the important element, for ordinarily business is not referred to as being large or small, heavy or light, but as being "good" or "bad."

Is this really the right conception from the standpoint of the individual? If business is large or active, he is moderately sure of having a job. But is having a job the *summum bonum* of the individual? Merely having a job is not so much after all. The job may be an unpleasant one. The income derived may not buy what the individual wants. Perhaps 10 years ago the income received and the market price of the things desired struck a balance, while now there is a lack of balance. Perhaps the income is doubled in 10 years, but the total cost of the things desired is trebled. Merely having a job is not sufficient.

Business can be heavy, or large or active, and therefore "good," according to the common conception, whereby each individual has a job, but without the individual being able to buy with his income what he ought to have, and without the total wealth increasing. Things may be done so inefficiently that all the work does no more than provide a mere subsistence, with no savings and therefore no advancement or progress, hence no real prosperity. It is not then a question merely of the quantity or volume of business, but also of the kind of business. Is the business of such a character that it involves improvement, advancement and progress, or is it merely working for a bare existence?

We should distinguish between merely active business and really helpful and progressive business. "How's business?" should refer not merely to quantity but also to kind or quality of business.

Industrial Management And the Buyers' Market

THOSE of our readers who are familiar with the forecasts of the Babson organization and other similar economic services, or who have put the matter to a searching personal analysis, are well aware that industry at the present time and for some period to come must encounter what is technically known as a buyers' market. That is to say, the future demands of consumers will be so hesitant, so difficult to crystallize into actual sales, and the capacity of industry to produce will so far exceed this demand that the buyer must be studied as never before and all ends must be shaped to his wishes. What is management to do to meet this condition?

As an unusual exposition of this situation and a terse analysis of the problem confronting management, the recent address of Dr. H. S. PERSON of the Taylor Society—"Shaping Management to Meet Developing Industrial Conditions"—is worthy of serious study. This paper, which will be found elsewhere in this issue, gives a particularly clear and germane view of market conditions and how management must change to meet them. Although directed to industry in general, it is of inestimable importance to the chemical and closely allied industries.

Dr. PERSON'S conclusion is more than apt, and all in executive positions, high or low, will find it a valuable subject for continual reference. What better message can be brought to industry today than this: "For a quarter century before the war even poorly managed enterprises were helped in their ascent to the heights of prosperity by the escalator of a sellers' market; now that escalator is out of commission, and the ascent to new prosperity must be achieved in the good old-fashioned way—by good management muscles, good management lungs and good management brains."

Readers' Views and Comments

Galvanic Corrosion on Yacht Sea Call

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to your issue of Nov. 15 and the letters by Mr. Hough and Mr. McKay on the subject of galvanic corrosion on the yacht Sea Call in which reference is made to some questions asked by me regarding the disintegration of the Monel yacht Sea Call, I will say that shortly after the meeting at Montreal I wrote to George Lawley, president of George Lawley & Son, Inc., builders of the Sea Call.

The following is Mr. Lawley's statement on the subject, which bears out the statement made by Mr. McKay.

Cleveland, Ohio. HENRY HOWARD.

Your letter of Oct. 11 received, and in reply would say that you have not been really and truly informed as to the trouble with the Sea Call. I think that Monel metal is a very good metal for a great many things. In the case of the Sea Call, if you remember, she was entirely plated from about one foot above the load waterline with Monel metal and the rivets we used were also Monel metal and not iron or steel. We found it impossible to obtain, after many trials, a stern post, or stem, and the architects finally informed us to use steel, which was done. As this was only a very small portion of the real surface below the waterline, and there being so much Monel metal—practically her entire body—electrolysis set up and would eat the stern post and stem very, very fast. The owner was so disgusted with the condition that he decided to break her up, which was done, as nothing could alter him in his decision. The Monel metal did not disintegrate and was not rotten. It would foul, however, in salt water very fast, a fungus-like grass would grow on that metal in 2 or 3 weeks, 4 or 5 in. long. This also disgusted the owner, as the idea was that it would not foul and that the expense of hauling out in foreign countries would be eliminated.

The steel framing of course was not affected in this case, as the water did not get to it, but the effect was so marked from action of the Monel metal that even the chain when at anchor, the tide running one way and perhaps the wind the other, was being eaten by electrolysis.

Any other information in regard to this craft I should be very glad to give you and when you are here I think you can find small samples of how it would eat steel. (Signed) GEORGE W. LAWLEY.

What Is Steel?

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your simple and effective answer to the question, "What is steel?" is highly commendable. In the interest of completeness I might add that the boundary between pure iron (ferrite) and steel may be sharply drawn from metallographic observations.

Thermal analysis shows no A_1 point in pure iron-carbon alloys until the carbon content is increased over about 0.03 per cent. By way of illustration I inclose several thermal curves of such alloys having carbon contents both above and below that figure. (Fig. 1.)

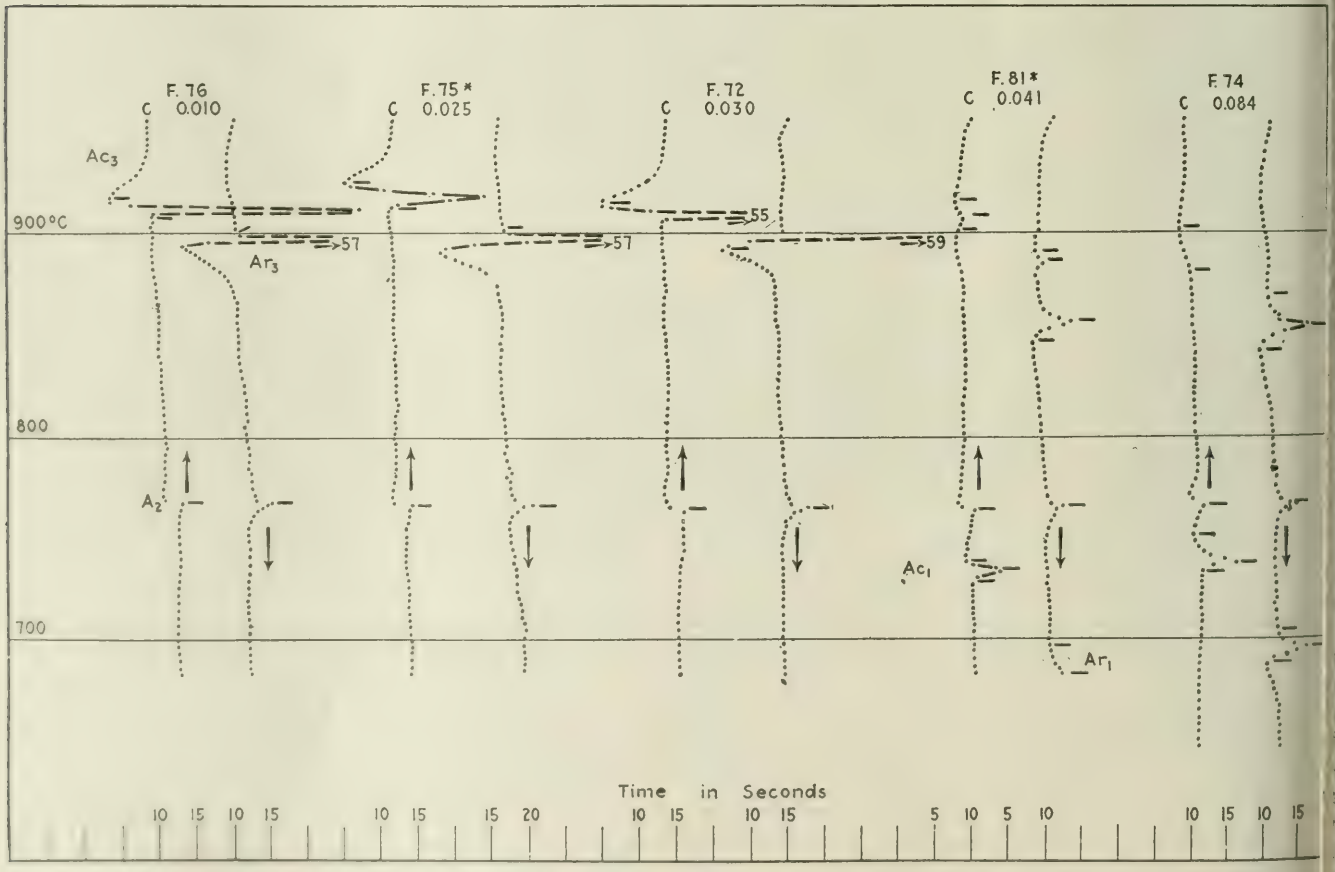


FIG. 1. HEATING AND COOLING CURVES OF VARIOUS PURE ALLOYS OF IRON WITH A SMALL AMOUNT OF CARBON

The presence of A_1 can be equally well established also by miscroscopic examination—i.e., no pearlite islands can be found when the iron contains 0.03 per cent carbon or less. It is thus evident that there exists a natural boundary between iron and steel readily fixed metallographically.

Having offered a simple and accurate definition of steel, why not do likewise for the constituents of this much abused metal? It would be quite a satisfaction for one to be able to discuss problems in heat-treatment with metallurgists without the necessity of a preliminary agreement on the meaning of the essential technical terms used.

HOWARD SCOTT,
Associate Physicist.
Bureau of Standards,
Washington, D. C.

Chemists in Public Life

To the Editor of Chemical & Metallurgical Engineering

SIR:—In connection with your editorials urging chemists to interest themselves in civic affairs it may interest you to know that the city of Stamford, Conn., has elected a chemist for Mayor. Major Phillips, of the Phillips Chemical Co., manufacturer of milk of magnesia, is an active member of the Stamford Chemical Society. He was elected Mayor on the Democratic ticket by a large majority in a city which is normally overwhelmingly Republican.

Our Stamford Chemical Society at its October meeting arranged a program dealing with problems of garbage and sewage disposal, which have become very acute in our community. The members of the city administration and the opposing candidates for the Mayoralty were specially invited guests and took part in the discussion.

R. H. STEVENS,
President.
Stamford, Conn.

Metallurgical Education

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read your editorial on Metallurgical Education in the issue for Nov. 22 with much interest as well as Dr. Little's report on Chemical Engineering Education which has just appeared.

Your description of the evolution of a new course in Metallurgical Engineering is probably not overdrawn as representing its first stage in some instances, but this stage is usually transient if sufficient funds are available for expansion. Almost any new course, especially where apparatus is involved, requires a large capital investment at the start. Tremendous capital has been required in recent years to take care of the enormous increase in students entering our schools as well as for the evolution of new courses. This achievement is indeed a convincing proof of our wonderful response to educational needs. The advance in primary and secondary school work has been scarcely less astonishing. I am very much inclined to think that our personnel for "white collar jobs" is in danger of growing too large while our personnel for the ordinary workaday jobs is decreasing in numbers and in efficiency.

I do not believe in standardized courses, because the needs of one locality are different from those of any other locality. We should rather try to fit men for locally important industrial needs. The few who do not fit into this scheme will be able to suit themselves at some other locality without great hardship. Our work must be intensive to be really effective. But the best result in product comes through the careful selection of the teachers. Personal traits in the teacher have far more to do with the result than a good curriculum. Mr. Dow's letter shows that he still feels keenly the effects of Dr. E. W. Morley's wonderful personality. We have a great many such teachers giving their all in this service unselfishly, and the attempt to substitute anything else must meet with failure.

The beginner in my time had only to make the acquaintance of atoms and molecules; now we have electrons, ions, atoms, molecules, crystal aggregates, colloids. The capacity of the student has not greatly increased. If we do not decrease the surface covered and invent better teaching methods, he must inevitably contract mental indigestion. One of the crying troubles of most teachers is their inability to imagine themselves in the position of the student. They forget that it has required years of training to acquire what seems now so simple, and they constantly shoot far over the head of the beginner, to his stupefaction and dismay.

EDWARD HART.
Lafayette College,
Easton, Pa.

Polish Chemical Industries

THE chemical industry connected with agriculture was already very far advanced in Poland before the war, for it constituted one of the sources of her great wealth; it should soon not only return to its former height of development but also make further progress. The status of the chemical industry in that country is described in an article in *Poland*, for October, 1922.

Sugar constitutes the most important branch of this industry, especially in Poznania and Congress Poland —the pre-war output amounted to about 700,000 tons. Many sugar factories were destroyed during the war, especially in Congress Poland, and the present production is only about one-third of the output produced previous to the war.

FOOD PRODUCTS

The united provinces of Poland form the chief European center for the culture of potatoes. The chemical industry which is dependent upon this product, such as alcohol, starch and sirup, is highly developed. The industry of drying potatoes (flaked potatoes) is carried on to a great extent in Poznania.

The brewing and malt industry of Poland is advancing rapidly; the species of barley grown there is of superior quality and a considerable quantity of hops is cultivated in Congress Poland and Volhynia.

During the last few years before the war the milk factories of Congress Poland and Poznania were largely employed in manufacturing technical byproducts of milk.

The manufacture of the byproducts of fruit and vegetables (jams, preserved fruit) was very insignificant, whereas the manufacture of the byproducts of sugar (cocoa, chocolate, sweetmeats) attained considerable importance in Congress Poland.

There are several large factories employed in producing soap, candles and glycerine, and in extracting fats. Today the outlook is more hopeful for this special branch.

CHIEF INORGANIC CHEMICAL INDUSTRIES

Sulphuric acid is produced in large quantities and very cheaply in Upper Silesia, as it is the refuse obtained when smelting zinc ore, and as a result of the importation of pyrites from Spain, Congress Poland has also been enabled to produce a considerable quan-

tity. Besides the Upper Silesian factories, there are also many large sulphuric acid and "oleum" works active in Congress Poland, Malopolska (Galicia) and Wielkopolska (Poznania).

Kitchen salt and brine are found in large quantities in certain districts of Poland. This is of great value to the future development of this branch of chemical industry which produces soda (common and caustic), muriatic acid, chlorine, bleaching lime, etc.

A great quantity of ammonium sulphate and cyanide of lime is produced from nitrogenous compounds in Upper Silesia and by the oxidation of synthetic ammonia.

Salts of potassium, which are in great demand both for artificial manure and in chemical industry, are to be found at Kalusz. Bertolet salts are manufactured in several factories and potassium nitrate is manufactured at Bory, near Krakow. Poland has yet another means of obtaining salts of potassium—viz., from the wash from molasses distilleries. Before the war several factories in Congress Poland were employed in producing carbonate of potassium from distillers' wash and potash from the strontium lye which is obtained when refining molasses.

Superphosphates are produced in valuable quantities in a number of factories in Congress Poland, Wielkopolska and Upper Silesia. This special line of chemical industry was ruined in Congress Poland during the war, but it is now beginning to revive again.

Dyestuffs are produced in several large factories and in many small ones. Salts of aluminum—i.e., sulphate of aluminum and other less important mineral products—are manufactured in several factories in Congress Poland.

Chief Organic Industries

During the last few years before the war Poland produced about one million tons of petroleum per annum. The industry of distilling rock-oil in order to obtain motor spirit, petroleum, lubricating oil, paraffine, petroleum asphalt and coke, has made rapid strides, although a fair quantity of crude oil is exported to other countries.

Since there is a lack of coke-producing coal in Congress Poland and Malopolska, the coke industry does not exist in these provinces, but it is exceedingly well developed in Upper and Cieszyn Silesia. Coal pitch, which is a residue from the gas and coke ovens, is distilled in order to obtain aromatic carbohydrogens, phenol, various oils and pitch; but this industry is extensively carried on only in Upper Silesia.

In spite of the abundance of raw materials, the dry distillation of lignite and turf is scarcely known in Poland, though it is an industry which would be of great advantage to the country. In view of the great extent of forest ground in Poland, the dry distillation of wood will doubtless become a very valuable industry. Before the war it attained extraordinary proportions in a primitive form. At the time of the war Poland started to manufacture pitch, turpentine and resin from the waste matter of pines which results from the felling of the same.

The manufacture of the so-called intermediate products of the synthetic organic industry, such as the mass-production of aromatic nitro-compounds (nitrobenzol, etc), amines, aniline, sulphuric acids, etc., was not very extensive in Poland before the war, except to a certain degree in Upper Silesia. Today, especially after the annexation of Upper Silesia, the needs of the country enforce a greater interest in the corresponding branches of the industries connected with the manufacture of colors, explosive materials, etc. The synthetic-organic industry, in particular the manufacture of colors, has made great progress in Poland, especially in Congress Poland, where there was a wide market for it. Today there is every prospect of further development, particularly after the annexation of Upper Silesia, for this latter province supplies Poland with a large quantity of raw material.

For obvious reasons, the manufacture of explosives was practically an unknown factor in Poland before the war. Now, however, it is being speedily organized, and in the near future Poland will no doubt be in a state to supply her own demands in this respect.

Other Chemical Industries

Before the war, tanning was a most important branch of industry in Poland, especially in Congress Poland, where it was technically in a flourishing condition. Several large factories in Congress Poland are employed in the production of tanning extracts. Nearly all the raw materials are supplied by foreign countries, partly by the Ukraine, but principally by North America.

The production of vegetable and animal fibers and subsequently bleaching, dyeing, printing and the finishing process of tissues and yarns is an important branch of chemical industry in Poland. The factories are well equipped technically. Congress Poland also possesses two artificial silk factories. Factories for the manufacture of rubber and celluloid and their byproducts, as well as other artificial plastic masses, are almost unknown quantities in Poland—a lack in Polish industry which will no doubt be rectified in the near future.

Manufacture of Essential Oils in 1921

The Department of Commerce announces that the census reports show a considerable decrease in the activities of the establishments engaged primarily in the manufacture of essential oils (not including synthetic or artificial oils) during 1921, as compared with the year 1919. The total value of products reported amounted to $3,271,120 in 1921, and to $5,698,403 in 1919, a decrease of 42.6 per cent.

Detailed statistics for the years 1921 and 1919 are given in the following table:

Products		1921	1919	Per Cent of Decrease
Total value of products		$3,271,120	$5,698,404	42.6
Oil of:				
Peppermint†,	pounds	152,134	236,233	35.6
	value	$368,353	$1,276,136	71.1
Spearmint‡,	pounds	99,056	29,985	*230.4
	value	$356,274	$145,709	*144.5
Cloves,	pounds	199,200		
	value	$335,376		
Nutmeg,	pounds	19,795		
	value	$21,939	$2,950,961	45.0
Sandalwood,	pounds	23,835		
	value	$178,968		
Other oils,	value	$1,086,507		
Witch-hazel extract,	gallons	(§)	510,110	
	value	(§)	$448,938	
All other products,	value	$923,703	$876,660	30.3

* Increase.
† Crude and refined are combined to avoid disclosure of operations of individual establishments.
‡ Crude only. No refined spearmint reported in 1921 or 1919.
§ Included in all other products to avoid disclosure of operations of individual establishments.

The returns indicate that the combined output of all establishments was approximately 56 per cent of the maximum capacity based upon a demand requiring full running time.

A Discussion of the Organization and Functions of the Bureau, Types of Standards Investigated, Funds, Personnel and Methods—Relation of Industrial Research and Technical Work to Fundamental Studies of Constants and Research in Pure Physics

By R. S. McBride
Assistant Editor, *Chemical & Metallurgical Engineering*

THE National Bureau of Standards, which was established in 1901 for the service of science and industry, has become the greatest physical laboratory in the world. At this time the organization and work of the bureau are of particular interest because of the change in directorship incident to the resignation of Dr. S. W. Stratton. The question has naturally been raised whether the new director, who has not yet been designated, will continue the work at the bureau along existing lines or will tend to divert it into new or different channels. For a clear understanding of any such problem, the present scope, organization and activities of the bureau must be considered.

Five Types of Standards

Probably the idea of standards suggests to nine out of ten persons matters of weight or measurement. As a matter of fact the "standards of measurement," to which the bureau gives much attention, form only one of five groups of standards to be considered. Standard constants, standards of quality, including specifications for materials of all sorts, standards of performance for machines or devices, and standards of practice, including codes of regulatory laws of a technical sort, also come under the attention of this institution.

These five types of standards have been outlined and the purpose of each has been shown clearly in a function chart published by the bureau, which is reproduced herewith. This brings out clearly the relationship of the different kinds of work to the fundamental function of the bureau—namely, "development, construction, custody and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry, and commerce."

Internal Organization

Because of its location, the Bureau of Standards has been organized to function almost independently of the rest of the Department of Commerce. This has necessitated complete mechanical and clerical organization, in addition to the scientific divisions of the bureau. The interrelation of these parts is shown on the organization chart, from which it can be seen that the scientific work of the bureau has been divided primarily into divisions of physics—heat, light, electricity and other branches. More recently there have been added divisions to deal with problems of particular industries such as the problems of physical metallurgy and of scientific ceramic manufacture. Problems of structural engineering and miscellaneous engineering materials are grouped together in another division for convenience of administration.

The special activities of the bureau which have been added since Mr. Hoover became Secretary of Commerce are in special groups dealing with problems of building and housing, simplified commercial practice and trade specifications that work closely with the Department of Commerce and less intimately with the research divisions that have hitherto formed substantially all of the bureau.

This type of organization has been intended to bring together under a single division chief the varieties of research and investigation requiring common methods for their study. Thus men having particular ac-

quaintance with methods of temperature measurement and research on thermal chemistry or thermal physics are engaged on problems applicable in many industries. Thermometer calibration, pyrometer development, heat conductivity of building materials, thermal properties of substances used in the refrigerating industry, the properties of refractories at high temperature, and many other subjects and commodities are thus considered in the heat division of the bureau. Other phases of investigations on the same commodities are often going on simultaneously in different divisions, especially where electrical properties, chemical properties or optical properties of the materials are involved. Only in the case of a limited number of industrial products having large importance from the standpoint of the government have separate sections been organized along commodity lines.

This type of staff organization has followed somewhat the lines which determine college organization. In fact in many respects the Bureau of Standards resembles closely a graduate institution where the scientific staff is engaged upon researches of greater difficulty and complexity, but otherwise similar to those done by the graduate students and teaching staff of any university.

Personnel and Appropriations

The Bureau of Standards was founded in 1901 with a total personnel of twenty-three, of whom fourteen were members of the scientific staff and nine of the non-scientific. From that small beginning, which was virtually only a weights and measures office, the bureau grew to a personnel of 1,150 at the end of the war period. However, much of the war-time growth was not of a sort that could be expected to continue, and at present the scientific staff consists of approximately 550 persons supplemented and assisted by 335 non-scientific staff employees. The growth in personnel is brought out most clearly by the graphical presentation of data given herewith.

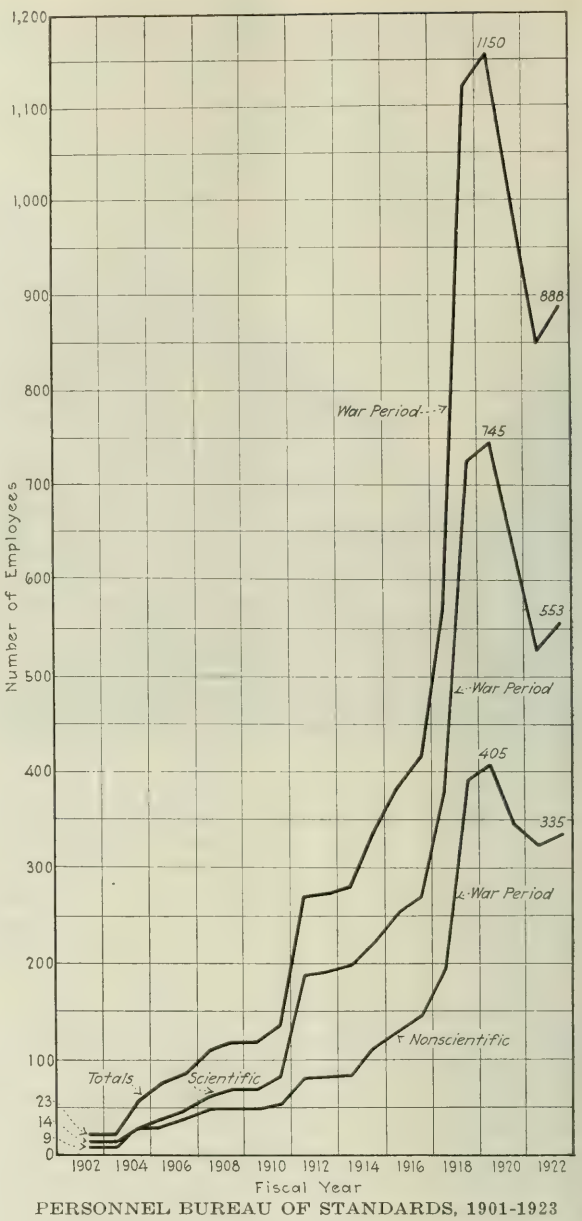
The scale of salaries paid to the scientific staff during the early history of the bureau was comparable with or slightly better than the college and university salaries of the country. However, during recent years the bureau has experienced great difficulty in getting the most desirable type of men to leave other positions and come to Washington, because the financial conditions were anything but attractive to them. The maximum salary paid is, of course, for the director, $6,000 per year; and the salaries scale down from this to about $1,500 as the average entrance salary for scientific and technical men. A large majority of the staff receives between $1,000 and $3,000 per year, only about 15 per cent of the total number being paid $3,000 or higher. When one realizes that the organization is almost altogether a research organization, the complication this limitation produces is evident.

APPROXIMATE TOTAL EXPENDITURES

Bureau of Standards
Fiscal Years 1902 to 1922

1902	$165,000	1913	$680,000
1903	145,000	1914	625,000
1904	340,000	1915	685,000
1905	170,000	1916	730,000
1906	170,000	1917	950,000
1907	170,000	1918	2,990,000
1908	185,000	1919	3,360,000
1909	245,000	1920	1,890,000
1910	426,000	1921*	1,319,000
1911	170,000	1922	1,507,000
1912	566,000		

*Excluding funds transferred from other departments.



PERSONNEL BUREAU OF STANDARDS, 1901-1923

The growth in appropriations has been about parallel to the growth in personnel. The approximate total expenditures of the bureau during its first 21 years are given in the accompanying tabulation. Of this total expenditure, slightly more than half has been for salaries, the remainder representing expenditures for apparatus and equipment, travel, and the multitude of operating expenses which any institution of such size occupying a group of twenty-four buildings is bound to incur.

Of the total expenditure during its life a large sum has gone for permanent buildings and grounds. Probably five or six million dollars is now so invested.

Of the expenditures since 1910 a very large proportion has been from appropriations granted as "special funds," which are sums of money given for the conduct of specific lines of work with no limitation as to the percentage for salaries, equipment, travel or other subdivision of the work. The influence of these special funds on the rate of increase in number of employees and total expenditure is evident from the curves and tables of data. At present a very large part of the total money is appropriated in this way.

Although established primarily as a bureau of phy-

CORRECT AS OF APRIL 1 1921

DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

FUNCTION

TO DEVELOP, CONSTRUCT, MAINTAIN AND HAVE CUSTODY OF STANDARDS OF MEASUREMENT, STANDARDS OF QUALITY, STANDARDS OF PERFORMANCE, STANDARDS OF PRACTICE, AND STANDARD CONSTANTS; TO COMPARE, IMPROVE, AND APPLY THESE STANDARDS TO SCIENCE, ENGINEERING, INDUSTRY AND COMMERCE

1920 APPROPRIATION	1921 APPROPRIATION
$1,894 576	$1,304,632

	DISTRICT OF COLUMBIA	FIELD SERVICE		DISTRICT OF COLUMBIA	FIELD SERVICE
1921 PERSONNEL	780	14	1921 PAYROLL	$1,224,060	$18,060

OFFICE OF DIRECTOR

DIRECTOR

FUNCTION: TO SUPERVISE THE ADMINISTRATIVE ROUTINE, SCIENTIFIC-TECHNICAL INVESTIGATIONS, THE INSTALLATION, MAINTENANCE AND OPERATION OF THE MECHANICAL PLANT, SHOPS, BUILDINGS AND GROUNDS

ASSISTANT DIRECTOR $4500

FUNCTION: TO ASSIST THE DIRECTOR IN THE SUPERVISION OF ADMINISTRATIVE ROUTINE AND THE DIRECTION OF SCIENTIFIC-TECHNICAL INVESTIGATIONS

PERSONNEL 6 PAYROLL $16,400

ADMINISTRATIVE BRANCH

THE OFFICE

Chief

FUNCTION: TO SUPERVISE THE UNITS OF THE ADMINISTRATIVE BRANCH, TO SELECT PERSONNEL AND REMOVE OFFICE PERSONNEL, TO PLAN CLERICAL ROUTINE, TO SUPERVISE EDITORIAL COMMITTEE WORK

PERSONNEL 3 PAYROLL $6,280

FINANCE SECTION

FUNCTION: TO KEEP CONTROLLING ACCOUNTS OF FUNDS, TO PREPARE FINANCIAL STATEMENTS AND ESTIMATES, TO AUDIT VOUCHERS, PREPARE BILLS, RECEIVE FEES AND PREPARE PAYROLLS, TO PERFORM ADMINISTRATIVE ROUTINE RELATING TO TEST RECORDS

PERSONNEL 11 PAYROLL $16,020

PERSONNEL SECTION

FUNCTION: TO PROCURE, INTERVIEW AND EXAMINE CANDIDATES FOR APPOINTMENT, TO RECOMMEND THE APPOINTMENT, PROMOTION, TRANSFER OR DISCHARGE OF PERSONNEL, TO MAINTAIN PERSONNEL RECORDS, TO DRAFT CHARTS AND GRAPHS

PERSONNEL 6 PAYROLL $9,040

PUBLICATION SECTION

FUNCTION: TO ASSIST IN EDITING MANUSCRIPT FOR PRINTER, TO PREPARE REQUISITIONS FOR PRINTING AND BINDING, TO RECEIVE, STORE AND ISSUE PUBLICATIONS, TO MAINTAIN MAILING LISTS

PERSONNEL 3 PAYROLL $3,100

PROPERTY, STORES & TRANSPORTATION SECTION

FUNCTION: TO STORE, RECORD AND ISSUE SUPPLIES, MATERIALS AND EQUIPMENT, TO KEEP PROPERTY RECORDS, TO MAINTAIN AND OPERATE ALL MOTOR VEHICLES

PERSONNEL 14 PAYROLL $14,500

MAIL AND FILES SECTION

FUNCTION: TO RECEIVE, INDEX AND ROUTE ALL INCOMING AND OUTGOING MAIL, TO MAINTAIN CORRESPONDENCE FILES, TO MAINTAIN TELEPHONE AND ELEVATOR SERVICES

PERSONNEL 24 PAYROLL $17,900

LIBRARY

FUNCTION: TO MAINTAIN BUREAU'S LIBRARY, TO RECEIVE, CATALOGUE AND CIRCULATE INCOMING PERIODICALS, TO COMPILE BIBLIOGRAPHIES, REFERENCE LISTS AND TRANSLATIONS

PERSONNEL 2 PAYROLL $2,600

PURCHASE SECTION

FUNCTION: TO PREPARE CONTRACTS FOR PROCUREMENT, LEASING OR PURCHASE OF SUPPLIES, REAL ESTATE, EQUIPMENT & SERVICES, AND APPROVE PAYMENTS, TO RECEIVE BIDS AND TENDERS, TO SECURE CONTRACT PERFORMANCE

PERSONNEL 4 PAYROLL $5,000

INFORMATION SECTION

FUNCTION: TO REVISE, WRITE AND DISTRIBUTE FORMS, TO PREPARE REPORTS, TO MAINTAIN INFORMATION SERVICE FOR BUREAU, TO RECEIVE AND STORE, TO PREPARE AND DISTRIBUTE THE MONTHLY TECHNICAL NEWS BULLETIN

PERSONNEL 2 PAYROLL $3,800

SCIENTIFIC BRANCH

WEIGHTS AND MEASURES DIVISION

Chief

FUNCTION: TO PREPARE SPECIFICATIONS AND TOLERANCES FOR USE IN STANDARDIZING MODELS AND MEASURES, TO DESIGN, IMPROVE AND CONSTRUCT WEIGHING AND MEASURING APPARATUS TO RECORD STANDARD LENGTH, MASS, TIME, AREA, VOLUME, DENSITY AND PRESSURE, TO TEST AND CALIBRATE WEIGHTS AND MEASURES APPARATUS BY COMPARISON WITH GOVERNMENT REFERENCE STANDARDS, TO CONDUCT RESEARCH TO ASCERTAIN PHYSICAL CONSTANTS MORE ACCURATELY, TO COOPERATE WITH STATE AND LOCAL GOVERNMENT AUTHORITIES IN THE PREPARATION AND ADMINISTRATION OF LAWS REGULATING WEIGHTS AND MEASUREMENTS

PERSONNEL 58 PAYROLL $101,260

- LENGTH SECTION
- MASS SECTION
- TIME SECTION
- CAPACITY & DENSITY SECTION
- THERMAL EXPANSIVITY SECTION
- GAS MEASURING INSTRUMENTS SECTION
- WEIGHTS AND MEASURES LAWS ADMINISTRATION SECTION
- COMMERCIAL SCALES SECTION
- GAUGES SECTION

HEAT AND THERMOMETRY DIVISION

Chief

FUNCTION: TO ESTABLISH STANDARD SCALES OF TEMPERATURE THROUGHOUT THE RANGE OF MEASURABLE TEMPERATURES, TO DEVISE AND IMPROVE SPECIFICATIONS AND METHODS OF STANDARDIZING TEMPERATURE MEASURING INSTRUMENTS, TO DESIGN, IMPROVE, AND CONSTRUCT STANDARD TEMPERATURE MEASURING INSTRUMENTS TO DETERMINE THE PHYSICAL CONSTANTS OF MATERIALS SUCH AS SPECIFIC AND LATENT HEATS, RATES OF REACTION AND CONDUCTION, MELTING AND FREEZING POINTS AND HEAT TRANSMISSION, TO DEVISE APPARATUS FOR AND CONDUCT FIRE TESTS OF STRUCTURAL MATERIALS, TO DETERMINE FUNDAMENTAL ENGINEERING DATA INVOLVING THERMAL CONSTANTS, TO INVESTIGATE PROBLEMS OF AND TEST AUTOMOTIVE POWER PLANTS, FUELS AND LUBRICANTS

PERSONNEL 72 PAYROLL $124,980

- THERMOMETRY SECTION
- PYROMETRY SECTION
- HEAT MEASUREMENTS SECTION
- LOW TEMPERATURE SECTION
- FIRE-RESISTANCE SECTION
- AUTOMOTIVE POWER PLANTS SECTION

OPTICS DIVISION

Chief

FUNCTION: TO DESIGN AND CONSTRUCT APPARATUS FOR MAKING SPECTROSCOPIC, POLARIMETRIC, COLORIMETRIC AND RADIOMETRIC ANALYSIS OF PROPERTIES OF MATERIALS; TO DETERMINE THE SPECTRAL TRANSMISSIVITY AND REFLECTIVITY AND THE EMISSIVE AND ABSORPTIVE PROPERTIES OF MATERIALS, TO TEST SUGAR AND SUGAR PRODUCTS, THE REFRACTIVE INDICES OF OPTICAL WATER GLASS, PHOTOGRAPHIC PLATES AND FILMS, OPTICAL MATERIALS, FINE WIRES, WATER SPRAYS, POISON GAS AND BIOLOGICAL FLUIDS; TO STANDARDIZE THE DESIGN AND PERFORMANCE OF OPTICAL INSTRUMENTS, PRECISION BALANCES, CAMERAS, AND SEARCH-LIGHT APPARATUS; TO ASSIST THE GOVERNMENT SERVICE IN THE MAINTENANCE AND OPERATION OF ITS SUGAR LABORATORIES

PERSONNEL 39 PAYROLL $76,700

- SPECTROSCOPY SECTION
- POLARIMETRY SECTION
- COLORIMETRY SECTION
- OPTICAL INSTRUMENTS SECTION
- RADIOMETRY SECTION
- DISPERSION PHYSICS SECTION
- INTERFEROMETRY SECTION

CHEMISTRY DIVISION

Chief

FUNCTION: TO DEVISE METHODS AND APPARATUS FOR ANALYZING AND TESTING MATERIALS; TO MAKE CHEMICAL ANALYSES TO DETERMINE THE COMPOSITION AND PURITY OF MATERIALS UNDER TEST, TO DETERMINE SPECIFICATIONS AND THE PHYSICAL CONSTANTS OF TECHNICAL MATERIALS, TO PREPARE PURE MATERIALS FOR STANDARDIZATION WORK

PERSONNEL 67 PAYROLL $128,660

- PHYSICAL CHEMISTRY SECTION
- ELECTROCHEMISTRY SECTION
- GAS CHEMISTRY SECTION
- REAGENTS AND APPARATUS SECTION
- ANALYTICAL METHODS AND STANDARD SAMPLES SECTION
- RUBBER, PAPER & TEXTILES SECTION
- METALS, CEMENT AND BITUMINOUS MATERIALS SECTION
- PAINT, VARNISH AND SOAP SECTION

ELECTRICITY DIVISION

Chief

FUNCTION: TO FORMULATE SPECIFICATIONS FOR AND TEST ELECTRICAL APPARATUS, STANDARDS AND MEASURING INSTRUMENTS, TO DEVELOP METHODS AND EQUIPMENT FOR MEASURING ELECTROMOTIVE FORCE, RESISTANCE, CURRENT, INDUCTANCE, CAPACITY, CONDUCTIVITY, ADIABATIC MODULATION, MAGNETIC PROPERTIES AND PERFORMANCE OF ELECTRICAL EQUIPMENT, TO DESIGN, IMPROVE AND CONSTRUCT ELECTRICAL APPARATUS INCLUDING LAMPS, BATTERIES, TRANSFORMERS, METERS, TELEPHONES AND RADIO SETS, TO DEVELOP AND IMPROVE PRIMARY STANDARDS, TO FORMULATE SERVICE STANDARDS FOR TELEPHONE, GAS AND ELECTRIC COMPANIES, PUBLIC UTILITY COMMISSIONS, AND MUNICIPALITIES, TO FORMULATE SAFETY CODES

PERSONNEL 127 PAYROLL $229,280

- STANDARDS OF RESISTANCE SECTION
- INDUCTANCE AND CAPACITY SECTION
- ELECTRICAL MEASURING INSTRUMENTS SECTION
- MAGNETIC MEASUREMENTS SECTION
- PHOTOMETRY AND ILLUMINATING ENGINEERING SECTION
- RADIO RESEARCH AND DEVELOPMENT SECTION
- ELECTROLYSIS PREVENTION SECTION
- SAFETY ENGINEERING SECTION
- GAS ENGINEERING SECTION
- ELECTRICAL AND OTHER SERVICE STANDARDS SECTION
- TELEPHONE SERVICE STANDARDS SECTION
- ELECTROCHEMISTRY SECTION
- RADIO ACTIVITY AND X-RAY MEASUREMENTS SECTION

ENGINEERING PHYSICS DIVISION

Chief

FUNCTION: TO PREPARE STANDARD SPECIFICATIONS FOR ENGINEERING, AERONAUTICS AND SOUND-RANGING INSTRUMENTS, AND MECHANICAL APPLIANCES, TO DEVISE AND IMPROVE METHODS OF TESTING THESE INSTRUMENTS, TO DESIGN, IMPROVE AND CONSTRUCT APPARATUS FOR TESTING AND MEASURING PURPOSES, TO TEST AND MEASURE THE PERFORMANCE OF ENGINEERING AERONAUTICAL AND SOUND-RANGING INSTRUMENTS AND MECHANICAL APPLIANCES AND DESIGN AND CONSTRUCT NEW TYPES, TO ANALYZE AND TEST THE AERODYNAMICAL PROPERTIES OF BUILDING MATERIALS, TO CONDUCT AERODYNAMICAL RESEARCH AND TEST THE RESISTANCE OF AIR TO AIRCRAFT AND PROJECTILES

PERSONNEL 51 PAYROLL $86,540

- ENGINEERING INSTRUMENTS AND MECHANICAL APPLIANCES SECTION
- AERODYNAMICAL INSTRUMENTS SECTION
- AERODYNAMICAL PHYSICS SECTION
- SOUND SECTION

METALLURGY DIVISION

Chief

FUNCTION: TO FORMULATE STANDARDS AND SPECIFICATIONS OF METALS AND ALLOYS, TO DETERMINE METALLURGICAL CONSTANTS AND PROPERTIES, TO DESIGN, IMPROVE AND CONSTRUCT APPARATUS FOR METALLURGICAL PROCESSES AND TESTING PURPOSES, TO MAKE PHYSICOCHEMICAL ANALYSES OF METALS AND ALLOYS TO DETERMINE CONSTITUTION, STRUCTURE AND CAUSES OF FAILURE, TO MAKE THERMAL ANALYSES OF METALS AND ALLOYS TO LOCATE CRITICAL POINTS IN STRUCTURE, TO DEVISE NEW AND IMPROVE AND TEST ESTABLISHED METALLURGICAL PROCESSES SUCH AS ANNEALING, QUENCHING, CEMENTATION, TEMPERING, TINNING, ROLLING, DRAWING, FORGING, CASTING, PLATING AND WELDING, TO PREPARE METALS AND ALLOYS OF THE HIGHEST PURITY AND ALSO COMMERCIAL GRADES

PERSONNEL 49 PAYROLL $ 75,160

- OPTICAL METALLURGY SECTION
- THERMAL METALLURGY SECTION
- MECHANICAL METALLURGY SECTION
- CHEMICAL METALLURGY SECTION
- FOUNDRY SECTION

CERAMICS DIVISION

Chief

FUNCTION: TO CONDUCT RESEARCH AND INVESTIGATE THE PRINCIPLES INVOLVED IN THE MANUFACTURE OF CLAY PRODUCTS, THE MANUFACTURE OF PORTLAND CEMENT AND GLASS, THE CONSTRUCTION OF REFRACTORIES AND THE ENAMELING OF METALS, TO DETERMINE STANDARD FORMULAS AND SPECIFICATIONS FOR CERAMIC MATERIALS, TO TEST CLAYS, GLASS, ENAMELS AND REFRACTORIES, TO STANDARDIZE MANUFACTURING METHODS AND PROCESSES

PERSONNEL 27 PAYROLL $40,740

- CLAY PRODUCTS SECTION
- ENAMELED METALS SECTION
- REFRACTORIES SECTION
- OPTICAL GLASS SECTION

STRUCTURAL ENGINEERING & MISC. MATERIALS DIV.

Chief

FUNCTION: TO MAKE PHYSICAL TESTS OF INDUSTRIAL MATERIALS SUCH AS METALS, WOODS, CEMENT, CONCRETE, STONE, SAND, LEATHER, RUBBER, TEXTILES, PAPER, OILS, LIME, GYPSUM, AND SAND-LIME BRICK, TO MAKE CHEMICAL, MICROSCOPIC AND PHOTOMICROGRAPHIC ANALYSES OF THESE MATERIALS, TO INVESTIGATE, TEST, AND IMPROVE MANUFACTURING PROCESSES TO MANUFACTURE STANDARD MATERIALS AND PREPARE STANDARD SPECIFICATIONS FOR THEM, TO STANDARDIZE NOMENCLATURE

PERSONNEL		PAYROLL
WASHINGTON, D.C.	87	$136,080
FIELD FORCE	14	18,040

- METALS SECTION
- CEMENT, CONCRETE, STONE, ETC. SECTION
- LEATHER AND RUBBER SECTION
- NORTHAMPTON, PA LABORATORY
- TEXTILES SECTION
- DENVER, COLO LABORATORY
- PAPER SECTION
- SAN FRANCISCO, CAL LABORATORY
- LUBRICATING OILS SECTION
- LIME, GYPSUM, AND SAND-LIME BRICK SECTION

OPERATION OF PLANT

POWER PLANT

Superintendent

FUNCTION: TO FURNISH BUREAU WITH LIGHT, HEAT AND POWER, TO MAINTAIN AND OPERATE THE MECHANICAL EQUIPMENT, TO KEEP A RECORD OF OPERATIONS, TO MAINTAIN AND OPERATE REFRIGERATION PLANT, TO MAINTAIN AND OPERATE STATIONARY AND PORTABLE STORAGE BATTERIES

PERSONNEL 23 PAYROLL $23,100

REPAIR FORCE

FUNCTION: TO INSTALL AND MAINTAIN PLUMBING AND PIPING, TO INSTALL AND MAINTAIN PLANT AND LABORATORY ELECTRICAL EQUIPMENT AND WIRING

PERSONNEL 14 PAYROLL $17,160

BUILDINGS AND GROUNDS

FUNCTION: TO CLEAN THE BUILDING AND MAINTAIN SANITARY CONDITIONS THEREIN, TO PROTECT BUILDINGS AND GROUNDS, TO CARE FOR GROUNDS, TO REPAIR BUILDINGS AND GROUNDS

PERSONNEL 38 PAYROLL $26,160

SPECIAL ACTIVITIES

BUILDING AND HOUSING

Chief

FUNCTION - NEW WORK TO MEET THE PRESENT EXIGENCY IN THE HOUSING SITUATION

PERSONNEL 12 PAYROLL $22,420

SIMPLIFIED COMMERCIAL PRACTICE

Chief

FUNCTION - TO ELIMINATE WASTE IN INDUSTRY BY PROMULGATING SIMPLIFIED STANDARDS

PERSONNEL 5 PAYROLL $13,350

SPECIFICATIONS

Chief

FUNCTION - TO UNIFY AND IMPROVE SPECIFICATIONS USED BY GOVERNMENT SERVICES AND PUBLIC

PERSONNEL 13 PAYROLL $9,600

CONSTRUCTION BRANCH

INSTRUMENTS & MACHINE SHOPS

FUNCTION: TO CONSTRUCT AND MAINTAIN SCIENTIFIC APPARATUS AND MACHINERY OF HIGH PRECISION

PERSONNEL 30 PAYROLL $34,380

WOODWORKING SHOPS

FUNCTION: TO CONSTRUCT MINOR BUILDINGS, FURNITURE AND CASEWORK, TO PERFORM CARPENTER AND PAINTING WORK IN BUILDINGS AND ABOUT THE GROUNDS, TO REPAIR FURNITURE AND EQUIPMENT

PERSONNEL 7 PAYROLL $9,500

GLASS-BLOWING SHOP

FUNCTION: TO CONSTRUCT SCIENTIFIC GLASS APPARATUS FOR LABORATORIES

PERSONNEL 2 PAYROLL $3,000

GLASS-GRINDING SHOP

FUNCTION: TO CONSTRUCT OPTICAL INSTRUMENT PARTS

PERSONNEL 8 PAYROLL $9,080

PHOTOGRAPHIC SHOP

FUNCTION: TO PERFORM PHOTOGRAPHIC, PHOTOSTATIC, BLUE PRINTING AND LANTERN SLIDE WORK, TO DESIGN PHOTOGRAPHIC APPARATUS

PERSONNEL 4 PAYROLL $4,200

AIRPLANE PHOTOGRAPH SHOWING GROUNDS AND BUILDINGS OF BUREAU

A—Heat and Engineering Physics. *B*—Administrative and Optics. *C*—Radio. *D*—Metallurgy. *E*—Shop. *F*—Electricity. *G*—Chemistry. *H*—Industrial Research.

sics and physical research, the Bureau of Standards has always included a considerable number of chemists and engineers. In fact the chemical division of the bureau has been one of the largest, including during recent years a total personnel of approximately one hundred. The number of engineers on the staff has also grown in proportion as the technical activities of the bureau have increased. It is the relation of these technical problems to the fundamental studies in physics that have made it difficult for many to understand the work of the bureau.

In the beginning the bureau gave practically all its time to studies of weights and measures and fundamental problems in heat, light, electricity or mechanics that one commonly associates with a physical laboratory. However, the application of such studies to the practices of engineering and industry was always an important part of the motive behind the work; and with increasing knowledge, the bureau acquired increasing contact with those active in industrial lines. More and more commercial laboratory men came to the bureau for information and more and more other government departments referred to it the problems of tests and purchases.

With the transfer to the Bureau of Standards of part of the Technologic Branch of the U. S. Geological Survey and later of the Contracts Laboratory of the Bureau of Chemistry, the Bureau of Standards was made in effect a supervisor of purchases for the government in so far as standards or specifications were involved. This did not make compulsory the reference of such problems to the bureau, but it did make available to other government institutions the advisory services of the bureau in such a way that many thousands of tests for other government institutions are now made annually. In fact, during recent years the number of tests performed for the government and outside agencies has exceeded 100,000 per year.

In order to do this testing work most intelligently and fairly to all, the bureau made a study of industrial processes and products; and after the investigators became familiar with these subjects, publications of a technical nature were issued from time to time. Thus there grew up the basis upon which the bureau has now built what is in effect a "Bureau of Technology" closely interwoven with, and in some measure superseding parts of, the original "Bureau of Physics."

It is practically impossible to generalize as to the advantages and disadvantages of this technologic work at the bureau. Circumstances in each of the fifty or sixty divisions are so different that any generalization is bound to be wrong in the case of many of the commodities or the branches of physics or chemistry which are represented. It is safe to say, however, that the new director, whoever he may be, will have confronting him one general problem that can never be wholly settled—namely, To what extent can the bureau take up practical engineering and technical studies, and to what extent must it confine its effort to the problems of so-called "pure science"? It is, of course, out of place in this article to undertake any recommendation on this point; but it may be profitable to point out by typical examples some of the important factors involved in any plan for the work of this great institution.

Standard Specifications

The United States Government is one of the greatest purchasers in the world. Naturally the maximum efficiency in purchasing is desirable not only for the sake of economy but also as an example to the individual and to business. As pointed out earlier in this article, many of the government purchases have been super-

vised by tests made at the Bureau of Standards. However, this scheme did not procure general uniformity of purchasing and more recently there has been established the Federal Specifications Board, of which the director of the Bureau of Standards is chairman. This board arranges for the adoption of uniform specifications for purchases by all of the departments of the government, in so far as the requirements of the government are such as to make the adoption of specifications worth while.

Many of these specifications, though adopted primarily for government use, will undoubtedly have general influence upon trade practices of the country. In the past there have been many such cases where the government adopted for commodities such requirements as were recommended by the Bureau of Standards and thereby established a trade custom that enabled all purchasers of such commodities to get first-quality product. One of the most conspicuous examples of success has been the standard specifications for incandescent electric lamps adopted first more than 10 years ago. Now it is possible to get anywhere electric lamps in conformity with the latest government standards. Indeed these standards are almost of universal effect. This is possible, as they are invariably adopted with the co-operation and assistance of the most forward-looking scientists and engineers in industry and not by any academic consideration of theory considered alone by the government investigators.

In many respects this work on standard specifications at the bureau has been a pioneer effort, for often those industries that previously had not considered any specifications or requirements for their product now realize the industrial advantage to the producer of having well-established, reasonable and enforceable requirements of this sort. The impartial judicial position which the Bureau of Standards can take in such work has lent great dignity to its efforts and has perhaps contributed most of any single factor to such success as has been attained.

Standards of Performance

Just as standard specifications for commodities are desirable, so too are standards of performance for machines and devices. It is quite as important to know how to rate a machine and what tests can reasonably be applied to determine performance as it is to specify the composition, heat-treatment, size or other characteristic of any commodity or of any part of the machine or device. The relation of the Bureau of Standards to such work has not been limited to tests or performance requirements on government purchases alone, but it has been to a considerable extent so directed. Purchase of motors, fans and other small electrical devices according to performance tests made at the bureau has been one good illustration of how this effort has been worked out. More recently work of a similar sort on dry cells and storage batteries has been carried through to the adoption of generally acceptable standards of performance for such equipment.

Standards of Practice

In the case of standards of practice, the work of the bureau has been limited largely to studies on public utility practice and safety standards. Codes and regulations involving technical detail work demanded

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Functions of the National Bureau of Standards

Development, construction, custody and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry and commerce.

Standards of Measurement:

To aid accuracy in industry through uniform and correct measures;

To assist commerce in size standardization of containers and products;

To promote justice in daily trade through systematic inspection and regulation;

To facilitate precision in science and technologic research through calibration of units, measures, and instruments involved.

By standards of measurement is meant:

Reference and working standards for measurements of all kinds, including fundamental and derived standards of measurement for expressing the quantitative aspects of space, time, matter, energy and motion, and of their interrelations. By definition, specification, or material standard, covering, for example, length, area and volume; mass, weight, density and pressure; heat, light, electricity and radioactivity, including for each the quantity, flux, intensity, density, etc.

Standard Constants:

To serve as an exact basis for scientific study, experiment, computation and design;

To furnish an efficient control for industrial processes in securing reproducible and uniformly high quality in output;

To secure uniformity of practice in graduating measuring instruments, or in compiling tables for standards of quality and performance, and wherever such uniformity is desirable;

To aid laboratory research by reducing errors and uncertainty caused by use of data of doubtful accuracy.

Standard constants are defined as:

Natural standards or the measured numerical data as to materials and energy, known as physical or standard constants, i.e., the fixed points or quantities which underlie research and industrial processes when scientifically organized. Mechanical equivalent of heat, light, electricity and gravitation; specific densities; viscosities; melting and boiling points; heat capacity; heats of combustion; velocity of propagation of light; conductivities of materials to heat and light; electrochemical and atomic weights; and many similar magnitudes determined experimentally with maximum precision and referred to fundamental standards of measure.

Standards of Quality:

To secure high utility in the products of industry by setting an attainable standard of quality;

To furnish a scientific basis for fair dealing to avoid disputes or settle differences;

To promote truthful branding and advertising by suitable standards and methods of test;

To promote precision and avoid waste in science and industry by affording quality standards by which materials may be made, sold and tested.

Standards of quality comprise:

Specifications for material (by description, sample, or both), known as standards of quality, fixing in measurable terms a property or group of properties which determine the quality. The numerical magnitude of each constituent property pertinent to the quality involved, and specific magnitude in units of measure of such significant factors as uniformity, composition, form, structure and others.

Standards of Performance:

To clarify the understanding between maker and user as to operative efficiency of appliances and machines;

To make exact knowledge the basis of the buyer's choice;

To stimulate and measure mechanical progress.

Standards of performance include:

Specification of operative efficiency or action for machines and devices, known as standards of performance, specifying the factors involved in terms susceptible of measurement. Numerical statement of speed, uniformity, output, economy, durability and other factors which together define the net efficiency of an appliance or machine.

Standards of Practice:

To furnish for each utility a single impersonal standard of practice as a basis for agreement of all interests, clearly defined in measurable terms;

To insure effective design and installation of utilities;

To promote safety, efficiency, and convenience in the maintenance and operation of such utilities;

To secure uniformity of practice where such is practicable, and effective alternates in other cases.

Standards of practice are defined as:

Codes and regulations impartially analyzed and formulated after study and experiment into standards of practice for technical regulation of construction, installation, and operation, and based upon standards of measurement, quality, and performance. Collation of standard data, numerical magnitudes, and ranges of the pertinent factors defining quality, safety, economy, convenience and efficiency.

thorough technical consideration in advance of adoption if they are to be fair and effective. In some cases uniformity of practice is of great importance, and in any such case the work of the bureau is of particular value because of its national character. However, in most cases the work of this sort is limited to an advisory or consulting function regarding matters of scientific fact. Regulatory measures which are matters of opinion are, or should be, in the hands of state and city authorities or intrusted to other government departments. As a matter of fact, the Bureau of Standards has substantially no work of a supervisory or administrative nature. Its whole organization is based on the assumption that it will not have any such police powers, even with respect to matters of fundamental standards of weight and measure, much less with respect to any other matters of science, technology or industry.

Growth of Industrial Research

The adoption of standard specifications, the determination of standard constants and other work on industrial materials have naturally led to an interest in industrial research. In some lines the bureau has found that industry was wholly unable to supply it with information regarding industrial processes in relation to composition or quality of the product sold. This led to a desire for a study of the industrial processes themselves; and the bureau has installed textile, paper, rubber, glass and ceramic equipment that makes its large industrial laboratory virtually a small-scale industrial city. To a considerable extent this work has been done with funds furnished by Congress for specific purposes. For example, one fund of this sort was specifically provided for the investigation of textiles, another for the investigation of optical glass, a third for the study of clay products, and several others of more general significance for industrial research, metallurgical research, etc.

In many cases the bureau has been encouraged by the members of industrial establishments to carry out this small-scale commercial, industrial research. In other cases there has been some criticism of the bureau for this work. This criticism has apparently been based largely upon the claim that the bureau should do nothing of this sort which industry can do for itself, but should limit its efforts to fundamental studies of science, either pure or applied, which are of interest to many industries or to all parts of an industry that cannot afford to carry out this work without government aid.

There is no doubt that the industrial work of the bureau has been more conspicuous and for many reasons more attractive to many of the members of the technical and scientific staff. Naturally this type of work is best appreciated by Congressmen, and thus encourages Congress to grant appropriations for subsequent work. Probably for this reason there has been a marked increase in this type of study, which began to be noticeable during several years preceding the war. However, it has been felt that in some cases the tendency has gone so far as to supersede fundamental scientific studies with so-called "practical" or technical investigations. Where this has occurred, there has been ample ground for the objection raised by those who no longer could get from the bureau the expected assistance on *fundamental* scientific work which that institution alone can do to best advantage in some cases.

Aluminum Products in 1921

The Department of Commerce announces that the census reports show a considerable decrease in the activities of the establishments engaged in the manufacture of aluminum products during the year 1921 as compared with 1919. The total value of products reported for 1921 amounted to $45,822,000, and for 1919 to $75,278,000, a decrease of 39.1 per cent. An additional production amounting to $1,847,000 in 1919 was reported by establishments engaged primarily in the manufacture of other products, principally brass, bronze and copper products. Corresponding figures for 1921 are not available.

The returns indicate that the combined output of all establishments was approximately 50 per cent of the maximum capacity, based upon a demand requiring full running time.

The statistics for 1921 and 1919 are summarized in the following statement:

COMPARATIVE SUMMARY OF STATISTICS FOR ALUMINUM MANUFACTURES, 1921 AND 1919

	1921*	1919*	Per Cent of Decrease†
Number of establishments	87	83	....
Persons engaged in manufactures	11,018	13,257	96.1
Proprietors and firm members	36	34	....
Salaried employees	1,398	1,821	23.2
Wage earners (average number)	9,584	11,402	15.9
Salary and wage payments	$13,945,000	$16,634,000	16.2
Salaries	3,110,000	3,307,000	6.0
Wages	10,835,000	13,327,000	18.7
Contract work	9,000	11,000	18.0
Cost of materials	25,974,000	49,272,000	47.3
Value of products	45,822,000	75,278,000	39.1
Value added by manufacture‡	19,848,000	26,006,000	23.7

* Figures given for 1921 do not include establishments reporting products below $5,000 in value. Eight establishments of this class reported a total of four wage earners and products to the value of $24,000. The figures for 1919, however, include three establishments of this class, reporting no wage earners employed and products to the value of $7,000.

† Percentages omitted where the base is less than 100.

‡ Value of products less cost of materials.

The figures for 1921 are preliminary and subject to such change and correction as may be found necessary after a further examination of the original reports has been made.

Use of Steam in Coal-Gas Retorts

The tendency toward lower standards of quality of gas in public utilities has increased the interest of the gas industry in processes that promise to increase the yield of gas per pound of coal coked, even though attended by a decrease in quality. The introduction of steam during or at the close of the coking process has shown considerable advantage in certain types of gas-making installations, notably in vertical retorts. The Bureau of Mines has co-operated with the American Gas Association in studying the effects of using steam in horizontal retorts, which are commonly used. It was found that the method of admitting steam had much to do with the results obtained. Little, if any, water gas was generated by decomposition of steam in the retort charge, unless the contact between the steam and the charge was intimate. Steam as usually introduced in the small gas plant where the process has been tried has no advantage. With prevailing standards of gas quality, little advantage can be taken of the use of steam, even if properly applied, as the production of any appreciable volume of water gas considerably reduced the general quality of the total gas production.

Only very recently has the thermal standard come to be universally adopted in place of the antiquated illumination standard. Should standards be further reduced, this process might show more marked economies.

Shaping Management To Meet Developing Industrial Conditions*

By H. S. Person
Managing Director, Taylor Society

An Analysis of Present Industrial Conditions—The Existence of a Buyers' Market for the Next Decade — How Management Must Change to Meet This Condition—What the Future Holds

In the conduct of any enterprise there is a major function, the responsibility for which resides somewhere in the organization, of determining future policy. In many enterprises this function may be regarded lightly, or even disregarded, on the principle that sufficient unto the day are the problems thereof; but in the larger enterprises, and in all well-managed enterprises of any size, it is not neglected. This is one reason for their good management.

The problem of future policy has many phases, of which the following come at once to mind: the commodities or services to be produced and sold; the quantities of these it is safe to attempt to produce and sell; the financial and technical equipment necessary; the technical methods of producing and distributing which shall be employed; the conditions of human co-operation which must be established in the enterprise. These, and many other major phases of policy not here enumerated, break down into numerous subsidiary but also individually important elements. The difficulty of solving the policy problem is not reflected in the simplicity with which these elements may be enumerated, for they are not clearly separable, but are complicated and cross-sect one another. Furthermore, solution of the policy problem requires measurements and estimates of elusive and changing governing conditions—the variable demands of markets for particular commodities and services; the variable strength of actual potential competition to meet these demands; the availability of financial and technical resources and changes in these; the availability of workers and the changing conditions of their co-operation; restrictions or regulations which may be imposed by governments, and so on. And thoroughgoing measurements and estimates of such things as these lead farther into the consideration of factors still more elusive; changes in the habits, tastes and mental attitudes of peoples; the probabilities of new discoveries and inventions; changes in the social machinery for the conduct of industrial operations; that complex of conditions generally designated by the inclusive term "industrial conditions."

What the American Executive Is

It is highly probable that an increasing number of enterprises will come to recognize that policy determination is a function which requires serious and continuous attention. It will involve the ascertainment of and analysis of facts concerning which executives have in the past had little interest, and it will involve, above all, much and careful thinking. It is questionable whether the American executive can be characterized as a thinking executive so much as one intuitional in reaction to immediate facts; he himself has been proud rather to consider himself the doer and go-getter par excellence—he who acts and gets while others think. If he is what he believes himself to be, he is the natural product of his economic environment; but one question to be raised tonight is whether there is not evident a sufficient change in the environment to make any such pride now unreasonable.

The particular phase of the policy problem which is to be considered tonight is presented in the question, "How must executives shape their managements to meet developing industrial conditions?" This question is fundamental, for a particular kind of management is an expression of decisions on many other matters of policy. The question is not to be understood as asking, "What new principles of management must be discovered and formulated to meet developing industrial conditions?" There are principles enough at our command—many more than have been generally recognized and utilized—to meet any conceivable conditions. We might change to a socialistic or communistic society and still be adequately served by the technical principles and methods already at industry's command. But under even moderately diverse industrial conditions we must utilize these principles and methods in different combinations, must weigh them differently, in accordance with the requirements of particular circumstances.

How Industrial Conditions Are Developing

Let us give our attention first to developing industrial conditions. A first glance is reassuring, for the revival due to follow the acute depression of 1921 is obviously already under way. This is indicated in all the reports of fundamental lines of activity. Bank clearings, car loadings, the production of basic commodities, and merchandise distributions have increased; stocks and bonds are more active; the spread between commodity prices has been reduced and in general a possible further long-run decline in commodity prices has been checked by price advances; there is an increase in employment and even in places a shortage of unskilled and skilled labor. Executives are reporting that they are "getting the red ink off their books"; and frequently there appear in the press optimistic utterances of captains of industry. We even already hear talk of a 1923 boom on the part of ultra-optimistic business men.

But a second, less superficial, consideration of conditions causes us to hesitate to join those who believe "it is all over except the shouting." May not this evidence of revival be only the evidence of rebound from the extreme depression, and may not the present rate of acceleration be only temporary, to be replaced by a rate more moderate? May not the projection of a curve into the future on the assumption of a continuance of the present rate of revival be a dangerous basis on which to establish managerial policy for the future? The more thoughtful and cautious fear so. When there is eliminated the activity to supply seasonal and terminable demand, and particularly the intensive activity to supply the abnormal demand for fundamental necessities to which the exigencies of war denied satisfac-

*Paper presented at a meeting of the Taylor Society, New York, Nov. 23, 1922.

tion—for instance, construction and all the lines of industry attendant on construction—when there is observed the fact that consumers' demand for a wide range of commodities and services is continuing to be hesitant and cautious, there is not left a sufficient amount of evidence to warrant a projection of the curve of industrial activity into the future at its present gratifying slope.

Consuming Public Has Cut Purchases

This point of view is expressed by a careful special correspondent of a dependable New York financial paper in a report from New England: "The only inference to be drawn [from facts enumerated] is that the bulk of the consuming public has been cutting off one thing after another in order to make its income go as far as possible in the matter of the commodities which it considers essential. Briefly, there are indications of a shrinkage in the American standard of living, which perhaps does not augur well for a long continuance of the present upward trend of industry, so called." How many in this audience have not reduced their standard of living from what it was during the period of 1914-1921, and how many, because of personal circumstances, do not expect to continue to keep it reduced for some time to come? The demand permitted by the aggregate of personal circumstances is what makes the market.

A third and more penetrating analysis, this time of more fundamental conditions, is even disconcerting to those who believe it is all over except the shouting. During the past decade, as a result of the study of earlier cyclic movements, we have learned that certain economic phenomena, such as the quantity of money and credit, have a definite relation to industrial activity. The store of money and credit influences prices and the price movement influences industrial activity. We should recall that the long period of accelerating industrial activity culminating in the frenzy of 1920-21 was coincident with a long upward swing in prices; that in general industrial activity increases in intensity with an upward price movement, is stagnant when there is a downward price movement, and is hesitant and uncertain in the early years of a new stable price level. Of course, the ideal condition is a fairly stable general price level, but when a condition of stable price level suddenly confronts an industrial generation which has become accustomed to a consistent upward price movement over a long period, the new condition of stability, because different from the accustomed, is upsetting to the individual, either as demander or producer, and it takes a considerable period, measured not in months but in years, for him to learn just what he can safely do both in purchasing and in producing.

Views of Harvard Committee

During recent years some sound work has been done in the analysis of fundamental industrial conditions and tendencies, which has given a basis for policy determination more substantial than anything we had previously had. It may be observed that during the past 3 years of experience wholly new to us the forecasts of these investigations have "called the turn" more accurately than the prophecies—or guesses—of business men. These investigators have succeeded in making some accurate measurements of basic elements which determine price conditions for a number of years ahead, and the safest judgment to accept is that, in the words of the Harvard Committee on Economic Research, "the present price level is substantially that around which the fluctuations of the business cycle must play" for the next 10 years. I make my own private reservations to that broad statement, for I believe the committee has failed to take into consideration the capacity of American managerial genius to increase vastly, when put to it under intensely competitive conditions, the quantity of goods for exchange which may be produced from a given combination of plant, equipment, materials and labor; but perhaps the committee is wise in not taking that into consideration, for it depends upon the wills of owners and managers, who are a conservative group when it comes to the adoption of new production methods.

Assuming that forecast to be correct, what is likely to be the effect of a new, high price level "around which the fluctuations of the business cycle must play"? Simply that you and I are, for a number of years, going to continue to be conservative as purchasers, and also conservative as producers. As producers we are going to wait for demand, and as demanders we are going to wait until we have adjusted our purchases to the new relation between our incomes and the cost of living. It is true that wages are settling at a new high level, but there still remains a large number of consumers whose incomes are not readjusted so easily and quickly, whose incomes as at present and will for some time continue to be adjusted rather to the old price level, and it does not take a very large bloc of maladjusted consumers to keep the market unsteady and uncertain.

The Market for the Next Decade

The conclusion I would have you draw is that for, say, a decade, consumers' demand is likely to remain so hesitant and uncertain as to be out of proportion to our capacity to produce. It does not seem necessary for me to give this particular audience any proof that the war has disclosed that our capacity to produce far exceeds anything we had believed it to be. I have talked recently with observing men who have covered the country from Maine to California, and they have reported that the most impressive single fact of their observations is the tremendous capacity of American industry to produce. You will recall President Friday's address at a meeting of this society two years ago; he stated that one outstanding fact is the increase in our productive capacity during recent years, and that if the war has taught us anything, it is that we allow a large part of that capacity to "run to waste through sheer idleness." Now I put this question to you as practical managers: If our productive capacity is so great, and if it can be made much greater simply by eliminating sheer idleness, and if consumers' demand is fairly certain to be hesitant for the coming decade, have you or have you not a really critical management problem?

However, before considering the kind of management that problem is going to force upon you, I want to make one more, a fourth, analysis of present industrial tendencies, painting the picture upon a large canvas. Let us give the picture a striking American title: The Overland Trail—from a dominant sellers' market to a dominant buyers' market. We all appreciate that we are now in at least a temporary buyers' market; I am suggesting that we are on the trail to a dominant buyers' market, and that we are possibly already on the great divide. If we are, we shall learn to manage our enterprises differently.

A summary review of the industrial history of the United States should make it patent that we have been brought up in a sellers' market. We have been pioneers—explorers, appropriators and exploiters of a vast continent of extraordinary resources. It has been a California of '49, or a Klondike, on the scale of a continent and a century. The exploitation of resources which have always had an immediate world market and cash value, the appropriation of stores of capital and treating it as income, has given our population a geometrically increasing purchasing power. Consumers' demand has kept ahead of and pulled along producers' capacity to satisfy the demand.

A Buyers' Market

But there comes a time in the history of an appropriating and exploiting people when they cease to be frontiersmen and appropriators; when the stores of nature's wealth are uncovered and appropriated, when future income through exploitation is capitalized at current values, when income becomes real income derived from productive effort and ceases to be in large part the appropriation of capital resources; when there emerges on the one hand a class of *rentiers* and on the other hand a larger class of laborers, clerks, sub-executives, major executives, merchandisers and others whose income is, on the whole, limited by the productivity of their efforts and whose consumers' demand power tends to become correspondingly fixed. In other words, industrial society tends to become more stratified and stable. There is then the danger of a period of maladjustment when technical equipment and productive capacity have overreached immediate demand, and when, if other markets are not sought, a buyers' market succeeds a sellers' market as the dominant factor in the industrial situation.

There were signs before the war that the industrial development of the United States was approaching that stage of evolution. Natural resources had become pretty well appropriated and capitalized—not only such resources as mines, forests and natural transportation routes, but also agricultural lands, for there was before the war an increasing proportion of tenant farmers, paying rent in cash or shares. Serious students were concerned over this tendency. Technical productive equipment was at the same time greatly increased, and there was no sign of a plan or even a clear intent to develop foreign markets. President McKinley's turn, just before his death, toward a reduction of the tariff obstacle to the development of foreign markets made no impression on the dominant political party, and there continued a period of tariff policy which has culminated in the Fordney-McCumber bill. It seemed to thoughtful observers that the quarter century before the war was a period of conscious or unconscious eat, drink and be merry, for today we are getting ours and tomorrow will take care of itself.

War Hastens Market Evolution

Then came the war, which was a tremendous shock to the industrial system. On the one hand it caused a still greater development of productive capacity, financed out of future earnings through the mechanism of bonus and taxation, and caused a coincident decline in consumers' demands (the frenzy of 1920 was but an unsubstantial flare-up), a decline which is likely to continue for some time because of the continuing heavy taxes and the maladjustments caused by the war. In short, the shock seems to have hastened evolutionary tendencies which would have developed more gradually and with only relatively minor depressions, and to have thrown us suddenly upon a buyers' market which will last for some time and may be the beginning of a dominant buyers' market.

What a Buyers' Market Means

A buyers' market means, for industries that are not competitive, a more radical and restrictive control or regulation, for when buyers look long at the dollar before parting with it, they look longer at the conditions which create the necessity for parting with all of it; and it means, for competitive industries, a strife for the consumers' dollar which makes so-called competition on a sellers' market seem but a children's game. In view of all these considerations, I think you will agree with me that there was never a time when management should have more concern over future policy—and over the quality of its future management.

Management on a buyers' market is quite a different thing from management on a sellers' market. On a sellers' market selling is but order-taking; on a buyers' market it must be real merchandising. On a sellers' market production is but the hasty and wasteful process of giving material things a form or other quality which will satisfy insatiable and not overcritical demand; on a buyers' market it must be more precise and economical. On a sellers' market financing is largely borrowing on the assumption of unexploited natural resources or an unexploited upward market; on a buyers' market it is a borrowing on demonstrable future earned profits. On a sellers' market the conduct of a business is easy and management is simple—in fact, there does not have to be any real management. But now that you appear to be face to face with a buyers' market and the necessity of developing real management, if you are to be successful in a most intense competition, if your competitor, instead of yourself, is to be the one to disappear in some readjustment of productive capacity to consumer demand, it is expedient for you to inquire into the nature of that real management.

The Problem Involved

The essential practical elements of the problem confronting that management may be summed up as follows: On the side of supply there is a tremendous production capacity involving heavy investments of capital in more or less specialized equipment, to preserve the value of which will require a continuation of the lines of activity for which it was designed. On the side of demand there is a conservative and hesitant market—in fact a buyers' market—which will continue for a considerable period. This will mean intense competition on the part of management to find the individual consumers and to sell them. In that competition selling price and cost of production will be critical factors. The hesitant market will tend to force selling price down, while higher prices of certain elements entering into cost will tend to keep that figure up.

The fact cannot be disregarded that, as was the experience after both of our earlier great wars, wages have settled at a new high level, and that the strength of organized labor and new immigration policy seem sufficient to hold them there during such a period as will determine the success or failure of competing enterprises. It should be observed also that many of the basic materials of industry are more or less closely

controlled, and that material costs are likely to remain high. Therefore management will be faced by high prime costs in the face of great pressure to reduce the selling price of fabricated products. The way out for the successful competitor appears to be this: to develop an inclusive system of management which will more than compensate for high prime costs by cost savings elsewhere, thereby effecting lower factory costs and making possible lower selling prices or making possible a higher quality of product at the original cost and selling price.

In the first place that management will give more attention to such problems as we are considering tonight—long-run tendencies in the industrial environment. These matters will no longer be regarded as merely "theoretical"; they will be regarded as very practical. Certain major executives will give more thought to policy and general plans, and not permit themselves to become too much absorbed in operating details and worn out by late afternoon worries. They will not confine their reading to the news headlines and market quotations of newspapers, but will read under the headlines, search for the facts and do some thinking of their own. They will find time for—and consider as important as some of the things for which they now find time—the reading of magazines of fact and opinion relating to administration, management, economics, politics and industrial relations. They will have in their organizations a unit to study and interpret industrial statistics. In illustration, a major executive of a certain medium-sized plant inquired of the Taylor Society the other day where he could find a young man, a college graduate trained in economics and statistics, to study for him the periodic reports of statistical service, and interpret them for the management in terms of the particular business. That enterprise is getting the jump on competitors.

Managers Must Study Markets

That management, in the second place, will provide for a more accurate judgment of the market with respect to the demand for the commodities it has to offer, competitors' ability to supply the demand, and what share of the market it can have reasonable expectation of securing. It is with the consumer that the impulse for industrial activity begins—"the consumer is king"; but on a sellers' market consumers are so numerous and insistent that we forget the source of the impulse and come to believe that it starts with the producer. Under the competitive conditions of a buyers' market, managers will see that in true perspective. Managers will learn that they cannot afford to misjudge demand, either with respect to what it wants, how much of that it wants, or what share of it competitors will permit a particular enterprise to provide. Excessive inventories are fatal on a buyers' market. An enterprise must avoid that by some unit of the organization, whether it be an individual or a group, which will make continuous and precise analyses of the market and provide the data for master plans and schedules. Call it what you will—market research, merchandise research, sales engineering.

In the third place, that management will set up in writing, on the basis of the data secured by market research, definite master plans, budgets and schedules of operations for a considerable period ahead, these being supported by definite and interdependent detail plans and schedules for the major operating departments —selling, production and financing, respectively. These master plans and schedules, and these supporting departmental plans and schedules, will be standards of performance, goals to strive for, lines to which to hew. To do without such plans and schedules means guessing, taking chances, departments out of alignment, unbalanced inventories, higher costs—losses for which the consumer willingly pays the price on a sellers' market, but which, on a buyers' market, become a loss to the producer which he cannot afford when competition is intense.

That management, in the third place, will have to conduct its selling operations with more skill than it has ever displayed before. On a sellers' market the consumer seeks the producer; on a buyers' market the producer must search out the consumer and sell him, in the midst of a keen competition both of other producers of the same commodity and other uses of the consumer's dollar. Just as there must be no misjudgment of the market, lest there be unsold inventories; no failure to make precise plans and schedules, lest there be unsold inventories; so also there must be no failure to search out and sell to the estimated number of consumers, or there will be unsold inventories.

Changes Caused by Buyers' Market

Are we able to imagine the detail changes which are likely to follow the development of the new merchandising? Is it not probable that there will be less of that advertising whose object is to create new wants in satisfaction of which consumers would spend surplus dollars, and more of that advertising whose object is to convince concerning the quality of staple merchandise offered in competition for the limited supply of dollars? Will not the work of salesmen be something besides either mere order-taking or mere psychological suasion; is not the salesman more likely to spend more time searching out prospects; calling on prospects as well as established customers; skillfully displaying the merits of goods; rendering intelligent—even scientific—service; planning and scheduling his work? Will not the supervision of sales executives and their assistants be more comprehensive and more skillful—again, more scientific—than anything we have seen; salesmen better selected, better trained, their work better planned and scheduled and given more intelligent and effective support by the directing staff? Will not the channels of distribution be more carefully studied and more discriminately selected?

I have called attention first to market analysis, master plans and budgets, and selling, as conspicuous features of the new management, not because they are superior in importance to other phases of management, but because they logically come first—the point of origin from which to lay out the operations of an enterprise being the consumer—and because in the sellers' market of the past these phases have been most neglected. It is not to be assumed, however, that I attach less importance to better production methods as a feature of the new management.

Good Production Methods Necessary

There are some who assert that the production problem is solved and that we should now give most attention to other phases of management. I believe they are too hasty in their judgments, especially if we are thinking in terms of a severe competition on a buyers' market. The production problem is far from

solved. It is true that we know more about good production management than about good sales management, and that we have a body of production management principles and practices at our command which, if utilized, would eliminate waste, reduce factory costs and permit price reductions to an astonishing extent; but it is equally true that they are not generally utilized, and the educational task of bringing about their utilization in a plant is as difficult and time-consuming a task as developing market analysis and improved selling methods. Perhaps more so, for the development of market analysis, master planning and selling is the problem of a small group of specialists, while the development of superior production methods is a problem involving the precise co-operation of many individuals of varying capacity for co-operation.

Furthermore, the more severe the competition the more important become good production methods. For in the final analysis, no matter how accurately we gage the market, how precisely we prepare schedules of operations, how skillfully we sell, the greatest weapon in competition is the combination of a dependable product, a dependable service and a quotation lower than competitors', and it is superior production methods which contribute most to making this weapon possible. If you can safely and consistently quote a lower price for an identical commodity and have a reasonably good selling organization, your competitors will hold you in dread.

Waste Must Be Eliminated

In the fourth place, therefore, the superior management of the next decade will develop the production department to a high degree of precision, in accordance with principles and methods already formulated and available. As some strong merchandisers secure their profits by taking discounts, so strong manufacturers can take their profits by eliminating waste—the waste of useless or unused plant; the waste of useless, unused or inefficiently used equipment and tools; the waste of unsuitable, inadequate or lost materials; the waste of inefficient methods; the waste of improperly chosen, improperly assigned, improperly instructed and inadequately inspired workers. Investigations and experiments will be conducted which will disclose the best equipment, tools, methods and materials for the fabrication of the product, and on the basis of the discovered best details will be established standards of product, equipment, materials and processing. Provision will be made for the maintenance of these standards, and these once established and maintained, a control of operations through planning, scheduling and checking of progress will be possible, which, as has been demonstrated in too few but an adequate number of instances, forges the competitive weapon of lower costs and lower quotations.

Finally, that management will win the co-operation of all the personnel of the enterprise, not as a matter of humanitarianism but as a matter of technical necessity. Without such co-operation all other provisions for excellence of management are impaired. The good will of the personnel is in many instances the determining factor in successful competition. The combinations of elements by which this good will is won may be different in different enterprises, but all will be identical in at least two respects: a group of elements which secure the personnel's cordial consent to the standards of all kinds which are established, and a sharing of the product of combined effort through wages which satisfy the personnel as reasonable and just.

The entire personnel of an institution, from major executive to the latest recruit, should be a co-operating group of individualities—co-operating, in the sense that each must play a part in a system of operations; individualities in the sense that each should be an original source of inspiration and new ideas and a creator of new methods which fit and promote the work of the system. Too many institutions simply inbreed. Individuals lose their individuality and the organization loses its vitality. The greatest asset of an organization is not plant and equipment, cash in the bank, or even an organization of persons; but a spirit of co-operation, an atmosphere of live interest in the best management principles and practice, an *esprit de corps* of search for wiser policies and better methods and individualities which have not lost the power of creation within co-operation.

It is not out of place to call attention to a special aspect of the new management—the utilization of a new type of executive. The long sellers' market of the United States has developed highly one particular type of executive—the forceful, acquisitive, go-getter type which drives straight to results regardless of methods and cost. But while the forceful, go-getter type of executive will always be essential, managers have come to realize that an organization must be balanced by the inclusion of the thinking, investigating, planning type of executive who surveys conditions and tendencies, formulates precise plans, establishes schedules and budgets, keeps departments co-ordinated, maintains precise control of operations, has regard for efficiency and economy of methods, and all the time appraises progress and results in terms of plans. Even the go-getter executive must become a thinking, planning executive after the enterprise is well established as a going concern. The thinking and planning type of executive will play a decidely important part in the future.

What the Future Holds

In conclusion, it should be understood that I am not pessimistic concerning what I believe is likely to be the developing industrial conditions. At the worst, consider what has been said as a word of warning. In the long run our very capacity for production will solve the problem, as it has in the past solved it under comparable circumstances; but the restorative power of that capacity for production must be realized chiefly through a regulation by better individual managements. We shall have short-time cyclic variations but fundamental increasing prosperity for industry in general during the decade of correction of maladjustments to new conditions. Note, however, the significance of the words "for industry in general." In the probable readjustment through competition on a buyers' market, some enterprises are certain to disappear, and they will be those particular enterprises which are satisfied with the management which is "just as good as the average," for that mental attitude almost invariably means managements which are poorer than the average. For a quarter century before the war even poorly managed enterprises were helped in their ascent to the heights of prosperity by the escalator of a sellers' market; now that escalator is out of commission, and the ascent to new prosperity must be achieved in the good old fashioned way—by good management muscles, good management lungs and good management brains.

Two Forms of Nitrogen in Steel

By Louis Jordan and F. E. Swindells
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When heat-treating two heats of silicomanganese spring steel it was found that certain hardening treatments very noticeably increased the combined nitrogen in one steel made in an electric furnace,[1] while an open-hearth steel of almost identical composition showed practically no increase in combined nitrogen.

The manufacturer's analyses of these steels for the usual constituents gave the following results:

	C	Mn	P	S	Si
Steel A (electric)	0.53	0.77	0.022	0.014	2.09
Steel B (open-hearth)	0.54	0.77	0.017	0.022	2.03

Analyses of the rolled stock as received by the bureau showed in the electric steel twice as much combined nitrogen as in the open-hearth steel (Table I).

TABLE I—COMBINED NITROGEN IN SPRING STEELS AS ROLLED

Electric Steel		Open-Hearth Steel	
Sample No.	Per Cent Nitrogen	Sample No.	Per Cent Nitrogen
A16	0.0041	B29	0.0019
	0.0051		0.0022
A2	0.0038	B1	0.0025
	0.0047		0.0031
	0.0051		
Average	0.0046	Average	0.0024

Further analyses were made on samples of steels A and B which had been given (1) a regular hardening treatment, as practiced by spring manufacturers, (2) a normalizing quench followed by the regular hardening treatment, (3) a sample of steel A which had been subjected to the normalizing quench only. In the "regular" treatment, (1) above, a hardening temperature of 900 deg. C. (1,650 deg. F.) was used. The normalizing quench (2) was from a higher temperature—namely, 980 deg. C. (1,800 deg. F.).

Combined nitrogen in the open-hearth steel was changed but little if at all by the treatments given. However, either a normalizing quench or a normalizing quench followed by the regular treatment doubled the amount of combined nitrogen in the electric steel (Table II).

TABLE II—INFLUENCE OF HEAT-TREATMENT ON COMBINED NITROGEN IN SPRING STEELS

Treatment	Electric Steel			Open-Hearth Steel		
	Sample No.	Per Cent Nitrogen	Average	Sample No.	Per Cent Nitrogen	Average
As received			0.0046			0.0024
Regular hardening treatment	A4	0.0065		B2	0.0037	
		0.0068	0.0066		0.0023	
					0.0024	0.0028
	A5	0.0061				
		0.0064	0.0063			
Normalizing quench	A20	0.0098				
		0.0086	0.0092			
Normalizing followed by regular treatment	A31	0.0109		B19	0.0025	
		0.0095	0.0102		0.0035	0.0030

It is difficult to believe that the heat-treatment itself as carried out could increase the total amount of nitrogen in the electric steel and make no change in the open-hearth steel treated simultaneously. It seems probable, in view of the limitations of the solution method for nitrogen explained in a previous article,[2] that there is no increase in the total nitrogen in the steel, but that some nitrogen that was originally present in some form not determined by this method was converted into a form that permitted its determination.

Of interest in this connection is a patent granted to Krupp Akt.-Ges.[3] which has claims based on the introduction of nitrogen into steel at temperatures below 580 deg. C. in the form of solid solution, as distinct from nitride of iron which is formed on heating above that temperature.

Electrolytic Iron Treated With Calcium

A series of ingots of electrolytic iron was next examined to determine if similar changes in combined nitrogen could be detected in iron free from the usual metallurgical impurities or alloying elements. These ingots had been prepared for another purpose and to all but one (ingot 385) small amounts of metallic calcium had been added just before casting in a chilled mold. Melting was done in a high-frequency induction furnace in crucibles made of 85 parts of magnesia and 15 of zircon. Combined nitrogen was determined in these ingots as cast. They were then given a heat-treatment similar to the treatment which gave the greatest increase in combined nitrogen in the electric furnace spring steel—namely, a normalizing quench from 1,040 deg. C. (1,900 deg. F.) followed by a second quench from 910 deg. C. (1,670 deg. F.). Table III shows that there was nearly always a marked increase in the combined nitrogen. Four of these treated ingots were annealed at 950 deg. C. (1,740 deg. F.) for one-half hour and then cooled slowly over a period of about 4 hours. No very definite change in the combined nitrogen was caused by this treatment—the slight differences observed were not uniform in direction.

TABLE III—COMBINED NITROGEN IN ELECTROLYTIC IRON INGOTS TREATED WITH CALCIUM*

Ingot No.	Per Cent Nitrogen As Cast	Average	Per Cent Nitrogen After Heat-Treatment	Average	Increase Due to Quenching	Per Cent Nitrogen After Annealng	Average
380	0.0087		0.0111			0.0126	
	0.0082		0.0101	0.0106	0.0018	0.0112	0.0119
	0.0096	0.0088					
381	0.0015		0.0029			0.0029	
	0.0030	0.0022	0.0037			0.0032	0.0030
			0.0051		0.0022		
			0.0059	0.0044			
382	0.0030		0.0050				
			0.0054	0.0052	0.0022		
383	0.0015		0.0040				
			0.0042	0.0041	0.0026		
384	0.0028		0.0042			0.0042	
			0.0037		0.0011	0.0030	0.0036
			0.0037	0.0039			
385	0.0016		0.0036			0.0024	
			0.0038	0.0037	0.0021	0.0021	0.0022

* The calcium added was equivalent to 0.2 per cent in 380 and 381; 0.1 in 382; 0.03 in 383; 0.01 in 384. No addition was made to 385. The residual calcium in the ingots ranged from 0.04 to 0.003 per cent.

Autoclave Steel

There was next examined a specimen of steel from an autoclave used for containing the catalyst and nitrogen-hydrogen gas mixture in the Haber process for nitrogen fixation. The gas mixture in this autoclave was treated at a pressure of 1,500 lb. per sq.in. and at a temperature of 500 deg. C.

	C	Mn	P	S	Si
Outside layer	0.42	0.65	0.031	0.033	0.29
Inside layer	0.14	0.65	0.032	0.036	0.29

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[1] H. J. French and L. Jordan. Discussion of paper by MacQuaid and Ehn. Paper No. 1163 issued with *Mining & Met.*, May, 1922.

[2] "Determination of Combined Nitrogen in Iron and Steel," by Louis Jordan and F. E. Swindells, *Chem. & Met.*, vol. 27, No. 23, p. 1125, Dec. 6, 1922).

[3] F. Krupp Akt.-Ges., Brit. Pat. 174,580; *Chem. Abs.*, vol. 16, p. 1738 (1922).

Analyses of the inside and outside layers of the plate for the usual elements showed considerable decarburization of the inside layer.

Nitrogen determinations showed that the inside contained about 50 per cent more combined nitrogen than the outside. One sample of this plate was given the regular hardening treatment previously referred to in the case of the spring steels and another sample the normalizing quench followed by the regular treatment. There was a very marked increase in the combined nitrogen in the outside layer with both heat-treatments. In the inside layer there was no change in the combined nitrogen. (See Table IV.)

TABLE IV—COMBINED NITROGEN IN AUTOCLAVE STEEL

	As Received		Regular Treatment	Normalizing Followed By Regular Treatment	
	Per Cent Nitrogen	Average	Per Cent Nitrogen	Per Cent Nitrogen	Average
nside.....	0.0145		0.0145	0.0146	
	0.0140	0.0142		0.0156	0.0151
Outside.....	0.0091		0.0162	0.0149	
	0.0093	0.0092		0.0128	0.0138

The failure of the combined nitrogen of the inside layer to be altered by heat-treatment may possibly be explained by the fact that the conditions of service (namely, at 500 deg. C. in the presence of hydrogen and nitrogen under pressure) were such that all the nitrogen, both originally present and diffusing into the plate, was converted during the operation of the autoclave into the form determined by the solution method. The outside layer of the autoclave plate was possibly at a lower temperature than the inside layer, a temperature below that necessary to convert to the nitride form the nitrogen diffusing from the interior.[4] A still more probable explanation is that the presence of hydrogen was necessary to cause all the nitrogen to form nitrides and that the outer layer of the plate was beyond the zone of hydrogen penetration, a fact indicated by the decarburization being limited to a narrow inner layer.

Fused Electrolytic Iron

An attempt was then made to check the previous results obtained with the electrolytic iron. Three ingots of electrolytic iron were prepared in a high-frequency induction furnace and cast in a chilled mold. One was melted under quiet air in a crucible of 85 parts of magnesia and 15 parts of zircon. The two others were melted in pure magnesia crucibles, one being under quiet air and the other under a stream of pure nitrogen. These ingots were given the same heat-treatment as the first electrolytic iron series—viz., a normalizing quench followed by hardening. No change in the combined nitrogen could be detected (Table V).

TABLE V—COMBINED NITROGEN IN ELECTROLYTIC IRON

Ingot No.	Method of Preparation	Per Cent Nitrogen As Cast	Average	Per Cent Nitrogen After Heat-Treatment	Average
388	MgO-zircon crucible; under air	0.0033		0.0031	
		0.0030	0.0032	0.0030	0.0030
456	MgO crucible; under air.....	0.0033		0.0034	
		0.0056		0.0034	
		0.0056	0.0048	0.0030	0.0033
457	MgO crucible; under nitrogen....	0.0070		0.0071	
		0.0072	0.0071	0.0065	0.0068

It is improbable that the observed increase in combined nitrogen in the above metals is due to nitrogen introduced during heat-treatment, since the electric and open-hearth steels were treated simultaneously, as were also both layers of the autoclave plate. The increase was found in one member of each pair but not in the other. In other words, the total nitrogen in these metals was not increased.

It is likewise improbable that the increase in nitrogen determined by the Allen method is due to the formation of iron nitride following the decomposition of nitrides not determined by this method of analysis, since this increase in combined nitrogen also took place in the first series of electrolytic iron ingots, which contained as the only impurity mere traces of calcium, the nitride of which is readily decomposed by acids.

It is to be concluded that nitrogen may be present in iron and steel in more than one form—as combined or nitride nitrogen and as uncombined nitrogen. The changes in the amounts of combined nitrogen are probably the result of conversion of free or uncombined nitrogen to nitride nitrogen. The free or uncombined form of nitrogen is not present in all samples of iron and steel, or may vary widely in amount.

The authors wish to acknowledge their indebtedness to H. J. French for carrying out heat-treatments of the metals examined and to H. A. Bright for making the chemical analyses other than those for nitrogen.

[4]Compare the claims of the Krupp patent, note 3.

Spanish Trade in Chemicals

Before the war Spain imported from abroad a great part of the chemical products employed by her industries, especially coloring matters derived from coal.

From the point of view of tonnage landed in Spain, the first rank was taken by superphosphate of lime and basic bessemer slag; then the following products may be quoted as having given rise to a good current of business: Vegetable preparations for the dyeing industry, vegetable preparations for medicinal purposes, coloring matters, sulphur (raw and refined), alkalis, insecticides and sulphate of copper, feculas for industrial purposes, gums, dextrine, etc., for stiffening purposes, paraffine and nitrate of soda.

Germany despatched approximately 25 to 30 per cent of the importations of this class of goods; Great Britain 20 per cent; the British possessions in Asia 12 to 15 per cent; the Dutch colonies 6 to 7 per cent (the two last-named regions sent principally oilseeds), while France's share of this trade amounted to between 10 and 12 per cent.

During the war the Spanish industry, finding itself mistress of the home market, equipped itself to supply a considerable number of products of which the importation had ceased; for example, arrivals of dyestuffs derived from coal fell from 1,351,058 kg. in 1914 to 406,342 kg. in 1917. This industry consequently insisted on a high customs tariff.

It seems that the commercial conventions inaugurated during the past 6 months will facilitate to a certain extent the importation of chemical products into Spain, but the final result cannot yet be foreseen.

It appears that in the case of some articles foreign industries must face a diminution of their sales in Spain, unless a great difference in the cost price can be attained. The manufacture of sulphuric acid and nitric acid has greatly developed in Spain.

The Minister for War intends to buy a large piece of ground (700 hectares) in the neighborhood of Madrid for the purpose of erecting chemical works with annexes in order to be able to manufacture products required for national defence now purchased abroad.

Gasification of Ohio Coals—I

The First of Two Articles Presenting the Results of a Preliminary Survey Made to Determine Suitability and Economic Value of Various Ohio Coals for Gas-Making Purposes

By D. J. Demorest
Professor of Metallurgy, Ohio State University

THE natural gas production of Ohio has dropped so far below the demands of that state that out of the total consumption of 145,000,000,000 cu.ft. in 1920 Ohio produced only 60,000,000,000 cu.ft., the difference being made up by gas piped in from West Virginia. The new wells drilled in Ohio all come in with lower pressure year after year. It is obvious that the natural gas supply will grow less with each year and will soon be entirely inadequate for the state's needs even with gas from West Virginia.

These facts were so evident several years ago that it became a matter of immediate importance to institute a survey to determine what resources the state possesses for the making of manufactured gas to supplement and ultimately completely to supplant the natural gas. The writer presented the case to the Engineering Experiment Station of the Ohio State University and the Legislature was asked to appropriate a sum sufficient to erect an experimental plant whereby the gas- and byproduct-making values of the coals of Ohio might be determined. The Legislature made such a grant to the Engineering Experiment Station, out of which $10,000 was allocated for this coal-testing work to cover the cost of erecting the plant. The gas and coal interests of Ohio were then asked to appropriate funds for operating the plant for one year. The Southern Ohio Coal Operators' Association through W. D. McKinney, its secretary, made a grant of $200 per month for one year and the Gas and Oil Men's Association through W. H. Thompson, its secretary, granted $100 a month for one year.

The Purpose of the Survey

It must be distinctly borne in mind that the researches reported in these articles constitute only a preliminary survey. It is hoped and expected that this preliminary survey will enable us to classify our coals so that we shall know which ones to select as the most economical for gas making, and then concentrate more detailed work upon those coals in order to discover exactly the best conditions for their gasification and to establish with a fair degree of accuracy their economic values to the gas industry.

Each coal yields its best value upon gasification under its own peculiar conditions. For instance, some coals must be gasified at comparatively high, others at comparatively low temperatures. The amounts of gas made, the total number of heat units in the gas, the number of heat units per cubic foot, the amount and nature of light oils recoverable, the amount and nature of the tar produced, the amount of ammonia recoverable, the impurities in the gas (such as hydrogen sulphide and naphthalene) and the quality of the coke all vary with the rate of gasification and the temperature. The amounts and qualities of these products which can be recovered also vary with the fineness to which the coal is crushed before charging in the retort and with the amount of moisture in the coal. It is also true that many coals which are not economically gasified alone may be very valuable for gasification purposes when mixed with a characteristic amount of some other coal.

In this preliminary survey it was possible only to carry out the carbonization experiments at the average temperature of 1,000 deg. C., which will probably give the best results for some coals but is too low a temperature for some other coals and possibly too high for still others. Furthermore, it was not possible in this preliminary survey to discover the optimum fineness for crushing nor to attempt to find the results obtainable by mixing coals or regulating the moisture content. In the further work which is to be done on certain selected coals, the economies resulting from steaming the coals and resulting from the use of sized coal will be ascertained.

In this work it was realized that the most highly refined methods for determining the benzol yield and the distribution of sulphur in the gas were not justified,

FIG. 1—FRONT VIEW OF RETORT STRUCTURE

because of the fact that in the preliminary work the time and money were not available for ascertaining the retort conditions which would give the best yields for each coal. Hence only comparative results were sought.

It is believed, however, that the results obtained from this preliminary survey are reasonably accurate and afford a basis for the selection of those of our coals upon which further detailed work should be done. Furthermore, they give a rough evaluation of all the coals for gas making.

The retort selected for gasifying the coal is an intermittent vertical type of exactly the same shape and dimensions as those in commercial use. In fact, the retort erected was an extra one of the 250 retorts

FIG. 2—SIDE VIEW OF RETORT STRUCTURE

erected at Rochester, N. Y., for the city gas supply. The United Gas Improvement Contracting Co., which erected the Rochester plant, also erected this experimental retort, generously doing it at cost.

The equipment required for recovering tar and ammonia from the gas made and the arrangement of machinery were designed in the department of metallurgy and erected by university mechanics.

The equipment for crushing the coal, washing the coal and testing and analyzing the products made are all a part of that possessed by the department of metallurgy.

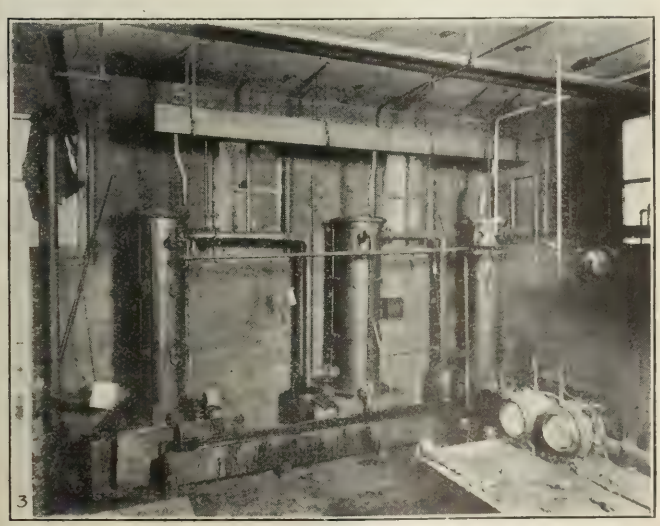
Figs. 1 and 2 are photographs of the retort structure and Figs. 3 and 4 are views of the byproduct recovery system. Fig. 5 is a diagrammatic sketch of the plant.

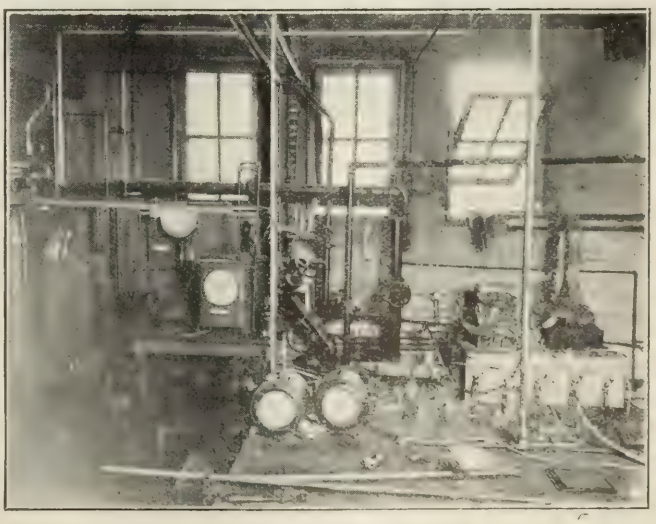
The retort carries a standard charge of 1 ton (2,000 lb.) of coal. The charge is all run in a fraction of a minute, and remains in the retort until the carbonization of the entire ton is complete, requiring 10 to 17 hours. In other words, the retort is of the intermittent type of vertical retort—not of the continuous type. The retort is heated for convenience sake with natural gas, burning at three different levels and giving an exceedingly uniform temperature around the entire setting. The temperature of the setting was recorded by a Brown recording pyrometer with the thermocouple halfway between the top and bottom of the retort. The thermometer was checked by a standard thermocouple and an optical pyrometer and was found to be correct.

The gas passes from the top of the retort *A* (see Fig. 5) through the bridge pipe *B* into the foul main *C*, thence down pipe *D* into the bottom of and up through scrubbing tower *E*, thence into the bottom of and up through scrubbing tower *F* and similarly through tower *G*. From tower *G* the gas is drawn through the exhauster *H* and to the furnace *I*. By means of the pump *J* a dilute sulphuric acid solution is continuously circulated through towers *E* and *F*. Cold hydrant water passes down through tower *G* and through the cooling coils *Z*, thence to waste. The cooling coils keep the circulating acid from becoming too warm. These scrubbing towers are filled with wooden grids staggered so that the gas and circulating liquids must come into intimate contact. The circulating acid solution removes all the ammonia from the gas and practically all of the tar not previously condensed. At *K* some gas is drawn off continuously for the determination of sulphur; at *L* the gas is sampled continuously for its "light oil" contents; at *M* a sample is continuously drawn for the determination of the B.t.u. value of the gas by means of a Smith continuous recording gas calorimeter, and at *N*, the gas is metered by a Bailey orifice gas meter, which continuously records the rate of gas making and integrates the total volume made.

The bottom of the retort setting is a heavy iron casting with an opening the size of the interior of the retort. This opening is closed by a cast iron door, *DD*, which is hollow and which is aligned with a channel in the iron bottom plate so that the tar which drips down against the door may drain out into tank *S*. The door is lifted into place before charging the coal and lowered for the discharge of the coke by means of a triplex chain-fall. The coke drops into a portable steel tank and is then dragged from under the retort and quenched with water drawn from an elevated reservoir.

Through the offices of the purchasing agent of the Ohio State University and the secretary of the Southern Ohio Coal Operators' Association carload lots of coal representing the important fields and seams of the





FIGS. 3 AND 4—TWO VIEWS OF THE BYPRODUCT RECOVERY SYSTEM

southwestern Ohio coal regions were shipped to the university siding. In nearly all cases the coal shipped was run of mine. Out of each carload there was taken a sample amounting to 5 tons for testing, for which the shipper received no pay, the university paying for the rest of it at the prevailing rates. The coals were tested as soon as possible to prevent the weathering changes that affect the quality of coke and gas from the coal.

The 5-ton sample of coal previously referred to is put through a set of Jeffrey rolls, which crush it to about ½-in. size. One ton of this crushed coal is then carefully weighed and hoisted by means of a winch into the bin *O*. All the meters are then inspected to see that they are set at zero, the seals are inspected to see that they are closed, the circulating pump *J* is started and the recording pyrometer *P* is read to be sure that the temperature is satisfactory; the door *Q* at the top of the retort is then opened and the coal slides from bin *O* through shoot *R* into the retort. While the coal is running it is sampled several times, a sample weighing about 10 lb. being obtained. While the coal is running into the retort the water seal in the foul main *C* is drained into tank *S*, where it serves to dilute the ammonia liquors yielded by the coal. As soon as all the coal has run into the retort, doors *Q* and *B* are closed, valve *T* is opened, exhauster *H* is started and valve *U* regulated so that the manometer *V* indicates ⅛ in. of water vacuum and manometer *W* on the foul main indicates 1/10 to ⅛ in. of water vacuum. Thereafter, during the entire run, valve *U* is regulated so as to maintain these vacuums, which are merely sufficient to withdraw the gas from the retort as fast as it is liberated. As soon as gas commences to burn in furnace *I* the motor of the gas calorimeter *M* is started and the calorimeter put into operation by igniting the gas in it by means of a spark plug. At the same time the aspirators of the sulphur train *A* (Fig. 6) and light oil train *E* (Fig. 7) are started and these two determinations proceed continuously during the entire run.

During the 10 to 18 hours which the carbonization of the coal requires, the operator's duties consist merely in seeing that the valve *U* is changed when necessary to maintain the proper vacuum on the retort, that the circulating pump is circulating the sulphuric acid liquor at the proper rate and that the proper excess of sulphuric acid is maintained in the circulating liquor, that the temperature of the retort is properly maintained, that the recording calorimeter, recording meter, sulphur train, light oil train, etc., are properly functioning.

The operator is instructed to regard the test ended when the rate of gas made per hour drops to 300 cu.ft. or when the B.t.u. value of the gas being made drops to 300 B.t.u. net per cu.ft., as it is not likely to be profitable to operate any retort plant beyond this point. It is interesting to note that usually the B.t.u. value drops to 300 at about the same time that the rate of gas making drops to 300 cu.ft. per hour.

When this point has arrived, the operator stops the sulphur and light oil determinations and records their meter readings, records the total volume of gas made and any other special records that are called for, shuts down the circulating pump, closes valve *U* and stops the exhauster, climbs quickly to the top of the retort and opens bridge-pipe door *B* to permit the remaining gas to escape into the atmosphere. It was very essential that valve *U* and all other openings in the by-product system be kept tightly closed until the bridge-pipe in foul main *C* is sealed off with water, as otherwise, owing to the chimney effect of the light coal gas in main *D*, air would be sucked into the system, resulting in an explosion in the foul main. This is quite disconcerting, as it generally blows the water-sealed top of tower *E* off—sometimes hitting the ceiling of the room. The towers *E*, *F* and *G* were designed with loose water-sealed tops to take care of this contingency. However, the explosions never take place if valve *U* is closed before opening door *B* and if thereafter no opening is made in the byproduct system (such, for instance, as might be made if the sulphuric acid solution sump *SS* were drained, exposing the bottom of the tower drains *TD*) until the bridge-pipe in the foul main *C* is sealed by water. (Since these tests the equipment has been changed and some of these operating details no longer apply.)

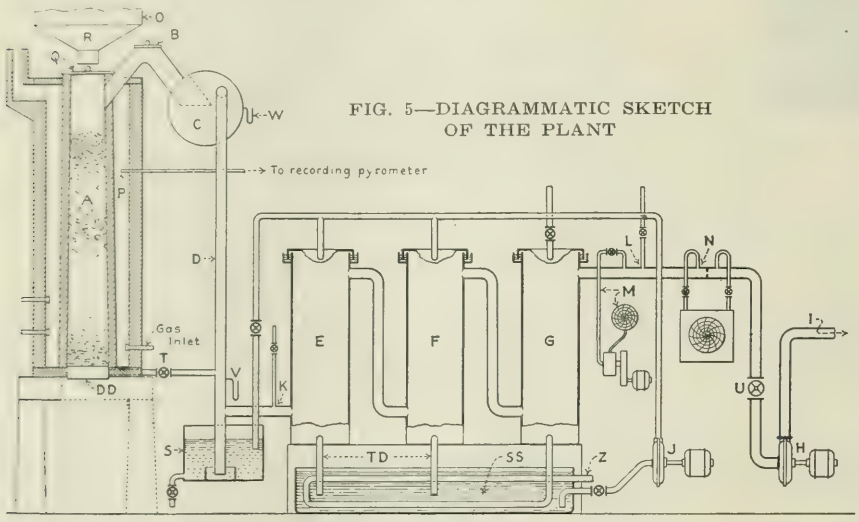


FIG. 5—DIAGRAMMATIC SKETCH OF THE PLANT

The tests were usually started about 8 a.m. so that they were finished before midnight. At this time the operator left for the night.

In the morning the discharge door *DD* at the bottom of the retort was opened and the coke dropped into the steel tank beneath the retort, the tank pulled under the quencher *WQ* and quickly quenched with the well-distributed spray. The tank *QT* when filled to 1 ft. from the top holds just enough water so that when it is all quickly sprayed upon the hot coke, the coke is quenched, but enough heat is retained to dry the coke partly.

While the coke is drying, the tar and ammonia liquor is drained out of the foul main *C* into tank *S*. The main is filled with fresh water. The liquor in the sump *SS* is pumped into tank *S* and the bottom scraped to remove any tar clinging to it. After sufficient time has elapsed to allow the tar and water in tank *S* to separate by gravity, they are drawn off and weighed separately and samples of each set aside for analysis. The coke is then screened through a 1-in. screen, each size being weighed. About 50 lb. of the coke comprising oversize and undersize in proper proportions is weighed, dried and weighed again to obtain the moisture in the coke. The dried coke is then sampled for analysis.

After oiling the motors, renewing the solutions and putting fresh recording charts on the recording instruments, the equipment is then ready for the next run. Under this schedule it was not feasible to make more than one test in 2 days if the tar, ammonia, etc., were obtained from each run. With a larger force a complete run can be easily made each day, and with two shifts two runs could be made in 24 hours.

The methods of chemical analysis used for the coal, coke, tar, ammonia liquor, gas, etc., are the standard methods usually followed by fuel chemists. (See the Gas Engineers' Handbook, Second Edition.) These routine methods will not be described in this article, but it is advisable to indicate somewhat in detail the way in which the "organic sulphur," "light oils" and naphthalene are determined. These determinations are started in the beginning of the run and continue until the test is ended.

As soon as the test on a coal sample is started, the determinations here described are started. For the sulphur determination the aspirator *A* (Fig. 6) draws gas from the main at *K* through the wash bottles *B* and *C*, which remove the H_2S. The gas discharges from the aspirator with the water into the inverted glass tank *D*, thence through meter *E* and into the burner *F*, where it ignites. This burner *F* is inclosed under the chimney *G*, in which is a large supply of ammonium carbonate that slowly vaporizes and passes with the burned gases into the tower *H*. This is filled with broken quartz and down its sides slowly trickles a solution of ammonium carbonate, which accumulates in the vessel *I*, containing all the sulphur of the gas that passes the wash bottles *B* and *C*. Bottles *B* and *C* are filled usually with a NaOH solution, although occasionally a copper sulphate solution is used to remove the H_2S in the gas. Tests show that either solution is satisfactory for this purpose. Therefore, the sulphur in the gas which burns at *F* is only the sulphur which is in thegas combined as CS_2, CH_3S or other "organic compounds" which are difficult to remove in the purifying processes of commercial gas making. The liquor accumulating in *I* is diluted, an aliquot part taken, bromine added, heated, made acid with HCl, boiled and the sulphur precipitated as barium sulphate and weighed. The result is calculated to grains of sulphur per 100 cu.ft. of gas.

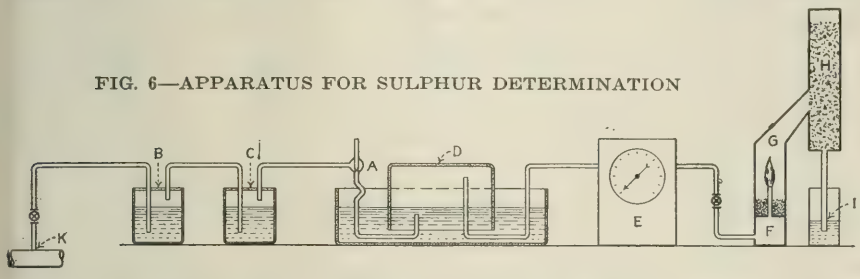


FIG. 6—APPARATUS FOR SULPHUR DETERMINATION

"Light oils" are determined in the gas taken from the main at *L* (see Fig. 7), drawn by aspirator *E* through the NaOH solution in *A*, solid calcium chloride in *B* and the bottles *C* filled with a heavy petroleum oil, and then through the meter *D*. The bottles *C* are weighed before and after the run and the increase in weight in the "light oils."

The naphthalene determination was made by the usual picric acid method on a half dozen samples, the gas being drawn from the main beyond tower *G* (Fig. 5). These determinations all gave practically identical results, showing that the naphthalene in the gases is practically a constant at the temperature of tower *G*, which is cooled by hydrant water. The results average 0.0035 gram per cu.ft., or 5.4 grams per 100 cu. ft.

These results for "organic sulphur" and "light oils" are incorrect in so far as the amount of sample withdrawn per minute was the same throughout the run while the amount of gas made varies from hour to hour. The sample taken should, for strict accuracy, be proportioned to the rate of gas making. The error made is not large, however, and the results are sufficiently accurate for comparative purposes. For the exact work to be published in a later contribution a proportioning meter will be used.

Many coals as they are mined contain so much ash and sulphur that the coke would be quite inferior and, of course, the quantity of gas would be correspondingly reduced. It was decided to wash as many of the coals as time and funds permitted, in order to determine any benefits obtained. A large proportion of the coals received, therefore, had at least three tests made on them —two tests on the coal as received and one test on the washed coal.

The washing was carried on under the direction of Prof. W. A. Mueller of the department of metallurgy and the equipment used was that belonging to the department. The coal was crushed and sized by screening, obtaining two products—through $\frac{1}{4}$-in. mesh and on $\frac{1}{4}$- but through $\frac{1}{2}$-in. mesh. The coarse product was jigged in a full-sized Jeffrey jig and the small-sized product was tabled on a Wilfley table. The purified products from these two operations were dried, sampled and mixed. One ton of the mixed material was weighed and retorted exactly as the raw coal was treated.

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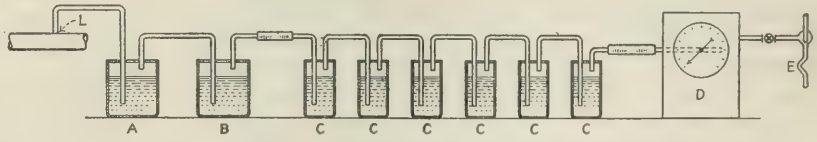

FIG. 7—SET-UP FOR LIGHT-OIL DETERMINATION

EDITOR'S NOTE: *The detailed results obtained in these researches and the author's comments thereon will appear in a subsequent issue of this magazine.*

Pulpwood Production in 1921

Preliminary statistics compiled by the Bureau of the Census show the following figures for 1921:

PULPWOOD CONSUMPTION AND WOOD-PULP PRODUCTION, BY STATES: 1919, 1920* and 1921

State	Pulpwood Consumption (Cords) 1921	1920	1919	Wood-Pulp Production (Tons, 2,000 Lb.) 1921	1920	1919
United States...	4,557,179	6,114,072	5,477,832	2,875,601	3,821,704	3,517,952
Maine.....	1,005,158	1,389,495	1,279,852	710,329	942,730	916,764
Michigan.....	186,532	243,632	207,234	103,532	132,776	106,194
Minnesota.....	164,547	254,193	203,862	117,934	170,216	129,560
New Hampshire...	258,206	403,530	375,597	152,797	239,634	232,134
New York.....	781,168	1,130,505	1,055,145	606,869	830,045	811,958
Oregon and California.....	192,869	190,399	171,765	124,494	148,877	123,990
Pennsylvania.....	326,486	490,784	423,822	167,310	238,013	215,686
Wisconsin.....	867,195	964,781	854,185	488,501	548,528	506,549
All other states....	775,018	1,046,753	906,370	403,835	570,885	475,117

* Compiled by the Forest Service.

The Measurement of Stirrer Performance*

By J. C. Wood, E. R. Whittemore and W. L. Badger

A Method of Measuring Stirrer Performance Is Suggested and Experiments in Which It Has Been Applied to the Ordinary Paddle Stirrer Are Described—The Surprising Efficiency of a Paddle Stirrer Also Is Discussed

THE purposes for which stirrers are used may be analyzed as follows:

1. To mix two or more mutually soluble fluids.
2. To emulsify two or more mutually insoluble fluids.
3. To hold an insoluble solid in suspension in a fluid.
4. To dissolve a soluble solid.
5. To mix two or more viscous, pasty or solid materials.

Evidently the performance of any given device will be different when applied to the various uses above enumerated; and in many cases in practice a given device will be of appreciable value only in one of the cases. Case 4 is perhaps only a special case of case 1, since it consists mainly of removing a film of saturated solution from the surface of the crystals and mixing it with the bulk of the solvent. It is hoped to present a paper soon on this phase of stirring.

The theory of stirring has never been discussed to the writers' knowledge; nor is there in the literature any quantitative data on the performance of any type of stirrer, from either the standpoint of power consumption or time for complete mixing. The writers have no mathematical theory to offer. We believe, however, that the fact that our experimental data seem to be unique gives them importance in spite of the fact that they are purely empirical.

Experimental Methods and Equipment

The tank used in this work was a wood tank about 5 ft. in diameter by 5 ft. high, and held about 600 gal. It was provided with a paddle stirrer (shown in Fig. 1). It had a vertical wood post (3x3 in.) standing in a simple step bearing and rotated by bevel gears and a countershaft. To this vertical post was attached a blade formed of a 3x3-in. timber shaved off at an angle of 45 deg. as indicated. This type of stirrer is very common and is regularly furnished by practically all makers of tanks.

The principal problem was, obviously, to determine when the tank was stirred. Sampling tubes of seamless copper ¼ in. inside diameter were inserted at four levels (1, 2, 3 and 4 ft. from the bottom of the tank) and extended in for three different radial distances at each level.

Figure 1 is a view of the inside of the tank showing these tubes. These proved to be stiff enough to hold their position with the most violent stirring used. They were brought down the outside of the tank and all ended at a common level so that the hydrostatic head on the outlet was the same for all.

At first, methyl violet was used. It was added in the form of a paste in water. Samples were taken from all tubes every 30 seconds and measured in a colorimeter. This was very slow and very trying on the eyes, and the work was greatly delayed by cloudy days. Also occasional tarry lumps of the dye would lodge in the end of one of the sampling tubes and spoil the whole run. This method was therefore abandoned.

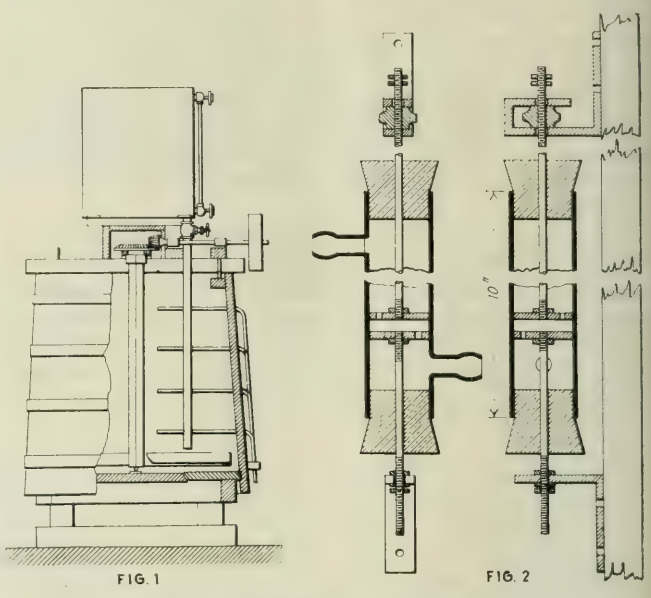

Fig. 1—Arrangement of apparatus
Fig. 2—Details of conductivity cell

Next was tried the addition of strong commercial hydrochloric acid, with titration of the samples. This was also very slow and tedious. It took 4 to 5 hours to make a test and analyze the samples. This preliminary work, however, showed that stirring was quite rapid. Most of the runs indicated a time of stirring of about 1 minute.

The Conductivity Method Finally Adopted

Finally the two junior authors developed a method based on electrical conductivity which promises to have a wide range of usefulness. A number of crude conductivity cells were made, and mounted so that liquid from the sampling tubes could be drawn through them. Several different types were used, but the form shown in Fig. 2 was found to be the most useful. The electrodes were of brass, but with alternating current no troubles were experienced from electrolysis. The position of the upper electrode could be accurately adjusted. In the tests here reported, four or five such cells were connected in series electrically, with a total drop of 220 volts across the set. Through each one was drawn a stream of liquid from one of the sampling tubes, and across each one was connected a voltmeter. The electrodes were adjusted before a test so that all the cells had the same electrical resistance at the start.

The tank was first filled with city water and then a small amount of saturated sodium chloride solution was run in from a storage tank. The amount used corresponded to 4 lb. solid salt per foot of water in the tank. The arrangement (shown in Fig. 1) permitted this solution to be added at the bottom of the tank. The

*Paper presented at the Richmond meeting of the American Institute of Chemical Engineers, Dec. 6 to 9, 1922.

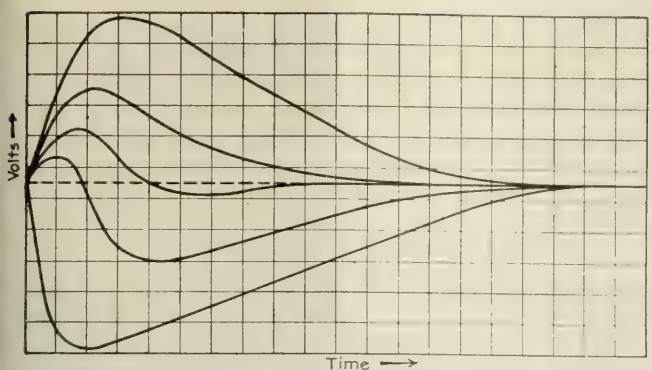

FIG. 3—THEORETICAL VOLTAGE CHANGES

stirrer was then started and readings taken of voltage changes, current, speed and power consumed. The routine was developed to the point where a run with all its data could be made, the tank dumped and made ready for the next run in 10 minutes. A preliminary study showed that the points nearest the center at each level were the last to come to equilibrium with the rest of the tank. Through a large part of this work only four voltmeters were available, and hence the sampling tube at the inner point at each level was used.

Adding strong salt solution to the bottom of the tank should decrease the resistance of the bottom cell and hence decrease the voltage drop across it while increasing the voltage drop across the other cells. As the salt is mixed with the tank contents this resistance should gradually rise to its final value at equilibrium. In the same way, the voltage across the second cell from the bottom should first rise, because, though its resistance had not changed, the decreased voltage drop across the bottom cell should increase the drop across all the others. But when the level of the salt solution rises to the second sampling tube, the resistance of the second cell (and its voltage also) should suddenly drop, with a corresponding increase in the voltage of the cells above it.

Discussion of Results

Theoretical Value of Conductivity

Based on such a line of reasoning, the change in voltage drop across the cells should be as shown in Fig. 3. Actual data from a typical run are shown in Figs. 4 and 5, exactly confirming the theory. Fig. 4 represents a run with water 4 ft. deep, and Fig. 5 one with water 3 ft. deep. In Fig. 4 cell 1 was connected to the center sampling tube 1 ft. from the bottom, cells Nos. 2, 3 and 4 being the corresponding points at the

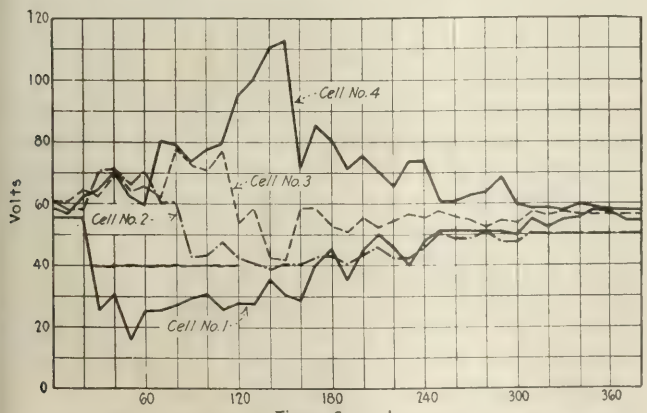

FIG. 4—ACTUAL VOLTAGE CHANGES. 7¾ R.P.M. 4 FT. LEVEL

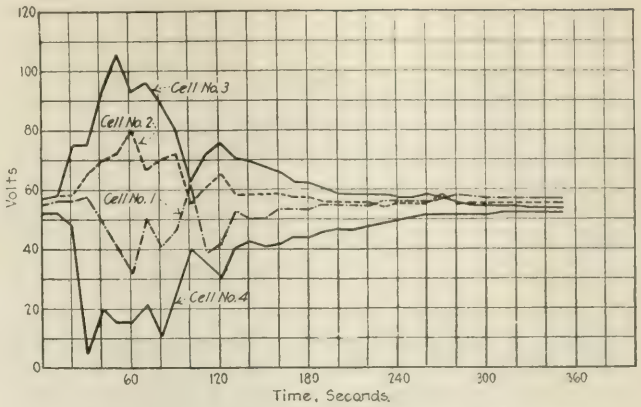

FIG. 5—ACTUAL VOLTAGE CHANGES. 7¾ R.P.M., 3 FT. LEVEL

2, 3 and 4-ft. levels. In Fig. 5 cells 1, 2 and 3 connect to the same tubes as before, but cell 4 was connected to the outer tube at the 3-ft. level. These runs were made with a cruder type of cell than the one shown in Fig. 2 and they could not be accurately adjusted for equal resistance (and hence equal voltage drop).

The way in which the curves of Fig. 4 correspond to our theory is most satisfactory. As strong salt solution is stirred and passes upward, the resistance of the cell suddenly decreases in regular order and the voltage across the rest rises. A most interesting point in Fig. 5 is that the outer *top* cell shows salt before the inner *bottom* cell. This is the result of a centrifugal component of the action of the stirrer, transformed into a vertical current of strong solution by the tank wall.

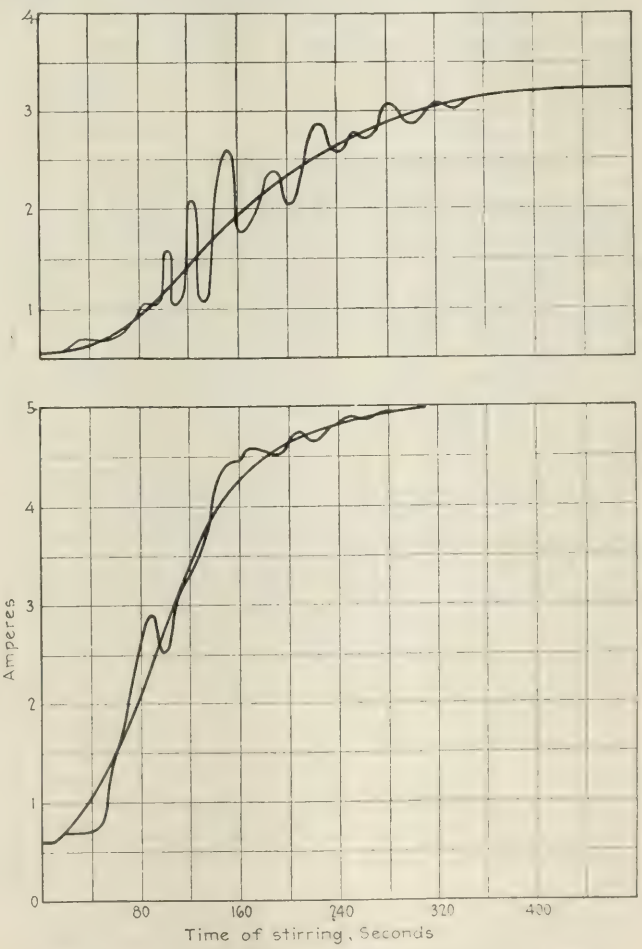

FIG. 6—TYPICAL CURRENT-TIME CURVES, 7¾ AND 10 R.P.M., 4 FT. LEVEL

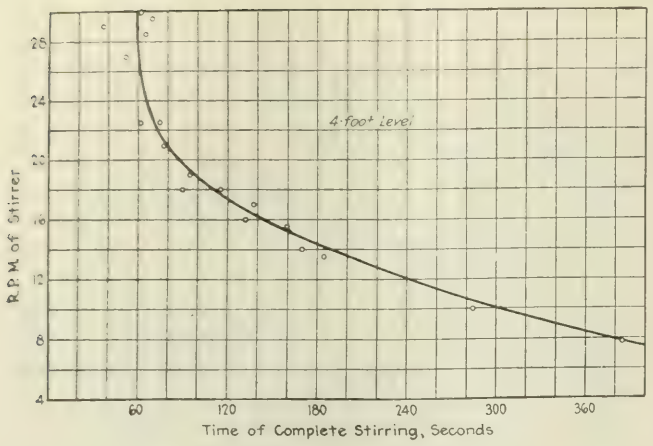

FIG. 7—STIRRER PERFORMANCE

Through most of the work the stirring was so rapid that changes in the voltmeter readings could not be followed. It was observed that the current in the circuit rose and became constant at about the time the voltmeters became uniform. By reading the ammeter every 10 seconds a current-time curve could be plotted, which approached an asymptote parallel to the time axis as stirring became complete. Most of the work was based on this curve. Samples of such curves are shown in Fig. 6. The pulsations in the observed curve represent slugs of strong solution swept past the ends of the sampling tubes by the rotation of the stirrer. A smooth mean curve was put in for purposes of computation. A curve which approaches an asymptote does not give a satisfactory end-point. The first derivative (determined graphically) was plotted for each of the current curves, and an arbitrary end-point taken as the time when $\frac{dc}{dt} = 0.04$ (c = current in amperes, t = time in seconds).

Vertical and Horizontal Uniformity

In the case of runs at the 4-ft. level, when time of stirring was long enough to permit following the voltmeters also, it was found that the voltmeters became constant before the current did. This means that a uniform vertical distribution existed, but that due to centrifugal action there was still a non-uniformity in a horizontal plane. The difference was great enough at very slow speeds to be unmistakable. Hence in all cases the end-point was taken from the curves for current.

From these methods of reading the curves of Figs. 7 and 8 have been plotted. The determinations of Fig. 7 were made with the tank filled with water to a depth of 4 ft., and those of Fig. 8 to a depth of 3 ft. The most striking thing about these curves is the short time

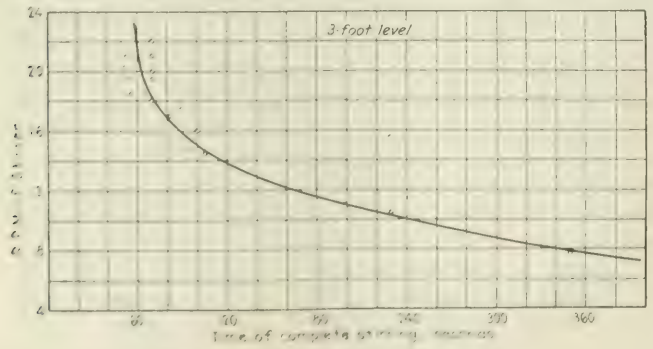

FIG. 8—STIRRER PERFORMANCE

necessary to mix this tank thoroughly with what would ordinarily be considered a very inefficient stirrer. The second point is that an increase in speed for this stirrer above 18 to 20 r.p.m. is useless so far as time of stirring is concerned. In fact in the vicinity of 30 r.p.m. there seems to be a break in the curves, and at rates above this mixing seems actually slower than below this speed.

The Illusion of Visible Swirl

Another feature that does not appear in the experimental data but which is interesting is that at all speeds the contents of the tank seem to be rotating as an even, homogeneous mass. The advocate of some special type of stirrer would insist that the contents of the tank were not being stirred at all. There was no visible swirling, eddying, churning or other indications of crossing of lines of flow. That this type of motion may produce very rapid and efficient mixing is a new thought in stirrer design. One needs but to consider the *apparent* motion of a fluid in a transparent tube at velocities above the critical. Small visible suspended particles move, apparently, in straight lines; yet the flow may be fully turbulent. Visible motion is due to particles of suspended solids which may very well have inertia

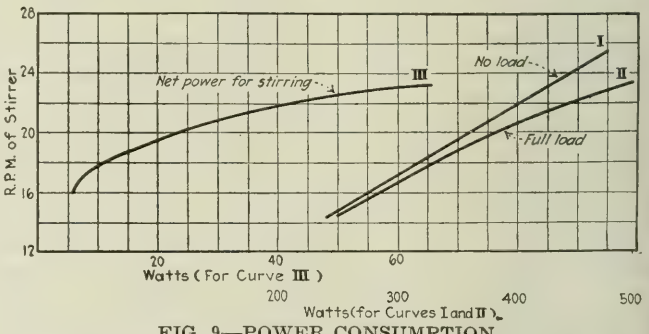

FIG. 9—POWER CONSUMPTION

Curve I, no load. Curve II, full load. Curve III, net power for stirring.

enough to flow in fairly straight lines in spite of the fluid turbulence around them. So in mixing two mutually soluble liquids (as salt solution and water) the visible motion of the mass is not an index of the true degree of turbulence.

Measurements of power consumed were not satisfactory. So much power was consumed in shafting, belting, gears, etc., that the power actually used for stirring was too low to measure for the slower speeds. Power measurements were simplified by the fact that a d.c. motor was used. Shunt field power was determined once and considered constant (as the control rheostat did not affect the voltage across the shunt coils). Power in the armature was determined from a properly connected voltmeter and ammeter in the armature circuit. A power reading was taken at a given speed with the tank empty, and again at the same speed with the tank filled with water to the desired height. The difference was considered the net power consumed in stirring. At slow speeds it was so small as to be less than errors introduced by fluctuations in the instruments. Such data as were determined are shown in Fig. 9. Here curve I is the no-load power consumption, curve II the full-load power consumption, and curve III the net power for stirring. This indicates clearly the very small amount of power really used at any reasonable speed and the relatively rapid increase in power at higher speeds. The point where a rapid rise of power consumption occurs without a perceptible increase in time

of stirring is one of the useful results to be obtained by applying this method of analysis to the stirring device.

Studies are now under way on rate of dissolving crystals and on the characteristics of propeller stirrers.

Conclusions

1. A plain paddle stirrer is a much more efficient mixer for miscible liquids than is usually supposed.
2. For the conditions of this set of experiments, a 600-gal. tank was thoroughly stirred in less than 1 minute at any speed above 22 r.p.m., though above 30 r.p.m. there seemed to be an increase of stirring time.
3. The visual appearance of a tank of liquid being stirred is not a measure of the efficiency of the stirring apparatus.
4. At the speed above which there is no gain in time of stirring, there is a rapid rise in net power consumption.

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Gas in Steel for Welding

About two years ago, according to the August, 1922, number of *Oxy-Acetylene Tips*, a trade publication of the Linde Air Products Co., a certain tube manufacturer reported welding troubles, which upon investigation seemed to be confined to a certain shipment of steel. Welds made on these strips in regular production were very brittle and had a rough outer surface. It appeared impossible to get a good weld with this material, and samples of it, together with some of satisfactory material, were critically examined at the company's research laboratory in Long Island City. Strips of the steels were connected up like blowout fuses in a vertical line, and a 12-volt current of high amperage was passed through the series until the strips began to melt at their centers. The current was then switched off, and the strips were closely observed in the process of cooling.

The good steel cooled off without any decided change in appearance, excepting a rounding off at the edges. The bad steel puffed and sparks were thrown off, an action that had been observed and reported in connection with the unsatisfactory welding of the metal at the tube company's plant. After the cooling had proceeded for some time the sample was found to be pitted with little holes and craters of larger dimension.

These results have been reported to the American Welding Society, and that organization is using the studies in a campaign designed to educate its members on the desirability of using only sound, gas-free metal for their welding operations.

Chinese Market for Chemicals

China is becoming an increasingly important market for chemicals, says Commercial Attaché Julean Arnold. Local manufacturing plants are springing up in connection with the production of certain commercial chemicals, which compete with the foreign products in some lines to such an extent as to reduce the trade materially. This is especially true of sulphuric, hydrochloric and nitric acids.

Details of the quantities of these various chemicals imported are lacking, official Chinese returns combining most of them under the head, "chemical products (not including match-making materials, medicines and soda)." Net imports of this group in 1921 were valued at 2,817,964 haikwan taels, against 2,291,203 taels in 1920. Match-making materials (except paraffine wax) were imported in 1921 to the value of 2,281,181 taels, compared with 1,893,670 taels in 1920; medicines (including cocaine and morphia), 7,056,080 taels, against 6,790,230 taels. In addition, were imports of glycerine valued at 93,280 taels, against 106,213 taels; soda, 1,775,509 taels, against 2,308,669 taels; and explosives for industrial purposes, 174,619 taels, against 237,723 taels.

Legal Notes

By Wellington Gustin

Similarity of Results in Patent and Secret Process May Justify Conclusion of Infringement

A patent and a secret process conflict in the case of A. B. Dick Co. versus Barnett is decided in the United States Court of Appeals, 277 Federal, 423. The federal District Court granted a preliminary injunction against the defendant preventing his sale of "Hesco" stencil paper, which is alleged to be an infringement upon the plaintiff's Fuller patent, No. 1,101,268.

Plaintiff owns patents covering the process and the product of plaintiff's so-called indestructible mimeograph stencil paper "Dermatype." These patents have been sustained in prior suits, therefore it was quite proper to assume their validity in the present suit on motion for a preliminary injunction, says the court. The contest then was as to infringement of them by defendant's acts.

This controversy turns on the construction to be given the claims in suit. Defendant contended that they were limited to a fully and permanently coagulated (insoluble) gelatin, and that the defendant's coating was almost entirely soluble. The experts were in conflict as to the true scope of the claims, as well as the nature of the plaintiff's process and its resultant product. The trial court recognized that whether the defendant used "a fully coagulated substance" or "a coagulated collodial substance" or their equivalents, within the meaning of the claims in suit, was a debatable question.

In reversing the order granting a preliminary injunction against the defendant by the District Court the Court of Appeals says that while plaintiff must demonstrate infringement, similarity of result may justify a conclusion of infringement, in the absence of proof that in some respects the secret process (which need not, however, be disclosed) or the resulting product differs from the patented process or product. Here, however, the affidavits of the expert and of the "Hesco" manufacturer, while guarding the secret process, purport to show important differences. Without passing upon their sufficiency, they raise at least a reasonable doubt as to infringement. The rule of law laid down and applicable here is that to justify a preliminary injunction in a patent case plaintiff has not merely the burden of proof but must "establish a *prima facie* case free from reasonable doubt."

For while ordinarily a preliminary injunction aims to preserve the *status quo* pending suit, in a patent case like this it may destroy it, says the court.

Equilibrium Diagram Of the Iron-Carbon System*

By Kôtarô Honda
Bessemer Medalist

Metastable or Graphite Lines Are Rejected, the Solidus Redrawn, A_4 or Delta Iron Fields Are Introduced—A_2 and A_0 Represent No Changes in Phase, but Are Traced Across the Diagram

MANY important investigations of the properties of the alloys of iron with carbon have recently been made, and the constitutional diagram of iron and carbon must be modified in some important points.

Some metallurgists believe that graphite always results from the breaking up of cementite soon after its solidification owing to its instability at very high temperatures. From the mode of occurrence, other metallurgists contend that it is a product directly separated from the melt, the graphitization taking place more easily in proportion as the rate of cooling through the solidifying range is smaller, and they propose the so-called double diagram representing the stable and unstable equilibriums.

Graphitization

According to the result of recent investigations by Dr. T. Murakami and the present writer,[1] graphite in cast iron is not a product directly separated from the melt, but is produced in the range from 1,130 to 1,050 deg.—that is, the graphitization always takes place after the solidification of the melt. This result was obtained from quenching experiments at very high temperatures. Thus the double diagram as given in many text-books of metallurgy is not correct, in agreement with Sauveur's view.

The question whether the liquid iron-carbon alloys contain carbon as graphite or as cementite has an intimate connection with the two theories of graphitization above referred to. Dr. Murakami and the present writer cooled the liquid alloys at different rates, or quenched them in a thick iron mold having a narrow hole, 2 mm. thick, 3 cm. wide and 6 cm. deep. This mode of quenching the melt was more effective than quenching in water. The quicker the rate of cooling the less the degree of graphitization. By quenching in the iron mold, even hypereutectic alloys approaching to the concentration of pure cementite do not graphitize at all.

These results show that in a liquid state carbon exists in the combined state, otherwise quick cooling will cause a greater degree of graphitization. If this conclusion be correct, it is very natural to conceive that the first product of solidification is cementite.

The formation of graphite is not a direct decomposition of cementite by equation

$$Fe_3C = 3Fe + C$$

but it is due to a catalytic action of gases, such as carbon monoxide or dioxide. The mechanism of this catalytic action is not yet certain, but the following assumption will not be far from the fact: As the temperature of the specimen falls from the melting point, a minute quantity of free carbon dioxide coexisting with carbon monoxide soon reacts on cementite and produces carbon monoxide by equation

$$Fe_3C + CO_2 = 2CO + 3Fe$$

This diminution or disappearance of free carbon dioxide causes a further dissociation of carbon monoxide

$$2CO = CO_2 + C$$

reproducing the dioxide, which again reacts with cementite. Thus, if there is in the metal a small quantity of free carbon monoxide, these two reactions are continuously repeated, and graphite is gradually produced with the consumption of cementite. The most favorable temperature for the graphitization is just below the eutectic point, 1,130 to 1,100 deg., but as the temperature falls, graphitization becomes less.

Thus, since graphitization always takes place after the solidification of the melt, the graphite lines in the double diagram must be omitted.

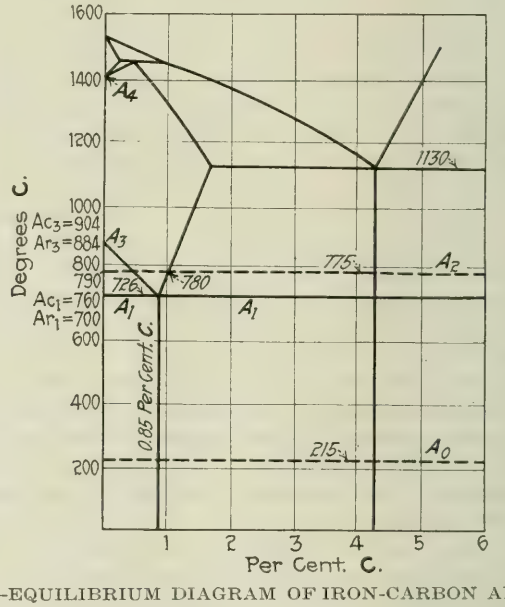


FIG. 1—EQUILIBRIUM DIAGRAM OF IRON-CARBON ALLOYS

In the recent diagram of the iron-carbon system, the solidus is usually shown as a curve bending considerably downward. But it can be shown by thermodynamics that if the liquidus is straight or slightly curved, the same must also be true for the solidus. Hence in my constitutional diagram (Fig. 1), the lower portion of the solidus is slightly bent upward.

A_4 or γ-δ Transformation

This is an allotropic transformation characteristic of pure iron; it was first observed by Osmond[2] thermally, then by Curie[3] magnetically, and afterward by others. The mean values of the recent measurement for Ar_4 and Ac_4 points are 1,400 and 1,410 deg. C. respectively. Ruer and Klesper[4] found that A_4 rapidly rises with the increase of carbon, and that at 1,486 deg. C. the melt

*The sixtieth report (slightly abstracted) from the Iron and Steel Research Institute, Sendai, Japan. This paper was communicated to the May meeting of the Iron and Steel Institute, 1922.

[1] *Iron and Steel Inst.* No. 2 (1920). *Science Reports*, Imperial Tohoku University, vol. 10 (1921), p. 273.

[2] *Iron and Steel Inst.* No. 1 (1890), p. 102.

[3] *Oeuvres*, p. 289.

[4] *Ferrum*, vol. 12 (1914), p. 257; (1916-17), p. 161.

with 0.38 per cent carbon is in equilibrium with γ- and δ-irons of the concentrations 0.18 and 0.07 per cent carbon respectively.

The recent progress of X-ray analysis has revealed the actual configuration of atoms in α- and γ-irons; but owing to the difficulty of experimenting at the high temperature, the determination of the atomic configuration in δ-iron has not yet been made. Judging from its physical properties, however, it seems to me very probable that the space-lattice in δ-iron is a body-centered cube as in α-iron.

A_3 or α-γ Transformation

This is a well-known allotropic transformation characteristic of pure iron; the transformation point during heating (Ac_3 point) is 904 deg. C., and that during cooling (Ar_3 point) 884 deg. C. With the addition of carbon in iron, this point falls quite continuously, till it reaches the eutectoid horizontal or A_1 line at a concentration of 0.85 per cent C.

By X-ray analysis, it is found that γ-iron possesses a space lattice of a face-centered cube.

A_2 or Magnetic Transformation

This transformation is sometimes called the α-β transformation. On several occasions[5] I have shown that the A_2 transformation in pure iron is a progressive change beginning from the lowest temperature and ending at about 790 deg. C., its rate of change increasing with the rise of temperature. This progressive change, as revealed by its magnetic property, is clearly seen from the magnetization - temperature curve in a strong field (Fig. 2). Though the temperature is kept constant in the transforming range for a sufficiently long period of time, the magnetization—that is, the transformation—does not progress with time.[6] In other words, the internal change corresponding to the A_2 transformation is a definite function of temperature, unlike allotropic transformations, such as A_3 and A_4, in which the change takes place at a definite temperature, provided a sufficient time is allowed. Hence it is not appropriate to consider the A_2 transformation as an allotropic change of phase.

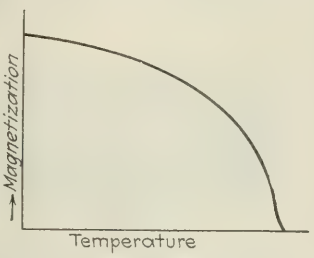


FIG. 2—MAGNETIZATION-TEMPERATURE CURVE OF PURE IRON IN A STRONG FIELD

The A_2 point as determined thermally is usually taken as 768 deg. C.; this is the temperature at which the rate of heat evolution or absorption is a maximum by cooling or heating respectively, and somewhat lower than 790 deg. proposed by the present writer. This latter is that at which the transformation begins on cooling or terminates on heating; it is the temperature at which iron changes from the ferromagnetic to the paramagnetic state. Since the change gradually takes place in the whole range of temperature below the A_2 point and every temperature in this range has the same quality with respect to the transformation, it is obviously not correct to call a temperature, 768 deg. C., at which the rate of change is a maximum, the A_2 or critical point or range.

According to the result of X-ray analysis,[7] below the A_3 point, iron has always the space lattice of a body-centered cube, which is in complete agreement with the view above given. There is thus no β-iron as an independent phase. The A_3 transformation during heating is then atomistically the change of the atomic configuration in iron crystals from a body-centered to a face-centered cube.

It remains to explain what is the nature of the progressive change in the A_2 transformation. According to the theory of Dr. J. Okubo and the present writer,[8] the gradual diminution of magnetization with the rise of temperature is due to the increasing velocity of rotation of the atoms about their magnetic axes. The angular velocity of this rotation is assumed to be comparatively small at room temperature, and the gyrostatic resistance to the turning of the magnetic axes of the atoms in the direction of the field is very small. But as the temperature is continuously increased to a very high degree, the angular velocity, by virtue of thermal impact among atoms, always becomes greater, and hence the gyrostatic action of the atoms rapidly increases, the substance becoming thereby less and less magnetizable, till magnetization vanishes. When the field ceases to act, the magnetic axes of atoms take random directions by virtue of thermal impacts. Thus in this theory, the A_2 transformation is of the progressive nature and the change will obviously be a definite function of temperature, as actually observed. The heat absorbed during Ac_2 transformation is the energy required to increase the angular velocity of the atoms, while the heat evolved during Ar_2 transformation is the energy of rotation liberated.

The A_2 points in pure iron during heating and cooling exactly coincide with each other, their value being 790 deg. C. According to the accurate magnetic determination of Ishiwara,[9] with the addition of carbon to iron, the Ac_2 point continuously falls to 780 deg. C. at about 1 per cent carbon and afterward remains nearly constant. Up to 0.5 per cent carbon, the Ar_2 point nearly coincides with the Ac_2 point, but afterward the former falls gradually below the latter, and at 4 per cent carbon, the difference amounts to 25 deg. C. Thus above the eutectoid points, the iron-carbon alloys are still ferromagnetic, though weakly so. Taking the mean of these two sets of values, the A_2 line beginning at 790 deg. continuously falls to 780 deg. at 1 per cent carbon and to 775 deg. at 4 per cent. Since the A_2 transformation is not the change of phase, the A_2 line is dotted.

From the above result, we conclude that above the eutectoid concentration the A_2 and A_1 points merge into a single point, but the A_2 point does not do so, as is usually believed to be the case.

Recently Ruer[10] observed in the heating curve of a cast iron (3.85 per cent C), a break at a point higher by 10 deg. than the cementite eutectoid point and took it for the graphite eutectoid; but according to the writer's view, it is attributed to the last part of the A_2 transformation, ending at the Ac_2 line.

A_1 or Eutectoid Transformation

This is the transformation characteristic of steel or cast iron. During heating the transformation takes place at 760 deg. C., but during cooling at 700; this is the

[5] *Sci. Rep.*, vol. 4 (1915), p. 169; *Iron and Steel Inst.* No. 1 (1915); *Sci. Rep.*, vol. 6 (1917), p. 213.

[6] K. Honda, *Sci. Rep.*, vol. 5 (1916), p. 285.

[7] Westgren, *Iron and Steel Inst.* No. 1 (1921); Jeffries and Archer, *Chem. & Met.*, vol. 24 (1921), p. 1057.

[8] *Sci. Rep.*, vol. 7 (1918), p. 141.

[9] *Sci. Rep.*, vol. 9 (1920), p. 401.

[10] *Z. anorg. allgem. Chem.*, vol. 117 (1921), p. 249.

temperature at which cementite dissolves in iron or separates from it. Theoretically the A_1 line must be horizontal, extending to the concentration of cementite; but it actually rises slightly at higher concentrations of carbon, the maximum increase being 20 deg. This increase is very probably due to the presence of silicon in these alloys as impurities. For it is well known that silicon raises the A_1 point of steel, and though in these alloys the quantity of silicon present does not differ much, yet the ferrite in which it dissolves continuously diminishes as the carbon increases, being zero at the concentration of cementite. Hence the concentration of silicon in ferrite steadily increases as carbon increases, and hence the A_1 point is raised. On the other hand, manganese is known to depress the A_1 point. Hence as the quantity of silicon present as impurities is greater and that of manganese smaller, the rise of the A_1 point is greater. In my ideal diagram of the iron-carbon system, the A_1 line is drawn horizontally.

Considered from the point of view of the microstructure, the A_1 transformation consists in

$$\text{Austenite} \rightleftharpoons \text{pearlite}$$

but as I have reported in other papers,[11] the above equation represents only the result—not the process itself. According to the writer's view, the process takes place in the order of

$$\text{Austenite} \leftrightharpoons \text{martensite} \leftrightharpoons \text{pearlite}$$

that is, during cooling, at the A_1 point the austenite changes to pearlite through martensite, and during heating the reverse change takes place. It should be here remarked that at the ordinary A_1 point, as soon as martensite is formed, it is immediately changed into pearlite or austenite, and hence in the case of equilibrium the martensite does not actually come into existence. Hence in the equilibrium diagram the martensite line ought to be absent It is only in the case of quenching or non-equilibrating transformation that the martensite is formed and, being formed, remains undecomposed.

Some metallurgists[12] object to the double reaction above mentioned, as contradictory to the phase rule, but they have misunderstood the meaning of the above reaction.

A_0 or Cementite Transformation

This is the transformation characteristic of cementite; it is in its nature the same transformation as the A_2 transformation in iron. The transformation is progressive and extends from the lowest temperature to 215 deg. C., the change being a definite function of temperature. During heating or cooling the transformation terminates or commences at the same temperature (215 deg. C.), the A_0 point. This point is observable for all alloys containing free cementite, and has always the same value. Since the transformation is not a true change of phase, in the constitutional diagram the A_0 line is drawn as a dotted horizontal line like the A_2 line.

Conclusion

To sum up, the constitutional diagram is greatly simplified on the one hand by the omission of the graphite line, and on the other by that of the β-iron line, that is, by introducing the dotted A_2 line. The A_0 line is newly added.

[11] *Iron and Steel Inst.* No. 1 (1919); *Sci. Rep.*, vol. 8 (1919), p. 181.

[12] Revue de Métallurgie, vol. 18, p. 433 (1921).

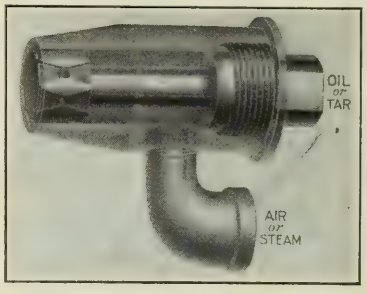
The Hauck Oil Burner

A New Appliance for Chemical and Metallurgical Heating Furnaces

THE Hauck Manufacturing Co., of Brooklyn, N. Y., has recently placed on the market a new and improved type of atomizer for burning fuel oil and distillate. This burner consists essentially of a cylindrical casing with slots parallel to the axis of the bore. These slots form with the inner wall of the casing longitudinal ports through which the atomized oil is impelled into the furnace. The ports are constructed in the form of a small Venturi tube, being constricted at the center portion and flared at both ends. At the throat or constricted portions of the orifice are radial openings which connect to the bore of the burner.

The material which is to be used for fuel is delivered to the burner through this central bore at a pressure of from 40 to 60 lb. per sq.in. It flows from the central bore through the radial openings into the restricted portions of the orifices.

The compressed air or steam which is used for atomizing is delivered to the burner at a pressure of about 80 to 100 lb. per sq.in. It flows longitudinally through the Venturi port opening, so that as it passes the constricted part of the opening its velocity is at the highest point. At this point it picks up the oil or other fuel which is delivered under pressure through the radial openings to the tube. It may be said to blast the oil and thus deliver it in the atomized or foglike form, which best promotes combustion.



It is claimed for this burner that it secures a thorough mixture of the air and fuel at the mouth of the burner. It is claimed also that it correctly proportions the air or steam to the oil, that it is accessible for purposes of inspection and that it can be conveniently removed from the furnace without affecting the operation of any other burner served by the same system.

Further advantages claimed for it are that reducing, neutral and oxidizing flames are readily obtained by the mere manipulation of the oil and air valves. This enables the operator to control closely the furnace atmosphere at the least expenditure of attention and labor. Another advantage claimed is embodied in the fact that combustion can be made to take place close to the burner nozzle, thus preventing oxygen from coming into contact with other portions of the furnace and reducing the amount of scaling. Another result of this lack of oxygen in the furnace atmosphere may be found in the reduction of spoilage and greater uniformity of the product obtained.

Instantaneous Measurement of High Pressures

Plates properly cut from quartz crystal liberate an electric charge when subjected to pressure. A stack of these plates in a small steel container is subjected to the pressure to be measured and the charge which is liberated passes through a special type of galvanometer. The galvanometer movements are photographed on a rapidly moving film.

Book Reviews

LABORATORY MANUAL OF COLLOID CHEMISTRY. By *Harry N. Holmes*, Professor of Chemistry in Oberlin College. John Wiley and Sons, Inc., New York; Chapman & Hall, Ltd., London, 1922. xii + 127 pp. 32 figs. 23.5x15 cm.

A "brief bibliography" of thirty-four titles of books dealing with the manifold theoretical and practical aspects of colloid chemistry, tabulated in pages 119 to 121 of this volume, indicates the considerable attention now paid to this important topic. In a field to which so many new workers are being continually attracted, it is obviously desirable to have an authoritative guide on experimental technique and methods. Previous manuals, such as Svedberg's "Herstellung Kolloider Lösungen," have covered only portions of the ground, usually for the benefit of more advanced workers. The need for a general laboratory outline of the subject, suitable for student use, has long been seriously felt, and the present volume has been prepared by Professor Holmes, at the request of the colloid committee of the National Research Council, to fill the gap.

In successive chapters the following subjects are developed: I, Suspensions—Coarse and Fine; II, Dialysis and Diffusion; III, Condensation Methods of Preparation; IV, Dispersion Methods of Preparation—Peptization; V, Coagulation; VI, Protective Colloids; VII, Solvated Colloids; VIII, Surface Tension; IX, Emulsions; X, Viscosity; XI, Adsorption From Solution; XII, Adsorption of Gases; XIII, Reactions in Gels; XIV, Experiments With the Ultramicroscope; XV, Soils and Clays; XVI, Special Topics. Altogether, no fewer than 186 experiments are outlined. No one student, of course, can be expected to perform all of these, and representative selections fitted for special courses are suggested in the introduction.

The book as a whole must be very highly commended. The directions, in general, are given in sufficient detail to enable the beginner to understand the purpose of each experiment and to take all precautions necessary to obtain the desired result, without being so full as to destroy his initiative. Much of the subject matter, of course, is intimately related with Professor Holmes' own research topics. A number of experiments have also been contributed by investigators well known in their particular fields, including W. D. Bancroft (on dyeing), S. E. Sheppard (on gelatin) and J. A. Wilson (on tanning). The greater part of the chapter on Adsorption of Gases is taken up with the work of Patrick on silica gels. With such a galaxy of experts, few errors of commission (and certainly none of omission) are to be expected. The relative space devoted to the work of Fischer and of McBain on soaps (pp. 35-39) might be reversed with considerable profit to the reader, and the purely empirical nature of the Freundlich adsorption equation (pp. 72-73) should certainly be emphasized, but these are minor points.

A more serious criticism that can be offered is that the author tends, in common with many of his colloidal colleagues, to exaggerate the scope of his special subject, and to inflate it unduly by including topics which properly belong elsewhere. It is a moot question whether adsorption ought to be included in colloid rather than in general physical chemistry, even though long-established custom in this case argues for its retention. To regard an experiment such as the catalysis of the reaction between carbon monoxide and oxygen by means of "hopcalite" (p. 110) as an application of colloid chemistry, however, is almost Ostwaldian.

Teachers of colloid chemistry will undoubtedly find this volume of the greatest assistance to them in the development of their laboratory courses. The frequent references to the original literature should prove a source of inspiration to the research worker, as well as to the student entering the subject for the first time.

JAMES KENDALL.

THE STEEL FOUNDRY. By *John Howe Hall*. Cloth 6x9 in. 334 pp. McGraw-Hill Book Co., Inc., New York, 1922. Price, $4.

Mr. Hall tell us that he has aimed at setting forth the metallurgy of the steel foundry from the point of view of the steel foundry engineer who is interested in securing a product of high quality at the lowest cost commensurate with this quality. The result is a readable and valuable book with a range extending considerably beyond the steel foundry proper.

The various processes of steel making are dealt with: crucible; acid and basic electric; acid and basic open-hearth, and bessemer, side-blow and bottom-blow. These are considered first in the light of their availability for the manufacture of steel castings, judgment being passed on the following points: Market, including quality, style of casting to be made, cost of production, tonnage in sight; raw material and fuel available; capital available; competition; labor available, and uniformity of operation. Mr. Hall states fairly the advantages and disadvantages of each process and gives estimates of cost for installation and operation. If there is such a person as a foundry engineer undecided as to the process to be chosen for a proposed foundry, he will find indicated here his proper course of reasoning.

This preliminary survey of methods of steel making is followed by a detailed account of the methods of operation for each process. To the foundry engineer who wishes to extend and consolidate his knowledge of the fundamental process on which his craft depends, this treatise on steel making will be interesting and useful. It takes up, however, over two-thirds of the book, leaving only one chapter, less than one-sixth of the book, for molding, pouring and digging out, with the same space for heat-treatment and annealing, and only four pages for finishing, straightening and welding.

With this division of space it is evident that the art of the steel-foundryman is but briefly treated. We should have liked to see Mr. Hall reverse the proportions of his dosage and apply his wide knowledge of the steel foundry to giving a more complete analysis and exposition of the steel-founder's craft.

One point which requires further consideration is his statement that cracks are favored by low carbon, an analysis which gives the maximum shrinkage. In order to make the matter complete, mention should be made of the fact that in castings of heavy section the change of volume while passing through the critical range may have an important influence on cracking. The matter is undobtedly complex and deserves detailed consideration. Let us hope that an early call for a third edition will give Mr. Hall occasion thus to increase our indebtedness to him.

The present tendency to increase continually the intricacy of the forms of steel castings would make a thorough study of the principles of molding and casting of great value. Not only would this be of direct aid to the foundryman, but it would help him in enlightening those for whom he works—the designers of steel castings. The manager of a successful steel foundry recently expressed the hope that a particularly warm corner of the hereafter would be reserved for the designers of modern steel castings for locomotives. It would be a pleasant thing to have a treatise on foundry practice to offer as a shorter catechism to save these brands from the burning. Full utilization of the possibilities made available by progress in the art of casting steel can be attained only by having considerable knowledge of the difficulties and the limitations of the art. This phase of the subject is somewhat neglected by Mr. Hall. What he gives makes us wish for more.

LAWFORD H. FRY.

HANDBOOK OF PETROLEUM, ASPHALT AND NATURAL GAS. By *Roy Cross*. 625 pp. Published as Bulletin 16 of Kansas City Testing Laboratory (Kansas City, Mo.). Price, $7.50.

Those in the petroleum industry who in the past have profited from the usefulness of this bulletin's predecessors will need no elucidation of its purpose. Others may be interested in the prefatory note to Bulletin 15: "The purpose of this publication is to set forth in concise form for the petroleum producer, seller, refiner and technologist the scientific information and statistics on the production, properties, handling, refining and methods of evaluating petroleum and related products." In addition to the sort of material usually found in handbooks, the technical man will find of value the descriptive chapters on petroleum refining, including

cracking, transportation, storage and gaging, general and chemical constitution of petroleum as well as the standardized and commercial methods of analysis. In the chapter on refining the author includes a detailed description of the decomposition of petroleum hydrocarbons in the presence of aluminum chloride. This review of the subject, together with the list of important references, is a real contribution to the literature.

Other new matter appearing in this bulletin includes tables and formulas for gaging the capacity of horizontal cylindrical tanks with "bumped" ends, methods for determining the capacity of oil pipe lines, details of refining and cracking costs, specifications and properties of petroleum products and the vapor volumes of distillates of different gravities at varying temperatures. A feature worthy of mention is the compilation and classification of United States patents on petroleum processes from 1850 to January, 1922.

The handbook is attractively bound in a black flexible cover and by means of its loose leaf binding it is possible to insert such new matter as is occasionally issued by the publishers.

S. D. KIRKPATRICK.

HANDBOOK OF CHEMICAL ENGINEERING. Prepared by a staff of specialists. *Donald M. Liddell*, editor-in-chief. 2 vols. Published by McGraw-Hill Co., New York. Price $8.

A pioneer book is always an experiment and its success depends upon many factors. The reviewer is concerned with only two of them. First, is it a good book and second, is it well printed? Now the "Handbook of Chemical Engineering" is well printed, but I promised myself the satisfaction of protesting against the occasional and apparently unnecessary transition from large to small type at various points in the text.

This book had a hard job when it came to my desk. It had been heard of some time ago and was being awaited with interest, so it had to take a rather stiff hurdle of standard. The Lord knows, and every chemical engineer knows, that it was needed badly. Before we go any further I want to make one thing clear. The book is a milestone in chemical engineering. It is not only a milestone, it is a splendid work and a real achievement. I read it, enjoyed it, found much profit in it and intend to keep it for reference.

If you were faced with the task of compiling a handbook of chemical engineering, what would you do? The reviewer would have done exactly what Mr. Liddell did—"analyzed chemical industries and selected the features essential to most of them for description." Thus the selection of subjects would be the first bone of contention, and so we shall discuss that first. Here is Mr. Liddell's list in the order in which they appear:

I, Generation and Transmission of Power. II, Material Handling—Transportation of Solids. III, Transportation of Liquids. IV, Transportation of Gases. V, Crushing and Grounding. VI, Grading (Sizing and Screening). VII, Mechanical Separation. VIII, Concentration. IX, Leaching and Dissolving. X, Evaporating and Drying. XI, Crystallization. XII, Thermometry and Pyrometry. XIII, Refractories. XIV, High-Temperature Production. XV, Mixing and Kneading. XVI, Sampling. XVII, Fermentation. XVIII, Distillation, Fractional and Destructive. XIX, Refrigeration. XX, Oxidation and Reduction. XXI, Electrochemistry. XXII, Catalysis. XXIII, Colloidal Chemistry. XXIV, Smelting —Zinc — Lead — Copper — Iron — Roasting. XXV, Lutes and Cements. XXVI, Radioactive Elements. XXVII, Rare Metals. XXVIII, Rare Gases. XXIX, Materials of Construction. XXX, Plant Design. XXXI, Method of Financing.

Comprehensive! That is the first reaction. Thus it would be for sins of commission rather than those of omission that the editor might be liable. That is in itself a recommendation. Every subject is there that should be, but there are some subjects which are not extremely relevant to chemical engineering. It is difficult, perhaps impossible, to draw the line, and much better to include than omit. The editor's predilection for metallurgy has given somewhat elaborate treatment to certain subjects which are of primary or sole interest to the metallurgical engineer. Chapter VIII, on Concentration (in the metallurgical sense), and Chapter XXIV, on Smelting and Roasting, are examples. It is perhaps a legitimate query whether a handbook of chemical engineering should carry these subjects. So too the treatment of Mechanical Separation (Chapter VII) and of Sampling (Chapter XVI) have a distinct metallurgical balance. A different emphasis would have been better. Again, Chapters XXVI and XXVIII, on Radioactive Elements and Rare Gases, are defended by the author specifically, but while the essays are most interesting, I question their inclusion under chemical engineering.

Finally, Chapter XXXI, on Methods of Financing, is a correct gesture in that it emphasizes the necessity of familiarity with the "business side of chemical manufacturing," but it is only one of half a dozen equally important subjects, all of which should be discussed if that phase is to have emphasis. It could have been omitted without diminishing the value of the book as a handbook of chemical engineering, and should have been omitted.

Perhaps it is also legitimate to suggest that future editions would be improved by a grouping of subjects under several general headings which suggest themselves. The present order of discussion is rather random when it does not need to be.

It is inevitable that with thirty-one contributors, the points of view toward subjects will vary with temperament and experience all the way from theoretical thermodynamic treatment to scientific co-ordination of practical data. In general the treatment is distinguished, as would be expected from the high caliber of the contributors. But the fact that one rather expects some variation in method of treatment does not eliminate a cretain disappointment at the unevenness. The editor himself has handled his subjects splendidly, almost ideally. In some of the articles there is an unfortunate lack of contact with plant practice. The authors treat the subject adequately from a theoretical standpoint, but when it comes to giving the basis for making plant installations they fall down. This is the exception, however, for in general the treatment of this phase is able and there is focussed on the many subjects an almost unique experience in that field.

It is not inappropriate for us to evaluate some of the chapters where this evaluation will be instructive. The Generation and Transmission of Power is a very meaty article. Perhaps the subject lends itself better than some to a quantitative study, but it is of unusual value and interest. The next three chapters, on the Transportation of Solids, Liquids and Gases, are likewise substantial. Perhaps the discussion of Oxidation and Reduction is more disappointing to the technical man than any other. A very adequate theoretical discussion but no technological information is given and such an important oxidizer as manganese dioxide is not even mentioned. In happy contrast is the next article, on Electrolysis (by the editor himself). It is a fund of invaluable information about plant practice. Catalysis is excellently treated, while Colloids, though interesting, is filled with much irrelevant material and there seems to be a desire on the part of the author to make you say "Oh, my!" Fractional Distillation is discussed from a theoretical standpoint and the reader would find a good deal of trouble in building a still from the data offered. The chapter on Plant Design escapes more than half the problem by conveniently distinguishing between machine design and plant design. The discussion of the economics and geography of the subject is interesting but not nearly as vital as the discarded half of the subject. There are many plants which have violated every principle developed in the article and still have been successful. "Machine design" is an essential part of plant design in the chemical field and there are many generalizations which would have been helpful. Materials of Construction was also a little disappointing and the lengthy report on portland cement seems unnecessary.

Future editions will rectify these faults, which are all relatively minor troubles. Meanwhile here is the first edition. The question for chemical engineers is really, Can I afford to be without this book? My answer is, No! And I should like to extend to Mr. Liddell my congratulations for a piece of work that is—memorable!

CHARLES WADSWORTH.

Recent Chemical & Metallurgical Patents

Production of Cyanamide From Calcium Cyanamide—J. H. Lidholm, of Sweden, had already patented (U. S. Pat. 1,380,223) a process for adding calcium cyanamide to the water simultaneously with the addition of carbon dioxide for precipitating calcium as carbonate. In this way the production of dicyandiamide is avoided. It has since been found, however, that a regulation of the alkalinity must be made to below 0.5 normal and at a temperature of roughly 30 deg. C. By keeping the temperature slightly above 30 deg. C. the precipitation of cyanimide carbonate is avoided. In this way a very nearly theoretically perfect production of cyanamide from calcium cyanamide can be obtained. (1,280,223. Nov. 21, 1922.)

Process for the Production of Hydrogen Sulphide—Henry Howard, assignor to the Grasselli Chemical Co., has invented a process for the production of hydrogen sulphide. It consists essentially in the use of zinc sulphide ores and sulphuric acid, and produces zinc sulphate and hydrogen sulphide. It differs from the so-called Christensen process, in which the same reaction is employed, in the volume of sulphuric acid used and in the fine division of the sulphide ore. Christensen used large volumes of sulphuric acid in order to dissolve the zinc sulphate as it was formed. The author of this process uses a very finely divided zinc sulphide (which passes through 200 mesh) and agitates this in about five volumes of sulphuric acid, although the actual ratio of acid to ore may vary over a considerable range. After the batch has been completed, one-half of the acid may be recovered and used again. (1,435,471. Nov. 14, 1922.)

Manufacture of Vulcanized Rubber Articles—M. H. Harrison and Harold A. Morton, of Akron, Ohio, have assigned to the Miller Rubber Co. the following patent for the manufacture of vulcanized rubber. The objection to present processes for making rubber mixes is that on the calender rolls, which are so geared that they operate at differential speed, considerable heat is generated, and vulcanization either in whole or in part takes place on the rolls themselves. This ruins the batches of rubber. To avoid this the authors suggest making two separate mixes, one of the rubber with zinc oxide and sulphur, the other with the rubber, zinc oxide and the organic accelerator. When these sheets have been rolled to a thickness of 0.015 in., it is possible to pile them up one on top of the other and so vulcanize the pile perfectly. Thus no loss is entailed due to the earlier vulcanization. (1,434,892. Nov. 7, 1922.)

American Patents

Issued Nov. 28, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,436,739—Evaporator.
1,436,819—Diolefines.
1,436,820—Manufacture of Paint.
1,436,940—Separation of Chloracetones.
1,436,949—Production of Ammonia.
1,437,041—Nitration of Cellulose.
1,437,045—Manufacture of Motor Fuel.
1,437,101—Recovery of Gasoline.
1,437,102—Recovery of Gasoline.
1,437,191—Elimination of Phosphorus.
1,437,292—Distillation of Carbonaceous Materials.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Catalyzer and Method of Producing the Same—W. D. Richardson, assignor to Swift & Co., has developed a method of producing a more efficient nickel catalyst by abrading crude nickel in the presence of water. The present method consists of grinding the nickel in the presence of oil to be hydrogenated. By this new process nickel is put into a ball mill in reasonably large lumps, either with or without an abrasive material, and the whole is ground to roughly 200 mesh in the presence of water. Then it becomes necessary to dry the mud thus produced and grind again the nickel catalyst with oil, inasmuch as water is a dilatory substance to the hydrogenation process. The greater efficiency of the nickel produced by water abrasion is given as a reason for adopting the extra processing. (1,419,986. June 20, 1922.)

The Use of Vanadium Oxide as a Catalyst—C. H. McDowell, H. H. Meyers and (in the case of patent 1,420,201) Warren B. Pattison have assigned their patents on the production and use of vanadium oxide as a catalyst to the Armour Fertilizer Works. Patent 1,420,203 has to do with the production of the catalyst. Alumina from the mineral alunite is used as a carrier for the vanadium and, for example in the case of sulphuric acid, can oxidize from 50 to 60 per cent of the sulphur dioxide to sulphur trioxide. In the presence of about one part of vanadium oxide to ten parts of alumina, a conversion of better than 87 per cent is obtained. In preparing the catalyst, ten parts of ammonium vanadate is added to about one hundred parts of alumina from alunite. The mixture is moistened enough to permit molding and briquets of suitable shapes are then prepared with just enough pressure to bind the material together. The heating of the dried briquet must be comparatively slow, but they are very durable if the heating is carried out carefully. Catalysts so prepared may be used as in patent 1,420,201 for the oxidation of ammonia, or as in patent 1,420,202 for the oxidation of sulphur dioxide in the preparation of sulphuric acid. Various temperatures and other conditions necessary to carry out the reactions are described in detail in the patents. (1,420,201; 1,420,202 and 1,420,203. June 20, 1922.)

Preparing Pigment Suspensions—George W. Acheson, of Newark, N. J., has been granted a patent for a process of preparing pigment suspensions in oil to be used in the manufacture of paints, inks, varnishes and similar products, consisting of a pigment and a vehicle. As a typical example of how the invention is carried out the author takes a suitable pigment such as ultramarine, zinc white or carbon black, and deflocculates it according to the known process whereby it is wholly or partly converted into a colloidal condition. The resulting paste is thinned with water to the consistency of a thin cream. This is then poured with stirring into the vehicle, which may, for example, be boiled linseed oil or a hydrocarbon oil of the paraffine type. To the pigment-oil-water mixture or emulsion is then added a small portion of some flocculating electrolyte, such as a solution of alum or dilute hydrochloric acid. After stirring, the mixture is permitted to stand until a curdlike precipitate or deposit is formed. These curds consist chiefly of oil and pigment from which the bulk of the water has been eliminated. Excess water may be drained off or can be evaporated as, for instance, by passing the mass through steam-heated rolls. The resulting product is then ready for shipment. (1,431,079. Assigned to Acheson Corporation of New York. Oct. 3, 1922.)

Acetaldehye From Acetylene—In the synthetic production of acetaldehyde a current of acetylene is passed over the mercuric salt in an acid medium. The activity of the mercuric catalyzer rapidly diminishes and the absorption of the acetylene becomes proportionately lower, finally stopping completely when the mercuric salt is reduced to the state of a grayish powder. The problem then is to regenerate this mercuric salt by oxidation. In the present patent, L. E. M. Trevoux of Petit-Quevilly, France, maintains the activity of the catalyzing agent by adding an oxidizing substance such as ferric oxide. When in turn the oxidizing agent is exhausted, the liquid is decanted and the ferric salt is again generated by boiling with nitric acid

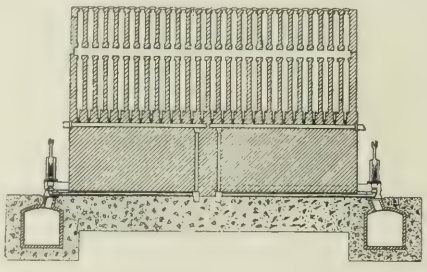
or preferably by electrolysis. It is this electrolytic oxidation that forms the principal feature in the patent. (1,428,668. Assigned to La Société Anonyme de Produits Chimiques Etablissements Maletra, of Petit-Quevilly, France. Sept. 12, 1922.)

Electric Furnace—O. A. Colby, of Irwin, Pa., has patented a crucible furnace, wherein the crucible is built up of alundum, sintered in place, resting on a resistor made of carborundum blocks. Current is led in by massive graphite blocks. Contacts at each end of the carborundum resistor is made by a packing of granular graphite. Through the brickwork surrounding the crucible, and at each end of the resistor, is provided a well or hopper, which is kept packed with this granular graphite, periodically replenishing that which is burned. These essential parts of the furnace are encased in refractory firebrick and insulating material, the whole bound with steel plates and mounted on trunnions. (1,435,211, Nov. 14, 1922. Assigned to Westinghouse E. & M. Co.)

The Solidifying of Sulphur—Present practice in the sulphur field consists of pumping molten sulphur from the pipes as it comes to the surface of the ground into a large area, roughly hundreds of feet square, and from 15 to 20 ft. high. The sulphur solidifies finally into a large mass or block, and it takes sometimes as long as 2 months for the material to solidify completely. Then it must be blasted down, much as rock is blasted, before it can be loaded into cars. The present invention has for its purpose the solidifying of sulphur in such a manner that it can be loaded directly into cars and does not have to be stored over long periods of time. It consists essentially of a belt conveyor, on which the sulphur is run to a definite thickness of layer. This layer solidifies very rapidly, since it is comparatively thin. Another layer is then superimposed immediately upon the solidifying of the first layer, and this process is continued as the belt slowly moves forward. A thickness of cake can be built up to any desired dimensions, depending on the length of the belt, and as the cake comes off the end of the belt, it can be broken up to any desired size for immediate shipment. (1,419,911. Raymond F. and Harold S. Davis of Pittsburgh, assignors to the Texas Gulf Sulphur Co. June 20, 1922.)

Recovery of Oxides of Nitrogen in Sulphuric Acid Manufacture—In the chamber or tower processes for the manufacture of sulphuric acid, oxides of nitrogen are added to sulphur dioxide, and with the addition of steam they produce sulphuric acid. These oxides of nitrogen are later absorbed in a reduced condition in the Gay-Lussac tower by means of a downcoming stream of cold, fairly concentrated sulphuric acid. If a very small quantity of sulphur dioxide, approximately 0.10 per cent, is present, the absorption takes place with greater rapidity than in its absence. This was developed by the author in patent 1,205,723. It was found, however, that the gases which escape from the Gay-Lussac tower could not be absorbed readily in the presence of this small quantity of sulphur dioxide in the ordinary water scrubbers, because the presence of sulphur dioxide prevented the re-oxidation of the oxides of nitrogen to the higher and soluble oxides. In order to obtain as efficient an absorption of oxides of nitrogen in the Gay-Lussac tower, and in addition, to recover all the oxides of nitrogen, the absorption is carried out in the presence of a small quantity of sulphur dioxide, after which the gases emerging from the Gay-Lussac tower are run through milk of lime scrubbers, which removes the sulphur dioxide and permits the subsequent oxidation of the oxides of nitrogen to the higher oxides, which are then removed in ordinary water scrubbers. Several other systems of recovery are possible, and are detailed at some length in the patent, all of them having to do with the fundamental problem of attaining the higher oxides of nitrogen for absorption in water in some way or other. (1,420,477. Andrew M. Fairlie, of Atlanta, Ga. June 20, 1922.)

Coke-Oven Decarbonization—All coke ovens of the vertical flue regenerative type are troubled with more or less carbonization of the fuel gas nozzles. To correct this it is the practice to introduce air into the fuel gas supply pipes at their outward ends during the period when that side of the gas channel is not passing gas to the vertical flues. This air burns and removes part



of the carbon. Due to the serious cooling effect and consequent cracking of brickwork, which a large quantity of this cool air causes, it is not possible to burn off all the carbon in this manner, and resort must be had to punching out the nozzles from the inspection holes above, which is costly and laborious.

In this invention, decarbonizing air is supplied to the inner ends (in the center of the oven). This preheats the air and thus a sufficient quantity can be introduced without danger of cracking the brickwork to decarbonize the nozzles completely. Also, the nozzles which carbonize worst are in the center of the oven and these receive the supply of decarbonizing air first. The accompanying figure shows the general layout of air passages to suit this invention. (1,435,361. Louis Wilputte, assignor of two-third to Alice A. Wilputte. Nov. 14, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Purifying Acetylene — Phosphorus compounds in acetylene are oxidized to phosphorous acid and removed as such by treatment with oxygen, preferably at a raised temperature, in the presence of activated charcoal as catalyst. Acetylene mixed with a small proportion of oxygen or air is passed through a reaction tower packed with activated charcoal and heated to 80 to 100 deg. C.; alternatively, acetylene and air are passed in succession over the charcoal. Phosphorous acid is recovered by extracting the charcoal with hot water. (Br. Pat. 184,184; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Oct. 4, 1922.)

Artificial Silk—To obtain non-tarnished films, artificial threads and other articles capable of taking a dye, from cellulose nitrate, acetate, butyrate and other esters of cellulose, there is added to a solution of the ester in a relatively volatile organic solvent a small quantity of a non-volatile organic solvent soluble in water. After forming the thread or film, by the evaporation of the volatile solvent, the non-volatile solvent is extracted by washing with water. As non-volatile solvent formamide, acetamide, chloral, and chloral hydrate are employed. The volatile solvent may be methyl, ethyl, butyl or amyl formate or acetate, together with methyl or ethyl alcohol. (Br. Pat. 184,197. J. Duclaux, Paris. Oct. 4, 1922.)

Alkali Phosphates—Mineral or precipitated calcium phosphate or bone ash is mixed with a solution of sodium potassium or ammonium sulphate and the product treated with sulphur dioxide. The reaction products are calcium sulphate and a soluble phosphate corresponding to the sulphate used, a soluble sulphite being also formed when tricalcium phosphate is treated. The formation of sulphite can be avoided if one of the three molecules of sulphate required for the reaction is replaced by one of sulphuric acid, and this may be accomplished, in the case of sodium phosphate, by the use of niter cake. No sulphite is formed when precipitated calcium hydrogen phosphate is treated, and in this case the sulphur dioxide can be recovered by heating the filtered reaction liquid. Other acids readily volatile from hot solutions, such as acetic or formic acid, or carbon dioxide, or hydrogen sulphide, may replace sulphur dioxide. (Br. Pat. 184,206. J. G. Williams, West Bridgford, Nottinghamshire. Oct. 4, 1922.)

Sweetening Gasoline — The desulphurization of liquid hydrocarbons, such as kerosene, benzine or shale oil, by treatment with alkaline hypochlorite, such as sodium hypochlorite, with free alkali is preceded, followed or both preceded and followed by treatment with alkali. The treatment may be effected in a vessel in which brine is being electrolyzed for the production of sodium hypochlorite, and the temperature may

be raised to, say, 120 deg. F. The product may be filtered through animal charcoal, fullers earth, dehydrated alumina or other adsorbent substance. (Br. Pat. 184,281. A. E. Dunstan, Sunbury-on-Thames. Oct. 4, 1922.)

Aromatic Amines—Aromatic amines are obtained by heating unsubstituted phenols with a mixture of ammonia, an ammonium salt other than sulphite and an alkali sulphite. The alkali sulphite may be that contained in the crude melt resulting in the preparation of the phenol from the corresponding sulphonic acid by alkali fusion. An example is given of the preparation of beta-naphthylamine. (Br. Pat. 184,284. W. L. Galbraith, W. V. Shannan, W. G. Adam and N. E. Siderfin. London. Oct. 4, 1922.)

Tungsten Filaments—Drawn tungsten filaments are produced from materials in which uranium oxide, or a substance that will yield uranium oxide in the subsequent treatment, is incorporated. The substance may be incorporated with unreduced tungstic oxide or with the reduced tungsten powder. It may be added as a solution of uranium nitrate, which is converted by subsequent heat-treatment into the oxide. Other substances—for example thorium oxide or boric acid or both—may also be present in the tungsten material. The tungsten material described in specification 155,851 may be used. (Br. Pat. 184,291. W. H. Le Maréchal, London. Oct. 4, 1922.)

Synthetic Resins — Synthetic resins obtained by the condensation or polymerization of aldehydes with alkali are rendered stable toward water by treating them in a state of fine subdivision with water, to which a little acid is preferably added. The products are soluble in fatty oil, spirit, benzene and other solvents used in the manufacture of varnishes; by rolling in the soft state they can be converted into the commercial form of sheet shellac. According to the example, the resin resulting from the condensation or polymerization of acetaldehyde is ground in a ball mill with a 3 per cent aqueous solution of acetic acid, the product filtered off and either melted or dissolved in a spirit or oil solvent. (Br. Pat. 184,442; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Oct. , 1922.)

Synopsis of Recent Chemical & Metallurgical Literature

Eliminating Static Electricity

The variety of circumstances under which static electricity is produced is surprising, and causes trouble in many chemical industries. In this connection the Bureau of Standards has prepared for publication, in the journal of the National Association of Dyers and Cleaners, a brief account of the sources of static electricity and some suggested means of avoiding it.

In general appreciable charges of static electricity can be produced only when the surrounding air is very dry, and static troubles almost never occur when the relative humidity is greater than 70 per cent. Consequently, the use of damp atmospheres, obtained, for instance, by injecting steam into the room, is one simple and effective means of combating the evil. Another precaution is to connect all metal parts of machinery together by substantial wires so that no difference in electrical potential can be produced between the various parts.

Fusion Rotary Retort

C. J. Goodwin, speaking before the South Wales Institution of Engineers, described the fusion retort and the principles underlying its design and operation. This device is planned for the recovery of oil from coal shale or like substances, which for effective work in this apparatus must be reduced to fine size in order to increase the oil yield, permit lower retort temperatures and insure more complete utilization of the raw material than is possible if the undersize pieces have to be rejected.

For successful retort operation the thickness of layer in contact with the retort should be a minimum and this material should be turned over frequently while being gradually increased in temperature so that the heated surfaces are free from caked material. The fusion retort accomplishes the stirring by rotation of the retort and use of a loose "star" or "cross" breaker. This breaker rolls in the retort when this is rotated, falling back from one edge to another with a chipping or hammering action that is intended to prevent a caking of the material on the inner shell of the retort. With a six-point star it is claimed that the noise and power consumption are sufficiently low to avoid any difficulty. The general character of the retort is shown in the illustration herewith.

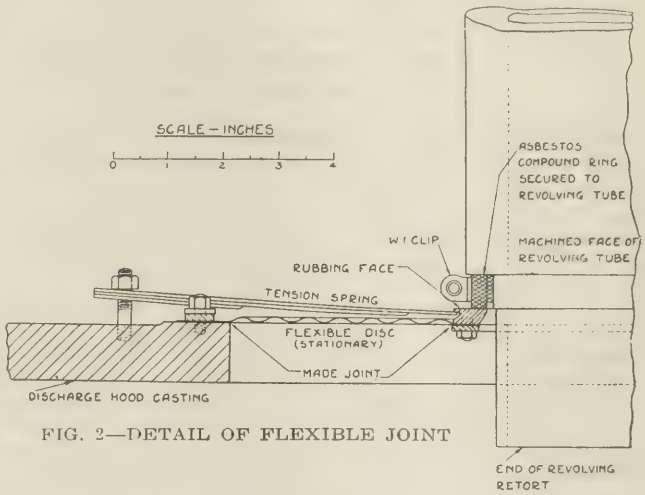


FIG. 2—DETAIL OF FLEXIBLE JOINT

The use of the rotary retort requires a gas-tight flexible joint at the ends. This feature of the construction is one of the most difficult. The form of flexible joint recommended is shown in Fig. 2. It is claimed that this retort has low first cost, low upkeep cost, low power requirement for operation and minimum contact of gas and oil vapor with hot surfaces. By progressive advance of the material through the retort, preliminary eduction of moisture is accomplished and desirable heating up of the solid to be retorted is insured.

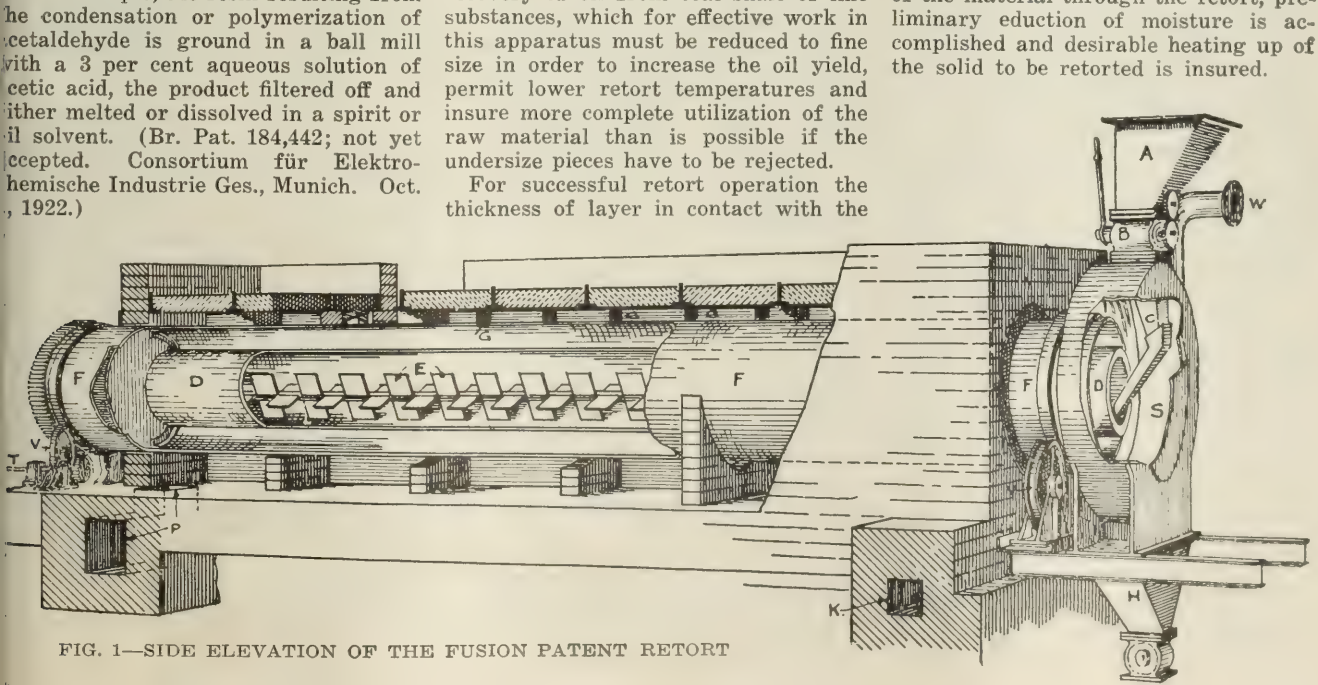


FIG. 1—SIDE ELEVATION OF THE FUSION PATENT RETORT

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Interdependence of Economics and Engineering Keynote of A.S.M.E. Convention

Forty-third Annual Convention of American Society of Mechanical Engineers Attracts Two Thousand Members and Guests to New York

THE American Society of Mechanical Engineers gathered in convention at their New York headquarters Dec. 4 to 7 for a 3-day session of marked success, about 2,000 members and guests being registered. Following the usual custom of the society, the first business on the program was the election of officers for the ensuing year, which resulted as follows:

President, John L. Harrington, of Kansas City; vice-presidents, W. H. Kenerson of Brown University, Earl F. Scott of Atlanta, Henry H. Vaughan of Montreal and W. S. Finlay of New York City; managers, A. G. Christie of Johns Hopkins, J. H. Herron of Cleveland and Roy V. Wright of New York; secretary and treasurer, W. H. Wiley of New York.

Engineer Should Lead Nation

At the opening session, Dean Dexter S. Kimball of Cornell, the retiring president, made an address in which he urged that some change be made in our industrial system so that a more equitable distribution of the fruits of industry might be obtained. Otherwise, he feared that our present civilization can not endure. Dean Kimball said that engineers must take a more prominent place in control of national affairs, and closed his speech with the following inspiring words:

"The scientific mind is capable of high development along business and financial lines, while yet retaining in its background the powerful scientific methods of attacking problems which have made modern industry possible. And this is the great contribution that the engineer can bring to the problem of universal well-being. The one great thing we are all seeking is justice; but there is no justice where there is no knowledge, and the engineer, again using this term in its widest sense, alone possesses an accurate and intimate knowledge of industry."

Engineering and Economics

The keynote of the convention was sounded on the evening of Dec. 6 when, in a joint session of the A.S.M.E. and the American Economic Association, plans were laid for a closer co-operation between engineers and economists. The principal speaker at this meeting, Dr. Wesley C. Mitchell, director of the National Bureau of Economic Research, pointed out that both the engineers and economists had much to learn from each other, and that, if the principles of economics could be applied by the practical methods of engineers, the true end of all industry —the improvement of the condition of the human race—would come much nearer to realization than at present.

Other speakers at this meeting included H. R. Seager, president of the American Economic Association; E. F. DuBrul, of the Machine Tool Manufacturers' Association; E. M. Herr, president of the Westinghouse Electric & Manufacturing Co., and Dean Kimball, retiring president of the A.S.M.E. It was brought out in the remarks of all these speakers that a vastly greater amount of education, especially along economic lines, was necessary for all, so that we may understand the underlying reasons for industrial conditions, work together for the improvement of these conditions and obtain greater justice and well-being for all.

Pan-American Development

Calvin W. Rice, secretary of the society, who has just returned from South America, where he attended the Brazilian Centennial Exposition at Rio de Janeiro, declared that through the efforts of the engineering profession a new era is dawning for Pan-America. As the envoy of many of the largest engineering organizations in the United States Mr. Rice participated in the International Engineering Congress at Rio, and, with the support of Secretaries Hughes and Hoover and other leading figures in Pan-American development, made a tour of South and Central America.

In Mr. Rice's address, delivered in the nature of a report to the engineers of the nation, announcement was made of the definite accomplishment of three steps in the movement toward the unity of the Americas:

(1) Action has been taken toward effecting a permanent organization to carry out the plans of the Rio congress, with Verne L. Havens of the McGraw-Hill Co., New York, as secretary.

(2) A standardization bureau, as suggested by Secretary Hoover, will be established in every Pan-American country.

(3) The dream of a transcontinental railway is approaching the stage of reality. A meeting to further this project will be called by the nations of Pan-America. Minor C. Keith of Costa Rica, the only living member of the committee that originally recommended the building of this railway, has been asked to preside.

Technical Sessions

The technical sessions were of great interest and were enthusiastically supported. Among the general topics treated were management, material handling, machine shop practice, refrigeration, education and training for industry, research, fuel engineering, steam power engineering, railroad engineering safety, standardization, ordnance, aeronautics, forest products, the power test code, and the boiler code.

L. P. Breckenridge, of Yale University, presided at a joint session of the fuels division of the society and the Stoker Manufacturers' Association. The fuels division has prepared a set of rules for householders governing use of fuel, management of furnace and the burning of substitutes for anthracite. Economy must be practiced by every consumer, the division warned, if an acute shortage is to be averted.

Helium Hearings Begin Before Public Lands Committee

The Committee on Public Lands on Dec. 5 began hearings on the helium bill. The only witness who has appeared at the time of this writing is R. B. Moore, chief chemist of the Bureau of Mines. At the request of the committee, Dr. Moore is explaining to the committee the full history of helium development. This will be completed before the bill itself is taken up. The committee feels that the subject is of sufficient importance that its members should have a clear picture of all the considerations involved in the whole subject of helium.

The committee is much impressed with the widespread sentiment manifested in many sections of the country for the helium bill. This was supplemented by a formal request from the Federated American Engineering Societies asking that hearings begin at this time. In view of this demonstration of interest among engineers and the public generally, the committee voted to begin the hearings at once.

Government Departments Report Year's Work

Active Development of Mineral Wealth Described in Bureau of Mines Report

A SUBSTANTIAL beginning of the active development of that vast mineral wealth which has heretofore been locked up in the public domain of various Western states, but which is now to be liberated under the terms of the general leasing law, has been made, according to H. Foster Bain, director of the Bureau of Mines, in his annual report just submitted to the Secretary of the Interior. In the fiscal year ended June 30, 1922, there was produced from government lands other than Indian lands, 18,236,362 bbl. of petroleum, of which the federal government received as royalty 3,616,852 bbl. worth $4,768,397.61, not including bonuses. In addition, at the end of the year $14,000 a month was being received by the government from natural gas leases on public lands in Wyoming. In the Rocky Mountain field alone there were on government land 336 oil wells, of which 267 were in the Salt Creek, Wyo., field. A hundred other wells were being drilled.

Up to the end of the year there had been issued 294 oil and gas leases in 4 states and 7,727 prospecting permits, on each of which drilling is required, in 18 states and Alaska. These figures do not include operations within the naval petroleum reserves, which by executive order are now administered by the Bureau of Mines. The field work is directed through a supervisor who has headquarters at Denver with branch offices at Casper and Salt Creek in Wyoming, Bakersfield, Taft and Maricopa in California, Winnett, Mont., and Shreveport, La.

Survey of Government Oil Wells

The largest number of producing wells belonging to the government is in the Salt Creek field of Wyoming, where the government holds title to nearly all the land. During the year the producing capacity of the wells far outran the capacity of existing pipe lines.

In California the principal activity has been with regard to leases within the naval petroleum reserves. The year marked final adjudication of the most important outstanding contest as to oil lands, that of the Honolulu Consolidated Co. Leases were granted by the Secretary of the Interior and accepted by the company and a drilling campaign promptly arranged. A careful study made by the Bureau of Mines brought out the fact that up to March 4, 1922, the government lands had lost by drainage approximately 22,000,000 bbl. of oil through failure to drill offset wells. Of this, on the scale now in effect, the government's loss in royalty may be estimated at 6,800,000 bbl., equivalent to $8,800,000. To prevent further losses, leases were accordingly granted to such lands as were being

(Continued on page 1192)

Fries Commends Personnel in Report of Chemical Warfare Service

THE WORK of the Chemical Warfare Service during the last fiscal year is reviewed in detail by General Fries in his annual report. The report itself covers thirty-nine pages. General Fries emphasized as the predominant impression the loyal and efficient manner in which the personnel have performed their duties under the stress of emergency work and the ever-present uncertainty as regards the continuance of the Chemical Warfare Service.

"This latter situation is a matter of real importance," says the report. "With the action of the Limitation of Armaments Conference, followed later by evident indications that the appropriation for this service would be very much curtailed, a large proportion of the civilian personnel has been confronted with the problem of seeking employment elsewhere at some indefinite future date.

"The organization has been built up carefully, and this has resulted in personnel of much training and valuable experience severing their previous connections and becoming definitely identified with this work. That these uncertain conditions did not effect the morale of the organization greatly is due to the high character and real interest of these people in their work. It cannot be urged too strongly that efforts be made to have definite policies established regarding the activities to be carried on by the Chemical Warfare Service. The personnel must know where it stands.

Service a Necessity

"The close of another fiscal year, with its attendant experiences and knowledge gained, leaves a keener and more definite realization of the importance and necessity for chemical preparedness. In any consideration of policies pertaining to the national defense, the field of chemistry dare not be neglected. Certainly investigations into the possibilities of chemical warfare must be continued and as information is obtained it must be made available to the army and navy and incorporated in plans and training.

Efforts of Past Year

"The year ended June 30, 1922, was noteworthy in many respects as regards chemical warfare. One of the outstanding features was the growing appreciation of the range covered by chemical warfare, and its usefulness in peace as well as in war. The rôle which chemical warfare must play in defense alone is a vast one and entitles it to the serious consideration of every student of defense.

"The use of smoke and incendiary materials for the purpose of screening

(Continued on page 1192)

C. W. S. Appropriation Cut

The Director of the Budget has approved an appropriation of $482,240 for the Chemical Warfare Service for the next fiscal year. This is a reduction of $135,000, the amount appropriated for the current fiscal year.

Will Attempt to Have Budget Enlarged

Cut in Budget Affects Salaries of Chemical Engineers

During this fiscal year the Chemical Warfare Service is expending $600,000 for the purchase, manufacture and test of chemical warfare gases or other toxic substances, for gas masks and other offensive and defensive materials and appliances. Out of that amount the service is expected to pay for all necessary investigations, experiments and research work. The purchase of chemicals and all scientific and technical apparatus and instruments must be taken from the same appropriation. It also is to include the miscellaneous operating expenses and the salaries of personnel.

A large portion of the decrease, upon which the Director of the Budget insisted, is being made in the salaries of the higher grade members of the staff. For instance, during the last fiscal year six chemical engineers of the $4,500 grade were allowed. This was reduced to three during the current fiscal year. During the next fiscal year no engineers of that grade are to be employed. The four associate chemical engineers of the $3,600 grade, which were allowed during the last fiscal year, are not provided for in the new budget. The highest salary allowed a chemical engineer is $2,800 and only one of that grade is provided.

At the sacrifice of a number of subordinate chemical positions, the number of principal chemists of the $6,000 grade has been increased from four to nine. During the current fiscal year six assistant chemists were provided. The Director of the Budget has approved an additional assistant chemist of the $2,500 grade for the next fiscal year. The new budget makes provision for one mechanical engineer at $3,600. The safety engineer formerly employed is dropped, as are the chemical laboratorians, the pathologists, the physiologists, the technical adviser, the technical patent expert, the associate and assistant technologists, and the toxicologists.

The friends of the Chemical Warfare Service in Congress will make a determined effort to override the Director of the Budget in the matter of Chemical Warfare Service appropriations. There is reason to believe that Congress will be convinced that the appropriation allowed by the Budget Bureau is inadequate and that an increase will be carried in the appropriation bill.

Equipment Association Begins Work

Opens National Offices in New York City and Launches Important Activities

The Chemical Equipment Association, comprising manufacturers of equipment essential to the chemically controlled industries has established national executive offices at 1328 Broadway, New York City. It has begun active work through a national membership for the fostering of trade in chemical equipment; for the improvement of practices in the production and distribution of such equipment, and in the performing of engineering services incidental thereto.

Not only does the activity of this association signalize the adoption of trade association methods by the chemical equipment companies, but it represents a movement toward manufacturing and distributing co-operation along the lines recommended by Secretary of Commerce Hoover, who personally encouraged the organization of the association. Commenting on the growing tendency toward co-operative associations, the New York *Tribune* in its issue of Nov. 5 quoted an officer of the Chamber of Commerce of the United States as follows:

> Such supply company organizations as the Railway Equipment Association, the Motor and Accessory Manufacturers Association, the Association of Ice Cream Supply Men, the recently formed Chemical Equipment Association and other groups representing the supply and equipment ends of leading industries, the members of which are manufacturers of miscellaneous commodities, but connected with a specific industry; for market expansion, educational work, publicity, research, credit protection and prevention of trade abuses is one of the most interesting current trade association trends.

The Chemical Equipment Association was organized Sept. 12, 1922, following preliminary activities of an organization committee of representatives of leading manufacturers.

The officers of the association are: President, Pierce D. Schenck, president of the Duriron Co., Inc., Dayton, Ohio; vice-presidents, J. George Lehman, vice-president and general manager of the Bethlehem Foundry & Machine Co., Bethlehem, Pa.; Walter E. Lummus, president, the Walter E. Lummus Co., Boston, Mass.; Adolph Coors, Jr., vice-president, Coors Porcelain Co., Golden, Colo.; treasurer, Percy C. Kingsbury, chief engineer, General Ceramics Co., New York City; secretary, Robert Everett.

The directors are: H. N. Spicer, the Dorr Co., New York City; P. S. Barnes, the Pfaudler Co., New York City; Edwin C. Alford, T. Shriver & Co., Harrison, N. J.; T. C. Oliver, Chemical Construction Co., New York City; Hamilton Allport, E. B. Badger & Sons Co., New York City.

The association has already established communication with nearly two hundred of the large industrial associations of the country, announcing itself as a source of information in chemical equipment supply matters, and has begun a regular bulletin service.

New York Section, A.C.S., Elects Officers

The separation of isotopes and their properties was the subject of a talk by James Kendall of Columbia University before the New York section of the American Chemical Society at Rumford Hall, Dec. 8. The subject was very timely in view of the recent selection of Frederick Aston as recipient of the Nobel prize in chemistry, in recognition of his work on this subject.

At the short business meeting which preceded Professor Kendall's talk, officers for 1923 were elected as follows: Chairman, Dr. C. A. Browne, N. Y. Sugar Trade Laboratory; vice-chairman, C. E. Davis, National Biscuit Co.; secretary-treasurer, Benjamin T. Brooks, Mathieson Alkali Works.

Executive Committee: M. H. Ittner, chief chemist, Colgate & Co.; James Kendall, Columbia University; H. C. Parmelee, editor, *Chem. & Met.*, and H. G. Sidebottom, Jayne & Sidebottom, Inc.

Councilors: C. A. Brown, C. E. Davis, Benjamin T. Brooks, James Kendall, H. C. Parmelee, H. G. Sidebottom, R. G. Wright, F. H. Getman, Ellwood Hendrick, K. G. McKenzie, David Wesson, H. R. Moody, M. H. Ittner, A. C. Langmuir, D. W. Jayne, B. R. Tunison, A. W. Thomas, Williams Haynes, Lois M. Woodford, Mary E. Pennington and F. M. Turner.

Chemical Exports Steady

Three Million Total for Month — Increase in Fertilizer Business

Exports of chemicals and allied products during October were valued at $8,159,044, according to returns to the Bureau of Foreign and Domestic Commerce. This figure indicates the continuance of exports in practically the same volume as in September and in October of 1921.

During October there was a slight increase in the value of the exports of chemicals proper, as compared with September. The value of chemicals, apart from allied products, exported in October is given as $3,811,342. There was a decided increase in the volume of fertilizers and fertilizer materials exported, but the value of those exports was less in October than in September. Fertilizers to the extent of 69,509 tons were exported during October, as compared with 55,518 tons in September. Exports of sulphate of ammonia decreased from 9,332 tons in September to 6,436 tons in October. Practically all of the October exports of this material went to Japan. Explosives exports in October aggregated 1,233,772 lb., a slight decrease as compared with the September forwardings.

Among the more significant items making up the October export figures are the following:

Benzol (lb.)	2,917,749
Sulphuric acid (lb.)	482,036
Boracic acid (lb.)	120,983
Wood and denatured alcohol (gal.)	124,718
Acetate of lime (lb.)	1,768,630
Calcium carbide (lb.)	720,272
Borax (lb.)	913,726
Caustic soda (lb.)	8,605,123

American Petroleum Institute Meets

Third Annual Convention, in St. Louis Attracts Good Attendance

The American Petroleum Institute held its third annual meeting in St Louis, Dec. 6 and 7. Addresses by men of national prominence in the petroleum industry attracted a large attendance at the various meetings of the Institute.

Two topics of vital importance to the industry were brought to the attention of those attending the meeting: first the methods of producing, to the best possible advantage, commercial gasoline, and second, the standardization of oil-drilling methods and equipment. The latter movement has been launched in order to make it possible to secure repairs and new equipment by reducing the number of varieties of equipment manufactured.

Thomas A. O'Donnell, of Los Angeles, president of the association, assailed centralized government and federal control of industries at the opening general meeting. He said:

"I do not believe in bureaucracy in government. I believe it is destructive and not in the public interest. I believe everybody in the petroleum industry must recognize the danger confronting not only that industry but other lines of effort. The most destructive thing conceivable is an active government interference in business."

Addresses were delivered by Ivy L. Lee, W. S. Farish, of Houston, Tex., president of the Humble Oil & Refining Co.; P. E. Kistler, of Chicago, Ill., president of the Producers & Refiners Corporation, and James J. McGraw, of Tulsa, Okla., vice-president of the Exchange National Bank of Tulsa.

Directors Elected

The following directors were elected:

Pacific Coast Group—P. H. Hillman, Standard Oil Co. of California; K. R. Kingsbury, Standard Oil of California; H. R. Gallagher, Shell Co. of California.

Central United States Group—W. S. Farish, Humble Oil & Refining Co.; Robert W. Stewart, Standard Oil Co. of Indiana; P. C. Crenshaw, Home Oil Co.

Eastern United States Group—George W. Crawford, Ohio Fuel Supply Co.; A. C. Woodman, Union Petroleum Co.; R. D. Benson, Tidewater Oil Co.; Edward Prizer, Vacuum Oil Co.

Ships—J. Howard Pew, Sun Co.

Pipe Lines—J. H. O'Neil, Prairie Pipe Line Co.; A. A. Moody, Jarecki Manufacturing Co.

Europe—W. C. Teagle, Standard Oil of New Jersey.

To fill the unexpired term of office of Judge Martin Carey, deceased, H. L. Pratt, Standard Oil Co. of New York, to represent the Far East section of the foreign trade group.

The principal speakers at the annual banquet, Thursday evening, were Amos L. Beaty, of the Texas Co., and Sir Auckland Geddes, ambassador to the United States from Great Britain.

Appropriations Announced for Government Bureaus

Technical Departments Assigned Budgets to Continue Present Lines of Investigation

Appropriations totaling $1,339,031 for the Bureau of Chemistry in the Department of Agriculture have been approved by the Director of the Budget. The principal items making up this total follow: For carrying into effect the provisions of the food and drug act, $704,401; for salaries and wages, $308,970; for conducting investigations, relating to the application of chemistry to agriculture, $97,900; for collaboration with other departments desiring chemical assistance, $14,000; for the investigation of problems connected with the manufacture of sugar and sirup, $35,000; to carry into effect the provisions of the act with regard to the prevention of imports of impure tea, $38,000; naval stores investigation, $10,000; insecticides investigation, $20,000; for investigations looking to the prevention of grain dust explosions, $25,000; for the investigation and development of methods of utilizing wool-scouring waste, $9,000.

Personnel

The budget for the next fiscal year provides for the employment of 219 chemists in the bureau. There are in addition a considerable number of employees with chemical training who are classified under other titles.

The budget calls for an appropriation of $310,775 for the Bureau of Soils. The principal items making up that total are: Salaries, $76,440; for chemical investigations of soil composition and soil minerals, $23,110; for physical investigations of important properties of soil, $12,225; for investigations of fertilizers, $60,000; for soil surveys, $120,000.

Bureau of Standards

Total appropriations of $1,742,360 were approved for the Bureau of Standards. The principal items making up that total are as follows: Salaries, $432,360; for apparatus, machinery and other appliances, $75,000; for testing structural materials, $195,000; for maintenance and operation of testing machines, $35,000; for investigation of fire-resisting properties of building materials, $25,000; for investigation of the standards of practice and methods of measurements of public utilities, $95,000; for testing miscellaneous materials, including chemicals, varnishes and inks, $40,000; for the investigation and standardization of methods and instruments employed in radio communication, $40,000; to develop color standards, $10,000; to study technical processes used in the manufacture of clay products, $30,000; to develop methods of standardizing mechanical appliances, $40,000; for the investigation of the problems involved in the production of optical glass, $20,000; to investigate textiles, paper, leather and rubber, to develop standards of quality, $25,000; for the standardization and design of sugar testing apparatus and the development of technical specifications for the various grades of sugar, $40,000; for the standardization and testing of standard gages and screw-threads, $40,000; for investigating mine scales, $15,000; for metallurgical research, $50,000; for investigations of high-temperature measurements and control, $10,000; for the investigation of the principles of sound, $5,000; for industrial research, $190,000; for testing large scales, $40,000; for investigations in the establishment of standards for instruments, tools, electrical and mechanical devices, $100,000; for the purchase, preparation and analysis of standard materials, to be used in checking chemical analyses, $10,000; for the investigation of radioactive substances, $10,000; for the maintenance and equipment of automotive engine test plants, $40,000; for determining fundamental data, $20,000.

Coal-Tar Tariff Provisions Discussed

Department of Commerce Will Compile Monthly Statistics on Imports of Dyes and Chemicals

Applications of the provisions of the new tariff law to imports of coal-tar products were discussed with the customs service by dye importers at meetings last week. Particular interest was evidenced in the attitude to be taken by the customs service in determining whether similar competitive articles are produced in the United States for the purpose of imposing the ad valorem rate based on the United States value.

Work on the rules to govern the imposition of tariff rates on coal-tar products, it was said, is going forward steadily, but progress is necessarily slow because of the scope of the investigations to determine United States value and the substantial results accomplished by imported coal-tar products as compared with domestic products.

To Compile Monthly Statistics

Statistics giving itemized imports of coal-tar dyes and chemicals will be published monthly by the Department of Commerce, through co-operation of the Customs Division of the Treasury Department and the Tariff Commission. Plans are being made to issue the first report in January, if arrangements can be completed in time.

The data will be gathered from customs invoices at New York, the principal port of such entries, by a clerk assigned to this duty by the Tariff Commission, and sent to the commission's headquarters in Washington, where they will be compiled by experts of the chemical division, and sent to the Commerce Department for publication. Colors, strength and, wherever possible, prices will be included in the reports.

It is expected that the monthly reports will be available for publication 2 weeks after the close of each period.

Will Survey White Arsenic Situation

De Long Arranges Conference With Producers, Independent of Investigation Demands of Legislators

The production of a larger supply of calcium arsenate, with which to check the ravages of the cotton boll weevil next season, is the purpose of a conference of manufacturers of white arsenic and calcium arsenate and officials of the departments of Agriculture, Interior and Commerce, to be held at the Hotel Astor, New York, Dec. 13.

The conference was arranged by C. R. De Long, formerly chief of the chemical division of the Department of Commerce and now head of the dye and chemical section of the Tariff Commission. Mr. De Long, who will preside at the meeting, explains that the object will be to find out just how much white arsenic is available for the manufacture of calcium arsenate, the principal boll weevil insecticide.

The Department of Justice will assign an agent to investigate whether there exists an unlawful combination to control the supply and price of white arsenic, according to a letter received by Senator Harris of Georgia from the department. Investigation was asked by Senator Harris after complaints from constituents that the price of calcium arsenate had doubled within a year and that the supply was short.

The Department of Justice also proposes to conduct another investigation into the fertilizer situation, following complaints from some sections that prices are uniform, according to another letter from the department. A fertilizer investigation by agents of the department last spring failed to disclose any combination.

Scarcity Due to Smelters' Inactivity

The high price of the arsenate, which has resulted in Congressional action, is caused, Mr. De Long states, by the shortage of white arsenic. This, he said, is a result of inactivity in the lead and copper smelting industry. The enormously increased demand for the insect poison, together with the decreased supply, has resulted in the present acute shortage, which promises to become more serious unless steps are taken to increase the output. It is hoped, as a result of the meeting, to uncover stocks of arsenic, and make them available for insecticide manufacture and to encourage a new undeveloped output.

Senator Smith of South Carolina introduced a resolution, which has since been adopted, directing the departments of Agriculture and Interior to make an investigation of this industry and report to the Senate the cause of the prevalent high price. It especially directs an investigation of the charges that this product is in the hands of a monopoly. Mr. De Long declares that plans for this conference were made prior to the introduction of the Senate resolution.

Bureau of Mines Report

(Continued from page 1189)

drained, and offset wells have been drilled with remarkable speed.

Other Mineral Reserves

The United States Government is one of the largest coal-land owners in the world and also holds important reserves of phosphate, potash and other salts. Although just at present, because of the prior development of mines and industries in the Eastern states, coal mining on the public domain is overshadowed by private industry, in the years ahead the leased mines may well become the more important. Every effort is accordingly being made to establish the new system on a correct basis, properly to protect the public interest in safe and efficient mining, and not unduly to hamper private initiative in operation. Coal is now being mined under lease in Washington, Montana, North Dakota, South Dakota, Wyoming, Utah, Colorado, New Mexico and Nevada. Phosphate rock is being mined in Idaho, and coal and other mines on Indian lands are being supervised in still other states. On the public lands proper the Bureau of Mines is now charged with supervision of 29 coal leases, 200 coal-prospecting permits, 5 coal licenses, 1 phosphate lease, 1 oil-sand lease, 1 potash lease and several potash prospecting permits. In all, nearly 240,000 acres scattered through 10 states require supervision, and the average is rapidly increasing. The work is directed through a mining supervisor with headquarters at Denver, Colo.

Safety and Rescue Work

In addition to the technical supervision of mineral production on public lands, the Bureau of Mines engaged in numerous other activities associated with problems of safety and efficiency in the various mineral industries. During the year, 16,291 persons were trained in first-aid and rescue work, thus constituting a considerable addition to the legion of skilled men and women who stand ready to render valuable humanitarian aid to those subjected to peril in times of mine disasters. Studies of health hazards in the petroleum industry were made by the bureau in co-operation with the Public Health Service and the American Petroleum Institute. Smoke abatement surveys were made at Salt Lake City, Buffalo, N. Y., and Grafton, W. Va. A fuel-economy survey of the government heat and power plants in the District of Columbia was undertaken. New plans were justified and set for impurity allowances in the Salt Creek, Wyo., oil field which will increase government revenue $40,000 per annum on present production. The value of waste coal in dumps at Wilkeson, Wash., was demonstrated, with the result that a plant for the recovery of 150,000 tons is now being erected. The difficulty in the way of using low-priced cyanide in metallurgical work was discovered and remedied, resulting in the breaking of a monopoly in this important chemical material.

Fries Commends C.W.S.

(Continued from page 1189)

troops on the field of battle, for screening naval squadrons at sea in attack or defense, is a field which requires the study of every student of tactics or strategy. Screening smoke materials are applicable to use in every character of projectile, whether dropped from airplanes, fired from guns or thrown by hand. They are used to form the screen for attack, and the screen for defense. The ability to use this screen close to or at a considerable distance from moving troops increases enormously the difficulty of knowing where to aim artillery and other long range guns. Research and development in this line are in their infancy, while the study of the tactical use of smoke has scarcely begun.

"Purely incendiary materials are generally of much less importance. They have their fields of usefulness in attacking military stores, ordnance depots and the like. On the other hand, a smoke-producing material as white phosphorus, which is also capable of creating casualties by burning, has a very considerable importance in attack or defense. White phosphorus is adaptable to use by every arm of the service and every projectile, not only as a smoke as stated above, but as a burning material to attack personnel. While few deaths will result, many will be put out of action, while the moral effect of burning phosphorus is too great to be overlooked at any time.

"Consideration of the possibilities in the field of chemical research will give an understanding of the advisability of continuing the work into the toxicological properties and characteristics of chemical compounds, which information this country must have to even approximate chemical preparedness. It is work that cannot be done properly along scientific lines in any other place than in such an institution as exists in Edgewood Arsenal. In addition, indications are sufficiently clear to show the possibilities of using many of the results obtained in this work to the advantage of the country in peace time. An analysis of the importance of this work in connection with the funds required to carry it on shows clearly a full justification.

Recommendations for Future

"For the healthy and reasonable continuance of the activities at Edgewood Arsenal in future, the following recommendations are made:

Establish a continuity of policy as regards the character and scope of research and development. An absolute minimum of $2,000,000 should be devoted to this work annually.

Increase the activities of the Chemical Warfare School to include the training of selected officers and non-commissioned officers of the line.

Maintain present large-scale plants in an operating condition. This can be done and provide for minor improvements at a cost not to exceed $150,000 per year.

Manufacture a limited number of gas masks and other protective devices annually. A minimum expenditure for this purpose would be $500,000.

Provide for the manufacture of training supplies and munitions at an estimated minimum cost of $200,000 per annum.

Provide for the upkeep and operation of utilities and the preservation of supplies and munitions in storage. This is an expenditure of approximately $400,000 per year.

Revoke the decision to turn over a section of the arsenal and a part of its facilities as an artillery station. All space and facilities are required for the normal peace time operation of the activities concentrated at Edgewood Arsenal and at the same time provide for a reasonable expansion in case of an emergency.

"The past year has seen the establishment of a sound and reciprocal basis of relations between the Chemical Warfare Service and other branches of the War and Navy Departments, and also other departments of the government. Chemical warfare can aid these departments greatly in peace. The store of knowledge in the C.W.S. of poisonous compounds has been shown to be of the greatest value to almost every branch of the government."

Personal

George W. Heintz, for a number of years vice-president and general manager of the United States Smelting, Refining & Mining Co.'s metal operations in Utah, Colorado, Nevada, Arizona and California, with headquarters at Salt Lake City, and for the past 3 years a vice-president in charge of Western operations of the same company in Boston, has resigned, effective Jan. 1, 1923. Simultaneously Mr. Heintz relinquishes the executive office of the Sunnyside Mining & Milling Co., the Bullion Beck Mining Co., the Niagara Mining Co. and the United States Stores Co., all of which are subsidiary or affiliated companies of the United States Smelting, Refining & Mining Co. After a short vacation Mr. Heintz will engage in consulting work in Boston.

Chester A. Hammill, geologist, gave an interesting address on recent developments in the oil and gas fields of Texas, at a recent meeting of the Technical Club, Dallas, Tex.

Hugh M. Henton, who is now assistant professor of mining and metallurgy in the Washington State College of Washington, Pullman, Wash., has not been connected with the Aluminum Castings Co., as mentioned in the personal in our issue for Nov. 15.

Dr. Horace C. Porter, consulting chemical engineer on fuels, Philadelphia, Pa., spoke before the Syracuse Section of the American Chemical Society, Dec. 8, on "Coal Carbonization and the World's Fuels."

Marcus A. Grossmann has been appointed metallurgist of the Atlas Steel Corporation, a consolidation of the Electric Alloy Steel Co. and the Atlas Crucible Steel Co. His new headquarters are in Dunkirk, N. Y.

G. A. Swain, assistant to the manager of the supply department of the Westinghouse Electric & Manufacturing Co., has been elected chairman of the committee on instruments and measurements of the American Institute of Electrical Engineers.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

New Records of Industrial Activity

Production and Distribution Movements of Basic Commodities Show Striking Increases, Thus Confirming Other Evidence of Business Expansion

OCTOBER set records for even greater industrial activity than in any month of the current year. The output of almost all basic commodities showed large increases, sometimes even when the usual seasonal declines were expected. Among others, the following products were produced in larger volume than in any month since 1920: pig iron, steel ingots, byproduct coke, copper, zinc, wood chemicals, cement, brick and crude petroleum. Consumption of cotton, wool and newsprint paper were at new high levels.

Corresponding increases are shown in the activity of all distributive movements, such as wholesale and retail trade, car loadings, bank clearings, magazine and newspaper advertising, postal receipts and the greater demands for money.

TABLE I—MONTHLY PRODUCTION OF BASIC COMMODITIES IN TERMS OF AN ESTIMATED NORMAL

(Estimated normal production = 100 per cent)

Commodity	May	June	July	Aug.	Sept.	Oct.
Anth. coal	0.4	1.0	1.4	1.9	61	94†
Bit. coal	41	43	32	46	72	75†
Pig iron	73	79	82	61	68	83
Steel ingots	81	82	79	70	74	85
Copper	70	75	75	86	80	84†
Tin, delivered	92	90	75	77	92	103
Zinc*	51	53	60	59	62	75
Petroleum	111	110	110	112	111	112†
Cement	119	120	128	121	123	126
Sugar meltings	146	135	131	144	110	108
Cotton consumed	88	92	84	97	92	95
Wood pulp	108	110	105	105	102	....
Paper (total)	100	100	93	107	105	....
Gasoline	96	101	109	103	104	....
Wool consumed*‡	116	116	103	126	121	131

*Seasonal variation not allowed for. †Preliminary. ‡Estimated.

Textiles Active

The textile industries, which are probably the most important consumers of chemical products, reported figures to the Department of Commerce showing the largest consumption of cotton and silk for any month in over 2 years. There was also a pronounced increase in the consumption of wool by textile mills in October. The total of 59,282,000 lb. is the largest since 1920, with the exception of March of this year, when 60,368,000 lb. was consumed. Consumption in the first 10 months of this year is about 25 per cent greater than in the corresponding months of last year. Woolen and worsted machinery showed further increases in activity in October. This was particularly marked in spindles and in wide and narrow looms, while combs, due to overtime work, showed 106.4 per cent of hours active in October. Cotton machinery activity also increased. Exports of cotton cloth declined slightly in October, with a total of 50,985,000 sq.yd. Consumption of cotton fabric by tire manufacturers increased.

Metals

Production of pig iron during October totaled 2,638,000 tons, the largest output since December, 1920. Daily blast-furnace capacity in operation increased from 77,005 tons at the outset of the month to 87,935 at the close. Steel ingot production was 3,283,000 tons, as compared with 2,713,000 tons during September, an increase of 21 per cent. Unfilled orders for finished products on the books of the United States Steel Corporation Oct. 31 amounted to 6,902,000 tons, as compared with 6,692,000 tons Sept. 30, an increase of 3 per cent.

The production of both copper and zinc showed large increases in October and in each case exceeds the output for any month in more than 2 years. Stocks of zinc again declined, reaching the lowest figure since 1919.

The petroleum industry established several new records in October. Pro-

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	161.72
Last week	160.60
December, 1921	145
December, 1920	245
April, 1918 (high)	286
April, 1921 (low)	140

The chemical market continued to show the strength that has been evident for the past few weeks. The prices of all of the commodities represented by this index were maintained at the higher levels previously reported. Increases were recorded for glycerine and cottonseed oil.

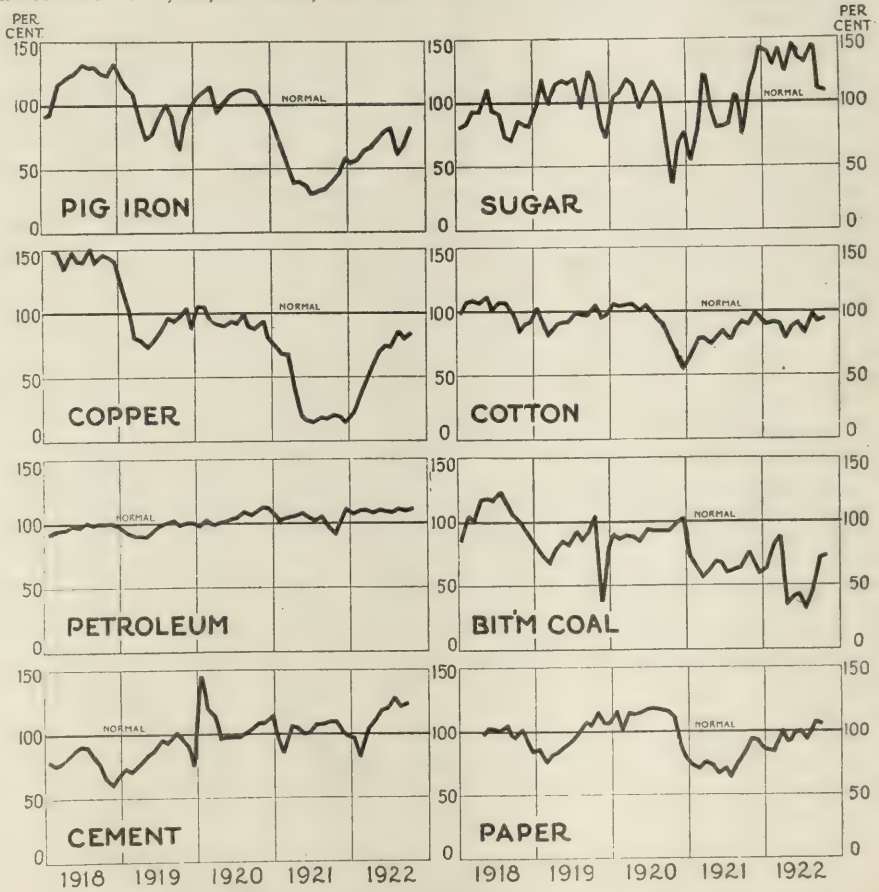


FIG. 1—TREND OF CURRENT PRODUCTION IN CERTAIN BASIC INDUSTRIES

duction at 47,255,000 bbl. of crude is the largest ever reported for one month. Consumption jumped to 52,269,000 bbl., compared with the previous maximum of 50,141,000 bbl. reported for August this year. Stocks again increased to a new high level of 274,438,000 bbl.

Paper and Rubber

Newsprint production also increased in October, with a total of 130,682 tons, or over 5,000 tons more than in September, and, with the exception of August, is the largest for any month since 1920. Newsprint consumption by publishers for October increased to 192,431 tons, or 20,000 tons more than in September, and the largest for any month since these reports were started. Stocks of newsprint, particularly those in the hands of publishers, declined.

Rubber consumption by tire manufacturers increased in October, compared with September, and was about 60 per cent greater than in October a year ago. There was a corresponding increase in the production of tires and tubes. Shipments of tires and tubes showed little change from September, while stocks increased slightly, although still considerably below those reported a few months ago.

Production Trends

Included with this article are two tables of interest as showing the general trend of production in the basic industries. Table I, a compilation of the Federal Reserve Bank of New York, shows production for the past 6 months expressed as percentages of an estimated normal production. In these estimates allowance has been made for year-to-year growth and for seasonal variations. These data are presented graphically in Fig. 1.

Table II is a tabulation of production figures for a number of important chemical and allied industries. These data are taken from "The Trend of Business Movements" section of the *Survey of Current Business.*

Better Demand and Firmer Prices in Chicago

Numerous Advances Reported Principally for Wood-Distillation Products and Heavy Chemicals

CHICAGO, Dec. 8, 1922.

Although little change was apparent in the general condition of the heavy chemical market during the week ended Dec. 7, prices as a whole were very firm and quite a few advances were reported. All wood products were in an exceptionally firm position and still higher prices were predicted in some quarters.

Alkalis Show Better Movement

Caustic soda continued firm, with a good inquiry reported by the dealers. Spot 76 per cent material was quoted in ton lots at $3.50 per 100 lb. for the solid and $4.25 for the ground or flake. *Caustic potash* was in fair demand and imported material testing 88-92 per cent was available at 7¼@7½c. per lb. *Soda ash* moved in a good volume, with $2.25 per 100 lb. the prevailing quotation quotation for 58 per cent material in cooperage.

Alums were in fair demand with the supply light. *Potash alum* was offered in small lots at 4½@5c. per lb. for the lump and 5½@6c. for the powder. *Aluminum sulphate* was scarce and the ground iron-free was very firm at 2½@3c. per lb. *Sal ammoniac* enjoyed a fair demand and the white granular was quoted at 7½@8c., per lb. in small or moderate lots. *Ammonium carbonate* was scarce on spot and the lump was held at 11@12c. per lb. Barium compounds continued firm and were unchanged in price. *Barium chloride* was available at $110 per ton and the carbonate at $90. *Copper sulphate* was in fair demand and crystals were quoted by first hands at 6c. per lb. *Carbon bisulphide* was still scarce and the small supplies on spot were firmly held at 7½c. per lb. *Carbon tetrachloride* was in good demand and the price was advanced to 10½c. per lb. for the large drums. *Furfural* was reported to be moving in a fair way and the price was unchanged at 25c. per lb. for 1,000-lb. lots. *Formaldehyde* was again advanced, the new level being 16c. per lb. in barrels for less than 5-bbl. lots. *Glycerine* was reported to be in a somewhat firmer position and the price of 18½c. per lb. for c.p. material in drums was maintained. *Magnesium metal* was in poor demand and the *powder* was offered in 100-lb. lots at $1.15 per lb.

Linseed Oil and Turpentine Sluggish

Bichromates were unchanged in price and were reported to be moving in a fair way. The *soda bichromate* was quoted at 9@9½ c. per lb. and the *potash* at 12@13c. *Potassium cyanide* was slightly lower due to fresh arrivals and single-case lots were available at 53c. per lb. *Potassium ferrocyanide* was very firm with only small lots available at 42@43c. per lb. *Potassium ferricyanide* was still very scarce, with only an odd lot here and there available at 95c@$1 per lb. *Permanganate of potash* was in fair request and supplies of the imported U.S.P. crystals were quoted at 18@19c. per lb. *Chlorate of potash* was firm with small lots of the powdered offered at 9c. per lb. *Sodium acetate* was in good demand and very scarce with only a few small lots available at 9@9½c. per lb.

Very little demand existed for *linseed oil*, with nearly all factors reporting the market extremely quiet. The boiled oil was quoted today at 90c. per gal. in single-drum lots and the raw at 88c.

Turpentine was in a position similar to that of linseed oil and very little was moved to the dealers. The consuming trade looks for lower prices and shows little or no interest in the present market. Today's price for single-drum lots was $1.46 per gal. delivered to the buyer's plant.

TABLE II—THE TREND OF CURRENT PRODUCTION IN CERTAIN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

Production of—	Feb., 1922	March, 1922	April, 1922	May 1922	June, 1922	July, 1922	Aug., 1922	Sept., 1922	Cumulative Total Through Latest Month 1921	Cumulative Total Through Latest Month 1922	Per Cent Increase or Decrease 1922 from 1921
Acetate of lime, thous. of lb.	7,942	11,134	7,836	7,107	.....	.....	8,532	.....	33,126	65,182	+96.7
Alcohol (wood), gal.	433,024	587,928	418,271	380,237	.....	.....	480,200	.....	2,223,669	3,678,970	+65.4
Cement, thous. of bbl.	4,278	6,685	9,243	11,176	11,245	11,557	11,664	11,424	72,307	81,563	+12.8
Coke, byproduct, thous. of short tons	1,795	2,137	2,227	2,537	2,580	2,486	1,794	2,244	14,558	19,703	+35.3
Coke, beehive, thous. of short tons	549	732	528	432	458	450	539	606	4,246	4,790	+12.8
Cottonseed oil, thous. of lb.	91,321	72,237	27,610	12,389	19,431	13,380	13,354	98,609	796,089	429,166	—46.1
Leather, sole, thous. of sides	1,466	1,473	1,327	1,321	1,359	1,353	1,509	1,491	12,771	12,991	+1.8
Leather, finished upper, thous. of sq.ft.	70,296	77,510	66,700	67,275	65,570	62,807	76,067	73,170	486,407	633,958	+30.3
Linseed oil*, thous. of lb.	6,647	7,232	6,069	7,952	8,271	5,795	5,536	11,237	75,790	65,196	—14.0
Metal											
Pig iron, thous. of long tons	1,630	2,035	2,072	2,307	2,361	2,400	1,816	2,034	12,232	18,299	+49.6
Steel ingots, thous. of long tons	2,072	2,816	2,794	3,099	3,012	2,843	2,532	2,714	13,858	23,591	+69.7
Copper, thous. of lb.	37,416	61,867	76,601	88,714	95,633	91,317	100,838	95,665	406,471	677,367	+66.6
Zinc, thous. of lb.	45,026	53,064	51,012	54,838	57,094	63,834	62,846	66,268	315,856	501,394	+58.7
Paper and pulp											
Wood pulp, chemical, sh. tons	144,568	170,995	147,608	167,197	164,931	154,617	172,700	170,329	1,607,095	1,450,242	+35.9
Newsprint, sh. tons	97,786	117,507	111,861	129,950	127,230	120,839	133,236	125,402	910,870	1,069,619	+17.4
All grades paper, short tons	404,031	475,353	528,461	589,971	593,335	552,914	635,107	623,088	3,769,749	5,124,748	+35.9
Petroleum											
Crude oil, thous. of bbl.	40,814	46,916	44,635	46,473	45,559	46,593	46,521	45,246	354,263	405,616	+14.5
Gasoline, thous. of gal.	398,223	472,228	472,920	513,659	525,941	.....	549,958	.....	3,424,761	3,947,313	+15.3
Kerosene, thous. of gal.	167,220	178,785	188,809	173,824	173,650	.....	184,383	.....	1,263,100	1,432,512	+13.4
Rubber											
Crude†, thous. of lb.	18,467	26,771	43,407	35,727	39,655	28,181	33,739	28,051	159,804	249,238	+56.0
Pneumatic tires, thous.	2,084	2,646	2,401	2,722	2,839	2,497	2,905	2,505	16,295	22,633	+38.9
Steel											
Imports, raw, lon tons	448,321	571,836	473,137	446,678	460,480	451,011	425,960	174,232	2,206,169	3,766,584	+70.7
Meltings, raw, long tons	415,723	535,357	531,962	577,330	532,052	530,334	540,024	312,909	2,798,365	4,267,292	+52.5

* Shipments from Minneapolis. † Consumption by tire manufacturers.

Stronger Market for Steel Products

Slight Declines, However, Shown for Pig Iron and Coke

PITTSBURGH, Dec. 8, 1922.

While there has been expectation in recent weeks in many quarters that steel prices would decline shortly, the expectation should have been confined to bars, shapes and plates, for other finished steel products are in a particularly strong position. Even in the lines mentioned, however, there is no particular weakness seen to be developing. The argument that actual ultimate consumption is hardly equal to the present rate of shipping by steel mills is more easily defended than would be a claim that all the steel now being shipped is passing promptly into consumption.

SHEET BARS TO BE HIGHER

In the actual steel market, the important event in a week of few definite developments was the announcement of the Carnegie Steel Co. of its first-quarter price on sheet bars, at $36.50, or somewhat above the average expectation, since the trade at large had scarcely thought the price would be above $35. The price applies to sheet bars supplied the subsidiary in the Steel Corporation, the American Sheet & Tin Plate Co., and to certain independent mills with which there are long-term contracts under which the Carnegie Steel Co. obligates itself to furnish sheet bars at a price to be named quarterly, the buyer having the privilege of refusing to take the steel in any particular quarter if the price is not considered satisfactory. The Carnegie Steel Co. does not sell sheet bars in the open market. Its price is, however, usually a lead to the independents who sell bars. On Nov. 23, on opening its order books for deliveries after Jan. 1, the American Sheet & Tin Plate Co. reaffirmed its former prices, $4.75 for tin plate, 2.50c. for blue annealed sheets, 3.35c. for black sheets, 4.35c. for galvanized sheets and 4.70c. for automobile sheets. The prospect is further reduced that these prices will be cut. As to automobile sheets, the independents had a 5c. price and are adhering to this figure, which they will probably be able to obtain in sales for first quarter, as the leading interest is filled for first quarter, its present sales being substantially for second quarter.

Bars, shapes and plates continue quotable at a general price of 2c., there being some concessions, as formerly in the case of particularly desirable orders.

Pipe mills have not caught up on deliveries and remain under considerable pressure, particularly in the case of butt weld sizes of merchant pipe, the best delivery on which is eight weeks, in the case of new orders. Wire mills are also under some pressure, particularly in nails.

Connellsville furnace coke for spot shipment is off 50c. in the week, at $6.75@$7. For delivery over the remainder of the year $7 or $7.25 can be done, and one sale at $6.75 is reported.

Valley pig iron has continued to decline in price, as it has been doing for 2 months or more. The week's additional decline is a small item, while the development of some demand, with perhaps two or three fair-sized purchases actually made for first quarter, is a strictly new development. The market now has two sides, even if the new side is thus far but a weak one. The market as quotable is down 50c. on bessemer to $28, 50c. on basic to $25 and $1 on foundry to $25.50, with single carloads generally going at $26, all prices being at valley furnaces, with $1.77 freight to Pittsburgh.

Arsenic Still the Feature of the New York Market

Consuming Interests Are Showing Concern Regarding Present High Prices and Possible Shortage

The manufacturers of insecticides and representatives of the consuming industries are vitally concerned with developments in the arsenic market. It is becoming more and more evident that the successful prosecution of the campaigns now proposed for combating the boll weevil depends primarily on the possibilities of a greatly increased supply of white arsenic. The recent inactivity of the lead and copper smelting industries and the smaller imports from Japan are the principal causes of the current shortage and consequent high prices. Among dealers and second hands the price range has reached 15 to 15½c. per lb., although producers' prices are somewhat under this.

NUMEROUS PRICE CHANGES

Formaldehyde prices were advanced ¾c. per lb., due to the recent increase in methanol quotations. Material at the works is quite scarce and some producers reported a heavily sold-up condition. Manufacturers of iodides announced an increase of 10c. per lb. on all varieties. Producers of oxalic acid have been forced to meet foreign competition and quoted lower prices at the works and for spot material. Prussiates showed a slight tendency to weaken during the interval in the absence of any noticeable activity. The alkali market for domestic consumption was strongly maintained and the volume of contracts for 1923 was quite satisfactory to producers. Bleaching powder was reported very firm at the works. Denatured alcohol was again advanced 2c. per gal.

GENERAL AND SPECIAL CHEMICALS

Arsenic.—The spot market is very strong and supplies are light. Producers report a sold-up condition at the works. The resale range is around 15@15½c. per lb., with domestic producers quoting 12¾c. per lb.

Barium Chloride—Consumers have shown little desire to purchase any round lots and importers are inclined to shade the market. Spot prices are quoted at $90@$95 per ton.

Bichromate of Potash—Producers quote the market around 9¾@10c. per lb. for spot and future shipments. Consumers have shown some desire for 1923 contracts.

Carbonate of Potash—Calcined 80-85 per cent was reported fairly steady at 6c. per lb. Hydrated 80-85 per cent has been quite scarce with holders asking around 7¼c. per lb. for limited quantities.

Caustic Potash—Imported 88-92 per cent material was quoted at 6½c. per lb. Importers offer shipments at 6¼c. per lb., duty paid. Activity was limited to small lot trading.

Caustic Soda—The export market showed very little change and prices remained at $3.50@$3.60 per 100 lb., f.a.s. New York. Domestic business continued along very active lines at 3¾@4c. per lb. ex-store. Producers quote contracts at $2.50 per 100 lb., basis 60 per cent. f.o.b. works in carload lots. A good inquiry was reported.

Formaldehyde—Prices were again increased to 14¼c. per lb. in carload quantities and 14¾c. in less than carlots. Business among resale dealers was somewhat quiet although a heavily sold-up condition at the works was reported. Second-hand lots were quoted at 13¾@14c. spot, ex-store.

Magnesium Sulphate—The market showed complete signs of improvement. Domestic, technical, was quoted at $1.85@$2 per 100 lb. in bags and $2.25 @$2.50 in barrels. Imported, technical, was held at $1.20@$1.30 per 100 lb.

Oxalic Acid—Domestic manufacturers have been forced to reduce prices to 13½c. per lb., f.o.b. works, due to the foreign competition. Imported goods are on the market at 13½c. per lb., ex-warehouse. Domestic goods on spot were held at 14@15c. per lb.

Prussiate of Soda—The spot market was somewhat weaker and sales were recorded for small lots down to 20c. per lb. The general range is 20@21c.

Soda Ash—There has been very little change reported in the export or domestic markets. Light ash, 58 per cent, bags on spot, was quoted at $1.75@$1.80 per 100 lb. Producers reported a very good contract call at $1.20 per 100 lb., basis 48 per cent, f.o.b. works.

VEGETABLE OILS

Linseed Oil—Immediate shipment oil was offered at 85c. per gal., carload basis. January supplies were available at 82c. and January-April at 78c. per gal. Future trading was dormant during the interval.

Coconut Oil—The general tone was rather quiet, but prices kept quite steady. Ceylon type oil at New York held at 8@8¼c. per lb., tank cars, with barrels around 8¾c. per lb.

Corn Oil—Offerings were somewhat limited and the spot market appeared nominal. Sellers were asking 8¾c. per lb., tank cars, for crude in nearby positions. Refined oil was well sustained at 11@11¼c. per lb. in barrels.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.37 – $0.40
Acetone	lb.	$0.21 – $0.21½	.21¾ – .22
Acid, acetic, 28 per cent	100 lb.	3.50 – 3.60	3.65 – 4.00
Acetic, 56 per cent	100 lb.	7.00 – 7.15	7.20 – 7.50
Acetic, glacial, 99½ per cent, carboys,	100 lb.	14.00 – 14.25	14.30 – 14.50
Boric, crystals	lb.	.11½ – .11¾	.12 – .13
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	..... –	.50 – .52
Hydrochloric, 18 deg.	100 lb.	.90 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg.	100 lb.	1.00 – 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech.	lb.	.11 – .11½	.11½ – .12
Lactic, 22 per cent tech.	lb.	.05 – .05½	.05¾ – .06
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg.	lb.	.05½ – .05¾	.06 – .06½
Nitric, 42 deg.	lb.	.06 – .06¼	.06½ – .07
Oxalic, crystals	lb.	.14 – .14½	.14¾ – .15
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¾ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.55 – 1.65
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.70 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.30½ – .31
Tartaric acid, imported, powdered	lb.	..... –	.31 – .32
Tartaric acid, domestic	lb.	..... –	..... – .32
Tungstic, per lb. of WO	lb.	..... –	1.20 – 1.30
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.39 – .41
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.38 – .40
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03½ – .03½	.03¾ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30¾ – .31
Ammonium carbonate, powder	lb.	.09 – .09½	.09¾ – .10
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech.	gal.	..... –	2.35 – 2.60
Arsenic, white, powdered	lb.	.15 – .15¼	.15½ – .15¾
Arsenic, red, powdered	lb.	.13½ – .14	.14½ – .15
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	90.00 – 95.00	96.00 – 100.00
Barium dioxide (peroxide)	lb.	.18 – .18½	.19 – .20
Barium nitrate		.08¾ – .08¾	.09 – .09¼
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	2.25 – 2.35	2.40 – 3.50
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.50 – 3.60	3.65 – 3.75
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.93 – .95
Carbon bisulphide	lb.	.06¾ – .07	.07¼ – .07½
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04¼ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05¼ – .06	.06¼ – .06½
Chloroform	lb.	..... –	.35 – .38
Cobalt oxide	lb.	..... –	2.10 – 2.40
Copperas	ton	25.00 – 27.00	27.50 – 30.00
Copper carbonate, green precipitate	lb.	.20 – .20½	.21 – .22
Copper cyanide	lb.	..... –	.50 – .55
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.	..... –	.25½ – .26
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ether, U.S.P. 100 drums	lb.	..... –	.13 – .14
Ethyl acetate com. 85%	gal.	..... –	.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.14¼ – .14½	.14¾ – .15
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth—imported powdered	net ton	30.00 – 32.00	..... – .....
Fuse oil, ref.	gal.	..... –	3.00 – 3.50
Fusel oil, crude	gal.	..... –	2.00 – 2.25
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c.p. drums extra	lb.	..... –	.18½ – .18¾
Iodine, resublimed	lb.	..... –	4.50 – 4.60
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.12 – .12½
Lead arsenate, powd.	lb.	.14 – .14¼	4½ – .15
Lead nitrate	lb.	..... –	.18 – .22
Litharge	lb.	.09¼ – .09¾	.09¾ – .10
Magnesium carbonate, technical	lb.	.07 – .07½	.07½ – .08
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.	..... –	1.20 – 1.85
Methanol, 95%	gal.	..... –	1.00 – 1.07
Methanol, 97%	gal.	..... –	1.03 – 1.10
Nickel salt, double	lb.	..... –	$0.10 – $0.10½
Nickel salt, single	lb.	..... –	.11 – .11½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.35 – .40
Phosphorus, yellow	lb.	..... –	.30 – .35½
Potassium bichromate	lb.	$0.09⅜ – .10	.10¼ – .10½
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.10 – .10½	.11 – .15
Potassium carbonate, 80–85%	lb.	.06 – .06¼	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07½ – .08	.08¼ – .09
Potassium cyanide	lb.	..... –	.50 – .53
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7.00
Potassium iodide	lb.	..... –	3.55 – 3.65
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.16 – .16½	.16½ – .17
Potassium prussiate, red	lb.	..... –	.93 – .95
Potassium prussiate, yellow	lb.	.39 – .39½	.39¾ – .40
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .06¾	.07 – .07½
Salammoniac, gray, granular	lb.	.08 – .08¼	.08¾ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 – 27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2 35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07¾	.08 – .08½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphite (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04¾ – .05¼
Sodium chlorate	lb.	.06¾ – .07	.07¼ – .07½
Sodium chloride	long ton	12.00 – 13.00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09¼ – .09½	.09¾ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.60	3.65 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03¼	.03½ – .04
Sodium nitrite	lb.	.08¼ – .09	.09½ – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.20 – .20½	.20¾ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 – 1.30	1.35 – 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04¼ – .04½	.05 – .05½
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10¼ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 – 20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.50 – 3.15
Sulphur, roll (brimstone)	100 lb.	2.15 – 2.20	2.25 – 2.75
Talc—imported	ton	30.00 – 40 00	..... – .....
Talc—domestic powdered	ton	18.00 – 25.00	..... – .....
Tin bichloride	lb.	.10½ – .10¾	.11 – .11½
Tin oxide	lb.	..... –	.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07¾ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.90 — $0.95
Alpha naphthol, refined	lb.	1.00 — 1.05
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00½
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70½
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.85 — .90
Benzidine sulphate	lb	.75 — .80
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Cresylic acid, 97%, resale	gal.	.85 — .90
Dichlorbenzene	lb.	.07 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.39 — .41
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.22 — .23
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.25 — .30
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06
Naphthalene, flake	lb.	.06 — .06

Naphthalene, balls	lb.	$0.07 —	$0.07
Naphthionate of soda	lb.	.58 —	.65
Naphthionic acid, crude	lb.	.65 —	.70
Nitrobenzene	lb.	.10 —	.12
Nitro-naphthalene	lb.	.30 —	.35
Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.85 —	.90
Ortho-nitro-toluene	lb.	.10 —	.12
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.50 —	1.55
Para-toluidine	lb.	.85 —	.90½
Phthalic anhydride	lb.	.37 —	.50
Phenol, U. S. P., drums	lb.	.34 —	.35
Pyridine, domestic	gal.	1.60 —	1.75
Pyridine, imported	gal.	1.40 —	1.60
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls.	lb.	.35 —	.37
Salicylic acid, U. S. P.	lb.	.40 —	.42
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.37 —	.40
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.20 —	.23
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.35 —	.37
Toluene, in drums	gal.	.40 —	.43
Xylidines, drums, 100 gal.	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.45 —	.50
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.40 —	.42
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.28 —	$0.30
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.39 —	.40
Candellila, wax	lb.	.34 —	.35
Carnauba, No. 1	lb.	.39 —	.40
Carnauba No. 2, North Country	lb.	.23 —	.24
Carnauba, No. 3, North Country	lb.	.17½ —	.18
Japan	lb.	.15 —	.15½
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04¾
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	.02½
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½ —	.03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¾
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09½
Stearic acid, double pressed	lb.	.09½ —	.09¾
Stearic acid, triple pressed	lb.	.10 —	.10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.25 —	....
Rosin E-I	280 lb.	6.35 —	....
Rosin K-N	280 lb.	6.45 —	$7.00
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.40 —	1.42
Wood turpentine, steam dist	gal.	1.35 —	....
Wood turpentine, dest. dist	gal.	1.25 —	....
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.43 —	....
Rosin oil, second run	gal.	.51 —	....
Rosin oil, third run	gal.	.53 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pine wood creosote, ref	gal.		.52

Fertilizers

All prices remain same as previous report.

Crude Rubber

Para—Upriver fine	lb.	$0.25 —	.25½
Upriver coarse	lb.	.17½ —	.17¾
Upriver caucho ball	lb.	.20¾ —	.20¾
Plantation—First latex crepe	lb.	.27¾ —	.27¼
Ribbed smoked sheets	lb.	.27¼ —	.27½
Brown crepe, thin, clean	lb.	.23 —	.23½
Amber crepe No. 1	lb.	.23 —	.23¼

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12½ —	.12½
Coconut oil, Ceylon grade, in bbls	lb.	.08⅝ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
Corn oil, crude, in bbls	lb.	.10¼ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½ —	....
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.11 —	.11½
Linseed oil, raw, car lots (domestic) bbls	gal.	.85 —	.86
Linseed oil, raw, tank cars (domestic)	gal.	.81 —	.82
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.87 —	.89
Olive oil, denatured	gal.	1.12 —	1.15
Palm, Lagos	lb.	.07½ —	.07½
Palm, Niger	lb.	.07 —	.07¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.11 —	.11¼
Peanut oil, refined, in bbls	lb.	.13¾ —	.14
Rapeseed oil, refined in bbls	gal.	.78 —	.79
Rapeseed oil, blown, in bbls	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¼ —	.09½

FISH

Light pressed menhaden	gal.	$0.54 —	....
White bleached menhaden	gal.	.58 —	.59
Blown menhaden	gal.	.64 —	.65
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Shellac, orange fine	lb.	.76 —	.77
Shellac, orange superfine	lb.	.78 —	.79
Shellac, A. C. garnet	lb.	.77 —	.78
Shellac, T. N.	lb.	.74 —	.75

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11 —	.11½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.11½ —	.12
Ferromanganese, 78-82% Mn, Atlantic seaboard duty paid	gross ton	100.00 —	105.00
Spiegeleisen, 19-21% Mn	gross ton	36 00 —	37.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	75 00 —	80.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.90 —	.95
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, c.i.f. Atlantic seaboard	ton	18 50 —	19.00
Coke, foundry, f.o.b. ovens	net ton	7.50 —	8 00
Coke, furnace, f.o.b. ovens	net ton	7.00 —	7.25
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	17 50 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	21.50 —	22.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	.....
Manganese ore, chemical (MnO_2)	net ton	75.00 —	80.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport.	lb.	.06 —	.08
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.11½ —	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.11½ —	.12
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.50 —	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	7.50 —	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 —	3.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13 90
Aluminum, 98 to 99 per cent	22.00 23.00
Antimony, wholesale lots, Chinese and Japanese	6 45
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00-33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	37.00
Lead, New York, spot	7.10
Lead, E. St. Louis, spot	6 95
Zinc, spot, New York	7.50–7.55
Zinc, spot, E. St. Louis	7.15–7.20

OTHER METALS

Silver (commercial)	oz.	$0.65⅜
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275 00
Palladium	oz.	60.00
Mercury	75 lb.	71.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

California

LOS ANGELES—The Comet Oil Co., recently organized with a capital of $600,000, has acquired property on East 26th St., near Downey Rd., as a site for a new oil-refining plant with initial capacity of about 2,500 bbl. It is estimated to cost in excess of $500,000. J. J. Gans, Michael Gore and Adolph Ramish head the company.

SAN DIEGO—The Shell Oil Co., 343 Sansome St., San Francisco, is arranging for the purchase of property on the tidelands for the erection of a new oil storage and distributing plant, to consist of two 25,000-gal. capacity tanks, pumping plant, pipe lines, etc. The company is also preparing to commence work on a similar plant on Front St., Ventura, with initial storage and distributing facilities for 75,000 gal.

SAN FRANCISCO—The De Boom Paint Co., 561 Clay St., has awarded a contract to James Furlong, Monadnock Bldg., for the erection of a new 2-story building on Commercial St., to cost approximately $20,000.

Connecticut

DANBURY—The Transloid Products Co., recently organized, has acquired the factory of the Warner Brothers Co., on East Liberty St., for the establishment of a new plant for the manufacture of composition products, known as Transloid. Machinery will be installed at once and operations placed under way. Charles Hetzel is president and general manager.

Florida

TAMPA—The Imperial Oil Co., 6006 Branch Ave., has awarded a general contract to William Kohler, 33rd St. and 14th Ave., for the erection of the initial buildings for its proposed new local plant for the production of lubricating oils. A list of machinery to be installed is being arranged, to include agitators, oil-blending apparatus, pumping equipment, tanks, etc., providing for a capacity of 500 gal. per day. W. F. Miller is president, and A. M. Allen, general manager.

BRADENTOWN—The local Board of Trade is perfecting plans for the construction of an artificial gas plant for service in this section. It is proposed to organize a company to operate the property, which is expected to be headed by C. N. Turner, proprietor of the Braden Hotel.

Idaho

NAMPA—The Board of Directors of the local Chamber of Commerce is considering plans for the establishment of a new starch-manufacturing plant, to cost about $40,000, with initial equipment. It is purposed to organize a company to operate the factory.

Illinois

CHICAGO—G. K. Nikolas & Co., 1227 West Van Buren St., manufacturers of lacquers, etc., are taking bids for the construction of a 3-story and basement plant addition, 50x70 ft., estimated to cost approximately $50,000. Meyer & Cook, 30 North Dearborn St., are architects.

Louisiana

NEW ORLEANS—The Union Carbide Co., 30 East 42nd St., New York, has perfected plans for plant additions for its subsidiaries, the Prest-O-Lite Co. and the Linde Air Products Co. The first noted will soon break ground for the erection of a large acetylene plant on site acquired some time ago on Upperline St., fronting on the 17th St. canal, estimated to cost in excess of $[illegible]. The Linde company, manufacturer of industrial oxygen, etc., has work under way on a new plant at St. Louis and North Anthony Sts., to cost more than $[illegible]. It is expected to have the latter [illegible] ready for the machinery installation early in the coming year.

Maryland

BALTIMORE—The Air Reduction Co., 342 Madison Ave., New York, will take bids at once for the erection of its proposed new local plant on Fayette St., near 11th St., for the manufacture of industrial oxygen, oxy-acetylene apparatus, etc., estimated to cost about $150,000, of which amount more than $85,000 will be used for equipment. Francisco & Jacobus, 511 5th Ave., New York, are consulting engineers.

Massachusetts

EAST WALPOLE—Bird & Son, Inc., 185 Devonshire St., Boston, manufacturer of prepared roofing, paper products, etc., has plans in progress for the construction of a new plant addition. Monks & Johnson, 99 Chauncey St., Boston, are architects.

FALL RIVER—The Standard Oil Co., foot of Slade St., has commenced the erection of a new distributing plant to cost about $37,000.

Michigan

SAULTE STE. MARIE—The Union Carbide Co., 30 East 42nd St., New York, will soon commence the erection of an addition to its local plant for considerable increase in capacity, to include a number of improvements in the present works, designed to give employment to an additional working force of about 300 operatives. A new set of kilns will be constructed. The expansion, with equipment, is estimated to cost about $500,000.

PALMYRA—The Simplex Paper Co. has commissioned the Austin Co., 16112 Euclid Ave., Cleveland, O., engineer and contractor, to prepare plans for a new local plant, to include power house, estimated to cost close to $100,000.

PETOSKEY—The Petoskey Portland Cement Co. is planning for the rebuilding of the portion of its plant, including laboratory, machine shop and other structures, destroyed by fire, Nov. 19, with loss of about $50,000. The work will be carried out in connection with the proposed new plant additions, estimated to cost close to $500,000.

MARYSVILLE—The Athol Mfg. Co., manufacturer of rubberized products, is planning for enlargements in its plant, to include the installation of additional equipment. It is purposed to add to the present line of production.

MONROE—The Consolidated Paper Co., East Elm St., has preliminary plans under way for the construction of a new mill for the production of strawboard and kindred specialties. W. C. Tullis is secretary.

PONTIAC—The Wilson Foundry & Machine Co. will commence the immediate erection of a new 1-story addition, 36x50 ft., to be equipped as a testing laboratory.

DETROIT—The Huron Portland Cement Co., Ford Bldg., has preliminary plans under way for the rebuilding of its local distributing plant at Atwater and Riopelle Sts., recently destroyed by fire. The new structure is estimated to cost in excess of $100,000. J. W. Boardman is vice-president.

New Jersey

KEARNY — The Egyptian Lacquer Co., Passaic Ave., has awarded a contract to the United Fireproofing Co., 8 West 40th St., New York, for the erection of a 3-story plant addition to cost about $37,000. Work will be placed under way at once.

ELIZABETH—The T. G. & M. Chemical Co., 517 Cortland St., Belleville, N. J., has leased the former factory of the Loewenstein Radio Co., on Meadow Lane, for the establishment of a new plant. Improvements will be made in the building and equipment installed at an early date. It is planned to remove the present works to the new location.

JERSEY CITY—Work will be placed under way at once on a new 1-story foundry at the plant of the M. W. Kellogg Co., Hackensack Ave., manufacturer of pipe, pipe bends, etc., estimated to cost $50,000.

NEWARK—The Blackstone Mfg. Co., 203 Johnston Ave., manufacturer of food colors, etc., has filed plans for the erection of a new 3-story plant at 206-10 Johnston Ave., to cost $25,000.

BAYONNE—The Vacuum Oil Co., 61 Broadway, New York, is taking bids for the erection of a 2-story storage and distributing building at its local refinery, 75x190 ft.

NEWARK—Fire, Nov. 25, destroyed a portion of the leather tannery of Kaufherr & Siegel, Ave. L and Magazine St., with loss estimated at about $45,000, including equipment and stock. It is planned to rebuild at once.

NEWARK—Louis Sacks, Wilson Ave., operating a foundry for the production of gray iron castings, has filed plans for the erection of a 1-story foundry addition, to cost about $13,000.

New York

LONG ISLAND CITY—The Liberty Paint Co., 39 10th St., has filed plans for the immediate erection of a new 2-story plant, 100x100 ft., estimated to cost about $100,000.

NEW YORK—The International Petroleum Co., 120 Broadway, has commenced work on a new oil project in the South American oil fields, comprising a pipe line, pumping plants, distributing and storage plants, and other structures to cost in excess of $15,000,000, with equipment. The company is associated with other oil interests in the enterprise, including the Leonard Oil Development Co., Transcontinental Oil Co., Colombia Syndicate, and affiliations of the Standard Oil Co.

Ohio

CUYAHOGA FALLS—The Common Council is considering tentative plans for the installation of a filtration plant at the city waterworks for the removal of excess iron from the municipal water.

CAMBRIDGE—The plant and property of the Florentine Pottery Co., East Cambridge, owned by the Pfau Mfg. Co., Cincinnati, now in charge of a trustee in bankruptcy, has been purchased by E. S. Romaine, Wheeling, W. Va., for a consideration of $50,000. The new owner is said to be planning to organize a company and operate at the plant.

Oklahoma

OKMULGEE—The Phillips Higrade Refining Co. has plans nearing completion for extensions and improvements in its local oil refinery, to include the installation of new recovery systems, bleacher and run-down tanks, power plant apparatus, and other equipment, estimated to cost close to $500,000. Work will be placed under way at an early date.

OKLAHOMA CITY—The Board of Works has commenced extensions and improvements in the local water system, to include a new filtration plant, estimated to cost in excess of $1,000,000.

TULSA—The Taylor Paper Co., Memphis, Tenn., is planning for the establishsment of a new branch plant here to cost approximately $100,000, including equipment.

Pennsylvania

PHILADELPHIA—The United Oxygen Mfg. Co., Westmoreland and B Sts., will break ground at once for the erection of a new 1-story plant, 25x45 ft., on Buckius St., near Richmond Ave. The general building contract has been let to George Tomlinson & Son, 1713 Sansom St., Philadelphia.

PHILADELPHIA—The Kohler Co., Kohler, Wis., manufacturer of sanitary ware and other pottery products, has acquired property at Turner and 32nd Sts., totaling about 15,000 sq.ft., as a site for the erection of a new 3-story branch plant. Plans will be placed under way at once.

PITTSBURGH—The Vitro Mfg. Co., Bessemer Bldg., manufacturer of enamels, dioxide, etc., is completing plans for the erection of a new 1-story plant addition, 32x45 ft., on Oliffe St.

PHILADELPHIA—The Great Eastern Mills Co., 440 7th Ave., Pittsburgh, has leased two buildings at 939-41 North Front St., for the establishment of a new mill for the manufacture of pulverized sugar.

PHILADELPHIA—The Pecora Paint Co., 4th and Sedgley Sts., has filed plans for the erection of a new 1-story building at its plant at 3rd and Sedgley Sts.

BRISTOL—The Megargee Paper Mills, Inc., Modena, Pa., is taking title to a tract of local property, totaling about 70 acres, for a consideration of about $60,000, to be used as a site for a new paper mill. Plans are under way for the initial plant unit, to consist of a number of buildings. It is expected to commence work at an early date.

PHILADELPHIA—The Continental Leather Co., 315 North 3rd St., will commence the immediate erection of a 1-story addition to its tannery at Tacony and Van Kirk

Sts. The general contract has been let to the Truscon Steel Co., 1432 South Penn Sq.

Tennessee

KNOXVILLE — The Knox Porcelain Co., recently organized with a capital of $370,000, to manufacture electrical porcelain products, will break ground at once for a new 3-unit plant, on tract of local property, comprising about 5 acres of land. It will be equipped for a daily production of close to 75,000 small porcelain specialties. J. N. House is president.

COLUMBIA — The Greenway Co., J. B. Greenway, general manager, has acquired a large tract of land on the Culleika Pike, and will use the site for a new plant for the manufacture of automobile tires, estimated to cost about $150,000.

Texas

RANGER—The Straits Oil Co., operating on the Barker property, about 6 miles from Ranger, is planning for extensions in its casinghead gasoline plant to cost about $25,000. The capacity will be considerably increased.

TEXAS CITY—The Marland Oil & Refining Co., Ponca City, Okla., is planning for the purchase of a site in this vicinity, on the waterfront, for the construction of a new storage and distributing plant, estimated to cost in excess of $100,000.

Virginia

BIG ISLAND—The Bedford Pulp & Paper Co., Richmond, has revised plans in preparation for the erection of a 3-story addition to its local paper mill, 60x140 ft., estimated to cost approximately $35,000, exclusive of equipment. The company has recently arranged for a bond issue of $800,000, a portion of the proceeds to be used for general expansion. Milton E. Marcuse is president. Charles K. Bryant, 1808 Hanover Ave., Richmond, is architect for the new mill extension.

STRASBURG — The Hy-Grade Manganese Co., Woodstock, Va., has acquired a building at East Strasburg, for the establishment of a new mill. The structure will be remodeled and improved, and equipment installed, including a grinding mill, power apparatus, etc. J. C. Ackerson is general manager.

NORFOLK—The Fisheries Products Corp. has tentative plans under way for the erection of a 1-story plant, 245x300 ft., at its site at Money Point, for the manufacture of fertilizer products, to replace the portion of the works recently destroyed by fire. The new structure, with equipment, is estimated to cost about $200,000. Headquarters of the company are at 50 Broad St., New York.

BIG STONE GAP—W. W. Taylor is arranging for the organization of a company to construct and operate a local plant for the manufacture of brick and other burned clay products. Daniel Bostic, Big Stone Gap, is also interested in the project.

GLASGOW — The Glasgow Clay Products Co. is planning for the installation of a rotary drier at its plant, with capacity of about 10 tons of shale per hour.

Washington

SEATTLE — In addition to extension and improvement work now in progress at its storage and distributing plant, to cost about $200,000, the Associated Oil Co., 1733 Railroad Ave., has plans in progress for additional work, including steel tanks, etc., estimated to cost about $150,000. A. J. McNeil, 207 White Bldg., is resident engineer for the company.

West Virginia

HALLTOWN—The Halltown Paper Board Co. is planning for the rebuilding of the portion of its plant, including power house, recently destroyed by fire.

FOLLANSBEE — The Jefferson Glass Co., manufacturer of illuminating glassware, is arranging a fund of $150,000, the proceeds to be used for extensions and improvements in its local plant. A portion of the structure will be remodeled and additional equipment installed. C. H. Blumenauer is president.

WARWOOD—The Centre Foundry & Machine Co. has awarded a contract for the immediate erection of a new 1-story foundry at its works, 100x320 ft., to be equipped for the production of gray iron castings. It will have a capacity of about 50 tons per day. F. H. Young is general manager.

Wisconsin

MILWAUKEE—The Pfister & Vogel Leather Co., 443 Virginia St., has awarded a contract to the Dahlman Construction Co., 456 Broadway, for the erection of a 1-story addition to its tannery, 63x63 ft. Work will be commenced at once.

MILWAUKEE—The Palmolive Co., manufacturer of soaps, has work under way on a 1-story addition to its plant, 50x80 ft., to be used for general increase in production. Lockwood, Greene & Co., Chicago, Ill., are engineers.

New Companies

THE KENWOOD WAX PAPER MILLS, INC., 4761 West Hipple Ave., Chicago, Ill., has been incorporated with a capital of $150,000, to manufacture plain and waxed papers. The incorporators are Louis G. Berman, Alfred G. Johnson and Otto C. Bruhlman.

THE STA-BRITE CO., New York, N. Y., care of the Delaware Registration & Incorporating Co., 2 Rector St., New York, representative, has been incorporated under Delaware laws, with a capital of $100,000, to manufacture paints, varnishes, etc. The incorporators are Joseph V. Burns and G. I. Lewis.

THE AUTOMATIC GLASS PRODUCTS CO., Toledo, O., has been incorporated with a capital of $150,000, to manufacture glass specialties. The incorporators are Charles H. Lemmon and M. J. Warner, both of Toledo.

THE AMERICAN DENATURING CORP., New York, N. Y., care of Wallace & Thatcher, Albany, N. Y., representatives, has been incorporated with a capital of $50,000, to manufacture industrial alcohol and kindred products. The incorporators are L. H. Washburn, K. M. Smith and T. J. Mattimore, New York.

THE RAYNAUD-CONRAD PAINT CO., New Orleans, La., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws, with a capital of $1,100,000, to manufacture paints, varnishes, oils, etc. The incorporators are Joseph Raynaud, C. Carlisle Conrad and George Steele, all of New Orleans.

THE WILLIAM J. SWEET FOUNDRY CO., Bayonne, N. J., has been incorporated with a capital of $15,000, to manufacture iron, steel and other metal castings. The incorporators are William J. Sweet, Charles V. Bruno and Harry A. Cooper, 12 East 34th St., Bayonne. The last noted represents the company.

THE SHERATONE PRODUCTS CORP., New York, N. Y., care of G. W. Phillips, 295 West 144th St., New York, representative, has been incorporated with a capital of $50,000, to manufacture polishes, chemical preparations, etc. The incorporators are W. H. Naugle and W. K. Rishel.

THE WEST COAST CHEMICAL CORP., San Francisco, Calif., has been incorporated with a capital of $300,000, to manufacture chemicals and chemical byproducts. The incorporators are P. E. and Henry P. Adams, Homer Lingenfelter and Clarence E. Todd, Hobart Bldg., San Francisco. The last noted represents the company.

THE BLUE RIDGE OXIDE CO., Allentown, Pa., has been incorporated with a capital of $30,000, to manufacture oxides, chemical products, etc. H. S. Hartzell, Allentown, is treasurer and representative.

THE LIBERTY MIRROR WORKS, INC., Pittsburgh, Pa., is being organized under state laws, to manufacture mirrors, glass novelties, etc. Application for a state charter will be made on Dec. 22. The company is headed by George F. and William H. Colbert, and Benjamin H. Thompson, 1209 First National Bank Bldg., Pittsburgh. The last noted represents the company.

THE LUFBERRY CO., INC., Bayonne, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are A. D. Harz, Burgess A. and Percival G. Cruden, 1 West 8th St., Bayonne. The last noted represents the company.

THE NATIONAL CONSUMERS' PAPER CORP., New York, N. Y., care of Horowitz, Riedler & Hurwitz, 1170 Broadway, New York, representatives, has been incorporated with a capital of $200,000, to manufacture paper products. The incorporators are H. and B. Kuskel, and H. L. Rosenberg.

THE WELCH JAPANNING CO., Woburn, Mass., has been incorporated with a capital of $10,000, to manufacture japanned metal products. George C. Dempsey, 133 Commonwealth Ave., Boston, is treasurer and representative; William C. Welch is president.

THE E. E. DICKINSON CO., Essex, Conn., has been incorporated with a capital of $750,000, to manufacture essential oils, extracts, etc. The incorporators are Edward E. and Edward E. Dickson, Jr., and Carl F. Anderson, all of Essex.

THE CHLOROPHEN CHEMICAL CO., Elkins, W. Va., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are C. L. Stuckey, F. A. Ravenscraft and F. S. Johnson, all of Elkins.

THE ILLINOIS PRODUCTS CO., 1850 West North Ave., Chicago, Ill., has been organized under state laws to manufacture chemicals and kindred products. The incorporators are Frank P. Lyons and Louis Lowy.

THE POLO OIL CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $100,000, to manufacture petroleum products.

THE HAGERSTOWN LIME & CHEMICAL CO., Hagerstown, Md., has been incorporated with a capital of $30,000, to manufacture chemicals, lime and affiliated products. The incorporators are Jacob S. Myers, Enos L. Kitzmiller and William R. Moler, all of Hagerstown.

THE RUSTOFF CO., Brooklyn, N. Y., care of Bick, Godnick & Freedman, 215 Montague St., Brooklyn, representatives, has been incorporated with a capital of $100,000, to manufacture chemicals and affiliated products. The incorporators are W. Godnick, J. A. Freedman and R. Mendel.

THE REPUBLIC PAPER PRODUCTS CO., Richmond, Va., has been incorporated with a capital of $100,000, to manufacture paper specialties. A. H. Cohen is president and I. W. Cohen, secretary.

THE REED SMITH CHEMICAL CO., Camden, N. J., care of the Corporation Trust Co., 328 Market St., Camden, representative, has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts.

THE PENN PROCESS CO., INC., Philadelphia, Pa., care of Albert W. Sanson, Bailey Bldg., Philadelphia, representative, is being organized to manufacture chemicals, chemical solutions and kindred products. The company is headed by Charles W. Beck, Sr. and Jr., and Horace D. Beck.

THE FOSTER PETROLEUM PRODUCTS CO., Jamestown, N. Y., care of A. C. Nelson, Jamestown, representative, has been incorporated with a capital of $25,000, to manufacture oil specialties. The incorporators are E. S. Nelson and C. S. and A. C. Foster.

THE KEENAN PETROLEUM CO., Houston, Tex., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are L. W. Keenan, C. W. Drury and R. K. Howell, all of Houston.

THE BRANFORD BROTHERS FOUNDRY, INC., Branford, Conn., has been organized under state laws to manufacture iron, steel and other metal castings. H. A. Cox is president; and Robert L. Rosenthal, treasurer, both of Branford.

THE MERIDEN INDUSTRIAL ALCOHOLS, INC., Newark, N. J., has been incorporated with a capital of $10,000, to manufacture denatured alcohol and kindred specialties. The incorporators are Jeffrey J. Lewis, Leo Roon and Morris Reiser, 321 Washington St., Newark. The last noted represents the company.

THE AMERICAN EFFECTION CORP., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $500,000, to manufacture chemicals and chemical byproducts.

THE IRVINGTON ALUMINUM FOUNDRY & STOVE WORKS, INC., Irvington (Alameda County), Cal., has been incorporated with a capital of $100,000, to manufacture aluminum, iron and other metal castings. The incorporators are Thomas Tierney, P. C. Hanson and Frank A. Leal. The company is represented by E. M. Grimmer, Irvington.

THE BLAISDELL PETROLEUM PROCESS & REFINING CO., Portland, Me., has been incorporated with a capital of $200,000, to manufacture petroleum products. L. T. Garniss is president; George W. Garniss, treasurer. The company is represented by Charles J. Nichols, Portland.

THE HOUSTON OIL CO., Houston, Tex., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $3,000,000, to manufacture petroleum products. The incorporators are Walter F. Brown, Joseph F. Meyer, Jr., and John A. Deering, Houston.

THE HAGIN TURPENTINE CO., Lyman, Miss., has been organized under state laws to produce turpentine and kindred products. The incorporators are E. Hagin and F. R. White, both of Lyman.

Industrial Developments

GLASS — The Scott-Warman Glass Co., manufacturer of hollowware, has commenced produced at its new local plant comprising a rebuilding of the factory destroyed by fire a number of months ago. Employment is being given to about 125 men on full turn, with a scheduled output of 2 carloads of bottles per day day. The company is said to have orders on hand to insure this basis of production for a number of months to come.

Owing to a shortage of natural gas, glass plants at Salem, W. Va., have been forced to curtail operations. The Salem Co-operative Window Glass Co. and the Salem Flint Glass Co. have temporarily suspended, with prospects of resuming at an early date.

PAPER—Officials of Sears, Roebuck & Co., Arthington and Homan Aves., Chicago, Ill., have organized the Eddy Paper Co. of Illinois, to take over and operate the mills of the Eddy Paper Co., at Three Rivers and White Pigeon, Mich. The acquisition is said to have resulted from financial difficulties. The new owners plan to resume operations at the mills at an early date, having the plants on a capacity basis in about 60 days.

The Dixie Wax Paper Co., Dallas, Tex., has opened its new plant at 3008 Williams St., on a production basis of 5 tons per day. The mill is said to be the only one of its kind south of Kansas City, Mo. It is expected to maintain full operations for an indefinite period. William H. Bryce is treasurer.

RUBBER—The Interlocking Cord Tire Co., Akron, O., is planning to increase production at its mill at an early date. Additional workers will be employed.

Following the appointment of a receiver for the Perfection Tire & Rubber Co., Fort Madison, Iowa, officials of the company are developing plans for a reorganization, and expect to place the local plant on an operating basis at an early date.

LEATHER—The Armour Leather Co., Chicago, Ill., is running its side leather plant at full capacity, with regular working force, and plans to continue on this basis for an indefinite period.

The American Oak Leather Co., Cincinnati, O., has placed its plant on a basis of about 85 per cent of capacity.

CERAMIC—The Hazleton Brick Co., Hazleton, Pa., is operating on a full production basis at its local plant, and will probably continue on this basis throughout the winter.

Operative potters at Trenton, N. J., out on strike for a number of weeks, have appointed a conference committee to negotiate for a settlement with the local sanitary ware plants. It is said that other local organizations in the different pottery centers will take similar action. A number of the potteries at Trenton have discontinued operations and are installing casting plants to eliminate a considerable number of workers heretofore necessary.

Brick-manufacturing plants in the Chicago, Ill., district, equipped with mechanical drier plants, are continuing operations at full capacity under a heavy demand for material. It is expected to continue without interruption for a number of months to come.

IRON AND STEEL—The Inland Steel Co., Chicago, Ill., has 3 blast furnaces in operation, and is running 15 out of 18 sheet mills.

The Scottdale Furnace, Scottdale, Pa., has been placed in blast following a shut-down of more than 2 years. The furnace has a capacity of 350 tons of pig iron per day, and will give employment to a working force of 250 men.

The Michigan Steel Corp., 1706 First National Bank Bldg., Detroit, Mich., recently organized with a capital of $1,000,000, is perfecting plans for the construction of a new mill on site comprising about 35 acres of land between Oakwood and Ecorse, Mich., lately acquired. The initial works will comprise six units, with power plant and other mechanical buildings, and is estimated to cost in excess of $600,000. It is expected to be ready for service in the fall of 1923, and will give employment to about 400 men. Initial production will be devoted to sheet steel for automobile and other important lines of manufacture. Frederick H. Lovejoy is chairman of the board; George B. Link, formerly connected with the West Penn Steel Co., is president and treasurer; and Frank R. Jones, vice-president.

The Trumbull-Cliffs Iron Co., Youngstown, O., a subsidiary of the Trumbull Steel Co., is developing record production at its new blast furnace, which has now been completed and in service for about a year [illegible], in a 24 hour period, the stack produced 867 tons of pig iron, and in a 30-day turn manufactured 22,500 tons.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has blown in its No. 5 furnace at Ensley, Ala., making six stacks in production at this place. Three of the furnaces are on foundry iron, the others on basic, while the Alice furnace is producing steel-making iron.

The National Enameling & Stamping Co., Granite City, Ill., expects to have its new sheet mill, now in course of construction, ready for service some time during next July. The mill will represent an investment of close to $1,500,000, and will give employment to a large increased working force at the plant.

The Cambria Steel Co., Johnstown, Pa., has been making a number of improvements at its limestone quarries at Naginey, Pa., preparatory to increasing production. Five large steam shovels will be used for rock digging, replacing man-labor. A daily output of 28 carloads of graded limestone will be produced for use at the Johnstown steel mills. The working force will be increased in a number of departments, bringing the quota to about 200 men.

The Shelby Iron Co., Shelby, Ala., has its blast furnace out for repairs, and is making ready to blow in the stack shortly after the first of the year.

COKE—The Semet-Solvay Co., Syracuse, N. Y., has arranged for an immediate increase in production at its Riverside coke plant from 250 to 400 tons per day, to accommodate the increased demand from the local works of the National Tube Co.

The Alabama By-Products Co., Birmingham, Ala., is making ready to place its new battery of 25 coke ovens in service, giving the plant a total of 75 ovens, devoted to high-grade foundry and gas house coke.

MISCELLANEOUS — The Champion Spark Plug Co., Toledo, O., manufacturer of porcelain spark plugs, is arranging for a heavy increase in production at its plant during 1923.

Paint manufacturers in the vicinity of Cleveland, O., are operating on a full capacity, full time basis, as compared with a usual decline in this same season in other years. Paint and varnish producers at Philadelphia, Pa., are also on a capacity schedule.

The Standard Chemical Co., Denver, Colo., is discontinuing production at its Carnotite properties, Paradox Valley district, Montrose County, for an indefinite period. About 250 men will be released from the works.

The Marland Oil Co., operating in the Mid-continent field, Oklahoma, has advanced production to a basis of 18,000 bbl. of crude oil per day.

The Texas Sulphur Co., Orange, Tex., is being reorganized and plans to resume operations at its properties at an early date at close to capacity basis. Charles F. Suderman is president.

Manufacturers' Catalogs

THE COMBUSTION ENGINEERING CORP., New York, has issued two new pieces of literature. The larger bulletin, on the Coxe stoker, covers particularly the performance of this stoker on Western and mid-Western bituminous coals. A number of test reports, each accompanied by corresponding curves, are included. These tests show very remarkable results and because they are complete in every respect they will be of considerable interest to the engineering world. Three years ago it was thought impossible to burn bituminous coal on Coxe stokers or any forced draft traveling grate stokers. Today we have a number of successful installations in some of the biggest and most important plants in the Middle West. Pictures of a number of them are shown in this bulletin. The smaller bulletin, the "Service Bulletin," while it is issued by this company, will be of value to all stoker companies. At the present time it is necessary for stoker manufacturers to render, gratuitously, service of a very costly nature. This booklet presents the stoker manufacturers' side of the question and shows why a proper charge for real stoker service would not only be fair to the recipient but would be to his advantage. It is illustrated with an interesting cartoon story.

THE JEFFREY MFG. CO., Columbus, O., in Catalog 257, treats of Standardized Scraper Conveyors. Interesting illustrations and descriptive matter on these conveyors are given.

THE DAYTON-DOWD CO., Quincy, Ill., announces Bulletin 249, which supersedes Bulletin 244 on Centrifugal Pumps.

THE COOPER HEWITT ELECTRIC CO., Hoboken, N. J., has issued pamphlets on "Quartz-Glass Apparatus for Photophysics and Photochemistry," "The Ultra-Violet," "Uviarc Lamps in the Laboratory," "The Lab-Arc," and "The Uviarc Test for Dyes, Inks, Textiles, Leather, Paints and Paper."

H. S. B. W.-COCHRANE CORP., Philadelphia, discusses, in a recent pamphlet, the deaëration of water to prevent corrosion in piping, economizers and boilers. The apparatus described is designed to deliver water free of dissolved oxygen, at any temperature from 140 deg. F. up, as required for hot water heating and service systems and for feeding to economizers and boilers. The method consists in heating the water by spraying in a chamber under vacuum and then vigorously agitating or scrubbing the water by blowing steam through it. The heating of the water to the temperature corresponding to the pressure existing in the vessel renders gases insoluble, while the subsequent reboiling of the water serves to pick up and flush out small gas bubbles which otherwise would not have time to escape from the water. The Cochrane vacuum deaërating heater is designed to be used where the auxiliaries are operated under vacuum or where they are operated under back pressure, also in connection with primary and secondary heaters and as the condenser for a make-up evaporator. The full vacuum corresponding to the temperature to which the water is heated is available to the house turbine or other auxiliaries exhausting to the heater. Charts are given showing the amount of iron converted into rust by water containing different amounts of oxygen, vapor pressures, corresponding to water temperatures and solubilities of oxygen and nitrogen in water at various temperatures and pressures. The Winkler test for detecting dissolved oxygen in water is also described.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold a meeting Dec. 26 to 30 in Boston, Mass.

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1913.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

TECHICAL PHOTOGRAPHIC AND MICROSCOPICAL SOCIETY will hold a meeting with the Society of Chemical Industry, Dec. 15, at the Chemists' Club, East 41st St., New York City.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City; Jan. 5 — American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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Some Light on The Arsenic Situation

TEN YEARS AGO arsenic was the yellow dog of every copper and lead smelter, the undesirable citizen in every smelting community. Today it has suddenly assumed the important rôle of the public benefactor. Without its use in the form of calcium arsenate the cotton farmer is practically defenseless against the ravages of an insect pest that has already left a trail of ruthless devastation.

But it is just this sudden change from yellow dog to benefactor that has played havoc with the arsenic market. A demand exists for which there is little hope of adequate supply. Confronted by this serious shortage and with speculation carrying prices to dizzy heights, it has been increasingly evident that the time was ripe for the industry to stop and take stock of the situation, weighing carefully the different factors and influences involved. Such a step was taken in a recent conference in New York, chronicled on the news and market pages of this issue.

The value of this meeting to the industries concerned and to the public as well can, perhaps, best be measured in terms of the new light shed on the arsenic situation. At least four things were accomplished that were decidedly worth while: First, the stocks on hand, trade requirements, productive capacity and foreign supply were accurately evaluated. Next was the quantitative view of the country's needs for calcium arsenate supplemented by Dr. COAD'S keen analysis and impartial portrayal of the economic status of the cotton farmer. The third accomplishment was the recognition by both producer and user of the need for a stabilized market. The last and in a way the most important finding was the welcome discovery that the current frenzy of speculation is not a serious factor in the situation, primarily because the quantities involved are probably of negligible proportions. In one case it was reported on good authority that a single 25-ton lot of white arsenic had actually been known to change hands as many as six times during a single day.

The Geological Survey is authority for the statement that stocks of domestic arsenic on Oct. 1 totaled but 1,230 tons and that 3,400 additional tons would be produced by May 1, 1923. If to this is added the 900 tons of imported material that has not yet passed into consumption and the 600 or 800 tons that may be expected from abroad, it will be found that the total falls short by at least 2,000 tons of the 8,450 tons estimated as the requirement of the trades other than calcium arsenate manufacture. Just how much arsenate the cotton grower actually needs was set forth so clearly by Dr. COAD, of the Department of Agriculture, that little doubt could be left as to the seriousness of the situation. Moreover, he sounded a note of warning to both the arsenic producer and the insecticide manufacturer who may disregard the farmer's ability to pay and his expectation of a return on his investment. The government's estimate that three times as much calcium arsenate will be consumed in 1923 as in 1922 is predicated on the assumption that the price will not prevent its use with profit on lands yielding but half a bale of cotton per acre.

The producers' appeal for stabilization requires but little elaboration here. One need only mark the peaks and valleys in the arsenic price curve to realize the hazards such a market has for the producer. And too often for comfort the insecticide manufacturer has found himself buying arsenic at top prices and forced to sell his arsenate after the bottom of the market has dropped completely out. He too is interested in lopping off the peaks and filling in the valleys.

These facts, together with the severe blow dealt to speculation and resale, are some of the accomplishments that have come out of this brief conference of arsenic producers and consumers. In the future we may well expect co-operation to be the keynote of further business progress, and even greater results may be expected when maker and user, buyer and seller, meet on a common ground for sober study of their mutual problems.

Approval From Germany

OF DOUBTFUL compliment to American chemical industry is the comment appearing in a recent issue of *Die Chemische Industrie* relative to our editorial criticism of the Allied Chemical & Dye Corporation, published recently under the caption "Looking a Gift Horse in the Mouth." It will be recalled that we referred to the corporation's policy of wholesale dismissal of technical men and the assumption of leadership by EUGENE MEYER and ORLANDO WEBER, whose financial interests are well known to overshadow their knowledge of chemistry or pride in the industry.

After publishing our editorial in full, our German contemporary closes with a comment by the translator, of which the following is a free version:

> In the interest of our German chemical industry it is to be hoped that the affairs of the Allied Chemical & Dye Corporation shall continue to be directed by the above-named gentlemen, one of whom is a Wall Street speculator, while the other gained his experience as an "efficiency expert" in the automobile industry. Against the consequences of such mismanagement it will soon become evident that even the new high protective tariff cannot prevail.

Die Chemische Industrie is the official organ of the Society for the Protection of the German Chemical Industry, and while its approval of American conditions is not particularly welcome in this instance, it coincides with the conclusion that has been reached in some quarters at home.

Hands Off For Two Years

DESPITE the marked increase in salaries granted a year ago, the Patent Office is still having difficulty in getting and retaining first-class examiners. The seriousness of the situation is shown in the fact that twenty-two examiners left the Patent Office during last August and September. But even before that exodus began there were seventeen vacancies on the staff. Inasmuch as the Commissioner of Patents holds that it requires two men during their first year of service to do the work of one experienced examiner, it will be apparent that this deficiency of thirty-nine indicates a need for seventy or eighty new men in order to put the staff on a suitable working basis.

It may be argued that this problem and its solution is wholly for government consideration; but there are responsibilities outside the Patent Office that cannot be dodged. There has been altogether too great a raid on the Patent Office staff during the past few years. Recognizing its own responsibility in this matter, the American Patent Law Association has just taken a step that should be of material help. The managing board of that body has written a vigorous letter to its members urging that for at least two years they refrain from hiring members of the Patent Office staff. Thus the association hopes to create a two-year closed season, during which the Patent Office can recruit its personnel and bring its work more nearly up to date.

Industry should follow this excellent example, for there is no greater sufferer from an inferior or inadequate staff in the Patent Office. The cost of contesting a single patent case consequent upon the faulty work of an inexperienced or overworked examiner may easily exceed the total cost of maintaining the patent department of a corporation. It will be profitable, therefore, even selfish, for industry to encourage the Patent Office in recruiting a normal staff and bringing its work up to date. To this end industrial corporations should join with the American Patent Law Association in keeping hands off the Patent Office staff for at least two years.

Support the National Exposition Of Chemical Industries in 1923

DISCUSSION and controversy regarding the chemical exposition have not been allowed to lag, due largely to the activities of those who have been promoting the idea of a co-operative organization. Also a committee of the Salesmen's Association of the American Chemical Industry has been active with inquiries and questionnaires in an effort to ascertain the desires of past and prospective exhibitors. The results thus far obtained are rather intangible, although more definite information may appear when the committee finishes its work.

The plan for a co-operative show has lost ground, if we may judge from a circular from ADRIAAN NAGELVOORT under date of Dec. 7. After analyzing the situation as he now sees it and still clinging firmly to his contention that a co-operative exposition "offers the ideal medium" for bringing all the elements of our chemical industry together, he concludes that "the concurrence of opinion of exhibitors and of the industry generally is for the abandonment of both shows for 1923." Not only do we differ with this opinion but we consider it an unfair statement. The campaign for a co-operative show has failed, at least for 1923, but it is unfair to infer that the National Exposition has met or should meet the same fate. As a matter of fact, we are reliably informed that 154 exhibitors have signed contracts for space in the Ninth National Exposition of Chemical Industries and that this is the largest number of contracts ever signed at a corresponding date previous to any former exposition. Whatever may be the ultimate fate of the chemical exposition with respect to annual or biennial, co-operative or non-co-operative shows, we consider it in the best interests of the industry as a whole to proceed with the Ninth National Exposition of Chemical Industries now scheduled for September, 1923.

Historical Perspective, The Father of Invention

WHY is it that we have made such great advances in the mechanical arts and in natural science during the past hundred years? Substantially all of our progress and marked improvements have been within these fields. In the arts of living, in politics, in government, in law and in the graces of life we have made very little if any progress. It is evident, however, that the last few generations of men have greater mental energy in the application of science and mechanical arts. Our forefathers were much more severely put to it to invent mechanical strategems than is the farmer of today.

Necessity is indeed the mother of invention, and the need has always been pressing. If we would seek the father of it, we believe he may be found in the historical perspective offered by patent office reports, the records in scientific journals and the transactions of learned societies. Only in these respects do we find successfully accomplished what KORZYBSKI calls "time-binding" elements. The records of living men are thus made permanent; and as they pass on others build improvements upon the contributions of the dead, so that, viewed as a whole, the record is a continuous one. The literature may be awkward; and the search may be difficult, but it can be done and it is done constantly. There is no such history of law; we have merely a protocol of decisions. Neither can we find such a history of anything else than science and the mechanical arts. We venture the opinion that historical perspective is the father of invention.

The Utility of Historical Chemistry

IN CHEMISTRY, as we go about among men who are true masters, we observe that usually their scientific scholarship carries them beyond the patent office reports and the files of the journals into the still unpublished and uncorrelated history of the science. An old chemist was lately addressing a group of his fellows composed principally of members of the staff of one of the great industrial establishments of this country. The corporation is fortunate in the knowledge that its men of science are fellow officers with its business administrators and sales directors in the struggle for progress. They are not common soldiers. A remarkable *esprit de corps* obtains in the laboratories, works and groups of officers. Everybody believes in the organization and has faith in it. Men who are ignorant of what chemistry means have not been invited to command. As a natural sequence to this, the type of chemists on its staff is of a high order. They are getting results, and there follow those intensive but unhurried habits of success that are its pleasant accompaniment.

The old chemist introduced into his talk a number

of incidents taken from the byways of chemical history, incidents that are not outstanding in the textbooks. He was graciously received and generously applauded, but he had, somehow, the feeling that he had been repeating that which was not new to most of his audience and intimating trains of thought that they had already considered for themselves. He was right. The pleasure of work in a sympathetic atmosphere had brought there a body of men who sense their science in the large, and who do not take it as a trade or a craft. If a chemist really loves his subject he wants to know all that he can about it, and this usually leads him also into the more remote but still living work of those who have long been dead. History gives us the perspective that the best of us need.

Railroad Service And Earnings

FEW of the industrial activities of the country are reported upon so fully and precisely as are the operations of the railroads, yet the general public is very poorly informed as to the actual facts. This curious and unfortunate condition arises from the circumstance that many groups of interested parties talk about the railroads and railroad conditions, each with personal motives. The object is not to inform the public but to argue for some private end. Those whose business it is to sell railroad material assert that the railroads are poorly equipped and ought to be put in position to spend a great deal more money. To support the argument they sometimes magnify the shortcomings of the roads in the rendering of service to the public. The salaried spokesmen of railroad employees, seeking high wage rates, often claim that the railroads are run extravagantly, wasting much money that could easily be diverted to payrolls. Salesmen of various classes of goods talk of car shortage and prospective traffic congestion as an argument why their goods should be bought promptly and stiff prices paid. Coal operators, members of "the badly functioning industry," endeavor to divert the public mind to the railroads as a great cause of the coal trouble because they do not keep large supplies of cars on tap. Many men who sought and obtained election or re-election to Congress attacked both the railroads and the transportation act, some asserting, for instance, that the act "guarantees" railroad earnings, when the one thing it does on that head is to limit disbursements to stockholders if earnings chance to be made.

In the circumstances the public cannot be expected to be correctly informed, nor is it reasonable to expect the general public to take pains to inform itself. The information is available, but it is voluminous and complicated. The public may think that those who talk about railroads and railroad conditions are giving information, but even if concrete facts are stated with technical accuracy, which frequently is not the case, the perspective is usually greatly distorted.

Insufficiency of railroad service in the past 3 months has been dilated upon particularly in reports of commodity markets, whereas the railroads have done a remarkable thing in getting along so well in the very unusual conditions of a 5-month coal strike ending and leaving demand for the movement of an unreasonable quantity of coal.

The railroads have been carrying a much greater volume of freight than before the war and have performed the service with proportionately less equipment, although burdened with employment regulations that did not formerly exist. The railroads are expected to provide themselves with facilities to carry peak loads when they are not permitted to make the charges that other industries having peak loads require. They are expected, in not a few quarters, to carry all coal offered when the time lost in a long strike is to be made up, to move the great bulk of the crops shortly after they are harvested and to pass through lean years somehow. Railroad charges are supposed to be such that 5¾ per cent on investment shall be earned, but the railroads do not obtain the earnings, while if a road makes more than 6 per cent in a year it is permitted to disburse only 6 per cent at the time.

As the value of money goes the limit is too low, yet the present outlook, politically speaking, is that if the transportation act is modified it will be in a direction unfavorable to the railroads. Wholesale bankruptcy of the railroads would mean government operation or ownership, which the public does not want. If this result is to be avoided, it seems imperative that the public be better informed by an impartial agency.

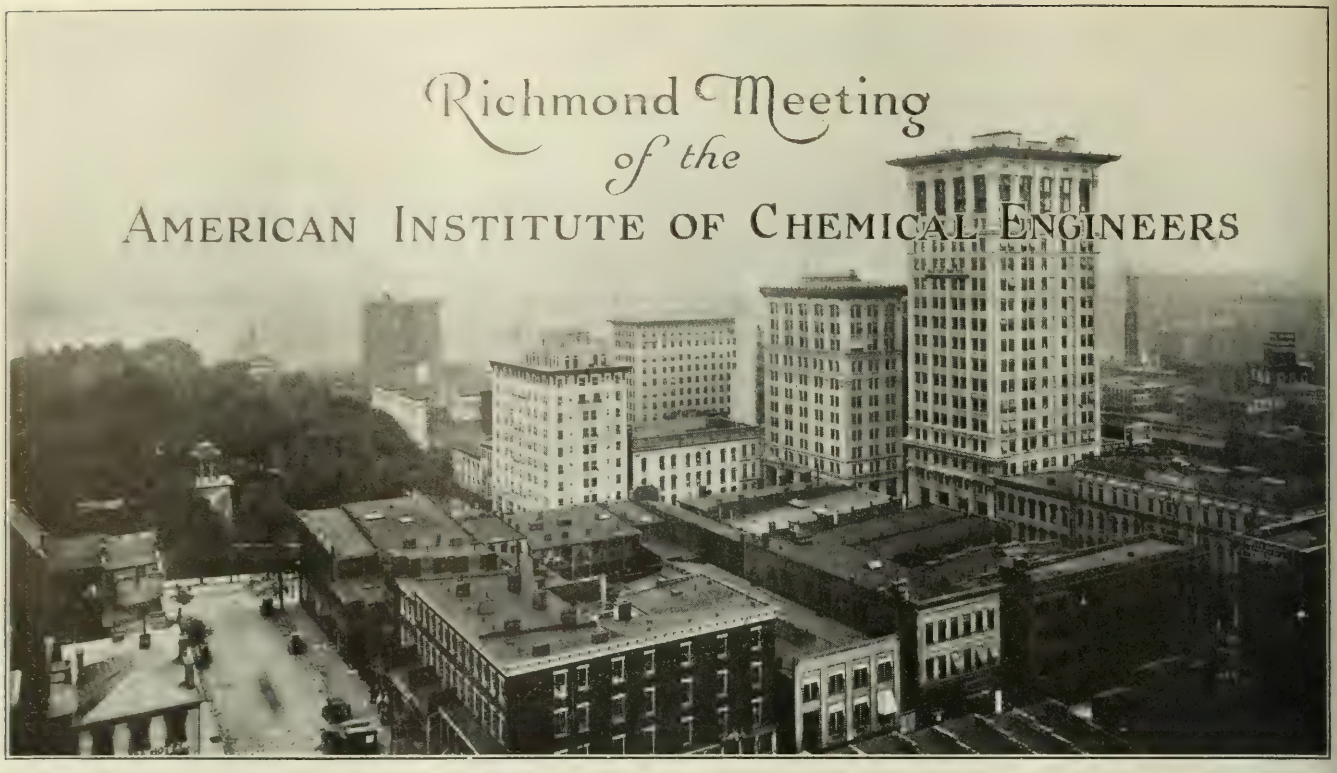
Efficiency Rampant

IN A formidable document of 400 pages the U. S. Bureau of Efficiency has just issued a "Report on the Statistical Work of the U. S. Government." Perhaps a useful purpose has been served in compiling and bringing together within the covers of one book a list of the varieties of statistical information collected and disseminated by the government; but the conclusions and recommendations of the bureau approach a degree of absurdity. It seems inevitable that inefficiency would result from the adoption of the bureau's ideas.

The statistical output of the government is grouped in this report under twenty-seven headings and the bureau undertakes to show that there is a great deal of duplication of effort and overlapping of work among the various statistical gathering departments. In the name of efficiency it is proposed to centralize this work, now conducted in over forty government bureaus.

In judging efficiency it is quite as important to measure the quality of the product as to measure the quantity. Sometimes quantity production can be achieved only at the expense and sacrifice of quality. The usual consequence is that the product is worthless in those cases demanding a superior grade of article. Doubtless this would hold true in the case of government statistical work, for a centralized and glorified statistical bureau would undoubtedly produce quantities of figures without much regard to their usefulness or significance.

Anyone who has used government statistics knows the particular value of those data furnished by bureaus that are essentially technical in their character. These figures are not only reliable and generally acceptable; they are also intelligently prepared and intelligibly presented. Their interpretation and application in science, industry or commerce is quite clear and easily accomplished. On the other hand, a different situation is found in those government offices that deal with statistics alone without a knowledge of the industry, the commodity or the business to which the data relate. Gathered and handled in a mechanical, perfunctory manner, the results are of doubtful accuracy and of uncertain significance. In our judgment any step that would consolidate the statistical work of the government would rob the best of it of its present value and tend to standardize downward toward mediocrity.



The Feature of the Technical Program Was a Symposium on Materials of Construction, Covering Wood, Stoneware, Tantalum, Magnesium Oxychloride and Glass—Interesting Industrial Excursions, Including War-Time City of Hopewell—Election of Officers and Transaction of Other Business

EDITORIAL STAFF REPORT

THE fifteenth annual meeting of the American Institute of Chemical Engineers was held in Richmond, Va., beginning Wednesday, Dec. 6, and extending through Saturday, Dec. 9. The feature of the meeting from the point of view of technical papers was a symposium on the materials of construction in chemical plants. A number of important papers were presented, some making a thoughtful review of the use of well-known materials such as wood and portland cement, others discussing materials comparatively novel, such as magnesium oxychloride cement and asbestos protected metal. An extremely dramatic paper from the point of view of the technical man was that presented by A. E. Marshall of Baltimore on the use of Pyrex glass as an engineering material. The other features of the meeting included visits to some of the large tobacco plants for which Richmond is extremely well known and of which industry it is the national center, and a visit to the city of Hopewell, the seat of the famous explosive plant of the du Pont company during the war.

It has become almost proverbial in reporting meetings to pass a bouquet to the local committee, and the Institute has been peculiarly fortunate in being entertained by exceptionally able local committees. In this case an especial palm is perhaps in order, because there were no members of the Institute on the local committee. The successful completion of a very attractive program was greatly appreciated by the members and guests and the rising vote of thanks which was given to the members of the local committee expressed very inadequately the gratitude of the convention. J. G. Armistead, the local chairman; Mr. Dabney, of the Richmond Chamber of Commerce; Dr. Ryland, of Richmond University, and Mr. Rudd are some of the men who will always be remembered by the Institute for the very enjoyable Richmond meeting.

Business Meetings

IMPORTANT CHANGE IN PUBLICATION POLICY

Some questions of fundamental policy were discussed and decided during the business session. One of the most far reaching had to do with the date on which manuscripts must be forwarded to the secretary in order to be included in the program of a meeting. This is far reaching because, in setting the date 60 days in advance of the meeting, a positive censorship is created and time given sufficient for the preparation of preprints. The committee felt that the policy of sending preprints was a good one, inasmuch as a free discussion of the papers would thus be very much encouraged. Finally, submitting the papers 60 days in advance of the meeting will facilitate the publication of transactions of the society by compelling authors to be prompt with their manuscripts. There was some objection on the ground that some papers would never be available for the Institute, but it was felt that the committee would use its discretion if such a situation presented itself.

ELECTION OF OFFICERS

President Henry Howard was re-elected for the year 1923, and the other officers were returned to office without contest as follows: First vice-president, A. W. Smith; second vice-president, H. K. Moore; third vice-president, H. S. Miner; secretary, J. C. Olsen; treasurer, F. W. Frerichs; auditor, C. F. McKenna. Prof. Edward Bartow of Iowa, Prof. R. H. McKee of Columbia and J. V. N. Dorr of New York City were elected to the council for three years. Reports from the secre-

tary and the treasurer indicated a healthy growth in membership and a financial condition which warranted a reduction in the annual dues to $18 for senior members and $12 for junior members.

A number of committees reported at the meeting in addition to the committee on publications, the report of which has been already referred to. The committee on evaporator test code, working in conjunction with the committee from the Society of Mechanical Engineers, reported progress. The committee on patents reported informally through letter that it was in accord with President Howard's efforts to insert a working clause in the Stanley bill. President Howard announced that the bill was a dead issue for this session of Congress, but that it would be in order for the Institute committee to act with other organizations when the bill comes up for consideration.

The new committee on chemical engineering education held its first meeting, which was reported successful. Plans were laid for carrying on this important work. A tentative weighting of general subjects in chemical engineering courses was adopted and it is one of the functions of the committee to endeavor to bring about a more even balance in the curricula of institutions offering chemical engineering.

A resolution instituted by the committee on licensing engineers was passed which reiterated the position already taken by the Institute that it did not favor the licensing of engineers and that it would use its influence and work for a repeal of present and existing legislation.

Social Features and Plant Visits

Richmond and its vicinity represent two things, a modern American community, aggressive, bustling, human, and a shrine of Confederate memories. Recall that Petersburg, only 15 miles from Richmond, was practically the last stand of the Confederacy, for when it fell Richmond and Appomattox were bound to follow. In addition Richmond was the capital of the Confederacy and therefore the Institute trips would naturally reflect both of these phases of Richmond. On the one hand, the tobacco industry, of which Richmond is the center, the home works of the largest fertilizing company in the world, the largest cedar plant in the world, and on the other hand Battle Abbey, the trenches around Petersburg where the Confederates held the Federals at bay for many weary months, the famous

THE HOUSE OF AMERICA'S GREATEST JURIST, JOHN MARSHALL

BLANDFORD CHAPEL

A Confederate shrine now, containing the beautiful Tiffany windows in memory of the soldiers of the South who fell in defense of Petersburg.

crater blown up by the Northern troops in an effort to pierce the Confederate lines and a hundred more historical relics of a similar kind.

Tobacco Industry

T. M. Carrington, president of the Tobacco Association of the United States, paved the way for an intelligent inspection of the tobacco factories with a very instructive address on the American tobacco industry. The figures were somewhat amazing as to the extent of the industry and the value of its products. More than $1,600,000,000 is spent annually for tobacco in the United States. Last year there was produced 60,000,000,000 cigarettes, 8,000,000,000 cigars and 275,000,000 lb. of tobacco. Mr. Carrington went on to develop the elaborate steps which are necessary in the growing and curing of tobacco. The tobacco plant seems to have more enemies than almost any other known plant, for a veritable army of worms and insects are intent on destroying it in some way or other. It is first sprouted on a carefully prepared field under canvas to protect the young plant from heavy rains and heavy sun, and when finally matured it is dried out in barns and finally aged in casks of oak.

So when at the start of the tour through the tobacco factory one sees the workmen removing the dried leaves from heavy casks the reason and history are somewhat more comprehensible. The leaves are first steamed and then dipped into a solution which contains licorice and sugar and a number of other things which go to make up the tobacco formula. The leaves thus impregnated are then squeezed to remove the excess liquid and dried at a relatively low temperature. The next step consists in forming pressed cakes of tobacco in hydraulic presses, after which the cakes are cut as desired. Perhaps the most interesting thing in a smoking tobacco factory is the automatic machinery for packing the material into tins or cartons as well as the manual dexterity of the girls who are handling tobacco which cannot be packed automatically.

In the cigar factory the preparation of the filler and the final wrapping are both carried out on automatic machines. In each case the only hand labor necessary is the placing of the leaf wrapper on the cutting die. The final wrapping machine is most ingenious, as it cuts the wrapper to the desired shape, picks it up and rolls it onto the filler, which has in turn already been placed in position automatically. The machine then takes the cigar to a rotating thimble, which seals the ends of

it and in the meantime the other end has been clipped off even. The only hand labor connected with the operation is, as has been said before, setting the filler on the cutting die and picking up the finished cigar for final packing.

The Hopewell Excursion

Hopewell has always been a name by which the chemical engineer conjures, for during the early part of the war period it sprang into being in almost unbelievably short time as an explosive plant of the du Pont company. At its height of construction and operation there were over 30,000 people in Hopewell. Shortly after the armistice, however, the town dwindled until barely 3,000 were left. Since then also a surprisingly large percentage of the equipment placed there during the war by the du Pont organization has been liquidated and there are many acres on which nothing remains except concrete piers and brick foundations where formerly acid and explosive units were in full operation.

The Institute arrived somewhat later than was expected and was able to inspect only the Hummel-Ross pulp factory. An interesting feature of this plant is the use of a large deposit of niter cake which was left by the du Pont company in a valley near by. A fiber company has bought up a large percentage of material and it is expected that it will last for a good many years. Other industries which exist at Hopewell are the Tubise Silk Mills, manufacturing silk by a Belgian process from wood; bag and trunk manufacturers, the Stamsocott Paper Co., the Hopewell Chemical Co. and a number of others. At the present time the town has grown substantially and consistently until now there are over 9,000 inhabitants. The site was well selected by the du Pont company, inasmuch as it offers the facilities of water transportation, relatively cheap fuel and a substantial supply of labor of all kinds from the surrounding country.

On the way back from Hopewell a stop was made first at the famous Blandford memorial chapel, which has been set aside in memory of the Confederate soldiers who fell in the defense of Petersburg. Each Confederate state has contributed a beautiful memorial window. In its peaceful setting, with the beautiful hills around it and the old brick walls of the cemetery acting as a frame, it makes a very moving appeal.

Another stop was made at the crater, and here an old Confederate veteran described the details of that memorable and unsuccessful attempt to pierce the Confederate defense. It was up to that time and until the world war the largest explosion in warfare, many thousand pounds of powder being used to make the breach.

GENERAL ROBERT E. LEE IS A NAME OF WHICH EVERY AMERICAN IS JUSTLY PROUD

BUYING TOBACCO IS THE MOST IMPORTANT STEP IN SUCCESSFUL MANUFACTURE

Other Industries Visited

A large delegation from the Institute visited the Virginia-Carolina Chemical Co.'s plan on the outskirts of Richmond, where they make sulphuric acid, acid phosphate and mixed fertilizers. It is scarcely a typical fertilizer plant, for the building and equipment in which the acid phosphate is made and the fertilizers are mixed are very modern, but it afforded a splendid opportunity to study modern methods of manufacture in the fertilizer industry. The flow of raw materials has been carefully worked out so that the handling of materials is reduced to a minimum. The acid phosphate is manufactured in one end of the building, then come the aging pits, the mixing apparatus in which the prime mixes or so-called fertilizer bases are made. Then the storage of acid phosphate and bases, and finally the mills for mixing the finished fertilizer. Transportation is carried out on elevated track by means of an electric engine and also by means of electric cranes on either side of the center of the building.

After this an inspection was made of the Richmond Cedar Works, which is the largest cedar works in the world. Here the sawmill was a source of great interest, on which cedar logs were cut up into lumber at the rate of forty or fifty logs an hour by common laborers. In the mill itself the cylindrical saws used for cutting out the staves for buckets and pails were interesting, as well as the galvanizing pit for the metal parts on the products.

The Institute was fortunate also in seeing the Richmond Car Works, the Standard Blotting Paper Co., a baking powder plant of the Southern Manufacturing Co. and the Cheek-Neal coffee plant.

Social Functions

Before taking up the technical papers it is most appropriate that the reception and banquet be mentioned. The reception was held on Wednesday evening after the first sessions of the Institute and an opportunity was given to meet the hosts and hostesses. At the banquet the Institute had a rare treat in the shape of an address by Arthur Glasgow, consulting engineer for the City Gas Works in London, England. Mr. Glasgow was originally a Richmond boy and spoke to the Institute both as a host and as a distinguished guest. His analysis of the industrial ills from which England has suffered was very keen and he discussed the unemployment problem very frankly. He had severe condemna-

THE FAMOUS CRATER
The breach blown in the Confederate defense around Petersburg by a Union mine. The attack was a failure.

tion for the Lloyd George government because of the payment of the unemployed. This, he said, was not even a palliative for the suffering, but merely intensified the tragedy.

The only solution to the present depression is the adoption universally of the slogan, "Work and Save." Only by such means can British industry pull itself from the strangling depression which the labor unions have caused. The killing of industrial initiative by compulsion has proved disastrous. As an example Mr. Glasgow says that 300 bricks per day were all that the British bricklayers were permitted to lay, whereas an average bricklayer could easily lay 1,500 bricks. This he said was typical of the mistaken policy followed by the unions of attempting to create enough work for everybody by limiting the amount any one was permitted to do. Such limitation is the very source of a disgruntled attitude. Only by working and by working hard can there be any joy in achievement. Only by production, by work and by saving can the British workmen emerge as satisfied, wholesome citizens from their present predicament. It is a lesson which American manufacturers and labor leaders cannot afford to miss.

Technical Papers

Symposium on Materials of Construction

The program of papers included a symposium on materials of construction. Some of these papers will appear in *Chem. & Met.* In this week's issue is the paper presented by Percy C. Kingsbury, on Chemical Stoneware. Dr. C. W. Balke's article on Ductile Tantalum, F. C. Zeisberg's on Glass Rings for Tower Packing, and The Industrial Use of Pyrex Glass, by A. E. Marshall, will all be printed within the coming weeks. In addition the excellent paper by Dr. J. H. Young on Asbestos Protected Metal, which deals with the interesting development of this commodity, has been promised for an early issue. The remaining papers presented in the course of this symposium are abstracted below.

The Use of Wood in Chemical Manufacturing

J. V. N. Dorr presented a thoughtful paper on the various uses of wood in chemical industries. The advantages of low initial cost, easy replaceability, low heat conductivity (under certain conditions this property is invaluable) are balanced on the other hand by the low mechanical strength and the consequently cumbersome apparatus which results, the flammability and the fact that the tanks must be kept in use else they dry out, permitting considerable leakage. The uses of wood under various conditions were discussed and the various kinds of apparatus, including wooden pipe, both stave and hollow, centrifugal and piston pumps, etc., were mentioned. Protected wood was also discussed, as for example the lead-lined equipment and hard rubber lining. Concrete-lined wooden tanks are also in use and a large number of impregnated materials were recorded as being desirable for a number of reasons, largely for their resistance to weathering.

In the Dorr equipment wood has had a number of uses. In the case of alum plants where three agitating tanks are used lead-lined tanks are specified on top of merchantable fir. The first two washing thickeners are also lead lined but the last one is usually of fir, sometimes even the second. In the case of phosphoric acid the agitating tanks are made of clear fir, and the mechanism, arms, shaft, etc., are also made of fir. The first thickener is fir, lead lined, but the succeeding ones are of clear fir. White oak wooden barrels for acetic acid centrifuged from aspirin powders, yellow pine cooling chambers in the purification of salicylic acid by sublimation, and a few other special items were mentioned.

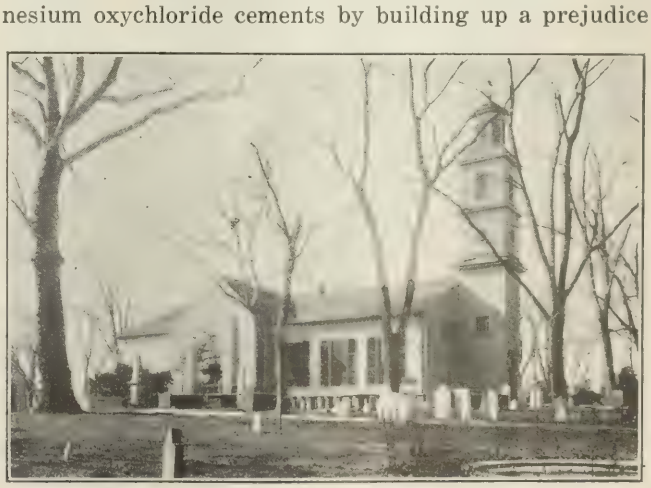
The discussion brought out the use of wooden filter presses for a number of different purposes, and further comments on the various uses of wood.

Magnesium Oxychloride Cement

A compound relatively unfamiliar to most chemical engineers was discussed by M. Y. Seaton under the general subject of magnesium oxychloride cement. It seems that this industry is comparatively young, although the cements have been known for some time. No scientific data had been accumulated in the early days of its use and it was most difficult to apply and somewhat unprofitable because of the uneven results obtained. The magnesium oxychloride cements bind woody fibers into floors and walls and a number of other surfaces and structures. One characteristic of these cements is that there is very high tensile strength at an early stage and the subsequent evaporation of water is permitted quite freely without injuring the cement. Another point of advantage is that the volume contraction is relatively low, as compared with other cements.

Some doubt exists as to whether the cement is a chemical compound or a solid solution. Probably there is a chemical compound present, $3MgO.MgCl_2.10H_2O$, but a good deal of the material is in solid solution, which gives the product its high tensile strength.

A fact which has militated against the use of magnesium oxychloride cements by building up a prejudice



HISTORIC OLD ST. JOHN'S

against them is the fact that they are decomposed by water to form magnesium hydroxide. This, however, is actually not deleterious, because hydrolysis changes the oxychloride into brucite-like hydrates. Brucite is a form of magnesium hydroxide which has very great stability and adds strength to the cement rather than weakening it.

Previous to 1914 all of the magnesium oxide used in this country was obtained by calcining magnesium carbonate, which was largely obtained in Greece. The war cut off this supply and the open-hearth steel furnaces demanded large amounts of dead-burned magnesite. This led to the exploitation of the California and Washington fields for these purposes, and this fact gave a home source of raw material for the magnesium oxychloride. As is the case with most cements, the chemical analysis is relatively unimportant. It is necessary to have plastic magnesium oxide in order to make the cement, and for white cement it is essential that it be iron free. Calcination therefore must be controlled within narrow limits of temperature. The ore must have been previously sized to within narrow limits. Practically all the burning is done on a rotary kiln at about 1,100 degrees. The magnesium oxide thus produced is then ground up in burr mills of the old fashioned variety so that 85 per cent of it will pass through 200 mesh.

This is then ready for preparation of the cement, and magnesium chloride is one of the other ingredients. This was originally found in the Stassfurt deposits, but recently it has been obtained from the sea water and brine bitterns in this country. However, these bitterns were worked over only at a time when potash was in demand from domestic sources, and as this time is past, all of the magnesium chloride is extracted from the Michigan brines.

One other interesting point about the magnesium oxychloride cement is that it is essential to supply premixed aggregates at the point of consumption. Unlike portland cement, the addition of excess cement does not make up for errors in mixing and it is therefore of vital necessity that the manufacturers put out a ready mixed product to obtain consistent results.

The Use of Concrete in Chemical Industries

A. C. Erwin, of the Portland Cement Association, presented a detailed and instructive paper on the use of concrete. Mr. Erwin emphasized especially the desirability of using less water in a mixture when making concrete from the cement and aggregate and much more water during the process of setting. This, he said, was his main message in the use of concrete not only in chemical industries but in all industries. The laboratory of the Portland Cement Association has established beyond a doubt the desirability of using less water in the mix. This is very difficult to apply in the field, because the material flows much better if it is soupy. Nevertheless, Mr. Erwin felt that too strenuous efforts could not be made toward the utilization of drier mixes in the field. Another point which he emphasized was the fact that inevitably a thin mixture will separate out in the molds—that is, the heavy aggregate will fall to the bottom and leave a top layer of much purer cement. Thus it becomes necessary to have much heavier construction than would otherwise be needed if even results were obtained by the use of the dry mix. Similarly the author pointed out the desirability of constant wetting during the first 10 days after the cement is laid.

THE WHITE HOUSE OF THE CONFEDERACY

Many other details in the use of cement were outlined and emphasized, but most of them were in accord with usual practice and need no special emphasis in this abstract. Finally, the cement gun was discussed. This is a machine which shoots a mixture of sand and cement by means of compressed air with considerable force on to a building. The water is injected into the mixture at the nozzle of the gun in an exact proportion so that the result is a mixture of concrete applied to a wall with very great force. Several of the engineers present confirmed the flexibility and satisfaction given by this machine and it was further pointed out that methods of application had improved so that the earlier results, uneven and somewhat unsatisfactory, had been completely eliminated by the improvement in the process of application. In addition, the cement gun, or gunite, as the product is called, can be used in lining tanks with cement very satisfactorily.

The Integral Waterproofing of Concrete

Prof. A. H. White, of Michigan, summarized some results of evperiments which he had made extending over a period of 10 years with waterproofing for concrete. The cry of the cement manufacturers has always been that waterproofings were unnecessary if cement was properly made. This, Professor White felt, was somewhat incorrect and from the very nature of things could not be expected to be the case. Concrete is impervious to water, nevertheless water goes through it by colloidal action and no matter how correctly the cement is mixed that colloidal action will take place inevitably. For this reason such materials as hydrated lime and clay, which are recommended as fillers, ought to have actually no effect on making the concrete more waterproof, because they are both colloids and they expand and contract as concrete does. Several other types of waterproofing compounds have been suggested. One is a water repellent type, such as asphalt, and the other is material such as soap, calcium oleate, etc. Professor White's experiments on ordinary and waterproof concrete blocks of various types consisted in studying the rapidity with which water was absorbed by the blocks and the rapidity with which the water rose due to the capillary action. Calcium hydroxide was found to give calcium carbonate after the solution had evaporated, and this seems to produce a waterproof surface to the concrete and the block was found to be as porous as ever after the surface of the concrete was ground off.

In other words; calcium hydroxide actually assists in the absorption of water and the block becomes waterproof on the surface.

A positive waterproofing as distinguished from that of hydrated lime, which might be called a negative waterproofing, would consist in a surface coat of asphalt or asphaltic material. One interesting thing which was discovered during the course of the experiments was the fact that waterproofing, instead of diminishing the compressive strength of concrete, seemed if anything to increase it, which superficially was a contradiction of the tests carried out by the Bureau of Mines, although further study of those tests showed them to be in conformity with these experimental results. It can therefore perhaps be safely said that waterproofing materials ought to increase the strength of concrete if the concrete is permitted to dry out in contact with air. Some interesting discussion developed more fully the points already brought out in the abstract of this paper and also indicated that similar experiments had been carried out by Bechold on plaster blocks which confirmed Professor White's conclusions with regard to waterproofing materials.

MEMBERS AND GUESTS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS ABOUT TO INSPECT THE VIRGINIA-CAROLINA CHEMICAL CO. WORKS

The Density of Lime as a Function of Burning Conditions

Prof. J. R. Withrow, of Ohio State University, gave a preliminary outline of some experiments which were in process at Ohio State on the burning of lime. It is his purpose to carry out in a miniature limekiln, which has been used in some fuel studies at Ohio State, the effect of time and temperature of burning on the properties of lime and the effect of the variation in the source of material. In carrying out a preliminary set of runs he has had to work out a new method of density determination which has to do with particle density and not bulk density. It is based originally on Washburn's porosity test with some modification thereof. The data obtained are plotted in various ways which it will not be necessary to discuss at the present time, as the data is somewhat inconclusive, but the work promises to develop some very interesting relationships and is being carried on in close co-operation with the extensive research work of the National Lime Association.

A GLIMPSE OF INDUSTRIAL RICHMOND WITH THE MAJESTIC JAMES RIVER IN THE BACKGROUND

Other Technical Papers

In addition to the symposium there were a number of other technical papers of importance. In the issue of Dec. 13 we published the paper by Prof. W. L. Badger, J. C. Wood and E. R. Whittemore on "An Analysis of Stirrer Performance." No discussion of the paper is therefore necessary in this report. In the discussion of the paper Mr. Field read an analysis of the various stirring operations in industry and the various types of stirrers in use.

H. D. Edwards, of the Linde Air Products Co., presented a paper on "The Use of Propane in Refrigeration." An interesting recent development in this field has interest to householders and other users of relatively small refrigeration units. Propane has many advantages. It has no corrosive action on metals and its water solution is harmless. It is stable, can be used in ammonia installations, produces lower temperatures than ammonia and is not dangerous except when it displaces the oxygen necessary for respiration. Considerably more expensive than ammonia, it is not expected to displace it, but will find an extensive use in its own field.

W. B. Pratt, of Boston, read a very interesting paper on "Sulphur Substitution Products of Terpenes." The work was undertaken to throw some light on the vulcanization of rubber, and the simpler substances were studied. How is sulphur combined in such compounds? Probably it is largely molecularly combined in several positions in the molecule. These facts have been established. There is some doubt as to the rest of it, however. The paper aroused some interesting comment.

Prof. J. H. James, of Carnegie Tech., made a further report on his experiments with oxidized oils. A

complete discussion of this paper will be postponed till a later issue. Another report of progress in a special field was made by Prof. Edward Bartow, of Iowa, "The Purification of Sewage by Aëration in the Presence of Activated Sludge." Typical recent installations were described, such as those in Chicago, Milwaukee and Houston, all operating on the diffusion process. The mechanical aëration principle used in England was also described. Various types of aërators and settling tanks received attention, and it was pointed out that practical demonstrations have shown the value of the dried material as fertilizer. Problems in the disposal of packing-house waste were also considered, the sludge rising to the top after treatment with H_2SO_4.

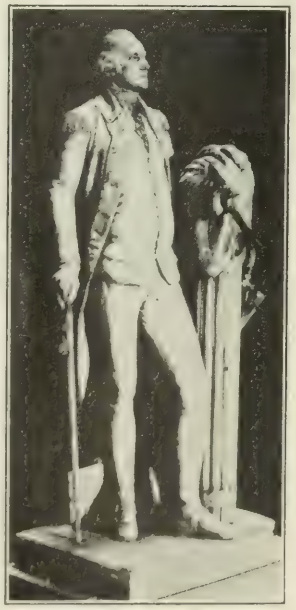
Absorption of Gases in Towers

Three papers on this general subject were presented. All three were definite contributions to the modern conception of chemical engineering as a study of unit processes. It was unfortunate that preprints could not be obtained, for most of the auditors were utterly unable to follow the analysis, which was essentially mathematical.

The paper by F. C. Blake, of the du Pont company, on "The Resistance of Packing to Fluid Flow" derived several relationships, assuming first, a dimensional homogeneity in the packing, and second, where the packing is irregular as in pumice, etc. The relationships plotted were values of $\frac{Pd}{M^2}$ as ordinates and $\frac{M}{\mu}$ as abscissas, where P is the pressure gradient, d the density of the fluid, M the mass velocity and μ the viscosity. Experiments showed that a relationship of this kind does exist.

Data with one fluid can thus be used to estimate the pressure drop with another fluid or at different temperature.

W. B. van Arsdale, of the Brown Company, discussed "The Effect of Rate of Flow on Absorption of Gases," and so did Prof. R. T. Haslam, of Massachusetts Institute of Technology. Mr. van Arsdale is after a fundamental equation (consequently not simple) which will apply to a wide range of tower design and conditions of operation. Previous work with constants based on the assumption of uniform temperature and uniform flow may vary as much as 300 per cent. It is certain that the volume of gas varies; the heat of solution also varies. Solubility does not follow Henry's law and there are undoubtedly cases where slow side reactions affect the results. Performance of towers may be expressed as an absorption coefficient, absorption factor, per cent saturation of liquid, per cent removal of gas or by a so-called solute transfer coefficient.



GEORGE WASHINGTON
Magnificent statue in the state Capitol of Richmond.

The paper is too full of meat to stand a short abstract. It can perhaps best be described as an attempt to determine by mathematical relationships the optimum style and size of the unit packing, the ratio of height to diameter of tower, the ratio of liquid supply and of gas supply per square foot of cross-section and the temperatures of both phases. Each of these factors affects the transfer coefficient.

Professor Haslam's paper reported results obtained on tower efficiency in some experimental work at one of the experimental plants. It must be admitted that M.I.T. never had a reputation for dodging mathematics and therefore if, in figuring tower efficiency, or K_A as they call it, they lump several effects into a general and approximate constant, serious consideration must be given the question before concluding that the analysis is not rigid enough. After all, results within 10 or even 20 per cent are as close as can be expected in designing such equipment. It remains for further data to establish whether a more rigid analysis is necessary. There is no essential disagreement in the two papers.

The final paper was a most entertaining and instructive one by Dr. Jerome Alexander on "The Importance of Impurities." Many examples of the value of minute traces of foreign material were mentioned, extending from the iodine in food, absence of which causes goitre, to such industrial applications as the Welsbach mantle.

Something Better in Enamel Smelters

Principles and Practices of Metallurgical Furnaces Successfully Applied to Terra Cotta Manufacture

AT THE MEETING of the Chicago Section of the American Ceramic Society, Dec. 2, 1922, H. E. Davis, of the Northwestern Terra Cotta Co., outlined the principles of design and construction which have been used in a recently completed enamel smelter. Metallurgical furnace experience has been adapted to the requirements of enamel smelting and it is expected that operating results will prove the advantages of this type.

Desiring something more economical than the method of smelting enamel first in saggers, a careful study of available smelters was made and the conclusion was reached that it would be best to have one designed by engineers familiar with the latest developments in metallurgical furnaces. The Singers-Kennedy Construction Co. was given the problem of designing and building as good an oil-burning furnace as possible for the purpose desired. The furnace as constructed is 12 ft. long, 7 ft. wide and about 6 ft. high.

Burners and Combustion Chambers

Gas oil (34 to 36 Bé.) is delivered to Advance Furnace & Engineering Co. burners at 20 lb. pressure, being heated in a steam box to about 130 deg. F. Air is furnished by a Roots blower at about 15 lb., with no preheating. The atomized oil is further broken up by being sprayed against a quarter sphere of carborundum suspended about 8 in. in front of the burners.

The combustion chamber is 4 ft. wide at the burner end, narrowing to a 2-ft. opening into the smelting chamber. The arch slopes down and the sides slope in, the entire length being about 30 in., which has been found necessary for completely burning oil, and delivering only hot gases to the smelting chamber. Complete combustion is effected largely through radiant heat, thrown back from the side walls of the combustion chamber. The angles of these are so designed as to

throw heat from the hottest portion back at the burner openings. Of the air required, 50 per cent is taken in through the burner ports and 50 per cent may be supplied through two more ports alongside of the burners. These can easily be closed off with a soap brick when desired.

Smelting Chamber

While many enamel furnaces have an arch which slopes down toward the center of the bath, thus forcing the hot gases into close contact with the enamel at high velocity, exactly the opposite principle was used in this smelting chamber. In accordance with metallurgical experience, the arch is built like a turtle back, arched both lengthwise and crosswise. The hot gases thus slow down to a rather lazy passage over the center of the bath, permitting a maximum amount of heat to be given up. In addition to this, the shape of the arch concentrates the radiant heat at the thickest part of the bath where it will do the most good.

Drying Table

At the end of the kiln the waste gases are drawn through a flue which is covered with a 3x6-ft. drying table to dry the quenched frit before grinding. It is estimated that the gases will reach the drying table at approximately 1,400 deg. F. and the stack at about 1,000 deg. F.

Insulation

Loss of heat through the furnace walls is reduced to a minimum by efficient insulation.

The bottom of the kiln is 11 in. of Sil-O-Cel brick underneath three courses of firebrick and a 6-in. hearth-tile. The walls are 9 in. of Sil-O-Cel brick, outside of 9 in. first quality firebrick and 6 in. hearth-tile down at the bath level.

The crowns are all 9 in., with Sil-O-Cel C-3 grouted over, thinly of course, at the center to prevent holding too much heat at this point. All arches and inner walls are made with "buttered joints" of high-grade fireclay and pointed up with high-temperature cement. As the insulating brick form the outer walls and are very soft, the entire furnace was incased in an armor of $\frac{3}{16}$-in. steel plate. This is a great protection to the insulation from knocking against it, and also prevents heat losses through cracks which might develop. The drying table and the flues leading in to it are all well insulated. The charging door is made of C-3 Sil-O-Cel, 9 in. thick.

Some interesting data on the value of insulation were found by actual tests. A 13-in. non-insulated firebrick wall has a loss of 1,450 B.t.u. per square foot per hour opposite the hottest point; $4\frac{1}{2}$ in. insulation reduces this to 350 B.t.u. per square foot per hour. An 18-in. firebrick wall non-insulated loses 1,100 B.t.u. per square foot per hour. The same thickness of wall built of 9-in. firebrick and 9-in. insulation, as in this furnace, loses 225 B.t.u. per square foot per hour.

Hearth Lining

Although the ideal hearth lining would be one tight enough to prevent absorption of the molten frit and yet open enough to resist sudden temperature changes without spalling, such an ideal is difficult to find in practice. In this furnace an experiment is being made with large blocks of Indiana clay burned almost to vitrification. The body used for this is the same as that to which the enamels are fitted in the ware, so that there will be little danger of attack by the molten frit. It is hoped that spalling will also be reduced. The interior of the hearth is 3x6 ft., made up of blocks 6x12x18 in.

Data on Theoretical Fuel Consumption

Although no tests have been made, the efficiency may be taken conservatively as 30 per cent, since the furnace is patterned very closely after a heat-treating furnace which had an efficiency of over 40 per cent on actual test. The maximum batch will be 400 lb. to be melted at 2,500 deg. F., specific heat about 0.3. There will thus be required $400 \times 2{,}500 \times 0.3$, or 300,000 B.t.u., but as the efficiency is 30 per cent, 1,000,000 B.t.u. will have to be supplied. With oil at 140,000 B.t.u. per gallon, this would mean about 7.2 gal. of oil per heat.

No enamel has been melted as yet, but preliminary trials to test out the burners and to dry out the structure seem to indicate that the furnace heats up very rapidly and that the combustion chamber does all that is expected of it.

A New Artificial Zeolite

Recently the British firm of Crosfields, manufacturer of soda and sodium silicate, has succeeded in making a satisfactory artificial zeolite. This material, which is being marketed under the trade name Doucil, is competitive with the semi-natural Permutit, Refinite and Borromite products. According to the British patent specifications Nos. 142,974 and 177,746, there are two different types of product, the former being more suitable for drying air and recovering solvent vapors on lines similar to those adopted in America by the Silica Gel Corporation, while the latter is more suitable for water softening and purification. The former product is obtained by neutralizing by means of hydrochloric acid about 50 per cent of the soda in a dilute solution of silicate of soda, the final product containing on the dry basis about $12\frac{1}{2}$ per cent Na_2O and 87 per cent of SiO_2. Doucil, on the other hand, is prepared by intimately mixing at temperatures below 20 deg. C. dilute solutions of sodium aluminate and "neutral" sodium silicate in order to obtain a product containing between 6 per cent and 16 per cent of alumina based upon the total solids originally present in the mixture. In both cases a stiff gelatinous mass is obtained after it has stood for a few minutes and by carefully drying at a gentle heat down to about 60 per cent moisture content it is possible to lixiviate the mass, remove the soluble constituents and leave the granular, semi-transparent and insoluble artificial zeolites ready for use. By varying the strength of the solution and also the final moisture content, it is possible to obtain gels containing various percentages of alumina between the limits given above.

The product is being sold at 11 cents a pound and it is stated that 1 cu.ft. will soften 1,000 gal. of water containing ten parts of calcium oxide per 100,000 or the equivalent of calcium and magnesium oxides. For regeneration 4 lb. of common salt is required per cubic foot of the material, and this is believed to be considerably less than the amount required by other zeolite materials. A guarantee is given that 5 per cent of the dry weight of the material is capable of being exchanged for calcium compounds and in experimental work 7 to 8 per cent has been obtained. Experiments are also in progress in regard to solvent recovery and air drying, but the makers' intention is to sell the material and not to manufacture actual plants.

Fundamental Properties Of Commercial Limes

II—The Settling of Milk of Lime Suspensions

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This Article Deals With the Factors Affecting the Settling Characteristics of Lime Suspensions and Presents Comparative Data on a Large Number of Commercial Quicklimes and Hydrated Limes

THE characteristics of a milk of lime suspension are of considerable importance in connection with the use of lime in many chemical and industrial processes. The rate of settling or permanency of such a suspension is of particular and direct importance in such processes as the unhairing and plumping of hides, the preparation of glue and gelatin, the defecation of sugar juices, preparation of whitewashes and lime paints, the preparation and use of sprays and insecticides, the treatment of water supplies, sewage disposal, treatment of textiles, and saponification and clarification of fats. In other processes involving the use of lime, such as causticizing, preparation of bleach and bleaching solutions and a number of processes in other industries, this property is of indirect importance in influencing the rate of reaction, rate of settling of sludges, etc. The particle size and nature of the ultimate product in the case of certain chemicals may in fact be more or less affected by differences in settling rates of the lines used.

Kohlschutter and Walther[1] have investigated the settling rates of suspensions obtained by slaking calcium oxide prepared from various sources and slaked with solutions of substances such as calcium chloride, oxalic acid or sodium carbonate. Determinations were made on products obtained by use of sufficient solution to yield a wet hydrate and no data were obtained relative to dry hydrates. They found that the rate of settling was greatly influenced by the kind and concentration of the solutions used in slaking the quicklimes. Their results are of theoretical interest only because c.p. oxides were used and concentrations of the slaking solutions which were employed were far greater than would be considered practical in industrial operations.

It is the purpose of the present article to present the results of a comparison of settling rates of a large number of representative commercial quicklimes and hydrates and the results of a study of the conditions affecting the rate of settling. Part of this work was done in the laboratory of the National Lime Association and part under a fellowship agreement with Indiana University.

The determinations of rates of settling reported here were made on portions of the same stock samples of quicklimes and hydrates whose available lime content were reported in the first paper of this series.[2] These limes represent all types of lime, varying widely in physical properties and ranging in chemical composition from the high-calcium to the high-magnesium type, and are of the average quality furnished continuously to the trade by companies located in all sections of the country.

The rate of settling was determined as follows:

(1) *Quicklimes.* Seven and one-half grams of the quicklime was carefully slaked to produce a putty of approximately normal consistency and permitted to stand for 24 hours. After this period of curing the putty was transferred to a 100-c.c. graduated cylinder having an internal diameter of 23 mm. and water added to bring the total volume to 75 c.c. The cylinder was then shaken to disintegrate and disperse the lime, after which the volume was made up to 100 c.c. and the cylinder again shaken for 30 seconds to insure uniform mixing. It was then permitted to stand without disturbance and the top of the lime suspension as it settled out was read at intervals of 5 minutes. The final volume (after 24 hours) was recorded in each case.

(2) *Hydrated Limes.* Ten grams of hydrated lime, equivalent approximately to 7½ grams of high-calcium quicklime, was mixed thoroughly with sufficient water to produce a putty of normal consistency and the paste permitted to stand for 24 hours to insure wetting of all the particles. This was transferred to a graduated cylinder and the settling rate determined as for quicklimes.

As indicated below, the concentration of the milk of lime suspension affects the rate of subsidence and the nature of the settling phenomenon. Consequently it was necessary in these tests to select such a concentration that the suspended material would settle *en masse* in order to get anything like an accurate comparison of the various limes. It was found that concentrations below 10 grams of hydrate or 7½ grams of quicklime per 100 c.c. would not give a definite line of demarkation in many instances. These quantities were therefore chosen as satisfactory. With most limes the supernatant liquid became quite clear after the first few minutes. In those instances where a slight milkiness persisted the quantity of material remaining in suspension represented only a very small fraction of the total solids present and would be insignificant in most processes involving such suspensions.

The data on settling of suspensions of freshly slaked quicklimes are tabulated in Table I and of suspensions of hydrated limes in Table II. Records were obtained at intervals of 5 minutes, but only a portion of the data is recorded here. In Tables III, IV, V and VI the limes are classified as to available lime content.

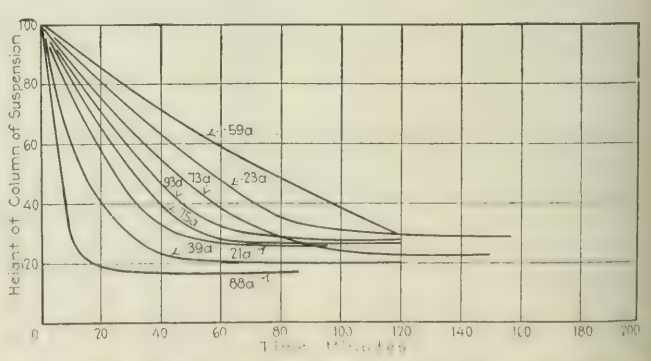

FIG. 1—RATES OF SETTLING OF TYPICAL MECHANICALLY HYDRATED LIMES

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[1] *Z. Electrochem.*, vol. 25, p. 158 (1919).
[2] *Chem. & Met.*, vol. 27, p. 347 (1922).

TABLE I—SETTLING RATE AND VOLUME IN WATER OF COMMERCIAL QUICKLIMES

N.L.A. Quicklime	Height of Column of Suspensions After the Following Intervals in Minutes								Time Required to Settle to 50 c.c.	Final Volume in 24 Hr. Water.
	10	25	40	85	160	315	1,965	1,965		
2	90.0	77.5	67.0	39.5	34.0	31.5	30.0	30.0	66.0	30.0
3	65.0	42.0	31.0	27.5	27.0	27.0	27.0	27.0	18.0	27.0
4x	99.0	95.5	91.5	81.0	61.0	49.0	37.0	37.0	295.0	37.0
4y	98.0	93.0	86.0	66.5	52.5	45.5	35.0	34.5	205.0	34.5
5	99.5	97.0	93.0	77.0	69.5	62.5	48.5	46.0	1,195.0	44.5
6	98.0	93.5	89.5	76.0	53.0	37.5	36.5	36.5	169.0	36.5
7	99.0	94.0	87.5	69.0	61.5	54.5	39.5	37.0	472.0	36.0
9	100.0	98.0	94.5	84.5	78.0	71.5	53.5	48.0	1,645.0	43.5
10	65.0	39.0	28.5	27.0	27.0	27.0	27.0	26.5	19.0	26.5
12	94.5	83.5	72.5	53.0	47.0	41.5	34.0	33.5	115.0	33.5
17	96.0	89.0	84.0	64.0	42.5	35.0	35.0	34.5	111.0	34.5
18	99.5	90.0	95.0	81.5	71.0	64.5	52.0	51.5	2,080.0	49.5
22	98.5	94.0	88.5	76.5	55.5	37.5	36.0	36.0	178.0	36.0
23	41.0	21.5	20.0	18.0	16.5	16.0	15.5	15.5	8.0	15.5
25	97.5	92.5	87.0	72.5	50.0	43.5	35.0	35.0	160.0	35.0
26	98.0	87.5	84.0	65.0	48.5	43.5	38.5	37.0	140.0	37.0
27	98.0	89.5	84.0	64.5	50.5	45.5	40.5	39.5	175.0	39.5
28	97.0	88.0	79.0	58.0	43.0	36.5	33.0	33.0	101.0	33.0
34	91.5	79.5	66.5	40.0	28.5	28.0	28.0	28.0	68.0	28.0
35	30.0	20.5	20.5	20.5	20.5	20.5	20.5	20.5	6.0	20.5
37	92.5	84.0	74.0	44.0	37.5	32.0	29.5	29.5	73.0	29.5
37x	95.0	85.0	75.5	46.5	39.0	33.0	28.5	28.5	79.0	28.5
38	96.5	86.0	74.5	50.5	43.5	37.0	34.5	34.5	89.0	34.5
40	51.5	23.5	21.0	20.0	19.5	19.5	19.5	19.5	11.0	19.5
41	99.5	97.5	92.5	80.0	73.5	65.0	52.0	50.0	1,585.0	49.5
42	97.0	91.5	85.5	72.5	48.5	38.5	34.5	34.5	156.0	34.5
44	99.0	95.0	90.0	75.5	57.0	50.0	38.0	38.0	315.0	38.0
45	24.0	20.5	20.5	20.5	20.5	20.5	20.5	20.5	5.5	20.5
46	98.5	94.0	89.5	75.5	58.0	52.0	41.0	38.5	410.0	38.5
47	97.0	91.5	85.5	73.0	47.0	37.5	33.5	33.5	153.0	33.5
49	92.0	82.5	67.5	46.5	40.0	35.0	32.0	32.0	66.0	32.0
51	92.0	82.5	68.0	50.5	44.5	39.0	34.5	34.5	90.0	34.5
52	65.0	44.0	35.0	29.5	26.0	25.0	23.5	23.5	18.0	23.5
53	64.0	44.0	29.0	23.5	21.0	20.5	20.0	20.0	19.5	20.0
57	96.0	90.0	80.0	59.5	53.0	47.0	37.0	37.0	220.0	37.0
59x	99.0	96.0	92.5	86.0	79.5	71.0	64.0	47.0	1,145.0	44.5
59y	97.0	93.5	87.0	72.0	50.5	43.5	33.5	33.5	167.0	33.5
62	97.0	91.5	83.0	60.0	48.0	41.0	32.5	32.5	137.0	32.5
63	57.0	39.5	26.0	22.5	22.5	22.5	22.5	22.5	16.0	22.5
64	95.5	89.0	79.5	58.0	51.5	44.5	34.0	32.0	190.0	31.0
65	86.0	77.0	63.0	33.0	27.5	24.0	23.5	23.5	58.0	23.5
66	98.0	94.0	86.5	66.5	52.5	46.5	36.5	36.0	220.0	36.0
69	99.0	98.0	95.0	85.0	65.0	57.5	46.6	46.5	939.0	46.5
71	17.5	16.0	15.5	15.5	15.5	15.5	15.5	15.5	1.5	15.5
72	97.0	93.0	83.0	64.0	57.5	52.0	40.5	38.5	400.0	37.0
73	96.0	91.5	84.0	66.5	45.0	38.0	31.5	31.5	127.0	31.5
74	59.0	42.5	29.0	24.0	21.0	19.5	18.5	18.5	18.0	18.5
75	83.0	73.0	58.5	33.5	28.5	27.5	27.5	27.5	54.0	27.5
76	98.5	97.0	92.5	81.0	74.5	67.5	49.0	45.5	1,287.0	43.0
78	82.0	68.0	53.5	46.0	40.0	34.5	27.0	26.5	55.0	26.5
79	96.0	91.5	84.0	64.5	54.0	48.0	37.0	36.0	250.0	36.0
81	98.0	96.0	91.0	79.0	62.0	55.0	42.0	40.0	649.0	39.5
82	97.0	91.0	86.0	80.0	75.0	67.5	51.0	47.5	1,467.0	45.0
85	93.5	86.5	72.0	53.0	46.0	40.5	33.0	32.5	115.0	32.5
86	20.5	19.0	18.5	18.0	17.5	17.0	17.0	17.0	2.0	17.0
87	20.0	19.0	19.0	18.5	18.0	17.5	17.5	17.5	2.0	17.5
89	97.0	93.5	84.0	72.5	66.0	58.0	43.5	41.5	828.0	40.5
92	57.5	44.0	33.0	28.0	26.0	24.5	24.5	24.5	18.5	24.5
93	99.0	99.0	98.0	97.0	94.5	82.5	57.5	52.0	2,268.0	47.0
94	96.5	93.0	83.0	74.0	68.0	60.5	46.0	44.0	1,028.0	43.5
95	98.0	92.0	82.5	62.0	54.5	47.0	33.5	33.0	242.0	30.0
96	98.0	88.5	78.0	53.0	46.0	39.5	32.0	32.0	107.0	32.0
102	100.0	98.0	94.0	85.0	68.0	51.0	39.5	39.5	385.0	39.5
103	94.0	83.5	75.0	52.0	39.0	32.5	28.5	28.5	90.0	28.5
105	98.0	93.0	88.5	77.0	53.5	44.0	39.0	39.0	205.0	39.0
107	95.5	86.5	78.5	56.0	40.0	33.0	29.5	29.5	96.0	29.5
109	97.5	87.5	77.5	58.0	51.5	45.5	36.5	36.0	190.0	35.5
111	73.0	44.5	28.5	23.5	21.0	20.0	20.0	20.0	22.0	20.0
112	96.0	80.0	63.5	44.0	38.0	31.5	21.0	20.0	55.0	17.0
115	97.5	92.0	87.0	73.0	48.5	35.0	30.0	29.5	155.0	29.5
118	96.0	90.0	84.0	67.0	38.0	26.0	25.5	25.5	121.0	25.5
119	94.0	84.0	75.0	51.0	37.5	31.0	27.5	27.5	87.0	27.5
121	96.0	89.5	83.5	66.5	39.5	31.5	25.5	25.5	131.0	25.5
125	59.0	31.5	23.5	21.0	20.5	20.5	20.5	20.5	15.0	20.5
127	98.0	92.5	88.0	76.0	54.5	39.0	34.5	34.5	175.0	34.5
117	95.0	87.5	81.0	61.5	32.0	25.5	23.5	23.5	111.0	23.5

TABLE II—VOLUME IN WATER AND RATE OF SETTLING OF HYDRATED LIMES

N.L.A. Hydrate No.	Height of Column of Suspension After Following Interval in Minutes									Final Volume. 24 Hr.	Time Required to Settle to 50 c.c.
	5	10	15	20	30	40	60	120	240		
2a	88.0	75.0	66.0	57.0	45.0	35.0	29.5	29.0	29.0	29.0	35.5
3a	90.5	81.5	73.5	66.0	54.0	44.5	33.0	30.0	30.0	30.0	34.0
5a	94.5	90.0	86.0	82.0	74.0	67.0	52.0	31.0	28.0	28.0	63.0
21a	88.0	76.0	65.5	56.0	43.0	33.0	27.0	26.5	26.5	26.5	24.0
23a	95.0	90.0	85.0	80.0	71.5	63.5	49.0	31.0	27.0	25.0	58.0
25a	89.5	79.5	70.0	60.5	45.0	36.5	24.5	24.5	24.5	24.6	26.5
35a	94.0	87.0	81.0	75.0	63.0	53.0	38.0	25.0	25.0	25.0	43.5
38a	92.5	84.0	80.0	73.0	62.0	52.0	36.5	33.5	33.5	33.5	42.0
39a	81.5	69.5	59.0	50.0	37.5	30.0	29.0	29.0	29.0	29.0	20.0
45a	89.0	81.0	73.5	66.0	53.5	42.0	39.0	39.0	39.0	39.0	33.0
46a	94.5	89.0	83.5	78.5	68.0	58.5	41.0	27.5	24.0	24.0	50.0
47a	95.0	91.0	87.5	84.0	77.0	70.5	58.0	34.0	29.5	29.0	74.0
51a	88.0	78.5	69.0	60.0	45.5	35.0	24.0	24.0	24.0	24.0	26.5
52a	91.0	84.0	77.0	70.5	59.0	49.0	34.5	25.0	24.0	24.0	39.0
58a	88.0	79.0	70.0	62.0	49.0	39.5	28.5	28.0	28.0	28.5	29.0
59a	96.0	92.5	89.0	85.5	78.5	72.0	59.5	32.0	28.0	28.0	76.5
63a	91.0	83.5	86.5	70.0	58.5	49.0	35.0	27.0	27.0	27.0	39.0
65a[1]	79.0	61.0	49.0	41.0	30.5	23.5	21.0	20.5	20.5	20.5	14.5
71a[1]	92.0	84.0	77.5	71.0	59.5	49.5	32.0	30.0	29.5	29.5	39.5
71aA	85.0	70.0	57.0	47.5	36.5	28.0	25.0	25.0	25.0	25.0	18.5
72a[1]	91.5	83.0	76.0	68.5	56.5	47.0	30.5	24.0	23.5	23.5	36.0
73a[1]	94.0	87.5	82.0	76.0	65.0	55.0	39.0	23.0	23.0	23.0	44.5
74a[1]	93.0	86.0	80.0	74.0	62.5	52.5	35.5	28.0	27.5	27.5	44.0
75a[1]	91.0	82.0	74.0	65.5	50.0	40.0	28.0	26.5	26.5	26.5	30.0
78a[1]	90.0	80.0	71.5	63.5	50.0	40.0	29.0	28.5	28.5	28.5	30.0
79a[1]	96.5	93.0	89.5	86.5	80.0	73.0	61.0	30.0	28.5	28.5	78.0
81a[1]	89.0	81.0	72.0	64.0	50.0	39.5	36.5	36.5	37.0	37.0	30.0
86a[1]	93.0	86.5	80.5	75.0	64.0	55.0	39.0	32.0	32.0	32.0	44.5
87a	92.0	84.0	76.0	68.5	56.0	46.5	34.0	34.0	34.0	34.0	36.0
88a	70.0	38.0	20.5	19.5	19.0	18.5	18.0	18.0	18.0	18.0	8.0
93a	92.5	85.0	77.0	70.5	58.0	48.5	32.5	28.0	28.0	28.0	38.0
94a	91.0	81.0	71.0	62.0	48.0	38.5	25.5	23.5	23.5	23.5	29.0
96a[1]	86.0	72.0	58.5	49.0	36.5	29.0	27.5	27.5	27.5	27.5	19.5
98a	93.0	87.5	81.0	75.5	64.0	54.0	39.0	24.0	23.0	23.0	45.0
99a	96.5	92.0	87.0	83.0	74.0	65.5	51.0	28.0	27.0	27.0	61.0
101a	91.5	81.0	71.5	62.0	49.0	38.0	28.5	24.5	24.0	24.0	29.0
103a	93.0	85.5	78.5	71.0	59.0	49.5	33.5	27.5	27.5	27.5	39.0
105a	65.0	35.0	26.5	23.0	21.0	21.0	21.0	21.0	21.0	21.0	7.0
107a	92.0	85.0	77.5	71.0	59.5	49.0	33.5	29.0	29.0	29.5	39.0
120a	95.0	90.0	85.0	80.0	70.0	61.0	45.0	25.0	24.5	24.5	53.0

TABLE III—CALCIUM QUICKLIMES

N.L.A. Quicklime No.	Time Required to Settle to 50 c.c.	Final Volume 24 Hr.	Available Lime Non-Volatile Basis
2	66.5	30.0	94.02
3	18.0	27.0	90.12
4x	295.0	37.0	94.00
4y	205.0	34.5	95.70
5	1,195.0	44.5	96 44
6	169.0	36.0	95.47
7	472.0	34.5	91.36
9	1,645.0	38.0	80.54
10	19.0	26.5	89 77
12	115.0	33.5	88.12
17	111.5	34.5	89.91
18	2,080.0	49.5	86.12
22	178.5	36.0	87.32
26	140.0	37.0	96.42
27	175.0	39.5	93.19
28	101.0	33.0	93.57
34	68.0	28.0	88.93
35	6.0	20.5	82.92
37	73.0	29.5	89.73
37x	79.0	28.5	94.69
38	89.0	34.5	93.29
41	1,585.0	49.5	82.43
42	156.0	34.5	82.85
44	315.0	38.0	91.95
45	5.5	20.5	83.88
46	410.0	38.5	90.45
47	153.0	33.5	92.00
49	66.5	32.0	90.45
51	90.0	34.5	92.81
53	19.5	20.0	33.42
57	220.0	37.0	88.23
59x	1,445.0	44.5	95.33
59y	167.5	33.5	91.26
62	137.5	32.5	88.49
63	16.0	22.5	90.15
64	190.0	31.0	95.87
66	220.0	36.0	77.62
69	939.0	46.5	60.35
72	400.0	37.0	83.74
73	127.0	31.5	84.22
76	1,287.5	43.0	93.18
78	55.0	26.5	87.41
79	250.0	36.0	90.51
81	649.0	39.5	87.03
82	1,467.0	44.5	77.44
85	115.0	32.0	88.58
86	2.0	17.0	79.05
87	2.0	17.5	94.00
89	828.5	40.0	92.95
93	2,268.5	45.0	95.67
94	1,028.0	43.0	92.43
95	242.5	29.0	97.53
96	107.5	31.5	93.71
102	385.0	39.5	93.13
105	205.0	39.0	69.20
107	96.5	29.5	87.09
109	190.0	35.5	94.87
127	175.0	34.5	88.54
Average.....	402.0	34.2	

TABLE IV—MAGNESIUM QUICKLIMES

N.L.A. Quicklime No.	Time Required to Settle to 50 c.c.	Final Volume 24 Hr.	Available Lime Non-Volatile Basis
23	8.0	15.5	49.99
25	160.0	35.0	81.63
40	11.0	19.5	48.45
52	18.0	23.5	51.31
65	58.0	23.5	48.98
71	1.5	15.5	45.44
74	18.0	18.5	51.77
75	54.0	27.5	59.45
92	18.5	24..	55.35
103	90.0	28 5	55.35
111	22.0	20.0	66.33
112	55.0	16.0	53.59
115	155.5	29.5	55.64
117	111.0	23.5	54.21
118	121.5	25.5	53.08
119	87.0	27.5	47.66
121	131.5	25.5	50.24
125	15.0	20.5	50.16
Average.....	63.0	23.3	

TABLE V—CALCIUM HYDRATED LIMES

N.L.A. Hydrated Lime No.	Time Required to Settle to 50 c.c.	Final Volume 24 Hr.	Available Lime Non-Volatile Basis
2a	25.5	29	85.63
3a	34.0	30	82.61
5a	63.0	28	89.00
21a	24.0	26.5	82.50
35a	43.5	25	90.84
38a	42.0	33.5	77.37
39a	20.0	29	79.06
45a	33.0	39	68.52
46a	50.0	24	78.36
47a	74.0	29	89.47
51a	26.5	24	82.20
58a	29.0	28.5	83.71
59a	76.5	28	90.16
63a	39.0	27	82.90
72a	36.0	23.5	60.20
73a	44.5	23	75.65
78a	30.0	28.5	73.11
79a	78.0	28.5	87.73
81a	30.0	37	83.03
86a	44.5	32	90.29
87a	36.0	34	80.70
88a	8.0	18	19.54
93a	38.0	28	77.57
94a	29.0	23.5	80.12
96a	19.5	27.5	80.10
98a	45.0	23	53.06
99a	61.0	27	51.11
101a	29.0	24	71.87
105a	7.0	21	49.70
107a	39.0	29.5	76.20
120a	53.0	24.5	45.95
Average	38.5	27.5	

TABLE VI—MAGNESIUM HYDRATED LIMES

N.L.A. Hydrated Lime No.	Time Required to Settle to 50 c.c.	Final Volume 24 Hr.	Available Lime Non-Volatile Basis
23a	58.0	25	52.91
25a	26.5	24.5	77.75
52a	39.0	24	44.15
65a	14.5	20.5	48.59
71a	39.5	29.5	51.10
74a	44.0	27.5	49.55
75a	30.0	26.5	58.35
103a	39.0	27.5	48.25
Average	36.3	25.6	

Curves obtained by plotting the volume of sediment against time for typical quicklimes and hydrates are shown in Figs. 1 and 2.

The data obtained in the study of the conditions affecting the rate of settling are given in Tables VII, VIII, IX and X.

Discussion

It will be seen that the curves showing the settling rates of typical hydrates and quicklimes are made up of two portions. The portion representing the earlier stages of the process more truly represents settling rate. As the settling continues the concentration of particles in the lower part of the settling tube is slowly increased and this zone of thickening, gradually merging with the zone of free settling, results in a slowing up of the rate of subsidence. Any further subsidence of the solids then really represents a dewatering effect. Although this last effect is characteristic of each particular lime, the real differences in settling characteristics are indicated by the upper portions of the curves. For that reason we have tabulated in the data the time required to settle to a volume of 50 c.c. For most purposes this value serves to differentiate and characterize the different limes.

The lower portion of the curve representing thickening or dewatering is interesting in connection with certain uses of lime, and data on the water-holding capacity of the different limes which will be published later will undoubtedly bring to light certain interesting differences. Some of these limes settle quickly to a thick dense mass, while others form a loose, free-moving mass with a very high water content. These differences are due chiefly to differences in the physical characteristics of the flocs and their interholding capacity.

TABLE VII—EFFECT OF AMOUNT OF WATER

Conditions	Sample No.	5 Min.	10 Min.	30 Min.	60 Min.	120 Min.	Final Volume 24 Hr.
Wet hydrates (slaked with excess of hot water)	A	97	91	82	58	50	40
	B	96	89	78	50	42	39
	C	96	87	75	45	34	34
	D	97	90	82	37	48	38
Slaked to dry hydrates..	A	92	75	56	32	32	32
	B	83	55	35	29	29	29
	C	86	63	40	25	25	25
	D	86	64	42	26	26	26

TABLE VIII—EFFECT OF TEMPERATURE OF SLAKING

Experiment No.	5 Min.	15 Min.	30 Min.	60 Min.	120 Min.	Final Volume 24 Hr.
1	93	84	71	54	32	32
2	97	91	82	58	50	40
3	97	94	85	65	55	38

TABLE IX—EFFECT OF CHEMICALS IN SLAKING WATER

Solution Used in Slaking	Volume of Lime Settled at Intervals of Minutes				
	10	20	30	60	120
Water	86	74	63	42	29
1% sugar	90	82	74	57	40
1% $CaCl_2$	46	29	22	22	22

TABLE X—EFFECT OF TIME OF SOAKING

Time After Mixing	Amount Settled After Minutes— 5	15	30	60	120	Final Volume 24 Hr.
1 min	91	72	49	31	31	31
1½ hr	92	75	51	31	31	31
30 hr	92	77	54	32	31	31

It is apparent from the data in the tables and the curves that, in general, suspensions of freshly slaked limes settle much more slowly and vary much more widely in their rate of settling than suspensions of commercially hydrated limes. Various factors are effective in producing these differences and numerous theories have been proposed to explain them.

Factors Affecting Rate of Settling of Suspensions in General

A number of factors have been recognized as affecting the rate of settling of the particles which make up a suspension.

(1) *Density of the Material.* The specific gravities of the calcium hydrated limes examined vary from 2.170 to 2.558, with an average value of 2.281, and of the magnesium hydrates from 2.237 to 2.586, with an average of 2.433. The latter as a class settle faster, but within each class the settling rates are not in the same order as the specific gravities and there is no discernable correlation between the two properties. The effect of other factors governing settling evidently outweigh the effect of gravity in the particular cases.

(2) *Size of Particles.* In general fine particles will settle less rapidly than coarse particles of the same

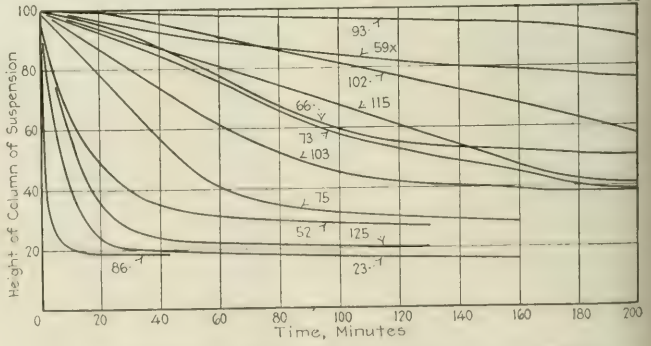


FIG. 2—RATES OF SETTLING OF TYPICAL FRESHLY SLAKED LIMES

absolute density. In practice, and this is particularly true of limes, the particles of a given material are rarely of uniform size and the nature of settling phenomena is more strictly a function of the relative proportions of particles of different sizes than of either the mean size or the true density of the material. It is conceivable that two samples might appear to settle at the same rate as judged by the subsidence of the column of suspended matter, yet the percentages of material remaining in suspension in the two at any given time might be considerably different as a result of the different rates of settling of the different sized particles, the determining factor in the rate of settling according to this standard being therefore the rate of settling of the finest particles. The finer these become the less is the effect of gravity and the nearer the approach to the colloidal state and the better the conditions for a permanent suspension.[3]

It is probable that in the case of most hydrated limes the colloidal state is not reached by a very appreciable proportion of the mass. There are very probably larger proportions of the more finely divided material and perhaps more colloidal matter in the suspensions of freshly slaked lime. Although no determinations have yet been made of the relative proportions of particles smaller than 250 mesh in these limes, it is probable that such differences may largely account for the variations in rates of settling. In the case of the hydrated limes there is no apparent correlation between the settling rate and the percentage of material passing the 250 mesh. The factors involved in the slaking of limes which would tend to affect particle size are discussed below.

(3) *Concentration.* The effect of concentration in the settling of suspensions is evidenced by the fact that in the case of very dilute suspensions containing some rather finely divided material there is no definite line of demarkation between the dispersed material and the dispersing liquid, whereas, if the concentration of the solids is increased, a concentration will be reached at which a line of demarkation will be shown. In the case of the dilute suspension a certain separation or classification of particles takes place and there is a free movement of individual particles, the coarsest settling first and the finest remaining in suspension. In the other case, however, there is no independent movement of individual particles, the coarser particles being retarded by the finer material which they carry down. As stated above, such concentrations were used in these tests that in most instances a definite line of demarkation was obtained.

(4) *Charge on the Particles.* In suspensions where a portion of the material approaches the colloidal state the effect of the charge on the particles is to be considered, the stability of such suspensions being determined by the conditions governing or affecting the nature and intensity of the charge. No specific data on this point in relation to limes are yet available, but the general effect of the addition to limes of various substances including salts is indicated below.

(5) *Aggregation or Flocculation.* The conditions governing the tendency of the individual particles of a dispersed material to form aggregates must necessarily influence the rate of settling of that material. These conditions as applied to limes will be considered in some detail.

[3]Deane, "Settling Problems," *Trans.*, Am. Elec. Soc., vol. 37, p. 71 (1920). An excellent discussion of the factors governing settling. See also "Third Crop Pest and Horticultural Report," Oregon Agr. Col. Exp. Sta., Jan. 10, 1921, and *J. Ind. Eng. Chem.*, vol. 14, p. 314 (1922).

Effect of Conditions of Slaking

In the production of hydrated limes and in the preparation of suspensions of freshly slaked quicklime there are a number of conditions imposed which may determine to a marked extent the above-mentioned factors and hence affect the settling rates of the products. Among the most important of these may be mentioned:

(1) *Amount of Water Used in Slaking.* Presumably the difference between the settling rates of hydrated limes and freshly slaked limes can be largely accounted for by the different conditions in hydrating, the most important of which is the relative quantities of water used. Commercial hydrated limes are usually made under conditions which produce a dry material without excess of water, while the milk of lime obtained from the quicklime under consideration was always obtained with excess of water to produce a wet product. The specific effect of these different conditions is quite strikingly illustrated by the data obtained by slaking the same limes in one case to a dry hydrate and in the other to a wet hydrate. These data are given in Table VII.

Whether these differences are due alone to differences in size of particles or the formation of aggregates, which may be a manifestation of polymorphism, or to the production of actually different chemical individuals such as differently hydrated molecules is uncertain. There are evidences of aggregation of particles in case of the commercial hydrates[4] and also certain indications of the existence of crystalline hydrates[5] and hydrated calcium hydroxide.[6] The variations in quantities of water affect not only the temperature of reaction but also the rate of reaction, both of which may affect the physical and chemical properties of the product.

(2) *Temperature of Slaking* and (3) *Temperature to Which Hydrate Is Heated After Slaking.* Both of these conditions are different in the production of lime suspensions in practice, and their exact effect is not clearly defined in the data comparing all limes, but it is specifically indicated in Table VIII. In experiment No. 1, the suspension was prepared by dropping a sample of N.L.A. quicklime, which had been heated to redness, into 50 c.c. of boiling water. No. 2 was prepared by using the cold lime and cold water. In experiment No. 3 another portion of the red hot lime was dropped into 50 c.c. of ice and water.

It is evident that the lower the temperature of slaking the slower the hydrate settles. Additional data in this connection will be published later.

The temperature to which the hydrate is heated after slaking is different under the conditions obtaining in the processes of wet slaking and dry slaking. The different commercial hydrates are very probably produced under considerably different conditions as regards the temperature to which the already hydrated particles are heated, although no definite data are available on this point. Unpublished data do indicate that

[4]Avaliable Oxide Content, *Chem. & Met.*, vol. 27, p. 349 (1922). U. S. Pat. 1,410,087.

[5]Emley, *Rock Products*, vol. 24, p. 34 (1921).

[6]Chimonov, *J. Russ. Phys. Chem. Soc.* vol. 44, p. 201 and *Chem. Abs.*, vol. 6, p. 1409 (1912). Burdakov, *J. Russ. Phys. Chem. Soc.*, vol. 44, p. 1325 and *Chem. Abs.*, vol. 7, p. 738 (1913). Selivanov, *J. Russ. Phys. Chem. Soc.*, vol. 44, p. 1797; vol. 45, p. 1535 and *Chem. Abs.*, vol. 7, p. 946, (1913). Carazzi. *Gazz. Chem. Ital.*, vol. 45, I, p. 529 (1915), and *Chem. Abs.*, vol. 10, p. 1456 (1916).

hydrates prepared in the laboratory and heated to temperatures above 100 deg. but below 450 deg. settle faster than those not so heated. It is quite possible that in the commercial hydrator temperatures may rise locally to a sufficient degree to form an "oxyhydrate" which may show a tendency to crystallize and increase the rate of settling.[1]

(4) *Use of Chemicals in Slaking.* Data recorded in Table IV show the effect of slaking the lime in sugar and calcium chloride solution.

It is apparent that the rate of settling is accelerated by the presence of calcium chloride in the slaking water used in producing the hydrate and retarded by the presence of sugar. The effect of adding sugar or salt after the suspension is made is of relatively little importance.

(5) *Time of Soaking of Hydrate.* As evidence of the possible presence of aggregates in commercial hydrates as the result of which their settling rates would be greater than those of the freshly made wet hydrate it has been shown that the length of time which a hydrate is soaked in water changes its rate of settling to a noticeable extent. The rate of settling immediately after mixing is more rapid than the rate after standing in contact with the water for some time. Data upon which this conclusion is based are given in Table X.

Conclusions

The data given in Tables III to VI indicate that suspensions of magnesium limes as a class settle much more rapidly than do suspensions of calcium limes. This may probably be explained by the fact that in calcining a magnesium lime the temperature required to decompose the calcium carbonate is very much above that required for the magnesium carbonate. The resulting magnesia is therefore superheated and is not so thoroughly dispersed in the slaking of the lime. The suspensions of the material would consequently be expected in general to contain a large proportion of coarse material and to settle more freely than that obtained from the high-calcium lime, which may be quite thoroughly disintegrated and dispersed.

From a consideration of the data in these tables it can also be said that those limes, both calcium and magnesium, which as a class have a high available lime content, settle slowest. It would naturally be expected that the higher this value the greater the number of patricles of the quicklime to undergo reaction during hydration. This would result in a breaking down of aggregates and a more thorough dispersion of the suspended particles in the milk of lime.

There are some notable exceptions to this conclusion. Lime No. 87, for example, with an available lime content of 94 per cent, settles out immediately. It is apparent, therefore, that in some cases factors other than those considered are of much importance.

A third generalization can be made—viz., that among the calcium limes the freshly slaked materials settle more slowly than the suspensions made from the mechanically hydrated limes. As pointed out above, the conditions obtaining in the mechanical hydration are such as to favor higher temperatures, which would tend to induce certain chemical reactions resulting perhaps in the formation of small quantities of an "oxyhydrate" which is described by Emley[2] as "a hard, gritty, yellowish material which shows a tendency to crystallize." The aging of the incompletely dried hydrate might eliminate this condition to some extent, but on the other hand it may induce aggregation or crystallization of the amorphous hydrate, resulting in slightly coarser and less easily dispersed particles. The sum total of this effect would vary with the various lines depending upon the other properties of the lime.

It will also be noted that the differences between the settling rates of hydrates are much less than the differences between the rates of settling of the freshly slaked material. Slaking with excess of water brings out the individual characteristics of the limes in this respect, while mechanical hydration tends to smooth out or reduce these differences. Extreme conditions in rate of settling are therefore best obtainable with quicklime. On the other hand, the use of hydrated limes will result in greater uniformity. There are a few exceptions to the conclusion that hydrated limes settle more rapidly than freshly slaked limes. No. 86 is an example. This discrepancy can be explained in this case by the fact that it contains a considerable amount of silica which is removed in the mechanical process of hydration, thereby eliminating a considerable amount of rapid settling material.

The differences between the slaked magnesium limes and the corresponding hydrates are much less than in the case of the calcium limes. The conditions obtaining in the mechanical hydration and storage, as compared with the slaking process, are probably more favorable for hydration of magnesia, thereby minimizing the difference in the degree of dispersion and settling rate of the magnesium limes.

There are indications that the lower the temperature of slaking the slower the hydrate settles. After-heating, if not excessive, tends to increase the rate of settling.

The effect of chemicals in the slaking solution is very marked. Certain chemicals, such as sugar, reduce the rate of settling and others, such as $CaCl_2$, increase the rate of settling.

The effect of increased time of soaking of the mechanically hydrated material is to decrease the rate of settling.

A survey of the data as a whole shows that it is possible to obtain a high-grade lime of almost any desired settling characteristics and that the settling characteristics of any given lime can be materially altered by suitable treatment.

[1] Emley, Bur. Standards Technologic Paper 85; *Trans.*, Natl. Lime Mfrs. Assn., 1914.

[2] Bur. Standards Tech. Paper 85, p. 17.

Use of Gunite in Preserving Mine Timbers

A most important question, on which adequate data are not available, is the effect of gunite in retarding the decay of timbers to which the gunite is applied, states the Bureau of Mines in Serial 2397, just issued. It is obvious that such information can be obtained only by observation of gunited timber in comparison with exposed timbers under similar conditions over a period of years. Experiments at the United Comstock, North Star and Empire mines and at the University of California are being watched carefully by the Bureau of Mines, and the final results will be published. From what has been learned of the density and non-porosity of gunite and its resistance to the absorption of water, it seems reasonable to believe, if sound timbers free from decay are carefully and completely covered with gunite, that the gunite coating will protect the timber against the attack of fungus and insects, and thus retard decay.

Polishing Aluminum and Its Alloys for Metallographic Study

By E. H. Dix, Jr.
Chief, Metals Branch, Engineering Division, Air Service

A METALLOGRAPHIC STUDY of aluminum and its alloys presents difficulties which are unique to this class of material. Aluminum itself is very soft and contains, even in its purest commercial form, constituents relatively much harder formed with other elements such as iron, silicon and copper. This combination of very soft matrix which is easily scratched, and hard particles which are easily blurred over, presents an exceedingly difficult polishing task. In addition the alloys are very difficult to etch, for in any given alloy there are usually three or more constituents to be identified. With our present methods of etching it is possible to bring out the grain boundaries and perhaps identify one of the constituents present, but the etching generally obscures the remainder of the structure.

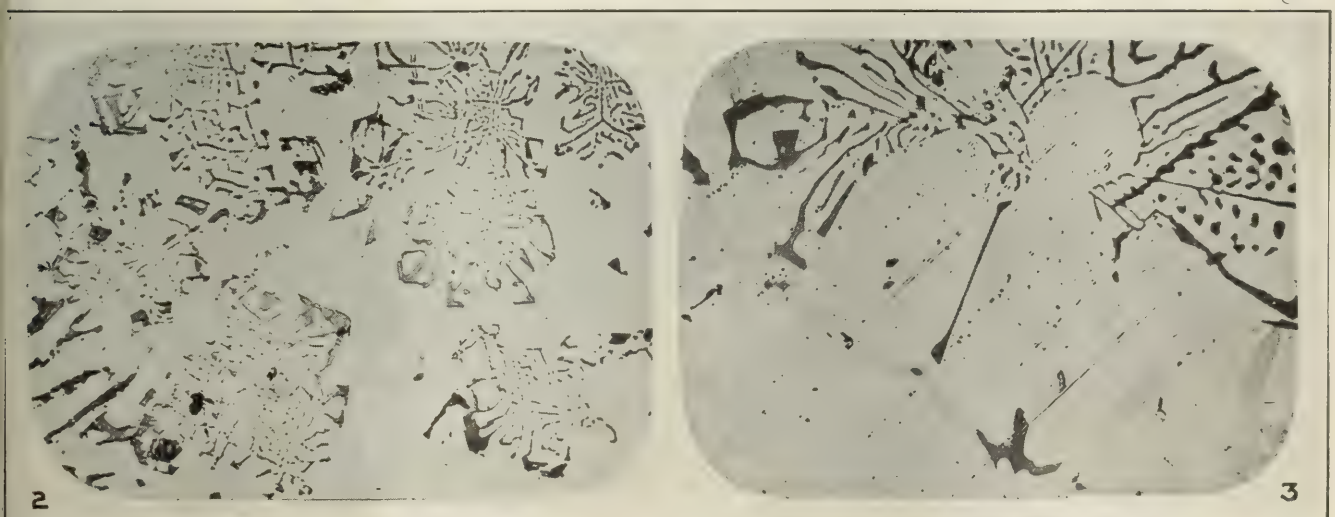
Recently it has been found possible to obtain a polished surface practically free from scratches and in which the hard constituents stand out in slight relief and in varying colors so that with few exceptions they can be identified without etching. The following is a brief description of the methods employed for this purpose in the metallurgical laboratory of the Engineering Division of the U. S. Army Air Service, McCook Field.

The first operations in the preparation of a specimen differ little from those used for other materials. Sawing should be performed with care so that the depth of metal disturbed is not so great but that it is entirely removed by grinding. Grinding is preferably done on two wheels, a coarse one to remove all of the material disturbed by sawing and a finer one to furnish a plane surface relatively smooth for subsequent operations. The specimen should be held against the coarse wheel so that the cutting is in a direction at right angles to the striations from the sawing. It is well to do more than just take out these grooves, because there is always a flow of metal underneath the saw tooth. Cutting on the fine wheel is again at right angles to the striations left by the coarse wheel, and this process of crossing the direction of cutting is followed in the subsequent polishing on papers; it is an old story to metallographers.

FIG. 1—DARK SILICON AND HALF-TONE $FeAl_3$ IN ALUMINUM INGOT. UNETCHED. × 1,000

Polishing on papers is best accomplished by hand, using a smooth swinging motion from the elbow with a stroke of 4 or 5 in. The pressure should be even, but not so light that the cutting is too slow; as the finer papers are reached the pressure should become lighter and lighter, because the heavier pressures at this stage make deep scratches which take longer to remove on the next paper. Care should be taken that the specimen is not rocked, causing it to be high in the center and low on the edges, because on the next paper it will be necessary to take down this high center before the scratches on the edge are reached.

Immediately after the grinding operation the paper may be any fine grade emery paper or grade No. 2 of the "Hubert Papers." (These are specially prepared



FIGS. 2 AND 3—IRON-SILICON COMPOUND. UNETCHED SPECIMENS. × 500

Fig. 2—Light gray constituent forming Chinese script markings. No. 1 ingot.

Fig. 3—Iron-silicon compound, showing somewhat darker, with light $CuAl_2$. In a crankcase.

FIGS. 4 AND 5—CRANKCASE OF NO. 12 ALLOY. UNETCHED

Fig. 4—Network appearance at 50 diameters.

Fig. 5—$FeAl_3$ needles, light $CuAl_2$ and black particles of silicon shown at 500 diameters.

for metallographic purposes, and a similar line known as "Manning Papers" can also be obtained.) Then in succession should be used Nos. 1, 0, 00 and 000. Cover the 00 and 000 papers with paraffine to prevent loose emery particles from becoming imbedded in the soft aluminum. This may best be accomplished by dissolving the paraffine in kerosene and painting the liquid over the paper. By the use of paraffine, the specimen should remain bright and clean all through the operations, and after polishing on the 000 paper should have fine striations all in one direction and no traces of any scratches from the previous operations.

The specimen should then be washed free from all particles of emery and grease. Small pores, so common in the cast alloys, should be carefully cleaned; otherwise, particles of emery are likely to remain, only to come out later on the polishing cloth and form deep scratches.

Wet polishing with some fine abrasive, such as Norton 65 F alundum, is the next operation. This is accomplished on a horizontal disk about 8 in. in diameter rotating at from 500 to 600 r.p.m., and covered with soft broadcloth having plenty of nap. (The "Kitten Ear" variety or imported "Priestly Cloth" has been found to be very satisfactory.) The abrasive is put in a flask filled with water and shaken up. The pad is thoroughly wetted and supplied with abrasive from the flask held in the left hand, the direction of rotation being counter-clockwise, while the specimen is held in the right hand so that the motion of the wheel is at right angles to the striations left from the 000 paper. It is moved radially back and forth from within 1 in. of the center to within about 1 in. of the outside, care being taken not to turn the specimen on the pad. This prevents a particle of abrasive from cutting a groove in the specimen, as it would be likely to do if it were held in one place. The specimen is lifted from the pad and turned through 180 deg. four or five times during this operation in order to prevent a surface flow of metal in one direction. During this time the coarser particles of 65 F have settled to the bottom of the flask, and if it is not shaken the abrasive in suspension becomes finer and finer, so that by the time all of the scratches due to the fine paper have been removed the heavier scratches caused by the 65 F have also been reduced by the finer particles of the abrasive. Examination under the microscope at this time should reveal the structure of the alloy somewhat obscured by very fine scratches all in one direction.

These are removed on a second pad of the same kind of cloth moistened with distilled water. On this is sprinkled magnesia powder (sold as "Heavy Magnesia Powder") which is thoroughly worked into the cloth by the hand and any coarse particles removed. The specimen is then held lightly on the pad, crossing the scratches from the previous operation. Move it in the same manner as when using the 65 F, except that the stroke is shorter and nearer the center of the pad. If the pad becomes too dry before all of the previous scratches are removed, the wheel is stopped, moistened, and more magnesia worked in. This is repeated until all of the scratches from the 65 F are removed. In this operation it is important to lift the specimen from the wheel frequently and rotate it through 180 deg.; otherwise a surface flow of the metal is sure to result.

The pad is now washed practically clean of the magnesia by adding more water and working out the powder with the hand. The specimen is then held near the center of the wheel, and is slowly rotated in a plentiful supply of water. The object of this operation is to remove the scratches left by the magnesia, but it must be performed with the greatest care. The pressure and length of time required depend on the nature of the specimen, and can be learned only after considerable experience. If this operation is properly performed, the specimen takes on a high polish and is practically free from scratches. It is quite possible that the specimen may become tarnished before the scratches are removed. The tarnish first appears around the hard constituents, particularly between the fine particles in eutectic areas. It may usually be removed by moistening the pad, dusting on a light supply of magnesia, and holding the specimen very lightly on the pad with a small radial movement back and forth, care being taken not to turn it. This operation leaves very fine striations all in one direction, but gives a clear structure. Specimens very prone to tarnish may be left in this condition; however, these striations can usually be removed by cleaning the pad as before and rotating the specimen with a change in pressure.

Alloys containing a considerable amount of very hard constituent, for instance $CuAl_2$, should be given a reasonably heavy pressure, but for the purer aluminums the pressure should be very light. Often, repeated

trials are necessary before a satisfactory polish is obtained. Polishing too long causes the hard particles to stand out in undesirable relief, giving black outlines and making focusing difficult. It is often necessary to go back to the 000 paper to correct this trouble. Too heavy pressure or too dry a pad when using magnesia causes the specimen to show milky streaks. These may be removed by polishing with a light supply of magnesia at right angles to the streaks until they disappear.

Magnesia as a polishing powder for aluminum was first mentioned by Hanson and Archbutt[1] in 1919 and is largely responsible for the success with which the polishing is now being accomplished. The powder feels coarse, but is so soft that it cuts without making deep scratches. It is desirable to use freshly distilled water with the magnesia; otherwise hard particles of carbonate form which scratch the specimen. The moisture of the air will do the same thing if the magnesia is not carefully washed from the pad after using. Soaking the pad in dilute HCl removes all traces of these hard particles. It is a good plan to soak the pad frequently in the dilute acid over night and then carefully wash out the acid before using in the morning.

When the specimen has been properly prepared, the structure as seen under the microscope is very striking, especially for magnifications of 500 or 1,000 diameters. The constituents are revealed in characteristic colors and often form geometric figures. Silicon is perhaps the easiest to recognize, appearing a dark slate with purple tinge and photographing black, as shown in Fig. 1, of high-silicon ingot (Cu 0.32, Si 0.99, Fe 0.51, Mn 0.0, Al 98.18) remelted and cast in standard tensile test-bar. The $FeAl_3$ needles are lighter than the silicon and have a lavender tinge. They appear in half-tone in the same figure. In addition to the needles there is a constituent, probably a compound of iron and silicon, that forms skeletons, often resembling "Chinese script," as in Fig. 2, of No. 1 ingot (Cu 0.11, Si 0.31, Fe 0.58, Al 99.0). It also seems to occur in globs and sometimes in stringers (see Fig. 3, of a crankcase alloy high in iron—Cu 6.70, Si 0.57, Fe 1.35). This constituent is the same color as the $FeAl_3$ needles and is probably the constituent indicated by the thermal curves of Merica[2] and the Eleventh Alloys Research Report.[3] It is thought to be a compound containing both iron and silicon. With the present state of our knowledge it is not possible to distinguish between these constituents by etching.

The compound $CuAl_2$ is harder than the other constituents and usually polishes in relief very quickly. It is nearly white with a slightly pink or orange tinge and appears very bright when thrown slightly out of focus. A network structure is formed in alloys containing over 4 or 5 per cent copper, as in Fig. 4, of a crankcase of No. 12 alloy (Cu 8.06, Si 0.78, Fe 0.74). High magnification (Fig. 5) shows $CuAl_2$, $FeAl_3$ needles and fine black particles of silicon.

Mg_2Si has an iridescent blue color and is readily recognized. Large crystals of this compound are shown in Fig. 6, of an alloy made with the proper percentages of Mg and Si to form the compound Mg_2Si (Si 20, Mg 35, Al 45). The same constituent is also closely associated with $CuAl_2$ in Fig. 7. The latter is of a sand-cast and heat-treated alloy, Cu 3.13, Fe 1.40, Si 0.20 and Mg 0.84. A figure pattern of $CuAl_2$ and aluminum contains fine black particles thought to be Mg_2Si, apparently forming a tenary eutectic. Most of the crystals shown in Fig. 6 had an iridescent appearance after the first polish, but on repolishing the true color was found to be a bluish gray. The iridescent appearance of the small particles in which Mg_2Si is usually found in the commercial alloys is thought to be due to a sort of tarnish which is difficult to prevent.

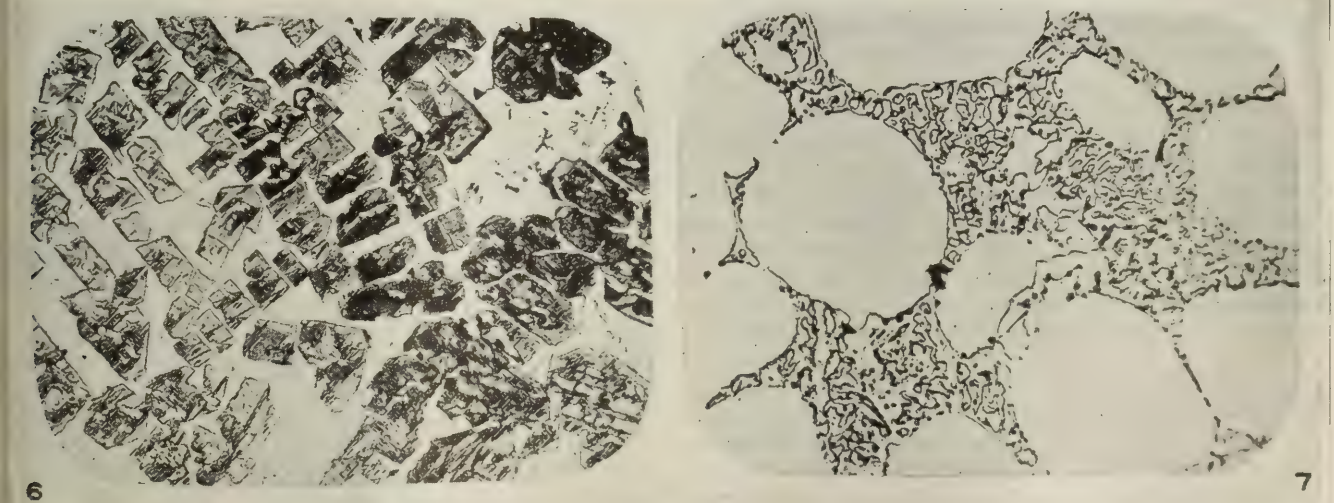
The compound $MnAl_3$ appears nearly the same color as the "X constituent" and often takes a similar form, and it is therefore very difficult to distinguish between them. When found in the same field, however, the $MnAl_3$ is seen to be more of a dove gray, lacking the lavender tinge of the "X constituent." The $MnAl_3$ is also apparently softer than the "X constituent" and in consequence has a dull flat appearance and does not appear bright at the edges when thrown out of focus. Since the "X constituent" does give a bright outline, this serves as a convenient way of distinguishing between them.

It is necessary to caution against hastily identifying

[1] *Inst. of Metals*, vol. 21, No. 1 (1919).

[2] Scientific Paper 337 of Bureau of Standards.

[3] The Institution of Mechanical Engineers (British), 1921.



FIGS. 6 AND 7—MICROS SHOWING Mg_2Si. UNETCHED

Fig. 6—Mg_2Si crystals in specially prepared alloy. × 100.

Fig. 7—Heat-treated Duralumin; light $CuAl_2$ and fine particles of Mg_2Si forming ternary eutectic with Al. × 500.

the various constituents by means of the description given above, because due to differences in the polish some very misleading effects may be obtained. In case of doubt it is advisable to repolish, carefully examining the specimen after different stages. This is a particularly valuable precaution just before rotating the specimen on the pad in the final operation, using only water, because it is this last operation that sometimes alters the appearance of the structure. Also, different equipment with other sources of illumination and lens systems will undoubtedly alter the appearance of the different constituents.

This description of the color of the constituents is based on their appearance, using a tungsten arc with a Wratten No. 78 filter. This combination gives a light closely approximating daylight. For photographic work the Wratten E orange filter has been found to give the best contrast.

A set of comparison standards of definite compositions will be found a great aid for the identification of unknown constituents. These samples may be preserved by a coat of cedar oil such as is commonly used for oil objectives. This prevents tarnish and may be quickly removed by alcohol, although if the oil is put on thin and permitted to dry thoroughly, it is not necessary to remove it from the specimen.

In conclusion I desire to acknowledge the very skillful assistance of Clifford McMahon in polishing the specimens, and of J. H. Hester for developing and printing the plates.

Legal Notes

By Wellington Gustin

Doubling Height of Smelter Stack Causes Fume Damage

The United States Circuit Court of Appeals affirms a judgment for Peter Henke in his action brought against the St. Louis Smelting & Refining Co. for damages to his orchard from fumes of defendant's smelting plant. 277 Federal, 666.

In 1904 defendant constructed a large smelting plant in Madison County, Illinois, near the city of St. Louis, Mo., for the refining of lead and other minerals. Plaintiff owned 30 acres of orchard in the vicinity of the plant, which he claims was permanently injured, caused by poisonous emanations from the plant settling upon his land. He asked for $50,000 damages, and the jury awarded him $4,000.

On the appeal the court says that in the action for damages from the smelter fumes, evidence of the crop produced and the sale thereof is admissible, not as showing the market value of the land itself, but as proving its adaptability to special purpose, in corroboration or support of evidence of market value.

Change in Stack Construction

In the smelter plant as originally constructed and as conducted down to 1915, the gases passed through a long tunnel, or "trail," and through a series of bays for arresting the solid matter, and thence into the air through a chimney 200 ft. high. For the 10 years preceding 1915 no injury accrued to the orchard by the poisonous emanations from the plant, which was about a mile away. But in 1915 such damage did accrue and the court said it may reasonably be concluded that it was through some condition in the plant which did not exist before 1915. It appears that in 1915 the "trail" was out of order, and was being repaired and replaced, and a new chimney 400 ft. high was erected. Plaintiff contended that with the plant in the condition it was prior to 1915, such gases as reached the orchard were not sufficiently charged with sulphur dioxide to injure the orchard, but that in 1915 the intervening and first occurring condition of the "trail" caused so much more of the poisonous substance to be discharged from the chimney that much more of it reached the orchard and did the damage, and that thereafter, through the doubling of the height of the chimney far more of the gases were carried over the orchard, and that a far greater quantity of the sulphur dioxide was thereafter precipitated upon the orchard than had ever been or would have been in the use of the old chimney under normal circumstances. Defendant contended that the height of the new chimney greatly diffused the poison so that in any event, by the time it fell upon the orchard, if any did so fall, it was practically innocuous. From the evidence on these facts the jury found for the plaintiff.

Schooner Sailed With Reasonable Dispatch and Freight on Caustic Soda Must Be Paid

In the cases of the Aegean Trading Co. and others against Seventy-five Drums of Caustic Soda, etc., in the United States Circuit Court of Appeals, 279 Federal Reporter, 109, a decree for Alex R. Mehaffy as master of the schooner A. J. West on his cross action is affirmed.

It was claimed that the trading company, being informed by one Barr, who solicited freight for the vessel, that she had already sailed, took up the bills of lading and paid the freight, but on learning that she had not sailed, stopped payment of the check.

Sailing Delayed by Strikes

It appears that the vessel had a hard time in obtaining her contracts for cargo, then about the time the check was given she suffered from strikes among dockmasters, delaying her departure. Under all the circumstances the court found that the vessel proceeded on her voyage within a reasonable time and that the freight was earned in transporting the caustic soda to Greece. The soda was on board the vessel in January, 1919; libel in Admiralty was filed March 15, 1919, but under an arrangement made in court the vessel was permitted to sail and did sail on March 22, 1919, and in due course delivered the soda to a port in Greece, its destination.

The vessel was about 60 days on the voyage, and consequently the schooner was less desirable as a carrier of merchandise than similar vessels. Also testimony showed that it would have taken her 2 or 3 weeks to load if all her cargo had been loaded at once. The fact that other steamers had been able to obtain cargo and proceed on voyage to Greece, during the period that the A. J. West was loading, did not show that an auxiliary schooner could do the same thing, considering all the circumstances, says the court. In the face of a harbor strike and only after considerable effort and the payment of an exorbitant price for towage was the vessel able to get away. This was held to be reasonable dispatch and the trading company should not have stopped payment on its check.

The Gasification of Ohio Coals—II

Results of a Preliminary Survey Indicate That These Coals Compare Favorably With Standard Gas Coals as Far as Yield of Gas and Byproducts Is Concerned—Discussion of Experimental Results and Comparative Data*

By D. J. Demorest
Professor of Metallurgy, Ohio State University

In THE preceding article it was pointed out, incidentally, that every coal has properties that differ from those of other coals and that to get best results from a particular coal it should be retorted at its characteristic temperature. It would have required, however, many thousands of dollars more than were available for this investigation if each coal had been investigated to discover its optimum operating temperature. Hence, 1,000 deg. C. was selected as being a satisfactory average temperature, the temperature being taken at a point about halfway between the bottom and top of the combustion chamber outside the retort. It would probably have been better if 1,100 deg. C. had been taken as the standard temperature. When this temperature (1,100 deg. C.) is maintained at the point halfway up the retort, the temperature at the bottom (in the combustion chamber) is 1,325 deg. C. (2,417 deg. F.) At times the gas supply was inadequate and the retort temperature fell so low that the retorting results were quite unsatisfactory. For this reason the results on samples 7, 7W, 8W, 10, 10W, which are shown in the accompanying tables, are not fair to the coals they represent, as far as the gas yields are concerned. The coke results are probably not seriously affected, since the coal was kept in the retort until the carbonization was complete, although the quality of the coke may have been seriously affected by carbonizing at the wrong temperature.

In order to have a check on the results of the retorting tests, however, a standard gas coal (Elkhorn) was run under the same conditions as the Ohio coals were run and also at the high temperatures commonly used in gas plants.

Several tests were made on each coal, but the results reported in this article are not the average results of the several tests. They are the results obtained on the tests when all conditions seemed to work for the highest accuracy.

Quality of Coke Obtained

The quantity and quality of coke obtained in these tests are probably an accurate index of the amounts and natures of the cokes from Ohio coals which will be obtained under commercial conditions, with this modifying statement: The coals shipped in for testing were mostly obtained at the worst period of depression in the mining industry in Ohio, and were dirty and poorly prepared because the normal operating procedures were not functioning at many of the mines from which samples were shipped. Hence the analyses of the ash in the coals and coke show abnormally high results for the coals from these regions. The results obtained on the washed coals are probably more nearly representative of the results which will be obtained on Ohio coals in commercial plants in the future, especially since the development of the very efficient machines for removing much of the ash and sulphur by dry-cleaning methods.

The writer used these cokes in a house-heating furnace last winter and found that they make splendid domestic furnace fuels, especially when mixed with about an equal weight of coal. Even when the coal mixed with the coke was of the smokiest type, a practically smokeless furnace was obtained when the coal and coke mixture was used. The coke when used alone tends to give too hot a fire unless there is a great deal of fine coke used. The author freely predicts that the future will see our cities no longer lying dirty and black under a pall of sooty smoke when the manufactured-gas plants which are bound to be erected about Ohio are selling coke regularly to consumers (perhaps under city ordinances) and householders burn a mixture of coal and coke or coke alone.

The tabulated results list the quality of the cokes under the symbols D, S, W and M, the meanings of which are:

D = Coke suitable for use in domestic furnaces.
S = Coke suitable for steam raising in power plants, etc.
W = Coke suitable for use in water-gas generators.
M = Coke suitable for use in blast furnaces or foundry cupolas.

It is our firm belief as a result of experience with these cokes that they will all be very useful for domestic heating. The only exceptions may be those cokes which come from coals having a large amount of fusible or "clinkery" ash, and these will be enormously improved by the use of dry cleaning or washing processes before the coal is retorted. Furthermore, it must be remembered that it is always possible to improve a coke by mixing a poor coke-making coal with a good coke-making coal.

All of the cokes made will be entirely satisfactory for steam purposes except those whose ash clinkers too readily. The ash of the Ohio coals and cokes are not more "clinkering" than those from other states. The cokes which are very friable would not do for locomotive use, because too much would be blown out, but the stronger cokes should be very satisfactory. The use of coke in the yard engines will do away with a great deal of the smoke nuisance.

For the manufacture of water gas the prime essentials are that the coke has as small an amount of ash as possible, that the ash has a high fusion temperature to prevent clinkering in the generator, that the coke has a high reactivity with water for the reaction $C + H_2O = CO + H_2$, and that the coke be not too friable, which would cause it to powder and blow out of the generator.

The qualities for a metallurgical coke are: Low ash, low sulphur, great strength and proper reactivity. The fusibility of the ash is of less moment.

Such properties as reactivity and strength of coke are difficult to measure and in the present preliminary survey time and funds have not been available for determining them. The results would not, moreover, have been satisfactory unless the cokes were made un-

*Part I was published in the issue of Dec. 13, 1922.

TABLE I—COMPARISON OF RESULTS OBTAINED IN THE GASIFICATION OF OHIO COALS*

Test No. †	1RM	2RM	3RM	3W	2 and 3	4RM	5RM
Hours	17	14.5	16	13	15	14.5	15.0
Retort temp. deg. C	975	975	950	1,100	980	1,000	1,050
Coal analysis:							
Moisture, per cent	5.49	5.62	6.41	4.30	. .	3.61	7.11
Ash, per cent	9.61	18.05	11.74	6.57	. .	11.05	10.45
Volatile, per cent	37.08	35.86	30.34	42.54		41.05	36.15
Fixed carbon, per cent	47.82	40.47	51.51	46.59	. .	44.29	46.29
Sulphur, per cent	1.29	3.65	2.91	3.43		4.22	1.98
Carbon, per cent	66.00	58.05	65.00	69.21	.	63.87	63.60
Hydrogen, per cent	4.88	4.45	4.70	4.96	.	4.65	4.40
Oxygen, per cent	17.02	14.65	15.41	14.59		15.07	18.30
Nitrogen, per cent	1.20	1.15	1.25	1.24	....	1.14	1.27
B.t.u.	12,005	11,053	11,731	12,624	. .	12,081	11,943
H — ⅛O per cent	2.76	2.62	2.78	3.14	. .	2.77	2.11
Ash fusibility:							
Incipient, deg. F	2,315	2,475	2,400	2,060	. .	2,570	2,140
Complete, deg. F	2,392	2,510	2,480	2,200	. .	2,700	2,580
Coke analysis:							
Moisture, per cent	1.90	0.51	0.35	0.96	0.50	0.30	0.19
Ash, per cent	15.80	24.87	17.50	13.04	22.40	17.20	16.09
Volatile, per cent	3.80	2.22	2.50	3.02	4.10	3.60	3.10
Fixed carbon, per cent	78.50	72.40	79.65	82.98	73.00	79.90	80.62
Sulphur, per cent	1.80	3.62	2.49	2.83	3.20	3.48	1.44
Lbs. dry coke	1,220	1,460	1,250	....	1,325	1,322	1,240
Per cent over 1 M	70	....	70	....	71	85	81
Per cent under 1 M	30	....	30	....	29	15	19
Quality coke ‡	D.S.	W.D.S.	W.D.S.	M.W.D.S.		M.W.D.	W.D.S.
Cu.ft. gas	7,500	10,900	9,500	11,000	11,300	8,800	9,450
Av. B.t.u., gross	480	485	450	470	4,720	542	490
Av. B.t.u., net	445	450	415	435	4,370	507	455
Total B.t.u., gross§	3,642	5,286	4,275	5,170	5,333	4,770	4,626
Organic sulphur	9	12.0	11.5	15	....	....	....
Lb. of ammonia	5.1	5.00	5.15	4.50	5.13	5.40	4.5
Lb. of light oil	2.0	10.0	6.0	....	12.0	9.5	13.0
Lb. of tar	70	80	77	83	72	92	80
Per cent water in tar	45.2	41.7	34.6	15.7	46.1	15.2	20.4
Analysis tar, dry							
Distill to 110 deg. C	1.20	.90	0.0	0.0	1.4	0.3	0.0
110 to 170	2.40	2.90	1.0	0.8	5.2	0.8	0.9
170 to 235	26.60	18.80	15.0	19.9	22.8	19.0	16.4
235 to 270	11.60	8.80	14.8	10.7	10.2	17.4	13.9
270 to 315	15.20	9.60	11.3	6.5	20.6	10.7	8.8
315 to 335	15.50	17.80	19.3	21.0	4.1	20.2	20.1
Pitch	30.40	20.20	39.0	41.0	34.8	31.6	39.6
Sp.gr	1.11	1.15	1.11	1.13	1.12	1.12	1.12

Test No.†	9W	10RM	10W	11RM	11W	12RM	13RM
Hours	14	15	16	12	13	9	12
Retort temp., deg. C	.....	.....	low	hot	hot	(1050?)	(1100?)
Coal analysis:							
Moisture, per cent	4.08	3.12	3.47	3.85	4.35	0.85	3.30
Ash, per cent	6.26	8.08	5.87	11.55	7.70	7.15	10.10
Volatile, per cent	42.16	38.03	38.66	37.45	38.55	34.90	39.00
Fixed carb., per cent	47.50	50.77	52.04	47.15	49.40	57.10	47.60
Sulphur, per cent	2.25	0.90	0.76	1.31	0.83	1.26	2.91
Carbon, per cent	70.36	70.68	72.62	67.91	70.70	78.08	68.90
Hydrogen, per cent	5.00	4.99	4.99	4.80	5.06	5.03	4.80
Oxygen, per cent	14.73	13.94	14.33	14.04	14.27	6.98	12.01
Nitrogen, per cent	1.40	1.41	1.43	1.39	1.44	1.50	1.28
B.t.u.	13,002	12,648	12,889	12,270	12,729	14,039	12,302
H — ⅛O per cent	3.16	3.24	3.20	3.05	3.28	4.16	3.30
Ash fusibility:							
Incipient, deg. F	2,100	2,750	2,765	2,550	2,700	2,315	2,375
Complete, deg. F	2,510	.....	.....	2,630	2,800	2,450	2,500
Coke analysis:							
Moisture, per cent	0.09	0.22	0.51	0.15	0.09	0.05	0.18
Ash, per cent	11.33	13.52	10.87	17.87	12.72	12.30	18.54
Volatile, per cent	2.17	2.53	2.53	2.29	0.81	1.12	1.31
Fixed carb., per cent	86.41	83.73	86.09	79.69	86.38	86.53	79.97
Sulphur, per cent	1.89	0.81	0.55	1.11	0.66	0.91	2.38
Lb. dry coke	1,280	1,250	1,258	1,335	1,300	1,300	1,280
Per cent over 1 in	80	70	66	88	85	90	76
Per cent under 1 in	20	30	34	12	15	10	24
Quality coke‡	M.W.D	W.D.S	W.D.S	W.D.S	W.D.S	W.D.S	W.D.S
Cu.ft. gas	7,900	5,000	6,000	9,500	11,000	10,000	9,400
Av. B.t.u., gross	565	500	515	510	495	525	500
Av. B.t.u., net	530	465	480	475	460	490	465
Total B.t.u., gross§	4,464	2,500	3,090	4,835	5,450	5,250	4,700
Organic sulphur	9.0	6.0	3.2	5.0	1.0	9.3	7.0
Lb. of ammonia	4.95	.....	3.8	4.1	4.7	4.6	5.34
Lb. of light oil	2.5	.....	17.0	17.5	.....	15	14
Lb. of tar	104	58	99	66	60	100	103
Per cent water in tar	40	50	58	30	40	40	40
Anal. tar, dry							
Distil. to 110 deg. C	0.0	0.1	0.0	0.8	0.3	0.4	0.2
110 to 170	0.8	0.5	0.6	0.8	1.8	3.6	1.5
170 to 235	22.0	18.2	15.7	16.1	18.3	19.4	23.5
235 to 270	9.0	13.1	13.0	10.8	7.8	7.3	1.6
270 to 315	11.4	12.6	18.0	20.9	8.7	9.2	11.4
315 to 335	9.2	13.1	16.5	19.5	22.6	13.6	22.1
Pitch	46.9	42.4	35.5	31.1	40.5	46.5	39.7
Sp.gr	1.13	1.08	1.08	1.12	1.11	1.04	1.12

Test No.†	5W	6RM	6W	7RM	7W	8RM	8W	9RM
Hours	13.5	13	13.5	.....	.....	17	18	14
Retort temp., deg. C	1,050	.....	1,100	1,000	1,000	1,050	900	1,175
Coal analysis:								
Moisture, per cent	6.90	6.83	5.74	5.80	6.13	5.75	2.97	3.13
Ash, per cent	6.35	8.68	6.53	11.29	6.25	11.72	8.30	7.84
Volatile, per cent	38.65	36.41	38.52	36.21	39.94	38.65	39.81	41.19
Fixed carb., per cent	48.10	48.08	49.21	46.70	47.68	43.88	48.92	47.84
Sulphur, per cent	1.05	1.21	1.00	2.41	1.30	2.23	1.67	2.50
Carbon, per cent	68.19	66.51	69.48	64.46	68.83	64.66	69.80	69.69
Hydrogen, per cent	4.88	4.67	4.72	4.48	4.97	4.59	4.99	5.07
Oxygen, per cent	18.13	17.59	16.91	16.11	17.34	15.55	13.90	13.57
Nitrogen, per cent	1.40	1.34	1.36	1.25	1.31	1.25	1.34	1.33
B.t.u.	12,500	12,030	12,579	11,705	12,547	11,802	12,623	12,798
H — ⅛O, per cent	2.61	2.47	2.60	2.47	2.81	2.64	3.25	3.37
Ash fusibility:								
Incipient, deg. F	2,650	2,350	2,375	2,160	2,565	2,440	2,620	2,100
Complete, deg F	2,700	2,600	2,625	2,330	2,600	2,500	.....	2,510
Coke analysis:								
Moisture, per cent	1.43	0.65	2.36	1.22	0.95	0.96	0.26	0.18
Ash, per cent	11.48	16.90	13.24	16.84	15.86	19.35	14.20	15.92
Volatile, per cent	2.70	2.62	4.60	3.60	2.86	2.95	1.80	3.18
Fixed carb., per cent	84.39	79.83	79.80	78.34	80.33	76.73	83.74	80.72
Sulphur, per cent	1.04	1.33	0.84	1.86	1.53	1.99	1.27	2.53
Lb. dry coke	1,200	1,250	1,120	1,310	.....	1,230	1,100	1,280
Per cent over 1 in	74	57	55	66	.....	69	77	80
Per cent under 1 in	36	43	45	34	.....	31	23	20
Quality coke‡	W.D.S.	W.D.S.	W.D.S.	D.S.	W.D.S.	W.D.S.	W.D.S.	M.W.D
Cu.ft. gas	8,400	7,500	6,100	3,000	3,000	11,950	6,350	8,800
Av. B.t.u., gross	495	490	504	436	very	370	542	500
Av. B.t.u., net	460	456	469	400	low	335	507	466
Total B.t.u., gross§	4,158	3,675	3,074	1,305	.....	4,425	3,442	4,150
Organic sulphur	.....	.....	.....	1.5	.....	12.0	4.0	9.50
Lb. of ammonia	4.6	3.4	3.3	1.6	.....	3.5	.....	4.65
Lb. of light oil	15.0	.....	.....	trace	.....	13.0	2.00	7.4
Lb. of tar	98	52	45	8	.....	68.5	.....	96
Per cent water in tar	31.1	14.8	44	43	.....	53.5	.....	47
Anal. tar, dry:								
Distil. to 110 deg. C	0.0	0.0	0.0	0.7	.	0.0	T	0.0
110 to 170	0.0	0.62	0.37	1.2	.	2.1	...	1.2
170 to 235	19.5	14.10	20.1	17.7	.	25.3	..	21.8
235 to 270	9.6	14.90	15.3	17.7		10.8	..	14.6
270 to 315	7.6	6.40	10.6	9.8		11.3	.	10.2
315 to 335	24.9	19.90	21.2	26.1		11.0		12.6
Pitch	37.9	43.60	32.1	26.8		36.9		38.8
Sp.gr	1.11	1.13	1.09	1.10		1.11		1.21

Test No.†	13W	14RM	14W	15RM	16RM	17RM	18RM
Hours	16	14	15	13	11	14½	17½
Retort temp., deg. C	980	low	too low	hot	1,075	1,100	970
Coal analysis:							
Moisture, per cent	0.05	3.20	3.54	3.90	1.80	3.90	3.15
Ash, per cent	6.30	13.45	6.16	13.50	12.45	12.80	15.00
Volatile, per cent	42.25	37.40	39.84	39.65	36.95	38.50	40.95
Fixed carb., per cent	51.40	45.95	50.46	42.95	48.80	44.80	40.90
Sulphur, per cent	1.67	2.35	1.55	3.18	1.14	2.88	4.89
Carbon, per cent	74.00	66.27	72.23	64.88	69.78	65.94	63.00
Hydrogen, per cent	4.70	4.62	5.00	4.66	4.77	4.85	5.00
Oxygen, per cent	11.98	11.98	13.71	12.67	10.46	12.21	11.02
Nitrogen, per cent	1.35	1.33	1.35	1.11	1.40	1.32	1.090
B.t.u.	12,987	11,992	13,122	11,842	12,532	11,794	11,632
H — ⅛O per cent	3.20	3.12	3.29	3.08	3.46	3.33	3.62
Ash fusibility:							
Incipient, deg. F	2,425	2,300	.....	2,480	2,670	2,400	1,875
Complete, deg. F	2,565	2,475	.....	2,540	2,750	2,540	2,125
Coke analysis:							
Moisture, per cent	0.20	0.37	0.15	0.42	0.10	0.25	0.20
Ash, per cent	11.10	21.55	12.15	20.74	18.00	20.30	21.95
Volatile, per cent	3.05	2.55	0.74	3.68	1.65	2.95	2.40
Fixed carb., per cent	35.65	75.53	86.96	75.16	80.25	76.50	75.45
Sulphur, per cent	1.53	2.47	1.29	2.50	0.78	2.36	3.64
Lb. dry coke	1,240	1,290	1,200	1,327	1,370	1,240	1,245
Per cent over 1 in	76	76	78	82	84	69	69
Per cent under 1 in	24	24	22	18	26	31	31
Quality coke	W.D.S.	W.D.S.	....	W.D.S	W.D.S	W.D.S	W.D.S
Cu.ft. gas	9,000	8,500	9,500	9,200	8,850	12,100	10,300
Av. B.t.u., gross	475	505	435	535	435	475	420
Av. B.t.u., net	440	470	400	500	400	440	392
Total B.t.u. gross§	4,275	4,293	4,133	4,922	3,850	5,750	4,326
Organic sulphur	6.5	12.0	3.0	22	8	7.5	15
Lb. of ammonia	5.0	3.8	4.6	4.80	4.50	4.8	4.8
Lb. of light oil	13	9.0	.....	23	16	13.5	13
Lb. of tar	90	60	86	82	115	73	102
Per cent water in tar	35.3	25.5	33.3	23.50	59.4	23.5	46
Anal. tar, dry							
Distil. to 110 deg. C	0.4	0.2	2.5	0.3	2.3	0.10	0.3
110 to 170	2.2	1.0	3.5	2.3	2.5	2.90	0.5
170 to 235	21.4	19.2	26.0	20.4	20.7	29.10	22.8
235 to 270	11.1	11.1	22.0	8.3	9.7	5.80	11.3
270 to 315	13.2	9.1	7.5	8.0	10.7	22.10	24.5
315 to 335	21.9	12.8	.....	18.7	17.3	9.40	6.9
Pitch	29.8	76.6	.....	42.00	36.8	30.60	30.7
Sp.gr	1.13	1.06	1.13	1.15	1.13	1.13	1.15

(Continued on next page)

der the best conditions for each coal. Hence the classification of these cokes has been made entirely by inspection of the coke as it was heaped in a pile after being screened. All cokes were screened through a screen made of rods 1 in. apart, and the percentage that remained on the screen was taken as a measure of the strength of the coke. These screening results, the analysis of the coke, the fusibility of the ash and the appearance of the coke were used to classify the cokes, which means that the personal element of the

TABLE I (Continued)

Test No.†	19RM	20RM	21RM	21	21
Hours	14.5	14	10	9.08	9.03
Retort temp., deg. C.	1,090	1,000	1,000	1,170	1,200
Coal analysis:					
Moisture, per cent	4.38	1.83	1.64	...	...
Ash, per cent	12.42	10.60	4.10	...	...
Volatile, per cent	37.10	41.80	34.50	...	...
Fixed carb., per cent	45.10	45.77	59.76	...	...
Sulphur, per cent	2.63	4.47	0.64	...	...
Carbon, per cent	64.00	68.45	80.44	...	...
Hydrogen, per cent	4.82	4.82	5.20	...	...
Oxygen, per cent	14.87	10.55	8.20	...	...
Nitrogen, per cent	1.26	1.13	1.42	...	...
B.t.u.	11,978	12,876	14,157	...	...
H — ⅛O, per cent	2.96	3.50	4.18	...	...
Ash fusibility:					
Incipient, deg. F.	...	...	...	...	...
Complete, deg. F.	...	...	...	...	...
Coke analysis:					
Moisture, per cent	0.20	0.27	0.22	...	...
Ash, per cent	20.02	24.17	7.76	...	...
Volatile, per cent	3.06	1.96	3.25	...	...
Fixed carb., per cent	76.72	73.60	8.77	...	...
Sulphur, per cent	2.34	3.84	0.66	...	...
Lb. dry coke	1,260	1,258	...	1,280	1,280
Per cent over 1 in.	59	86	...	...	...
Per cent under 1 in.	41	14	...	...	...
Quality coke	M.W.D.	M.W.D.	M.W.D.	M.W.D.	M.W.D.
Cu.ft. gas	10,800	8,500	9,500	9,886	11,209
Av. B.t.u., gross	460	493	600	600	552
Av. B.t.u. net	424	458	570	543	503
Total B.t.u., gross§	5,000	4,191	5,700	5,930	6,187
Organic sulphur	10	13	...	...	...
Lb. of ammonia	3.85	...	...	...	...
Lb. of light oil	3.2	9	10.6	...	...
Lb. of tar	61	80	...	118	73
Per cent water in tar	58.8	45.3	43.5	...	...
Anal. tar, dry					
Distil. to 110 deg. C.	2.0	0.0	3.0	...	...
110 to 170	3.0	4.0	3.0	...	...
170 to 235	23.00	25.0	19.0	...	...
235 to 270	11.00	11.0	19.0	...	...
270 to 315	6.00	3.0	2.0	...	...
315 to 335	...	...	...	...	...
Pitch	...	...	...	...	...
Sp.gr.	1.12	1.13	1.11	...	...

* Coke, light oil, tar and ammonia are given in pounds per 2,000 lb. of coal as in cubic feet at 60 deg. F and 30 in. Hg, organic sulphur in the gas in grains per 00 cu.ft.

†Test No. 1—Athens County, Ohio, Middle Kittanning No. 6; seam, 72 in. thick.
Test No. 2—Perry County, Ohio, Middle Kittanning No. 6; seam, 48 in. thick.
Test No. 3—Athens County, Ohio, Upper Freeport No. 7; seam, 48 in. thick.
Test No. 4—Athens County, Ohio, Pittsburgh No. 8; seam, 96 in. thick.
Test No. 5—Perry County, No. 6; seam.
Test No. 6—Morgan County, Ohio, Middle Kittanning No. 6; seam, 48 in. hick.
Test No. 7—Athens County, Ohio, Middle Kittanning No. 6; seam, 72 in. hick.
Test No. 8—Perry County, Ohio, Middle Kittanning No. 6; seam, 84 in. thick.
Test No. 9—Perry County, Ohio, Middle Kittanning No. 6; seam, 42 in. thick.
Test No. 10—Athens County, Ohio, Middle Kittanning No. 6; seam, 60 in, hick.
Test No. 11—Athens County, Ohio, Middle Kittanning No. 6; seam, 60 in. hick.
Test No. 12—Smithers Creek, West Va., No. 2, gas.
Test No. 13—Athens County, Ohio, Upper Freeport No. 7; seam, 48 in. thick.
Test No. 14—Hocking County, Ohio, Middle Kittanning No. 6; seam, 48 in. hick.
Test No. 15—Meigs County, Ohio, Pittsburgh No. 8; seam, 60 in. thick.
Test No. 16—Boone County, West Va., Kanawha No. 5; seam, 52 in. thick.
Test No. 17—Athens County, Ohio, Middle Kittanning No. 6; seam, 66 in. hick.
Test No. 18—Vinton County, Ohio, Jackson No. 4; seam, 48 in. thick.
Test No. 19—Hocking Coal No. 6.
Test No. 20—Belmont Co., No. 8; coal.
Test No. 21—Elkhorn coal.

‡ Quality of coke.
M=metallurgical, W=water gas, D=domestic, S=steam, from a physical point f view, determined by inspection.
§ Total B.t.u. value given in thousands; thus, 3,642=3,642,000.

riter's judgment has entered into the classification nd hence no claim is made for infallibility in this lassification. Any coke which is good enough for ater-gas making or blast-furnace use will, of course, e excellent for domestic or steam purposes.

None of the cokes made in these tests were "stick-rs." That is, none of them swelled so as to jam in ie retort and fail to discharge easily when the dis-harge door was opened.

Properties of the Gas

The amount and quality of the gas obtained per ton f coal are very powerfully influenced by the condi-ons of retorting, particularly the temperature. In oke-making practice the temperature is lower and the mount of gas made is lower per ton of coal than in as retorts when the gas is the first consideration. For instance, at high temperatures the oxygen from coals tends to react with carbon, thus

$$C + H_2O = CO + H_2$$
$$C + 2H_2O = CO_2 + 2H_2$$

(the oxygen being largely liberated as water), and if all the oxygen should be so used the gas so made would be about 13,000 cu.ft. per ton of coal in addition to the hydrocarbons. At low temperatures the above reactions are very slow and most of the oxygen passes out as steam condensing in the cooling system. As previously mentioned, heating rates were more nearly like those used in coke-oven practice than gas-house practice, hence, these results for gas are probably somewhat low; at the same time low temperatures tend to be favorable to a high yield of light oils and tars.

The amount of sulphur in the gas combined as "organic sulphur" was in all cases far lower than the commonly accepted allowance of 30 grains per 100 cu.ft., even when the highest sulphur coals were used. Hence no fear on the score of sulphur in the gas from these coals need be had. Of course, the raw gas contains a large amount of H_2S, but since the advent of the "Seaboard process" for removing H_2S from gas and the improvement of other methods, the cost of the removal of H_2S is so low as to be but a very minor factor. It is quite possible, indeed, that the recovery of sulphur which is possible by the Seaboard process may turn high sulphur into an asset rather than a detriment.

We can, therefore, judge the value of our coals as gas-making coal solely on the basis of the value of the coke, B.t.u. in the gas, and the yield of ammonia, tar, light oils, etc., recoverable from a ton of coal.

Plotting the results of gas making against chemical analysis reveals no relationship, using as a base of comparison any of the items of either proximate or ultimate analysis. The reason is that the influence of varying retorting conditions is much more powerful than the influences of variation in chemical compositions in these coals.

Coals From Different Seams Compared

Coals from seams No. 4, 5, 6, 7 and 8 were included in the tests, and these were checked against Elkhorn coal and Smithers Creek No. 2 gas coal from West Virginia. The results from each seam were averaged to get the figures given in Table II. All results are for products obtained from 1 ton (2,000 lb.) of coal, except the determination of B.t.u., which is on the basis of a cu.ft. of gas.

In Table I test No. 21 shows the results obtained by

TABLE II—COMPARISON OF RESULTS OBTAINED WITH COALS FROM DIFFERENT SEAMS
(Yields per short ton of coal)

Seam	Smithers Creek No. 2 Gas	4	5	6	7	8	Elkhorn
Pounds of coke	1,300	1,245	1,370	1,260	1,257	1,302	1,280
Cu.ft. of gas	10,000	10,300	8,850	9,287	9,725	8,833	9,500
Av. gross B.t.u.	525	420	435	484	474	523	600
Total B.t.u.	5,250	4,326	3,850	4,477	4,605	4,627	5,700
Pounds of ammonia	4.8	4.5	4.32	5.00	5.1	...	...
Pounds of light oil	13	13	16	9.64	11	13.8	...
Pounds of tar	102	100	115	73.3	88.3	84.6	118

Only one sample of coal was obtained from each of No. 4 and No. 5 seams. However, when the best results obtained from each seam are compared the figures are:

Seam	Smithers Creek No. 2 Gas	4	5	6	7	8	Elkhorn
Pounds of coke	1,300	1,245	1,370	1,240	...	1,327	1,280
Cu.ft. of gas	10,000	10,300	8,850	12,000	11,000	9,200	9,500
Av. gross B.t.u.	525	420	435	475	470	535	600
Total B.t.u.	5,250	4,326	3,850	5,750	5,170	4,922	5,700
Pounds of ammonia	4.6	4.8	4.5	4.8	4.5	4.8	....
Pounds of light oil	15	13	16	13.5	...	23	...
Pounds of tar	100	102	115	73	83	82	118

retorting Elkhorn coal at higher temperatures, and from these it would seem probable that improved results would be also obtained by retorting Ohio coals at higher temperatures.

Summary of the Results

Coke—The coke obtained from the Ohio coals is equal in quantity to the coke obtained from recognized gas coals. Its quality for metallurgical purposes is decidedly inferior except when certain coals like Pocahontas is mixed with the Ohio coal before retorting. The cokes obtained from the Ohio coals are in general quite satisfactory for domestic heating. The more friable cokes could probably be made satisfactory by using a small proportion of Pocahontas or similar coal with the Ohio coal; the exact proportions will be determined by later tests. The ash in the cokes obtained in these tests is higher than is desirable, but this is largely due to the fact that the coals were obtained when the mines were not properly functioning. The fusibility temperature is in many cases satisfactorily high. Preliminary tests made in domestic furnaces would seem to indicate that these Ohio cokes will be satisfactory for domestic heating, which is by far the most important outlet for coke. When the coke is mixed with about its own weight of coal the mixture burns with a practically smokeless chimney.

Tar—The tar made is somewhat less in amount when Ohio coals are coked than when a standard gas coal like Elkhorn is coked, although in some cases the tar obtained from Ohio coals was practically as high as from Elkhorn. The value of the tars could not be compared, as time and funds for the complete analysis of the tars were not available.

Ammonia—The results obtained in these tests would indicate that the Ohio coals will yield about the same amount of ammonia as a standard gas coal (No. 2 gas or Elkhorn).

Light Oils—The amount of light oils obtained from the gasification of the Ohio coals is practically the same as that obtained from standard gas coal. However, the composition of the light oils was not investigated.

Gas—The volume of gas obtained by the gasification of Ohio coals at the temperatures used is about the same as that obtained from standard gas coals. The B.t.u. value of the gas from Ohio coals is considerably smaller than that obtained from Elkhorn, although nearly equal to that obtained from the No. 2 gas coal. This is especially true of the No. 8 coal. The total B.t.u. value of the gas from a ton of Ohio coal is in general lower than that from Elkhorn coal.

The impurities such as "organic sulphur" and naphthalene in the gas obtained from Ohio coals are satisfactorily low, being well within the ordinary legal requirements when the gas is made with vertical retort equipment. The large amount of H_2S in the gas before purification need not be regarded as a detriment. In fact, in some cases the recovery of the sulphur may produce revenue.

It is not claimed that Ohio coals are as satisfactory as the accepted standard gas coals for gas-making purposes. However, from all technical points of view Ohio coals can be satisfactorily used for gas and byproduct making, including the use of the coke for domestic purposes. If economic conditions, such as the cost of mining, freight rates, etc., are such that Ohio coals can be delivered to a gas plant at a lower price than other coals, it is quite possible that they may compete successfully for these purposes.

Since the work reported in these articles was completed new equipment has been added and the general arrangement has been changed as a result of the experience gained in the past year and a half. With these changes it will now be possible to obtain highly accurate data on the carbonization of the different coals. Using the results obtained in the present investigation as a basis for selecting the most promising types of Ohio coal, it is believed that it will be possible to arrive at an exact evaluation of these coals as compared with the standard gas coals of other states.

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Some of the Frequently Met Errors in Cost Analysis

By W. A. Breen

MANY thousands of dollars are spent yearly in endeavoring to determine the cost of production, and this cost analysis is valuable for many purposes, among which are the pricing of inventory, the determination of selling prices and the checking of operating efficiency. For some purposes the absolute accuracy of cost is not relatively important, for if the same error is made on each of several operations or periods which are being compared, the errors will cancel out. However, this is not the case when costs are used to determine company policy. Can one style of product be produced more cheaply than another, or is it advisable to discontinue one line and concentrate on another? When such questions as these are to be answered it becomes of vital importance to determine the true cost. In large industrial plants with the many varied operations, it would often be prohibitively expensive to install recording devices which would be necessary to make a direct charge to each product of such expenses as steam, power, light, etc. Therefore, arbitrary methods of prorating certain direct expenses as well as the indirect or overhead expenses have been resorted to.

Traditions Should Be Viewed With Distrust

The writer wishes to express his strong distrust of traditions in cost analysis. He believes that there is always a better way to do a thing, the more especially if it has been done one way for a long time. A commonsense study of operating methods will bring this home to anyone who takes the trouble to analyze costs and cost data, provided he is willing to leave the beaten path of studying the finished cost of articles and examine operating procedure. It is a very frequent experience that a change of procedure looks to be profitable when the cost of a single product is considered, but ceases to be profitable if the true cost to the whole plant is evaluated.

For example, there was in a certain department a battery of four machines which produced rolls of material, and these were piled in storage by one man. It was decided that due to the design of one of the machines its product could be made more cheaply in another department where an idle machine could be utilized and would then turn out more goods per hour than the original unit. The change was made. However, they neglected to discharge one-quarter of a man who was used for removing the products of the four

machines to storage and the department in which this man worked had to distribute this quarter of a man over the three other machines. In the other department an additional quarter of a man was needed to remove the finished goods from the new machine and a whole man had to be hired to do this work. So the final cost to the company of this change of operation was nearly the cost of one man's wages, although a definite saving had been shown and was actually made on paper in so far as the operation of the machine itself went.

There is another excellent example which shows the necessity of computing the actual cost instead of using figures dependent upon arbitrary methods of prorating certain items. A plant in Chicago was receiving a viscous material in tank cars, some from St. Louis and some from New York. The price billed by the Eastern shipper allowed for the difference in freight between the two points, thus the purchasing department seemed justified in making the distribution. Steam, however, had to be used to heat up the material, in order that it could be made liquid enough to pump. These fuel charges had always been prorated to the different materials unloaded on a per gallon basis, and consequently the figures reflected the same cost in the storage for both materials. An actual test was made on the amount of steam consumed and it was found that due to the long trip from the Atlantic seaboard to Chicago the liquid became so viscous that $25 worth more steam per car was required to bring it to the stage sufficiently fluid to be pumped, and thus on only four cars per day a loss of nearly $30,000 a year was covered up by an arbitrary proration of these charges.

Example of Studying Actual Operating Conditions

For further illustration let us look at a paper mill. Here costs were found on different groups of products, each group being composed of several weights of paper and the cost of each being by actual test sufficiently close to justify a group figure. From the mill the paper was shipped to other mills to be impregnated with waterproofing liquid. This liquid, being cheaper than the paper, was used in excess so as to employ a maximum amount of saturant. At one mill a special machine was evolved which would accomplish this result, but it required more men to operate it. The extra labor cost was not great enough to offset the saving. Then came a labor shortage and wages began to rise and in a short time the new method was costing $2.40 per ton of paper more than was being saved by the additional saturant. Naturally, this fact indicated the desirability of scrapping the process. Before making this change, however, the investigator went to the paper mill and worked out an actual cost for the paper sent to the saturating mill. Here he found that because of the greater saturating ability of the altered machine, the paper made for it cost actually $5 per ton less, since cheaper ingredients could be used. As this paper was grouped in the cost system, however, with identical weight of stock shipped to other plants, the saving was not discovered until a study of the actual operating conditions was made.

Such examples are legion in which a different result can be obtained by going into the matter further than the immediate department or process in question, and it is frequently necessary to follow clear through to the profit obtained from the sale of the material. There is one case where it was found more costly to put a certain liquid into a heavy, expensive package than into a light one, and the question was discussed of charging more to the customer desiring this heavy package. Upon examining profits, however, it was found that the profit made on the heavy package was greater than on the light one, because the material sold as gross and more weight was actually bought for a given purpose.

Interest

Conventional cost finding does not include interest on money invested in buildings and equipment necessary to the manufacture of a product in considering cost of production, and there is some justice in not including it in the cost. When making a study of costs, however, it is well to consider it very much in the light of rent oftentimes. For example, how ridiculous it is to compare the cost of trucking by hired teams as against trucking with your own teams without including the interest on money invested in trucks and garage. Yet this very thing is being done every day by large corporations which are fooling themselves into thinking they are saving money. Still another example: Ten per cent earnings by two branches of a business. This figure came to be discussed at one time and it was found that if the branches were considered separately one branch paid 15 per cent while the other and larger half earned only 3½ per cent. In other words, the interest on the investment had not been considered. If it had, such a condition would have come to light years before.

These things seem so sufficiently obvious in relating them that one wonders why they are not immediately evident. It is partly due to the large amount of routine necessary in cost analysis work. Unless this routine is extended intelligently during expansion, absurd conditions arise such as the above illustrations. It is necessary to view cost methods with considerable common sense and to investigate operating conditions in connection with cost analysis. If the two do not go hand in hand, it is inevitable that confusion and erroneous conclusions will follow.

New York City.

Extraction of Precious Metals From Oil Shales

For a year or more statements have appeared in the technical press, and especially in various trade journals, indicating that valuable metals, such as gold, silver, platinum and other rare metals, have been found and also have been successfully extracted from oil shales. These reports stated that decarbonization and special methods of chlorination treatment, leaching and subsequent precipitation, also cyanidation followed by table concentration of the residues after cyanidation, all indicated that gold and silver and other metals could be and were successfully recovered.

Such articles have caused much misunderstanding, and as the correctness of some of the statements made in them has been questioned, an investigation of the subject was begun by the metallurgical division of the Bureau of Mines, in order, if possible, to determine to what extent, if any, metals of value do occur in oil shales, and if so, the feasibility of atempting their recovery by the processes said to have been used for that purpose.

Results of the Bureau of Mines investigations are given in Serial 2413, by Thomas Varley, superintendent of the Intermountain Experiment Station, Salt Lake City, Utah. This serial may be obtained by addressing the Bureau of Mines, Washington, D. C.

The Unique Development of Modern Chemical Stoneware*

An Account of the Progress Made During Recent Years in the Manufacture and Use of Chemical Stoneware—The Process of Manufacture, the Extending Uses, the Physical and Chemical Properties and the Probable Future of This Interesting and Useful Product

By Percy C. Kingsbury
Chief Engineer, General Ceramics Co., New York City

IT IS quite certain that the only material available for the first chemical experiments was clay ware molded to the desired shape and fired. Chemical ware may therefore be considered as dating from the beginnings of chemistry. As an industry, however, the manufacture of stoneware apparatus for chemical purposes is comparatively modern. The first plant devoted entirely to this industry was put into operation in 1836, although prior to this date several manufacturers of other clay products were making various shapes for the chemical industry as a side line, one manufacturer in Philadelphia having made chemical ware since 1816.

As might be expected, chemical ware has improved steadily in quality and workmanship during this time, although some of the ware made in Europe 50 years ago and which is still in service in this country bears very favorable comparison with much of the material sold today as chemical ware.

Early Products Limited by Potter

While there has been for many years a gradual improvement in the quality of this ware, it is only during the past 20 years or so that any serious effort has been made to manufacture anything except the simpler shapes. The chemical engineer of those days was compelled to design his plant to comprise only such shapes as the potter was willing or able to make. This is the reason for some of the inefficient apparatus seen around chemical plants today. A typical illustration of this is given in Fig. 1, which shows a vessel used for the absorption of hydrochloric acid gas in water. It is, as will be noted, a sphere flattened on the bottom. The purpose of the vessel is to offer a surface of contact between the gas and the absorbing liquid and to dissipate the heat of absorption by radiation from the exposed surface.

It will be observed that the path of the gas through the vessel is extremely short, the gas is not brought down near the surface of the liquid, but is free to short-circuit across the top of the vessel, the surface of contact between gas and liquid is very small compared with the floor space the vessel occupies, and as regards the removal of the heat of absorption by radiation, it is a well-known fact that the sphere is the shape having the smallest surface for a given volume, so that in this respect it would be a physical impossibility to devise a more inefficient vessel. I have no doubt, however, that every member present can recall many installations in which this shape is used today for the absorption of hydrochloric acid and also for the condensation of nitric acid.

This is only one instance out of many that could be cited to illustrate how, to a large extent, the potter decided what kind of chemical ware equipment should go into a chemical plant.

At that time the engineer had no choice, as the various other materials that have been developed during recent years with more or less success for handling acids and other corrosive liquids were not then available. He had to put up with the inconvenience and loss due to the shortcomings of the ware manufactured in those days. The inertia of popular opinion is such that some prejudice persists in the minds of a few chemical engineers today, notwithstanding the fact that the reason for it has long since ceased to exist. I may say, however, that this prejudice appears to be confined to this country.

Extent of Stoneware Industry

According to the report of the U. S. Geological Survey for 1920, which has the latest figures available, chemical stoneware is manufactured in New Jersey, Ohio, Pennsylvania, New York, Massachusetts, Iowa and California. The industry is, however, centered in New Jersey, one plant alone producing about 10 per cent more than the entire state of Ohio, which is the next most important producer. This New Jersey plant, which is the largest plant in the world devoted exclusively to the

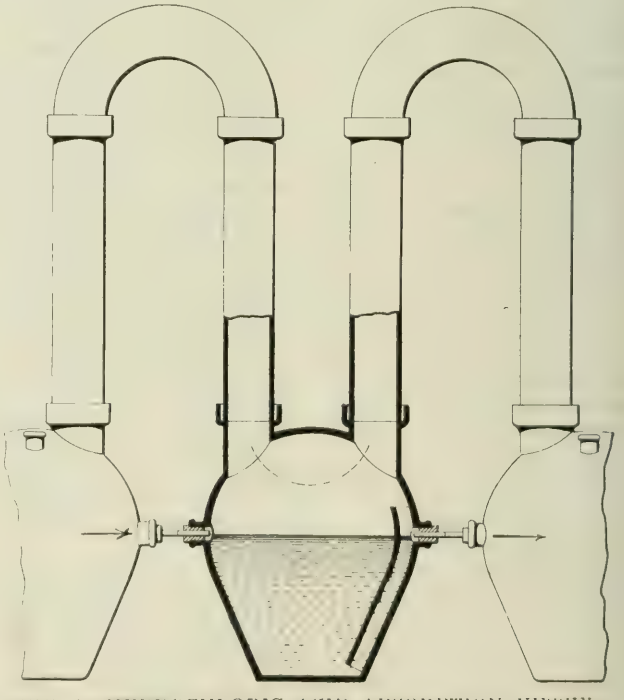


FIG. 1—HYDROCHLORIC ACID ABSORPTION VESSEL

*Paper presented at the Richmond meeting of the American Institute of Chemical Engineers, Dec. 7, 1922.

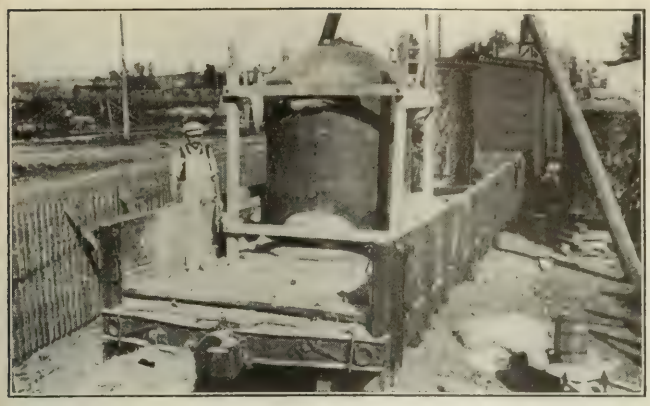


FIG. 2—1,200-GAL. ACID EGG

manufacture of chemical ware, produces as much as all the other plants in the United States put together.

What Is Chemical Stoneware?

Before considering the improvements that have been made in the chemical stoneware industry, let us first define this material.

Chemical stoneware may be considered as a skeleton or framework of more or less refractory particles held together by vitrifying clays. It is obvious that the physical properties of this ware can be modified within comparatively wide limits by variations in the raw materials used for this skeleton, in the degree of fineness to which these materials are ground and in the percentage employed in the mixture. At one extreme we have the coarse-grained chamotte bodies, which are of the nature of firebrick and which are used, for example, for conveying acid gases at a high temperature, as in a saltcake plant, where hydrochloric acid gas leaves the furnace at a temperature of 400 deg. C. or more. At the other extreme are the fine-grained porcelain-like bodies required for the large storage-battery tanks used in power plants and for electrolytic cells. An infinite gradation of products is of course possible between these two limits and the selection and preparation of a suitable material to meet some definite purpose require considerable judgment.

The Clay Must Have Special Properties

The clay which forms the vitreous bond between the particles must meet certain very specific requirements. It must vitrify at a definite temperature—i.e., the temperature of the kiln—this being adjusted by mixing it with definite proportions of other fluxing materials. It must be very plastic so that it may be molded into the many different shapes the potter is called upon to make. There must be a considerable difference in temperature between the vitrifying and the fusing points, as otherwise the shapes made from it will soften and collapse or at least deform in the kiln. It must have considerable mechanical strength in the green state so as to be able to support its own weight before firing when made up into large and often complicated forms. The shrinkage in drying and firing must be uniform, as otherwise it would be impossible for the potter to work to accurate dimensions, and the clay must be tough so as not to tear apart when subjected to the strain due to shrinking.

No natural clay will meet all these requirements, and it is necessary to mix several kinds of clay in order to obtain the desired results. Clays suitable for the highest grade of chemical ware are not widely distributed, and for many years we imported about 80 per cent of our clays from Germany, notwithstanding the fact that our plants are located in one of the greatest clay deposits in the United States.

Preparation and Aging of the Material

The various clays are mixed in the desired proportions, washed and screened to remove soluble and other foreign matter. The excess water is then removed by means of filter presses. The other components are then added and the mixture passed several times through a mill in which it is kneaded thoroughly until it is perfectly homogeneous. The mixture is extruded from the mill in large blocks, which are then stored away for 2 years in a saturated atmosphere. This has the effect of greatly increasing the plasticity of the clay, and for some of our work where great plasticity is necessary, the body is stored for 5 years. The nature of this so-called aging action is still a matter of controversy. The popular opinion seems to be that it is bacteriological. It is known that it can be induced and accelerated by the addition of certain organic products, but after some experimental work along these lines we no longer use these expedients. When the clay bodies are ready for use, they are made up into the various desired shapes, due allowance being made for shrinkage.

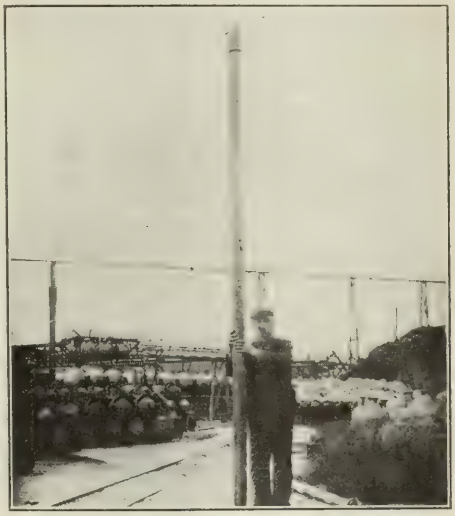


FIG. 3—STONEWARE PIPE

Plaster of paris molds are usually employed for this purpose, but many other methods are also used. Thus pipe and other cylindrical and prismatic shapes are extruded, some shapes are cast, a few shapes are turned up by hand and others are dry pressed. Where the quantities are large, as for instance in the case of carboy stoppers and Raschig rings for packing rectifying columns and scrubbing towers, elaborate automatic presses are used for this purpose.

Drying Must Be Carefully Controlled

After being shaped, the ware is dried. The most extraordinary precautions have to be taken at this stage of the manufacture. The shrinkage in drying is quite considerable, varying with the nature and moisture content of the body from 6 to 12 per cent linear. If the rate of drying of any particular shape is not uniform throughout, the uneven shrinkage causes deformation and often also internal stresses, the results of which are not apparent until after the manufacture is com-

pleted. In order to insure a uniform shrinkage at this stage, the drying has to be conducted very slowly or a drier must be used in which the temperature and moisture content of the atmosphere are under control. Where complicated shapes are to be made or where extreme accuracy in dimensions is desired, a drier of this type is indispensable.

Salt Added During the Firing

The dry ware is packed in large kilns, which are then bricked up and carried to a temperature of about 1,300 deg. C. Just before the maximum temperature is reached common salt is thrown into the fireholes. The salt volatilizes and the vapor reaches every part of the kiln. A surface reaction takes place between the salt and the aluminum silicate of the clay body, sodium-aluminum silicate being formed, and dense fumes of hydrochloric acid pass out through the stack. I shall refer to this and other methods of glazing later on. When the maximum temperature is reached the kiln is cooled down very slowly by radiation until the contents can be removed.

The time required for firing a kiln depends on its size and to some extent on the nature of the contents. Our largest kilns require 3 weeks for a cycle—3 days for setting and discharge, 4 days for heating and 13 days for cooling. This method of firing periodic kilns is extremely inefficient, practically all the heat being dissipated except a little that is used for drying green ware. For this reason we have recently installed at one of our plants a kiln divided up into chambers and furnished with an arrangement of flues so that the heat of the chambers that are cooling off is utilized for heating those that are going under fire.

In the open kilns referred to above the products of combustion come into direct contact with the ware. In this reducing atmosphere the traces of iron in the clay impart a bluish gray color to the body and a chocolate color to the glaze. In an oxidizing atmosphere the ware would be yellowish with a golden yellow glaze. White chemical ware, which is occasionally required for pharmaceutical and similar purposes, requires not only raw materials free from iron and other coloring matter but the ware must be fired in a muffle kiln, as the atmosphere in an open kiln contains volatilized iron, which would stain the ware.

After removal from the kiln, the ware is tested and sent to the grinding shop if any further finishing is required. The material is quite hard and carborundum is mostly used for this purpose, although less expensive materials, some of which are of our own manufacture, are also employed.

Many of the manufacturing processes referred to above and much of the mechanical equipment is of course common to most clayworking operations.

The raw materials used in this industry are acid proof within the usual limits for siliceous bodies, reference to which will be made later on, and they suffer practically no chemical change during the various manufacturing processes. There are, however, many problems of a physical nature met with in this class of work, the solution of which has to be acquired in the plant and laboratory, as there is little or no technical literature on this subject. It is not my intention this morning, however, to discuss our manufacturing problems, but to direct your attention to the progress that has been made within recent years in adapting this ware to the requirements of the chemical industry.

FIG. 4—FITTING FOR FUME DUCT

FIGS. 5 AND 6—SPECIAL STONEWARE TANK

Properties of Chemical Stoneware

The possibilities as well as the limitations of chemical ware are best shown by a consideration of the chemical and physical properties of this ware. A typical analysis of chemical stoneware is as follows:

COMPOSITION OF MIXTURE 57

	Per Cent		Per Cent
SiO_2	73.23	K_2O	2.02
Al_2O_3	22.27	Na_2O	1.42
Fe_2O_3	0.58	Loss on ignition	0.06
CaO	0.58		
MgO	Trace		100.16

This ware resists the action of all acids excepting only those which react with the silica—i.e., hydrofluoric acid and hot strong phosphoric acid. Concentrated solutions of the caustic alkalis when hot also have some action on it. This action is, however, not considerable and caustic alkalis may usually be handled to advantage in chemical ware. As might be expected, a stoneware that is high in alumina resists the action of caustic alkalis much better than one that is high in silica.

Glazes for Chemical Ware

Chemical stoneware is usually glazed, the glaze, however, being merely a finish to give a smooth surface to the ware and not for the purpose of adding to the acid-resisting properties. As a matter of fact, the glaze is less resistant to chemical action than the body, and for this reason we are occasionally called upon to furnish unglazed ware. Under these circumstances a very dense body must naturally be employed. Some ware is manufactured for chemical purposes having a more or less porous body that depends for its acid-resisting properties on a heavy coating of a prepared

glaze applied before firing by means of a brush or spray or by dipping. These glazes may be considered as clays with a low melting point which fuse in the kiln to a more or less homogeneous layer at the temperature of vitrification of the body. Such ware can scarcely be considered as chemical stoneware, as it offers no advantage over the various materials on the market coated with so-called acid-proof paints, varnishes and enamels which become valueless as soon as there is the slightest imperfection in the exposed surface. There can be no question that salt glaze is much to be preferred for chemical work. A composition of this glaze is roughly as follows:

SiO_2	66.80	Na_2O	12.55
Al_2O_3	20.65		
			100.00

It is a sodium-aluminum silicate—i.e., a glass intermolecularly combined with the body so that it cannot craze nor peel.

Physical Characteristics

The physical characteristics of chemical stoneware are given in the following table:

Tensile strength, lb. per sq.in.	1,000-2,200
Compressive strength, lb. per sq in	25,000
Modulus of elasticity, lb.	6,000,000-9,000,000
Thermal conductivity, B.t.u.	0.55-0.6
Specific heat	0.2
Specific gravity	2.17
Coefficient of expansion (linear per deg. C.)	0.000003-0.000005

These are, of course, average values, as the physical properties vary considerably with different grades of

FIG. 7—CONDENSATION COIL

ware. This is particularly true of the tensile strength. Thus the body we use for acid pipe lines has a tensile strength of 1,000 lb. per square inch, the body used for electrolytic work has a value of 1,700 lb. per square inch and the bodies used for pump and exhaust fan impellers and for blowcases are much higher. We have tested an 18-in. impeller to 4,500 r.p.m. without bursting it—i.e., a peripheral speed of over 21,000 ft. per minute.

Attempts are frequently made to modify the physical properties of chemical ware by the addition of materials such as carborundum, various refractory oxides, etc. These products are placed on the market from time to time under fancy trade names and extravagant claims are made for them which have seldom been justified. This, however, opens a fertile field for the future development of this industry.

Practically any shape that can be made in metal or any other structural material can be duplicated in stoneware if due consideration is given to the physical properties of this ware. The accompanying pictures will

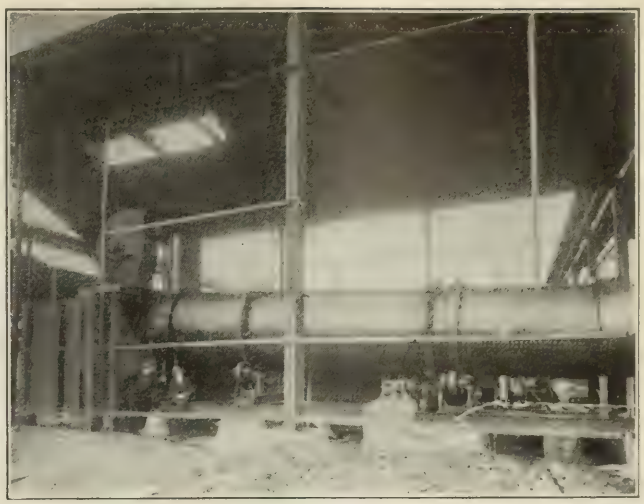


FIG. 8—ROTARY DRIER

illustrate the possibilities that chemical ware offers to the chemical industry. In line with the general trend toward large-scale production we have been called upon to furnish equipment in as large units as possible. There is naturally a limit to the size to which clay ware can be made, but Fig. 2 shows a remarkably large vessel—undoubtedly the largest made in this country. It is the body of an acid egg or blowcase and was used for forcing a sludge into a filter press by means of compressed air at a pressure of 50 lb. per square inch. The vessel, which has a capacity of 1,200 gal., was of course protected by a steel shell on the outside. The sludge in this case was formed by treating carnotite residues with muriatic acid in the extraction of radium. Still larger shapes have been made in Europe, a 1,500-gal. vessel having been exhibited at a recent exposition in Dresden. The filter presses used in connection with the blowcase referred to were the usual wooden plate and frame presses. We designed and installed this equipment several years ago. It is interesting to record that we have now succeeded in making these filter presses also out of stoneware.

Fig. 3 shows a 4-in. pipe about 14 ft. long. One end is closed, the other end is open and has a branch near the top with a flange under it. These tubes are used for cooling hydrochloric acid gas from about 80 deg. C. to about 15 deg. C. in the following manner: A stoneware tower has a perforated plate on top and twenty-six of these tubes hang in the tower supported by their

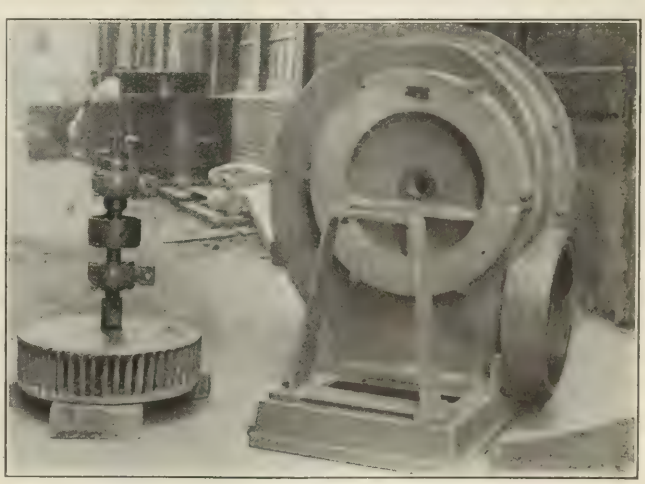


FIG. 9—LARGE EXHAUST FAN

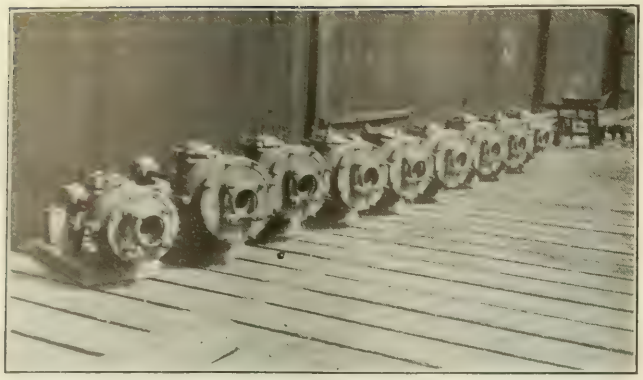


FIG. 10—STONEWARE PUMPS

flange on the perforated plate. Each tube is cooled by water which is carried to the bottom by a pipe and which overflows through the branch at the top. I will show you presently a picture of the complete plant in which this device is used. The idea is adapted to all kinds of purposes in the chemical industry, but the tubes are not usually so long as in this case.

Fig. 4 shows part of a 48-in. diameter fume duct we manufactured a few years ago. This particular fitting is about 8 ft. high.

Fig. 5 is a tank we made during the war for the manufacture of radiators for airplane engines by electrodeposition of copper. I want you to note how accurately the slots match up. You will see it better perhaps in Fig. 6.

A stoneware coil (Fig. 7) usually impresses one not familiar with the manufacture of clay products. Given the right kind of body, however, they are not difficult to manufacture and will stand a remarkable amount of rough handling. The most usual size has a $2\frac{1}{2}$-in. tube with a wall $\frac{3}{16}$ in. thick and 80 ft. long. It is wound on a stoneware drum, but is not attached to it, so that the tube is free to expand and contract with change in temperature. We have shipped these coils all over the world. They are used principally for the condensation of nitric acid, for which they are ideal. They are also made as shown in the picture for cooling corrosive liquids. You will note that one of these coils has a corrugated cross-section for the purpose of increasing the cooling surface of the tube.

Fig. 8 shows a rotary drier with a cylinder about 20 ft. long. The entire cylinder was made of chemical stoneware and the flights were made integral with it. The feeding head was also of stoneware, as shown in the picture. The material to be dried was saturated with muriatic acid and every part of the machine coming in contact either with the moist material or the vapor had to be made of stoneware. The vapors were drawn off by a stoneware fan and condensed in stoneware towers.

A stoneware exhaust fan similar to that referred to above is shown in Fig. 9. This is the largest size we make to this design and will handle about 6,000 cu.ft.

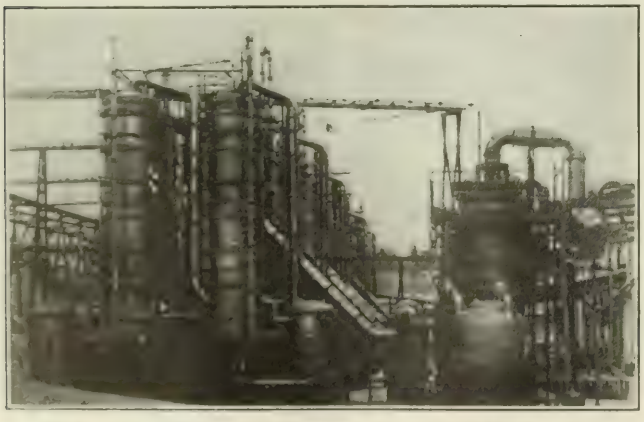


FIG. 11—MURIATIC ACID PLANT, ALL STONEWARE

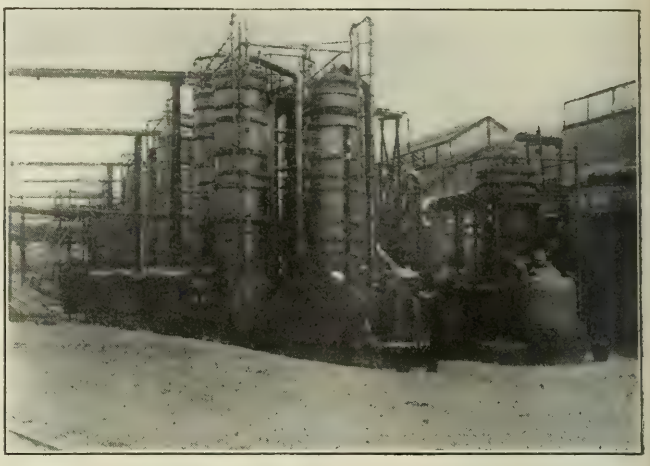


FIG. 12—ANOTHER VIEW OF MURIATIC ACID PLANT

per minute. We furnished a very large number of these machines during the war for handling the oxides of nitrogen evolved from nitrating operations. The body and impeller—in fact every part coming in contact with the gas—are made of chemical stoneware. I scarcely need say that a very high-grade body is required for this class of work. The impeller shown in the picture is tested to 1,500 r.p.m. The smaller sizes are tested to 3,000 r.p.m.

Stoneware pumps (Fig. 10) are used for innumerable purposes around chemical plants and for handling every imaginable kind of corrosive liquid. They are also used largely for handling food products such as soup and vinegar, as they can be kept perfectly clean.

If stoneware chemical plant is to be thoroughly satisfactory, it must be carefully erected, and we therefore endeavor to use our own experienced men for this work wherever possible, whether the plant has been designed by ourselves or by our customers or their engineers.

Fig. 11 is a muriatic acid plant. This is the plant in which were used those 4-in. pipes 14 ft. long shown in Fig. 3. I want you to note that this plant has no protection whatsoever from the weather. The hydrochloric acid gas enters the pipe line at about 250 deg. C. and reaches the first tower at about 80 deg. C. The entire equipment is subject to zero temperature in winter and also to wind and snow and rain, but it has given no trouble whatsoever.

The Future of Chemical Stoneware

I have endeavored so far to show what has been accomplished in stoneware equipment for the chemical industry, and in conclusion would like to say a few words as to the future of this industry.

An important fact to be borne in mind is that although chemical stoneware is undoubtedly the best material for chemical plants handling corrosive products, yet it is no longer absolutely indispensable except in a few particular cases. No material has the general

utility of stoneware, but for any specific purpose there is some other material that can be substituted for it except in a few special instances. In practically every case these substitutes have no advantage over chemical stoneware—in many cases they have very distinct disadvantages and they are almost invariably much more expensive. Every few weeks one or more of these new products is brought to our attention and most of them die a natural death after the usual comparative tests have been made, and this situation has acted as a stimulus to the chemical ware industry.

The production of chemical stoneware in the U. S. in 1920 increased 54 per cent over the 1919 production and when the figures for 1922 are available they will undoubtedly show a still further steady increase. This is concrete evidence of the confidence of the chemical industry in American-made chemical ware which the manufacturer can easily retain if he will continue to improve his product and will base his sales propaganda on definite demonstrable facts and accurate data rather than on extravagant general statements and so-called "talking points."

Wooden Barrels for Chemicals

Summary of Proper Use by Which User May Choose Type Best Suited to His Industry

THE Associated Cooperage Industries of America, which is the trade association of the barrel manufacturers, has recently issued a booklet entitled "Slack Barrels for Chemicals," which calls attention to the wide use of barrels for containers in chemical and allied industries. This booklet gives a good summary of the proper uses of the slack barrel, and, when combined with other summaries furnished by this association, is of sufficient interest to engineers to warrant reproduction here. These summaries follow:

The cooperage industry has devoted some time and thought to the subject of improving barrel service to the chemical and allied trades, particularly with reference to the specific commodity and the principles of packing. With a proper knowledge of these, it is a comparatively simple problem to decide upon the kind of barrel best suited for shipping various chemicals.

From the scientific and technical point of view, standards of measurement, standards of performance and standards of quality have been established by the Bureau of Standards, Washington, D. C., covering barrels for certain food products and other commodities. Inasmuch, however, as the chemical and cooperage manufacturers have not so far developed a certain rule of measure for chemical containers, the chemical industry accepts wood barrels by contract specifications. Barrels used at the present time for shipment of chemicals are known as "slack," "semi-tight" and "tight."

The following outline is designed to give an idea of the proper kind of barrels required for use in chemical industry. It does not pretend to cover barrel use in detail, but merely discusses the basic operations which are common to the entire industry. The chemical products listed will not therefore be a complete directory of what the wooden barrel is capable of carrying:

Slack Barrels

The slack barrel is an ideal container for shipping chemicals which are not efflorescent, also for compounds and materials, varying in weight from 50 to 500 lb.

Products Shipped—Ammonium picrate, asphalt, cement, dry chemicals, lime, arsenate, paint pigments, picric acid, compounds, dye materials, glass, crockery, brick, clay, terra cotta, etc.

Appreciating the fact that there is considerable variation in the density of chemicals and in the manner of their preparation for shipment, the need for careful specification is apparent when making estimates as to the most efficient utilization of wood barrels. The slack cooperage industry has established a code of grade rules and specifications applicable to use of various timbers. Gum, elm, cottonwood, basswood, oak, beech, maple, etc., are used and graded as No. 1, millrun and No. 2. Coiled elm hoops are also of standard quality and dimensions. Wire and steel hoops used by specification.

Specifications for slack barrels most commonly used in chemical industry are as follows:

13½ in. head	20 in. staves
16½ in. head	24 in. staves
17⅝ in. head	28½ in. staves
19⅝ in. head	30 in. staves

Slack casks for crockery and glass 24 to 48 in. head, 34 to 42 in. staves.

"Tongued and Grooved" Slack Barrel

To provide a practical, efficient and economical container that would adequately fill the requirements of the chemical industry for the shipment of efflorescent and semi-liquid products, the slack cooperage industry has evolved what is known as a "tongued and grooved" slack barrel. This package is made from staves ⅜ in. thick, heading ⅝ in. glued; silicated when found necessary.

The staves being tongued and grooved and heading glued, a practically water and air tight package is provided. Gallonage capacity is usually referred to when ordering this kind of container. The dimensions are as follows:

17⅛ in. head, 30 in. staves	for 30 to 32 gal. size
20 in. head, 34 in. staves	for 45 gal. size
21 in. head, 34 in. staves	for 50 gal. size
22 in. head, 34 in. staves	for 55 to 57 gal. size

Tight Barrels

Products Shipped — Chemicals, alcohol, beverages, compounds, cider, dyes and colors, solutions, extracts, grease, oils, food products, glue, paint, varnish, polish, sirup, molasses, vinegar, etc.

The "tight" barrel, as the name implies, is used for the shipment of liquid and semi-liquid chemicals. Laboratory tests have been made to obtain a better knowledge of the action of acids and chemicals on wood barrels; when necessary, silicate, paraffine and glue are used as liners. Rough usage tests have been applied to determine a definite understanding as to quality, grade, specification and standards of timber for tight barrel construction. White oak, red oak, ash and fir are used, and steel hoops of standard gage. Sizes range from 5 to 60 gal. capacity, according to specifications.

It is evident from the above that the user of barrels can well pick out for himself the type of barrel he desires; but in purchasing, in order to realize the full value of the studies made by the Associated Cooperage Industries of America, a careful specification of the service which the barrel is to perform should be furnished to the barrel manufacturer.

The Glass Industry in Poland

The glass industry in Poland is mainly organized by the Union of Glass Works. Forty-six establishments belong to this union having at present seventy furnaces working and employing about 10,000 workers. Thirty-five smaller glass works are not affiliated with the union; the total number is thus eighty-one, employing more than 12,000 workers. The annual production may be computed at about 102,000 tons a year. This quantity not only provides for national needs but leaves a surplus of 40 per cent for export. The principal foreign market for Polish glass is Rumania.

In 1921 Polish glassworks exported only about a thousand tons; on the other hand, glass goods were imported to the extent of 7,300 tons. Now, however, exports are increasing and imports are decreasing; imports still include mirrors, optical glasses, watch glasses and certain categories of glass for technical apparatus.

The Polish glass industry flourishes especially in what was formerly Russian Poland, as the Polish market before the war was largely Russia. It bids fair to become an important export industry.

Recent Chemical & Metallurgical Patents

Process of Filtering Vapors — A patent has been granted to Willett C. and Frank E. Wells, of Columbus, Ohio, for an apparatus and process of filtering vapors such as those given off during the process of distilling petroleum oil. The invention is a process of filtering the vapors of hydrocarbons evolved by passing a permanent neutral gas through the heated oil and this with its load of vapor up through filtering material such as fullers earth for the purpose of removing color and bituminous matter, and then to a condenser where the distillates are recovered. As the filtering material receives its heat solely from the gas and vapor passing through it, it is necessarily of lower temperature than the fluid which heats it. Consequently, a portion of the less volatile vapors condense in the filtering material, and this condensate is absorbed and retained until the continuously increasing temperature of the succeeding vapor evaporates it. In so doing it continuously deposits more condensate of less volatility in its stead, thus very materially narrowing the volatility range of any portion of the distillate. (1,433,050. Oct. 24, 1922.)

A New Titanium Pigment—In a previous patent (No. 1,348,129, granted July 27, 1920) V. M. Goldschmidt, assignor to the Titan Company, of Christiania, Norway, described a material for use as a pigment comprising a more or less crystalline titanium oxide. In a more recent patent he describes a titanium pigment in which all or part of the titanium is present in the form of a titanate. The specific source referred to is the calcium titanate, although acid, normal and basic titanates of other bivalent metals are included in his specification. These pigments, he claims, are insoluble or sparingly soluble in water, and are very stable against both oxidation and reduction. Accordingly they resist the action of both the atmosphere and vehicle. The titanium compounds contained in the pigment have high specific gravity and high refractive index, thereby giving the pigment great hiding power. The normal calcium titanate ($CaTiO_3$), which combines great stability with a high refractive index (2.4 in sodium light), may be prepared in the following manner: Ilmenite is treated with sulphuric acid and after the resulting sulphate mass in lixiviated, the titanic acid is precipitated from the resulting solution. This product, which will usually contain a quantity of the SO_4 radical, is then mixed with slightly more than an equivalent of lime and the mixture is heated to a sufficiently high temperature to cause the formation of calcium titanate, preferably in a crystalline condition. The resulting product is of a white or yellowish-white color and is said to be an excellent pigment. The titanates and their double salts give white pigments when the bases of the salts are colorless, and different colors when the bases are colored. (1,436,164. Nov. 21, 1922.)

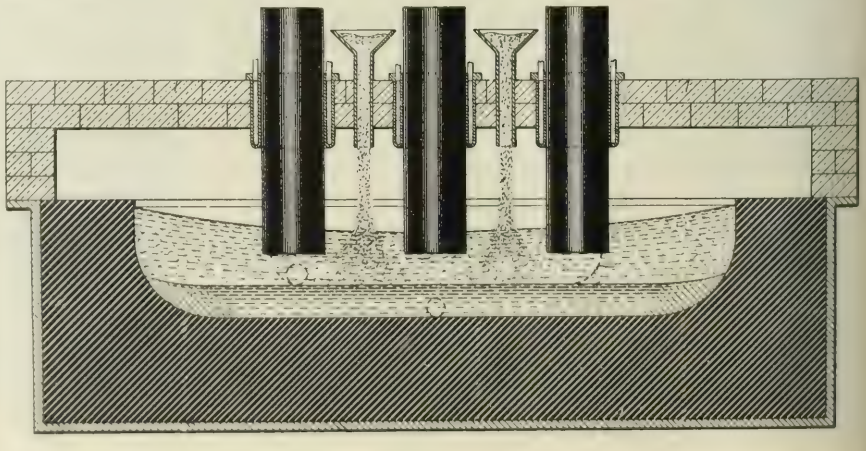
American Patents
Issued Dec. 5, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,437,394—Purification of Phenol Contaminated Liquors.
1,437,401—Purification of Phenol Contaminated Liquors.
1,437,405—Treating Molten Metal.
1,437,483—Production of Aldehydes.
1,437,636—Chlorinating Organic Compounds.
1,437,689—Separation of Petroleum.
1,437,743—Extraction of Oil.
1,437,769—Duplex Tunnel Kiln.
1,437,775—Fusible Combustibles.
1,437,783—Condensation Product.
1,437,801—Sugar Extraction.
1,437,838—Soluble Lime-Sulphur Composition.
1,437,932—Treating Hydrocarbons.
1,437,933—Treating Hydrocarbons.
1,437,952—Plastic Compositions.
1,437,980—Distillation Process.
1,438,123—Process of Making Alcohols.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Production of Ferrovanadium—B. D. Saklatwalla and A. N. Anderson have patented a method for reducing refractory oxides with carbon in an electric furnace. The accompanying illustration shows, to scale, the principal lines of their preferred furnace. Current must be led in at not less than 150 volts and 35 amperes per sq.in. of electrode cross-section; the electrodes must be correctly spaced and immersed in the slag bath; and the cold charge must be fed between the electrodes, falling directly into the hottest portion of the furnace with little or no preheating. In this way direct reduction of the refractory (vanadium) oxide is quickly effected by the carbon without the formation of lower oxides on intermediate compounds—a circumstance found highly desirable. The charge consists of ore, iron scale, coke and fluxes (glass cullet, lime and fluorspar). Glass cullet and iron oxide are of advantage in that they increasse the electrical resistance of the slag, and the former also decreases its swirling motion by increasing its viscosity. This swirling motion draws the cold charge into the best region for quick reduction, and a 50 per cent ferrovanadium has thus been made. (1,435,742 Nov. 14, 1922. Assigned to Vanadium Corporation of America.)



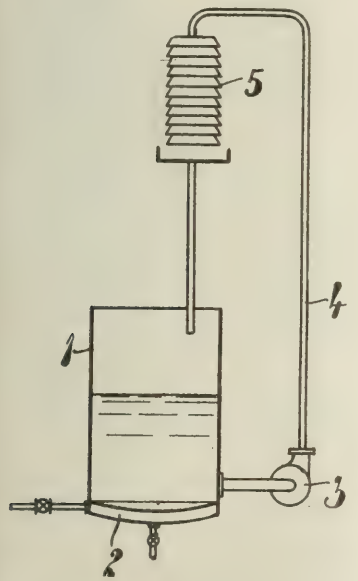
Iron-Free Nitric Acid—An apparatus for the concentration and purification of nitric acid is described in a specification taken out by George H. Tozier of Rochester, N. Y., and assigned to the Eastman Kodak Co. It is particularly designed to remove traces of iron from commercial nitric acid. The principle of the process is the insertion of a reflux condenser in the vapor line from a Duriron nitric acid still. The still is steam jacketed and the vapors from the boiling weak nitric acid are conducted through a vertical line to a reflux condenser, which is made of Pyrex glass or fused quartz. This condenser is also steam jacketed. The theory is that the iron is mechanically carried over by the particles of nitric acid coming out of the still, and the condensation which takes place in the reflux condenser serves to wash the ascending vapors and to carry the impurities back into the still. The temperature in the jacket of the condenser is maintained at a point low enough to bring out sufficient condensation to remove all the objectionable impurities.

From the reflux condenser the vapors pass through an ordinary water-cooled tube condenser. The tubes are preferably made of Pyrex or fused quartz. The condensate runs from this con-

denser into bleachers, where air is blown through the acid to remove nitrogen oxides and any chlorine, bromine or other gaseous impurities. (1,529,177. Sept. 12, 1922.)

Chlorinating Paraffine Hydrocarbons—The patentee has found that by causing the liquid hydrocarbons of the paraffine series to react with chlorine gas under the influence of actinic rays and in the presence of an absorbent such as silica gel, activated carbon or pumice in a finely divided condition as a catalyzer, and passing the hydrocarbon and chlorine through successive quantities of such absorbent, the reaction can be made to proceed more smoothly and regularly and quickly, and the resulting production of chlorohydrocarbons can be made more definite in character and amount. It has also been found that the reaction can be further hastened and improved by impregnating the finely divided absorbent with metals or metallic compounds. (George T. Koch, of Homer, Ohio, assignor to the Ohio Fuel Supply Co., Pittsburgh, Pa. Oct. 24, 1922.)

Transformation of Cyanamide Into Urea—J. H. Lidholm, of Sweden, has patented a method for transforming cyanamide into urea. The trouble with the present method is that when carried out at 65 deg., at which temperature the reaction of cyanamide plus water gives urea, the rate of reaction is so rapid that it is difficult to keep the



temperature constant. To do this an apparatus is suggested. In the figure, 1 is an open container having a steam jacket 2 at the bottom or other equivalent means for heating the content of the container. A pump 3 circulates the content of the container through the pipe 4 up to a cooling tower 5, from which it again flows down into the container 1.

In carrying out the process in the apparatus described the cyanamide solution is introduced into the container 1 and sulphuric acid is added in such quantity that the solution becomes about 1-normal with respect to the acid. The solution is then heated by supplying steam to the jacket 2 of the container so that the temperature will rise to about 65 deg. C. When the reaction has started and the temptrature begins to rise, the solution is continuously pumped up to the cooling tower, where a part of the water of the solution is evaporated and carried away by the atmospheric air, the evaporation causing a cooling of the solution, which then flows back to the container. In this manner the reaction temperature may be kept practically constant during the operation and the heat evolved by the reaction utilized for a partial concentration of the solution. (1,436,180. Nov. 21, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Motor Fuel—A fuel for internal combustion engines comprises a solution of water in benzol and acetone. Ethyl or methyl alcohol and ether may be added. The water should comprise 8 to 16 per cent of the liquid. The preferred composition consists of 60 lb. of ethyl alcohol, 20 lb. of acetone, 10 lb. of benzol or benzene, and 10 lb. of water. (Br. Pat. 183,577. H. R. Ricardo, London. Sept. 20, 1922.)

Cellulose Products—A cellulose product adapted for the manufacture of viscose and termed hydra-oxycellulose is prepared by treating cellulose admixed with water first with gaseous chlorine in excess of the amount required to saturate the water present, and afterward with strong hydrochloric acid, preferably the acid produced in the first stage of the process and which is brought into action by drying the moist product—for example, by heating at 60 deg. C.—until a brittle product results. The proportions of water and chlorine to be observed in the case of wood pulp are: cellulose 100 parts, water 100 parts, chlorine 10 parts; in other cases a larger proportion of chlorine may be necessary—for instance, with oat straw, 30 to 50 parts of chlorine for every 100 parts of cellulose would be required—in any case the proportion of water lies between one-half and twice the weight of the cellulose material. By subjection to the usual xanthogenation process, the cellulose conversion product is converted into a viscose which at the usual concentrations has the character of a jelly. The viscose solution is adapted for the manufacture of artificial silk, paper size, leather board, etc.; and it may be mixed with materials such as zinc, chromic and ferric oxides, clay, starchy matters, paper pulp, dissolved resins, esparto rosin, fats, waxes, glycerine, shellac, dyes and pigments; and in most cases such addition would be added before the preparation of the viscose solution. According to the material added, substitutes for horn, bone, ivory, ebonite, wood, celluloid, leather and india rubber are obtained. When used for the manufacture of solid bodies, the solution is poured into molds and permitted to stand to separate air bubbles—this separation is facilitated by pouring a thin film of water on to the surface—and the mold then heated to 40 deg. C. for some hours; a compact mass capable of being manipulated is thus obtained, which is subsequently washed with warm water and dried, or heated to 100 deg. C., to render it, or an article made therefrom, impervious to water. Of the materials specified that may be incorporated with the product, zinc oxide and ferric oxide are particularly useful; with the former, the product may be bleached by calcium or sodium hydrochlorite or may be dyed, the dyes being applied previous to coagulation or after washing and before drying. Pigments such as ultramarine may be added. The viscose material, if impregnated with glycerine before coagulation or after washing the coagulated material, gives a coagulated mass of the consistency of india rubber or of leather; a good imitation of leather is prepared by adding zinc oxide and resin oil and afterward impregnating with glycerine. Omitting the glycerine, the material is suitable for buttons, door knobs, etc. The viscose material may also be used as a bond for abrasives in making grindstones, hones, emery cloth, polishing sheets, knife boards and razor strops. (Br. Pat. 184,610. C. C. L. G. Budde, Sunderland. Oct. 11, 1922.)

Cellulose Acetate—Cyclobutanone or side chain homologs thereof, such as dimethyl- or diethylcyclobutanone, is employed as a solvent for cellulose acetates in the manufacture of solutions, plastic masses, artificial silk, films, etc. The solvents, diluents, filling substances, coloring matter, etc., may be added in addition. Examples of proportions are given in the specification. (Br. Pat. 184,671. H. Dreyfus, London. Oct. 11, 1922.)

Purifying Acetylene—To the alkali hypochlorite solution used for removing phosphine and H_2S from acetylene is added a substance such as alkali bicarbonate that prevents the solution from containing any considerable concentration of free hypochlorous acid. When exhausted, the purifying solution is regenerated electrolytically, preferably with the use of graphite anodes and an addition of potassium chromate. (Br. Pat. 184,778; not yet accepted. Elektrizitätswerk Lonza, Basel. Oct. 11, 1922.)

Motor Fuel—A fuel for internal combustion engines consists of a mixture of a hydronaphthalene, an aliphatic hydrocarbon of low boiling point, and methylated spirit, blended by a small proportion of ether or an alcohol of high boiling point. In an example, 30 parts of tetrahydronaphthalene, 35 parts of petrol or light petroleum and 30 parts of methylated spirits are blended by 5 parts of amyl alcohol. (Br. Pat. 184,785. Riedel Akt.-Ges., Berlin. Oct. 11, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Arsenic Situation Clarified by Conference Between Producers and Users

Meeting Held to Investigate Present Shortage Evaluates Existing Stocks, Trade and Agricultural Requirements and the Possibilities of Increased Production

PRODUCERS of arsenic, manufacturers of arsenical insecticides, glass makers and other users of arsenic met at the Hotel Astor, New York, Dec. 13, to give sober study to the arsenic situation and if possible to unearth a supply of calcium arsenate sufficient to provide for next year's campaign against the boll weevil.

The meeting was called by C. R. DeLong, of the U. S. Tariff Commission and former chief of the chemical division of the Department of Commerce, and was one of the features of the annual convention of the Insecticide and Disinfectant Manufacturers' Association. Although the meeting had nothing to do with the pending Congressional resolutions for investigation of the arsenic industry, all angles of the present situation were discussed by men who were thoroughly informed of developments in the different branches of the trade.

Dr. R. B. Coad, Southern field agent for the Bureau of Entomology of the Department of Agriculture, presented an accurate analysis of the problem from the cotton farmer's viewpoint. Hamilton M. Brush, manager of the sales department of the American Smelting & Refining Co., and F. Y. Robertson, vice-president of the United States Smelting & Refining Co., reported for the arsenic producers. Frank Hemingway, of the Sherwin-Williams Co., former State Senator George F. Thompson, of the Niagara Spray Co., O. A. Hasse, vice-president of the Glidden Co., and R. N. Chipman, of the Chipman Chemical Engineering Co., were some of the insecticide manufacturers who contributed to the discussion.

Arsenic Requirements

Naturally the discussion largely centered around calcium arsenate, the poison that has been found most effective in combating the Mexican boll weevil. According to Dr. Coad, of the Department of Agriculture, approximately 16,000,000 lb. of calcium arsenate was sold in the South last season and there was a demand for more than that amount. On the whole, the results from calcium arsenate were good, he declared, and while in the outlook for next season the price of calcium arsenate and the price of cotton will be factors in the situation, it looks, nevertheless, as if the demand would run far ahead of the supply.

In an attempt to figure the minimum requirements of arsenic for purposes other than calcium arsenate, the following figures were worked out for refined white arsenic:

	Tons
Arsenate of lead	2,000
Paris green	1,200
Proprietary mixtures	750
Sheep dips	1,000
Weed killers	1,500
Glass	2,000
	8,450

On this basis, Dr. Coad said, there is barely enough arsenic in sight to meet requirements, leaving calcium arsenate out of consideration entirely. Last year the production of calcium arsenate used nearly 4,000 tons of arsenic and next year, it is estimated, there will be a demand for not less than three times last season's requirements.

What Can the Farmer Pay?

Discussing the price the cotton farmer would be willing to pay for calcium arsenate, Dr. Coad said that the sale of calcium arsenate in the South is no longer a pioneering proposition, and that the farmer knows now how much he can pay for it and still make a profit on his crop.

After a great deal of investigating, the department has arrived at the conclusion that the farmer should be able to trade a pound of lint cotton for a pound of calcium arsenate; that, moreover, the price of calcium arsenate should be figured on the basis of the probable price of cotton next fall. If, for instance, cotton should sell at 18 or 20 cents, the farmer should not have to pay more than 18 or 20 cents for calcium arsenate delivered on his farm. Allowing a spread of 4 cents for distribution in the South, Dr. Coad said, would drop the price back to 14 cents. The question is, he continued, how much can the insecticide manufacturer afford to pay for arsenic in order to make calcium arsenate? No manufacturer, he declared, can afford to pay over 10

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How the Bureau of Standards Holds Its Techincal Employees

The general impression regarding government salaries is that they are very inadequate, failing to attract the better class of techncial men, especially under present conditions. A recent statement by F. C. Brown, assistant director of the Bureau of Standards, is, therefore, of considerable interest:

> There have been in the twenty-one years a total of 574 college graduates who have entered the Bureau of Standards and who later left. On the average these men remained at the bureau for 2.5 years for what we would like to term a graduate course of training. During their stay at the bureau they received an average increase in salary of $133 per year. There were, of course, among these men many who found themselves in the wrong place, but probably one-half of this number left the bureau merely because of special opportunities opened to them, with anywhere from 50 to 200 per cent increases in salary. The Bureau of Standards employees are tempted away for two reasons, first, because they have the bureau's stamp on them, and second, because of the special training they get here.
>
> With regard to the college graduates who have come to the Bureau of Standards and who have remained, I would state that in general these have been the ones who have found themselves suited to the work and happy in it. At present we have 330 employees who have come to us either as college graduates or who have finished their college work while engaged here. Of this number 60 have the Ph.D. degree. About 22 of our employees have obtained the doctor's degree while working here, and a number have other advanced degrees. Among these men the average entrance salary has been with the bureau on the average of 4.7 years each, and their average salary at present is $2,348. This group has therefore received an annual increase averaging $180. Almost all of these individuals have had many opportunities to leave the bureau at large increases in salary. They have felt the spirit of the institution and have been conscious of the part they are playing. Aside from this, many of them keenly appreciate the variety of opportunities that the national capital offers.

Dr. Brown's statement is accompanied by a chart showing the distribution of salaries among the 536 technical employees of the bureau.

Annual Reports of Government Laboratories

Bureau of Standards Has Devoted Efforts Toward Standardization and Elimination of Waste

THE most important efforts of the Bureau of Standards during the past year were those directed toward the elimination of waste, says the annual report of the bureau.

A complete study of automobile engine performance, both in the laboratory and in cars on the road, is being carried out with the object of increasing the efficiency of internal-combustion engines. If the bureau, through this work, can assist in lowering the gasoline consumption of automobiles only 10 per cent for given mileage, it will represent a saving to the country of something like $100,000,000 per year.

Varied Research Problems

Large sums are lost each year through the corrosion of underground pipes, conduits and metal structures. Part of this is the result of electrolytic action, while part is caused by conditions of the soil. The bureau has mapped out an extensive program to study this subject, and, if possible, to suggest means for preventing the waste. Pieces of pipe have been buried in different sections of the country, and the effect of the soil in these localities on the metal will be studied.

Most appliances used for heating by gas are operated at very low efficiency, with a consequent waste of gas and also with a very bad effect on persons working in the same room, because imperfect combustion means generation of carbon monoxide, which is extremely poisonous. The bureau has studied the subject of improving both natural and artificial gas burners very thoroughly and has already issued recommendations which will greatly reduce gas consumption and improve the health of the users.

In the field of building construction, more material than is necessary is often used for a wall, column or floor slab, because information concerning the stresses which such structures or members can safely bear, their ability to resist fire, etc., is inaccurate or incomplete. In order more definitely to formulate safe and economical standards in this field, the bureau is investigating the suitability of re-rolled steel as a reinforcement for concrete, the strength of walls and floors, the resistance of buildings to fire and the constitution of cement and concrete.

If, through these investigations and many others similar to them which might be mentioned, the bureau can assist in preventing even a small portion of the avoidable waste in industry, the saving to the citizens of this country thus brought about would more

(Continued on page 1239)

Fixed Nitrogen Research Laboratory Reports Work of Past Year on Fixation Processes and Nitrogen Compounds

IN HIS annual report, F. G. Cottrell, the director of the Fixed Nitrogen Research Laboratory, reviews the work of the laboratory and summarizes the principal investigations which have been conducted in the matter of the fixation of atmospheric nitrogen. Since this is the first year the laboratory has been under the Department of Agriculture, the report is prefaced by a brief statement as to the establishment and previous work of the laboratory.

Seventeen technical reports on the work of the laboratory were prepared during the past year. In the present state of development of fixation processes in this country, fixed nitrogen cannot be produced for fertilizer purposes in competition with Chilean nitrate and with ammonia obtained as a byproduct in the coking of coal, except under unusually favorable circumstances. There is every reason to believe, however, that the cost of fixation can be materially reduced through further study and development. During the past year the laboratory has studied the cyanamide, synthetic ammonia, arc and alkali cyanide processes with that object in view.

Ammonia Synthesis

The direct synthetic ammonia process has received considerable attention during the past year. The main features of this process which require further development and on which the laboratory has been engaged during the past year are: The catalyst problem, involving the large-scale production of an active catalyst, the further development of the present catalyst, and the search for new and improved catalysts; the production and purification of the hydrogen-nitrogen mixture; the development of apparatus which will stand the unusually high pressures and temperatures used; and the removal of the synthesized ammonia from the unconverted gas.

Cyanamide Process

The laboratory has made a rather critical study of the present form of the cyanamide process, from which it appears that improvements leading to a drastic reduction in the cost of operation are rather improbable. The process requires a relatively large amount of electric power for the manufacture of carbide, and hence cheap power is necessary to its profitable operation. Important data on the formation and decomposition of cyanamide have already been obtained, but further study is required to complete the investigation.

Next in importance to the fixation of nitrogen is the transformation of the different nitrogen-containing substances in order to make them more useful in agriculture, in explosives and in the arts. During the past year the laboratory has conducted a number of investigations in this connection.

Urea, for example, is one of the most attractive nitrogen-containing materials from the fertilizer standpoint, but at the present time its cost for such use is prohibitive. The laboratory has developed on a semi-technical scale a process for the production of urea from ammonia and carbon dioxide which seems to possess possibilities of ultimately yielding this material at fertilizer prices.

The laboratory is making a rather extensive study of the chemistry of cyanamide and its derivatives to open up this new and cheap source of numerous, useful compounds. During the past year methods have been developed for the production of free cyanamide (H_2CN_2) in quantity, for the production of urea from cyanamide on a semi-technical scale, and for the preparation of guanidine salts. Cyanamide derivatives which appear to have value as ingredients in explosives have also been studied and the results of the investigations communicated to the ammunition division, ordnance office, War Department. In addition, a theoretical investigation on the chemistry of cyanamide was made for the purpose of clarifying the chemistry of this large group of compounds. This investigation is being continued.

Numbering of Steels Referred to Engineering Standards Committee

After extended discussion of the problem involved in the numbering of steels, the conference called by the American Engineering Standards Committee, at the request of the Bureau of Standards, decided the matter could be handled better by a sectional committee of the American Engineering Standards Committee. For that reason no plan or program was adopted so that the sectional committee could consider the matter without limitations as to whether the classification be based on chemical analysis, heat treatment or physical tests.

It was the sense of the conference that there should be a uniform numbering system for forging, casting, structural, tool and other steels, including structural plates.

France and Switzerland are the only two countries which have given serious consideration to this problem, it was brought out, but it is believed something can be learned from the experience in those countries. It was the general opinion that a code of numbering would be useful only when based on definite specifications. It was suggested that the American Society for Testing Materials and the Society of Automotive Engineers be named as sponsors for the consideration of the problem.

Proposes Government Operation of Muscle Shoals

Representative Dickinson Introduces Bill to Form Federal Operating Company for Production of Explosives and Fertilizer—Farm Bloc Withdraws Support of Ford

A GOVERNMENT - CONTROLLED corporation to produce nitrate for war purposes and cheap fertilizer for farmers has been proposed as a solution of the Muscle Shoals problem by Representative Dickinson, Republican, of Iowa, a leader of the "farm bloc," who introduced a bill to put his plan into effect.

In a statement introducing the bill, Mr. Dickinson expressed the feeling that the general criticism to which the Ford offer has been subjected is so strong as to endanger the future disposition of the plant and that the importance of an early conclusion in this is a matter so grave that he is led to the conclusion that some plan of federal operation is the only solution that will insure early completion and operation for the production of farm fertilizer at the lowest possible cost.

Provisions of Bill

The bill provides that a government-controlled corporation, to be known as the Federal Chemical Corporation, to consist of five members, three to be appointed by the President, the two others to consist of the Secretary of War and the Secretary of Agriculture, shall be given full power to complete and operate the plant for the manufacture of fertilizer at the lowest possible cost, for distribution among the farmers, with further power to sell the excess water power under conditions, limitations and safeguards of the national water-power act.

The proposed bill will conserve the $100,000,000 of government funds invested in a nitrate plant at Muscle Shoals for future war-time needs, and during peace provide for the operation of the plant for the manufacturing of fertilizer.

Fertilizer is to be manufactured and sold without profit except a 4½ per cent interest charge on any additional funds necessary to complete and equip the plant for such purpose. No item of war expenditure to date has been converted to the needs of agriculture. The decline in soil fertility endangers our food production.

The placing of the Muscle Shoals plant in the hands of any individual tends to monopolize such production, besides putting in his hands immense water power of great value for manufacturing purposes.

Would Complete Dams

Dams on the Tennessee River contemplated in 1918 would be completed under Mr. Dickinson's bill, and surveys would be made for storage reservoirs. Wherever private interests benefit from the establishment of these reservoirs the bill stipulates they shall bear a proportionate share of their cost.

Another section of the measure provides that, subject to the approval of the President, the corporation be authorized to negotiate with the Alabama Power Co. to settle "the difficulties existing between the Government of the United States and the said power company by virtue of the joint ownership of the power plant at Gorgas, Ala., and it is authorized to sell the interest of the Government of the United States in said plant to the said Alabama Power Co."

Disposition of Plants

Nitrate Plant No. 1 under the plan would be remodeled to manufacture explosives and fertilizer, and Plant No. 2 would be used altogether for the production of fertilizer to be sold to consumers directly or through agencies in various parts of the country. The corporation also would be authorized to fix prices for fertilizer charged by private manufacturers who buy raw materials from the Muscle Shoals plant.

Discussion of Ford Offer Revived

The breach between Senate farm bloc members over the Muscle Shoals project was reopened last week in an hour's tilt between Senator Heflin, Democrat, of Alabama, who again urged acceptance of Henry Ford's development offer, and Chairman Norris of the Agriculture Committee, who opposed the Ford proposal.

Senator Heflin asserted, and Senator Norris denied, that Mr. Ford proposed to cut fertilizer prices in half if his offer for the power plant should be accepted. Senator Heflin scored the government development project in the bill of Representative Dickinson, and declared that the Norris government operation bill would block developments of power or fertilizer.

See Surrender of Farm Bloc

Representative Kearns of Ohio, member of the House Military Affairs Committee, commenting on the Dickinson bill, said:

"I note that Representative Dickinson, a member of the farm bloc of the House, has introduced a bill providing for government ownership and operation of the nitrate plants and part of the water-power projects at Muscle Shoals, Ala. This, the newspapers state, means that the farm bloc has abandoned its support of Henry Ford. I am glad the truth in regard to the so-called Ford offer for Muscle Shoals is finding the light.

"The advocates of the Ford offer urged the acceptance of it to save the government from government operation of the nitrate plants. The advocates of government operation of the nitrate plants urged scheme to save the government from endowing Henry Ford with a government subsidy.

"Neither course is necessary. Congress has already provided sufficient funds to carry on the work of completing the Wilson Dam at Muscle Shoals up to September, 1923. Doubtless a further appropriation will be made by this Congress, available within the next fiscal year. That is all that need to be done about Muscle Shoals.

Should Wait for Water Power

"Very important experiments on a commercial scale in the manufacture of fertilizer materials are now going on under scientific leadership here and abroad. It is practically a certainty that long before the Wilson Dam can be completed scientific knowledge in relation to the production of atmospheric nitrogen will be tremendously advanced. This is no time to make plans for nitrogen fixation which could not in any case be carried out for 3 or 4 years. Any plans made now would quite likely be utterly obsolete by the time the power becomes available through the completion of the dam.

Ford Proposal Unfair

"The Ford propagandists have been diligent in getting to the public statements relative to the making of fertilizer at Muscle Shoals, but in none of these statements that I have read or heard have they told the farmers the truth about the Ford offer. Mr. Ford's proposition does not guarantee the manufacture of fertilizers, but he does have in mind, if he should get these properties and a hundred-year lease of the water power at Muscle Shoals, the carrying on of a gigantic manufacturing plant for his own selfish purposes. I cannot bring myself to believe that the government ought to finance his scheme for him. I do not believe he ought to be given something that no other man or set of men can be given in the United States. My only object in opposing the Ford offer is to call the attention of the public to the true facts, and whenever the country knows the truth in connection with the Ford offer I do not believe there will be one fair-minded and unprejudiced man in the entire United States who will say the Ford offer ought to be accepted."

Chemical Engineers Oppose Licensing Measures

At the Richmond meeting of the American Institute of Chemical Engineers held Dec. 6 to 9, the following resolutions were passed:

Resolved, That the American Institute of Chemical Engineers reiterates its opposition to the licensing of chemical engineers and to the activities of those agencies that are fostering this movement. And be it further

Resolved, That the American Institute of Chemical Engineers encourage and lend its moral support to legitimate efforts to defeat or repeal such legislation as far as chemical engineers are concerned.

G. E. Co. Establishes Prizes for Electrical Advances

Charles A. Coffin Foundation Will Furnish Rewards for Service and Inventions in Electrical Field

Prizes to encourage and reward service in the electric field will be given annually, it is announced by the General Electric Co., from the income of a $400,000 fund in honor of Charles A. Coffin, who founded the company.

The foundation will be controlled and administered by a foundation committee appointed by the board. This committee, within the limits of the purposes for which the foundation is created, will have power to change the conditions applicable to the distribution of the fund and the amounts for each particular purpose.

The income of the foundation will be distributed in four ways—to employees of the General Electric Co., public utility companies, electric railway companies and American technical schools.

To Reward Employees

Eleven thousand dollars in prizes will reward the most signal contributions by employees of the General Electric Co. toward the increase of its efficiency or progress in the electrical art. Particularly, the prizes are to further encourage suggestions from workmen. With each prize the company will give a certificate of award. Foremen's prizes are to be awarded for the best department, taking into account its appearance, efficiency of operation and conditions which add to the better conduct of the work and the welfare of the employees.

Recognition for Public Utilities

A gold medal, to be known as the "Charles A. Coffin Medal," will be awarded annually to the public utility operating company within the United States which, during the year, has made the greatest contribution toward increasing the advantages of the use of electric light and power for the convenience and well-being of the public and the benefit of the industry. The company receiving the medal will also receive $1,000 for its employees' benefit or similar fund.

A gold medal, to be known as the "Charles A. Coffin Medal," will be awarded annually to the electric railway company within the United States which, during the year, has made the greatest contribution toward increasing the advantages of electric transportation for the convenience and well-being of the public and the benefit of the industry. The company receiving the medal will also receive $1,000 for its employees' benefit or similar fund.

To Aid Technical Students

Five thousand dollars is to be awarded annually for fellowships to graduates of American colleges and technical schools who, by the character of their work and on the recommendation of the faculty of the institution where they are studying, could with advantage continue their research work either here or abroad; or some portion or all of the fund may be used to further the research work at any of the colleges or technical schools in the United States. The fields in which these fellowships and funds for research works are to be awarded are electricity, physics and physical chemistry. A committee appointed by the foundation committee will award such fellowships and funds for research work, with the advice and co-operation of a committee of three, one to be appointed by each of the following: National Academy of Sciences, American Institute of Electrical Engineers, Society for the Promotion of Engineering Education.

This committee is to be known as the Charles A. Coffin fellowship and research fund committee and the fellowships are to be known as the Charles A. Coffin fellowships. The expenses of the committee are to be paid out of the income of the foundation.

Charles A. Coffin

On May 16, 1922, Charles A. Coffin, in his seventy-eighth year, retired from the active leadership of the General Electric Co. Mr. Coffin has been identified with the development of the electrical industry since 1882. He was the founder and creator of the General Electric Co., of which hs has been the inspiration and leader for 30 years.

Dr. Rosenhain's Lecture Tour in America

Dr. Walter Rosenhain, head of the metallurgical department of the National Physical Laboratory (that British institution corresponding somewhat to the American Bureau of Standards), and widely known for his erudition, will tour the Eastern states during February and March, 1923, lecturing before various universities and educational organizations. His itinerary, as at present arranged, follows:

Lehigh University, Bethlehem, Pa., Feb. 14 to 16; Franklin Institute, Philadelphia, Feb. 15; American Institute of Mining Engineers, annual meeting, New York, Feb. 19 to 23, where he will speak at the banquet, Feb. 21, and deliver the second Institute of Metals lecture on Feb. 20 or 21; Columbia University, New York City, Feb. 23; Yale University, New Haven, Conn., Feb. 26 to 28; Waterbury, Conn., March 1 and 2; Providence, R. I., March 3; Massachusetts Institute of Technology, Cambridge, Mass., March 5, 6 and 7; Schenectady, N. Y., March 8 and 9; Rome or Corning, N. Y., March 10; Case School of Applied Science, Cleveland, March 12 and 13; Detroit, Mich., and Ann Arbor, Mich., March 14 to 19; University of Illinois, Urbana, Ill., March 20 to 22; Chicago, Ill., March 23 and 24; Toledo, Ohio, March 26; Huntington, W. Va. (International Nickel Co.), March 27; Charleston, W. Va., March 28; Pittsburgh, Pa., March 29 and 30; Washington, D. C., March 31 to April 4 or 5; New Haven, Conn., dedication meeting of the American Chemical Society.

The subjects of his lectures are as follows: Hardness and Hardening; The Structure and Constitution of Alloys; Strain and Fracture in Metals; Aluminum Alloys; Metallurgical Research at the National Physical Laboratory.

The subject of the second annual lecture before the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineering is to be entitled "Solid Solutions," with which he expects to deal on theoretical and fundamental lines.

Before the Franklin Institute, he will deliver the second lecture above, "The Structure and Constitution of Alloys," under which title he expects to deal with the constitutional or equilibrium diagrams of alloy systems, their experimental determination and their full interpretation.

Which of the other lectures will be given at the other dates cannot be stated. Engineers who wish to attend any of these lectures given near their home will do well to communicate with W. M. Corse, National Research Council, Washington, D. C.

Materials of Construction Topic Planned for A.C.S. Meeting

A symposium on "Materials of Chemical Equipment Construction" is being planned for the spring meeting of the American Chemical Society by the Industrial Division. The literature upon this subject is so widely scattered that in many cases much time must be spent in duplicating work which has already been done. The symposium will tend to bring together such matter for which chemists are constantly in search. Philip A. Singer, of the Singer-Perlstein Co., Chicago, Ill., will act as chairman of this symposium.

The subject matter of the symposium will cover woods, metals, vitreous materials, coatings, rubber, fabrics, etc. All of these headings will deal with the resisting properties to acids and alkalis, their resistance to temperature, oxidation characteristics, cost, chemical composition, etc.

Prospects Bright for Helium Development

After having listened to extended testimony with regard to the helium situation, the Committee on Public Lands of the House of Representatives on Dec. 14 closed its hearing on the bill providing a comprehensive helium program. It is very apparent that the committee is favorably inclined toward the measure. In addition to the testimony of R. B. Moore, chief chemist of the Bureau of Mines, and of the helium specialists in the army and navy, a representative of the American Investment Corporation, which is interested in the commercial airship, testified. Each of the witnesses sought to prove that helium is essential to the development of lighter-than-air craft, either for military or commercial uses.

Meeting of Chicago Section, American Ceramic Society

Proposed Ceramic Course at New Crane Junior College and Technical Man's Status in Production Discussed

Nearly seventy members of the Chicago Section, American Ceramic Society, attended the annual meeting which opened with a luncheon at the Morrison Hotel, Saturday, Dec. 2. It is not possible to attribute the large attendance entirely to the fact that a handsome pottery lamp base was to become the property of some lucky member, for the enthusiasm continued unabated even after C. A. Underwood's name had been drawn from the hat. The proposed course in ceramics at the new Crane Junior College is a subject which is of direct interest to every ceramic man and the technical program presented many interesting and instructive features.

Officers for the ensuing year were elected as follows: Chairman, B. T. Sweely; vice-chairman, W. W. Wilkins; secretary-treasurer, H. E. Davis; councilor, C. W. Parmelee.

Proposed Ceramic Course

Facilities for technical education in ceramics are increasing every year, but so far there has been little attempt in this country to provide training for craftsmen in the industry. It is felt that a course in ceramics in some of the technical secondary schools would prove of great value in arousing interest in the ceramic industries. Some of the young men might wish to pursue their studies further along this line at the universities, while others might seek employment with ceramic plants, where their training would be of benefit not only to themselves but to their employers as well.

A. Meyer, assistant principal of the new Crane Junior College in Chicago, has made a thorough study of the whole situation and is most enthusiastic over the possibility of establishing a course in ceramics in this school. In his address he pointed out how such a course would fit in very nicely with the curriculum and stated his belief that the appropriation could be obtained without difficulty if the matter were presented to the proper authorities. After a number of members had brought out the value of such training from different points of view, it was resolved to appoint a committee to draw up appropriate resolutions urging the establishment of this course, and to bring the matter to the attention of the proper officials of the Chicago Board of Education. The committee consists of H. T. Bellamy, chairman; G. G. Lawson and H. C. Beasley.

The paper on the design and construction of a new enamel smelter which was presented by H. E. Davis, of the Northwestern Terra Cotta Co., is of considerable interest and is abstracted on page 1211 of this issue.

Defects to which enameled steel ware is subject were discussed by B. T. Sweely, of the Cribben & Sexton Co., manufacturer of stoves and ranges. The importance of proper pickling conditions was stressed and recommendations were made for the proper application of the ground coat. Mr. Sweely stated that flat ware should never be burned to exceed 1,600 to 1,625 deg. F. if the steel is to be kept straight. With hollow ware, temperatures of 1,700, 1,750, 1,800 or even up to 1,850 deg. F. may be used. He attributed fish scaling to a condition where the coefficient of expansion of the enamel is lower than that of the steel. While this is by no means the only factor, it is a very important one and this trouble can be largely overcome by having the expansivity of the enamel equal to or greater than that of the steel.

Incidents from actual experiences were used most effectively by E. O. Herman, of A. D. Little, Inc., to show how the technical man may be of greater value to the production department.

Co-operation Between Plant and Laboratory

In general, the production man is chiefly interested in more pieces and lower costs, while the laboratory technical man is concerned with quality. Unfortunately in many cases the two types of men cannot understand each other because they really speak different languages, and often little attempt is made to view problems from the standpoint of the other man. Co-operation in such cases is obviously difficult, if not impossible.

There is an opportunity for a technical man with the proper training to act as interpreter between the research or laboratory man and the production man. Endless tact and patience are required for such work, but it results in proper recognition of the value of the technical department by the production and sales departments and thus reacts for the good of the whole organization. Necessary steps in obtaining recognition were summarized as contact, conference, confidence and co-operation.

Mr. Herman also pointed out the importance of going out after problems so that the technical control will function as a preventive and not only as a curative agent. The accounting department and salesmen's meetings offer fertile fields for discovering worthwhile problems. In order to accomplish these results, however, it will be necessary for the technical man to study many subjects, particularly those relating to the non-technical phases of business.

New Paint Plant of Pittsburgh Plate Glass Co. Nearly Complete

The Pittsburgh Plate Glass Co. is completing in Milwaukee, Wis., the first unit of what will be the largest single paint and varnish plant in the United States, Ludington Patton, vice-president of the company, asserts. All the scattered paint and varnish laboratories of the company will be consolidated at Milwaukee.

Determination of Dye Strength Standards Delayed by Lack of Funds

Work of the interdepartment committee of chemists appointed to determine for the Treasury Department the commercial standards of strength of dyes in use prior to July 1, 1914, which is to be the basis for the assessment of import duties under the new tariff act, has been delayed owing to the difficulty of obtaining some of the old samples and because of the slowness of Congress in authorizing an appropriation for extension of the Customs Division's laboratory at New York.

This work, however, is expected to be finished early in the new year, at least so far as affects the colors which are imported in large quantities. Dyes which were imported in single strength prior to July 1, 1914, but now are imported in double concentrations will be assessed for duty at twice the rates mentioned in the tariff act. The committee in charge of determining standards of strength is composed of Dr. G. W. Knight, chemist in charge of the New York customs laboratory; Peter Feiberger, specialist in dyes attached to that laboratory for special assistance in administering the new tariff on coal-tar products; W. A. Watson, color specialist of the chemical division of the Tariff Commission, and G. Appell, of the chemistry division of the Bureau of Standards.

The Customs Division is working on permanent regulations for the administration of the coal-tar rates. One of the important clauses which has received tentative approval for these regulations is that whenever a color which has been imported as non-competitive, thus paying duty on United States selling price, is found to be competitive with a domestic product, which would cause the higher American value to be assessed under the law, 30 days' notice of this fact shall be given importers in order that imports in transit may be entered before the higher rate becomes effective. This tentative decision has been reached on the ground that such a change would be one of classification and not of appraisement, and changes of classification affecting rates for many years have been given 30 days' notice by the Treasury Department.

To Protest Freight Rate on Empty Carboys

Empty carboys should take a lower freight rate than loaded carboys, in the opinion of the traffic committee of the Manufacturing Chemists' Association, but before filing a formal complaint to secure such an adjustment in rates, the committee will await a report from the carboy test committee, which now is conducting experiments in loading and packing. At present returned empty carboys take a higher classification than do the loaded carboys. The committee voted to recommend a petition for the reduction of the carload minimum of 24,000 lb. on empty returned carboys, to 17,000.

Photography Holds Floor at Rumford Hall

Four Papers on Various Phases of the Art and Its Application Presented at Joint Meeting

Friday, Dec. 15, was photographic night at the Chemists' Club auditorium, when the Society of Chemical Industry held a joint meeting with the Technical Photographic and Microscopical Society and heard four excellent papers on photochemistry, color photography, motion pictures and the application of microscopy and photomicrography to the paint and rubber industries.

Dr. A. B. Hitchins, of the Ansco Co., was the first speaker and made some informal remarks on the importance of motion pictures to industry. He emphasized the value of the cinematograph in motion study, in sales promotion, general publicity and educational work. One of the most interesting points brought out by the speaker was his mention of a motion picture history which is now being compiled.

Photographic Emulsions

"Photochemistry and Photosensitive Material" was the subject of a paper by F. F. Renwick, of E. I. du Pont de Nemours & Co. He described briefly the process of manufacturing photographic emulsion by adding a solution of silver nitrate to a solution of potassium bromide, iodide and gelatine. After mixing, the emulsion is ripened—that is, maintained at a definite temperature for a definite time, during which period the grains of silver bromide grow and their sensitiveness increases. The emulsion is then allowed to solidify and is pressed through a die by a hydraulic ram, forming shreds which are washed in cold water, drained and then remelted. A small amount of chrome alum is added to act as a hardener and the emulsion is coated on the film.

This is the process in a few words but, simple as it sounds, it is one of the most complicated and least understood manufacturing processes in industrial chemistry. A slight variation in the temperature or time of digestion, size of grains, quality of gelatine or other raw material, age of emulsion or the extent of the washing to remove soluble bromides, all exert a tremendous influence over the quality and properties of the finished product. The speaker emphasized the importance of obtaining exactly the right grade of gelatine and stated that it is impossible to obtain American-made gelatine which is as satisfactory as the imported material. Mr. Renwick showed some slides illustrating the apparatus used in the large-scale manufacture of emulsions and concluded his talk with some illustrations showing the value of dyes as sensitizers.

Color Measurement

Dr. Herbert Ives presented a talk on color measurements, treating it from two standpoints—the artistic and the physical. Considered from the artistic standpoint, it is a hopeless task to attempt to duplicate in photography the thousands of colors that exist in nature. Dr. Ives explained briefly how, by means of three dimension co-ordinate charts, any shade may be resolved into its constituent primary colors and synthesized.

The value of the microscope in industrial problems was brought out in a paper by Henry Green, of the New Jersey Zinc Co., who described the newly developed product known as 1-A zinc oxide, which is used as a pigment filler in rubber and paint. This grade of zinc oxide is so finely subdivided that it is really in a class by itself, only gas black being of a degree of subdivision to compare with it. Mr. Green showed a number of slides which illustrated very graphically the remarkable degree of subdivision which has been obtained in this pigment, and showed by tests on automobile tires how it improves the quality of the rubber in which it is used. He also discussed the relation of pigment size to the hiding power and plasticity of paints.

Badische Plants Closed by Strike

All the works of the Badische Anilin und Soda Fabrik at Ludwigshafen and at Oppau are closed as a result of a strike which throws about 22,000 men out of work. It is reported that a number of workmen in other industries in Ludwigshafen have begun a sympathetic strike, but their efforts to make it general have so far failed. Mannheim, up to the present, is free from strikes. Statements that the movement is Communistic are made in pan-German circles, but should be received with caution. The strike in the aniline works originated owing to the refusal of the management to reinstate three dismissed members of the workmen's council.

Arsenic Situation Clarified

(Continued from page 1234)

cents and sell calcium arsenate in the South for 14 cents, but with 10-cent arsenic and 14-cent calcium arsenate the manufacturer should be able to make a legitimate profit.

Producers to Increase Output

Hamilton M. Brush gave some high spots in the history of the arsenic industry as viewed by the largest single producer. From 1910 to 1913 arsenic was purely a byproduct and was sold or given away in order to get it out of the plant. The price then was about 3 cents per pound. It is not until the price gets up to 6 or 7 cents that any arsenic can be recovered at a profit and it is only after the price is up to 10 cents that the smelter can begin to make money. The present production of the American Smelting & Refining Co. is about three times what it was in 1911 and twice what it was last year. Sales in 1922, which were six times those of last year, averaged 7½ cents a pound. However, the sales record, both as to volume and price, showed tremendous fluctuation from month to month, making it practically impossible for the producer to predict either market or price. He expressed the belief that if it were possible to stabilize the arsenic market at a price somewhere between 8 and 10 cents per pound, it would be possible for the producing interests in this country to take care of any possible demand from the insecticide manufacturers. Mr. Robertson, of the United States Smelting & Refining Co., confirmed Mr. Brush's statement as far as his own company was concerned. Their production is now sold up to June, 1923, and average sales have been at 8.30 cents. A representative of the American Metals Co. stated that its production in Mexico at one time had varied between 200 and 500 tons per month.

For the purpose of preparing a summary of the meeting to be given out to the press and also to act as a co-operative agency to work with various governmental departments, the following standing committee was appointed by the chairman: B. R. Coad, of the Department of Agriculture; George F. Loughlin, of the U. S. Geological Survey; H. M. Brush, of the American Smelting & Refining Co.; F. Y. Robertson, of the U. S. Smelting & Refining Co.; R. N. Chipman, of the Chipman Chemical Engineering Co.; Frank Hemingway, of the Sherwin-Williams Co.; O. A. Hasse, of the Glidden Co., and W. O. Tuck of the Corona Chemical Co., representing the Pittsburgh Plate Glass Co.

Bureau of Standards Trying to Eliminate Waste

(Continued from pgae 1235)

than pay the cost of many research institutions as large as the Bureau of Standards for a number of years.

New Divisions

Two new divisions, the work of which is of great interest to the public, have been added during the year. The first is the Division of Building and Housing, while the second is that of Simplified Practice.

The Division of Simplified Practice is working in close co-operation with American industries to eliminate useless sizes of the commonly used industrial products and is directing the attention of manufacturers to the advantages of concentrating on the sizes and types in greatest demand.

The variety of the bureau's work is indicated by the fact that its report covers, besides those activities just mentioned, investigations in the fields of weights and measures, electricity, heat and thermometry, optics, chemistry, engineering physics, structural, engineering and miscellaneous materials, metallurgy and ceramics.

Association for Advancement of Science Plans Meeting

The Boston meeting of the American Association for the Advancement of Science, to be held Dec. 26 to 30, promises to be of considerable interest to chemists. There will be an extensive symposium on the progress of chemistry in which some noted chemists will take part. In addition, there will be a symposium on photochemistry and photochemical reactions. The American Physical Society has invited the visiting chemists to attend a symposium upon ionization potentials and atomic radiation. The meetings will begin Wednesday at 9 a.m. in the Massachusets Institute of Technology, and will continue until Friday evening, or possibly until Saturday. The titles of the papers to be presented in the symposia are given below. In addition to these papers there will be a considerable number of reports upon research work in progress in different institutions.

PHOTOSYNTHESIS AND PHOTOCHEMISTRY

Thursday afternoon will be devoted to the symposium on photochemistry and photochemical reactions. Among the speakers scheduled are S. E. Sheppard, of the Eastman Kodak Co., and H. A. Spoehr, of the Desert Laboratory.

PROGRESS OF CHEMISTRY

The symposium on the progress of chemistry will extend over all three days. The program follows:

"Compressibilities and the Size of Atoms," by T. W. Richards, Harvard University.

"Proteins and the Theory of Colloidal Behavior," by Jacques Loeb, Rockefeller Institute.

"X-Rays," by William Duane, Harvard University.

"X-Rays and Crystal Structure," by George L. Clark, Harvard University.

"The Chemistry of Volcanic Action," by A. L. Day, Geophysical Laboratory.

"Chemistry at the Fixed Nitrogen Laboratory," by F. G. Cottrell, director of the laboratory.

"The Chemistry of the Photographic Process," by C. E. K. Mees, Eastman Kodak Co.

"The Properties of Elements and of Groups of Elements in an Electronegative Condition, With Reference to the Constitution of the Metallic Compounds," by C. A. Kraus, Clark University.

"Changes in Volume During the Solution of Solids," by Gregory P. Baxter, Harvard University.

"International Critical Tables," by E. W. Washburn, National Research Council.

"The Present Status of the Theory of Complete Ionization," by D. A. MacInnes, Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology.

"The Present Status of the Theory of Incomplete Ionization," by James Kendall, Columbia University.

"Ionization Potentials and Chemical Action," by W. A. Noyes, Jr., University of Chicago.

"The Separation of Isotopes," by R. S. Mulliken, University of Chicago.

"The Structure of Atoms and the General System of Isotopes," by William D. Harkins, University of Chicago.

The members of Section C are invited to attend a symposium on "Ionization Potentials and Atomic Radiation," to be held by Section B. The speakers are Paul D. Foote, K. T. Compton and Henry Norris Russell.

On Friday evening the section will be entertained at a smoker to be given by the Northeastern Section of the American Chemical Society.

German Potash Prices Jump 145 Per Cent in Month

According to cable advices received by the Department of Commerce, German potash prices effective Dec. 1 were approximately 145 per cent higher than those of Nov. 1.

November potash deliveries were stimulated by impending increases in price and freight rates, which increases became effective Dec. 1. Export sales also increased, and orders were received from countries which had not been previously purchasing.

A decreased demand for coal-tar dyes is reported for the month of November.

Personal

Prof. DUFF A. ABRAMS, head of the Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill., gave an interesting address on the subject of "Some of the Subtle Properties of Concrete," at a meeting of the Engineers' Club, Trenton, N. J., Dec. 7.

R. L. AGASSIZ, president of the Calumet & Hecla Mining Co., New York, and Calumet, Mich., has been elected president of the Copper and Brass Research Association.

C. H. BRANDES is returning to New York the latter part of December after a 4 months' business trip in Europe.

GELASIO CAETANI, recently appointed Ambassador from Italy to the United States, expects to arrive about Dec. 20. He has accepted the proposal of the American Institute of Mining and Metallurgical Engineers to give a dinner in his honor at a convenient date after his arrival.

M. G. DONK, for the last 2 years a chemist connected with Edgewood Arsenal and previous to that time connected with several large private chemical works, has been added to the staff of the chemical division of the Tariff Commission. He will specialize in heavy chemicals. The Tariff Commission also has added to its chemical division Mrs. FLORENCE BURLINGAME, who for several years was a chemical research assistant employed by the War Trade Board. She will have charge of the chemical statistical work of the Tariff Commission.

ELLERY K. FILES, who has been connected with the pyroxylin department of the Duratex Co. of Newark, N. J., has just been appointed manager of that company's rubber department.

Dr. KUNO B. HEBERLEIN will return to New York the latter part of this month after a 2 months' business trip to England.

FRANK W. MCSPARREN, Cornell '14, formerly with the National Aniline & Chemical Co. and the du Pont company, has joined the chemical division of the U. S. Tariff Commission.

Dr. WALTER ROSENHAIN expects to arrive in America early in February and will remain about 2 months. His itinerary and titles of his lectures are given elsewhere in this issue.

THOMAS W. STREETER, vice-president of the American International Corporation, has been elected chairman of the executive committee of the Simms Petroleum Co., 120 Broadway, New York.

W. E. SYMONS, treasurer of the American Welding Society, New York, has resigned.

ALBERT THOMAS, director of the International Bureau of Labor, Geneva, Switzerland, arrived in this country on Dec. 12, and is now touring the principal cities of Canada and of the United States as far west as Chicago. He expects also to visit Havana. On Jan. 19 he will address the New York Conference of Business Paper Editors.

Obituary

Dr. HERBERT CLARK EMERSON, 57 years old, president of Springfield Hospital, war-time fuel administrator of Springfield, former member of the board of health and health physician of the city, an analytical and consulting chemist, died recently at his home.

SPENCER B. NEWBERRY, president of the Sandusky Portland Cement Co., Sandusky, Ohio, died at Cleveland, Nov. 28, at the age of 65.

JAMES REAVEY, for more than 20 years assistant chemist for the San Francisco board of public works, died recently at the Morton Hospital, San Francisco.

PETER D. THROPP, of Trenton, N. J., head of the Trent Rubber Co., the Eureka Flint & Spar Co. and a number of other prominent local companies, died at his residence recently from a stroke of paralysis. He is survived by his wife, a son, a daughter and three brothers.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Facts and Figures of the Arsenic Shortage

Government Estimates of Existing Stocks, Production and Manufacturing Requirements—Causes of Present Shortage and Possible New Sources of Supply

AT THE conference of the producers and users of arsenic held in New York, Dec. 13, George F. Loughlin, of the United States Geological Survey, gave a valuable report on the arsenic situation. According to the estimate of V. C. Heikes of the Salt Lake City office of the Survey, the production of refined and crude arsenic during the current year amounted to 10,947 short tons. The sales of crude arsenic amounted to 1,366 tons. All the crude arsenic sold was used in making sodium arsenate, a weed killer, either at the place of manufacture or at places nearer the consumer. The production of refined white arsenic having a purity of 99.5 per cent or more amounted to 9,581 tons, valued at $1,486,000, or 7¾c. a pound. The stocks of domestic arsenic on hand Oct. 1 were reported as 1,230 tons, and the quantity to be made between Oct. 1 and May 1, 1923, was estimated at 3,400 tons.

Supplementing this report, C. R. DeLong, of the Tariff Commission, stated that during the first 9 months of 1922 the imports of all forms of arsenic into the United States amounted to 3,500 tons, of which 2,600 tons was received prior to July 1. The difference, 900 tons, represents the proportion of imports which has not yet entered into consumption. Mr. DeLong also reported that late consular dispatches from Japan indicated there were no stocks on hand and that current production, which is proceeding at a rate of 130 tons per month, is under contract until April, 1923. Nor were either Spain or Mexico in a position to furnish any appreciable quota of arsenic, according to Mr. DeLong's statement.

Domestic Producers

Six Western smelting plants that handle copper and lead ores and are equipped with arsenic refineries made white arsenic, crude and refined, in 1922. The American Smelting & Refining Co., which operates the plants at Globe, Colo., and Tacoma, Wash., reported the largest output. The Anaconda Copper Mining Co. had some difficulty in getting sufficient labor to operate at greater capacity its ore-reduction plants at Anaconda, Mont., but reported the second largest output of refined arsenic and the largest output of unrefined arsenic. At the plant of the United States Smelting, Refining & Mining Co. at Midvale, Utah, the output consisted of refined white arsenic, of which a normal quantity was sold. All the company's crude material was worked up into sodium arsenite solution, many thousands of gallons of which was distributed to railroad companies for killing weeds on rights of way. This weed killer is also made in large quantities by the Chipman Chemical Engineering Co., which purchases crude arsenic for shipment to several of its plants in Eastern and Western states.

Wide Fluctuations in Price

But few commodities in the chemical market have shown as radical price variations as has been the case with

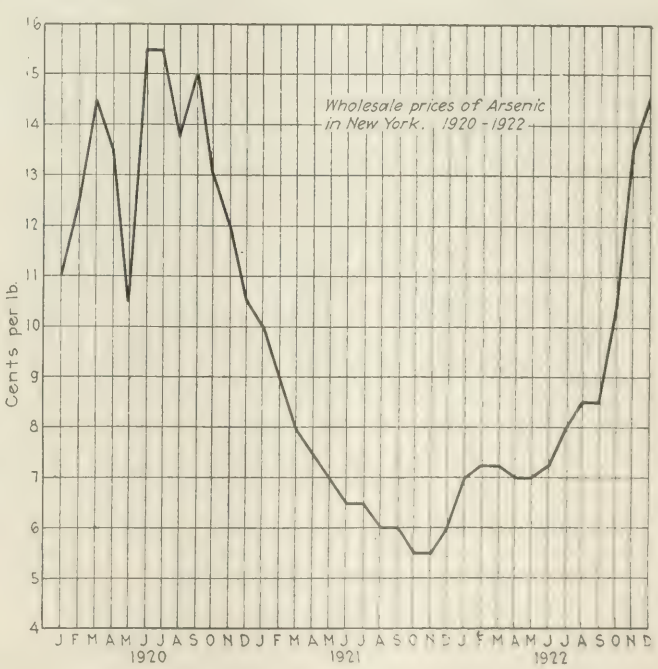
"Chem. & Met." Weighted Index of Chemical Prices

Base 100 for 1913-14

This week	168.73
Last week	161.72
December, 1921	145
December, 1920	245
April, 1918 (high)	286
April, 1921 (low)	140

The marked advance in this week's index resulted largely from the 25 per cent increase in the price of methanol—from $1 to $1.23 per gallon. Other important commodities to show increases were ammonium sulphate, formaldehyde, aniline and linseed oil.

Production and Imports of White Arsenic 1910-1922
Production
Imports
Thousands of Tons
Year
1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922



white arsenic. The fluctuations since 1920 are shown in the accompanying chart. During 1922 the range has been from 6c. per pound in January to 15½c. in December. In July the price was 7⅜c. per pound, but in August it suddenly jumped to 8½c., just as the manufacturers of insecticides decided to buy, and it rose rapidly until December. The average price per pound to consumers, however, seems to have been between 7 and 7⅜c., and the maximum price for wholesale lots is understood to have been 8½c. Contracts were said to have been made in October for German and Japanese arsenic, to be delivered in November and December, at 9½@10c. a pound, but dealers predict still higher prices at the beginning of the insecticide season next spring. Lead arsenate, as paste, was quoted at 8@14c. a pound. Red arsenic was quoted at 12 @13c. a pound, and the quotations on calcium arsenate ranged from 11 to 20c. a pound and at the end of November, 10 to 12c. was bid. Elemental arsenic was quoted at 17c. a pound.

Increased Consumption Indicated

In 1922 about five times more lead arsenate was made than all the other arsenical compounds put together, including calcium arsenate, paris green and bordeaux mixture. The reports indicate, however, that during the period from Oct. 1, 1922, to May 1, 1923, the output of calcium arsenate will be larger and that of lead arsenate may be somewhat smaller than heretofore. The makers of plate glass bought their usual quantity of refined arsenic, about 1,000 tons.

The use of arsenic in the United States and abroad in weed-killing compounds has increased during the last year. In the Southern states the cotton boll weevil is being fought with calcium arsenate, of which about 8,000 tons was distributed to the cotton growers in 1922. According to reports received at the Delta laboratory of the United States Department of Agriculture at Tallulah, La., no calcium arsenate remained in the warehouses after September. Dr. B. R. Coad, in charge of that laboratory, reports that the demand for calcium arsenate in 1923 is expected to be twice as great as in 1922. The use of arsenic as a larvacide in mosquito-control work is being extended in the malarial region of the South.

Cause of Shortage of Supply

Though the unusually large demand for arsenical compounds for use as insecticides is doubtless the principal cause of the shortage of arsenic, there are a number of other causes. Among these are the reduction in the quantity of copper ores treated at Anaconda, Mont., and at Tacoma, Wash., the small supply of arsenical dust from the lead smelters in Montana, Utah and Colorado, and the decrease in the imports from Canada, Japan and Mexico. The present demand for arsenic amounts to 12,000 short tons a year, whereas the supply available in 1921 from both domestic production and imports amounted to only 6,455 tons.

Some New Developments

The arsenic plants at smelting works in the United States have an annual producing capacity of 18,300 tons of white arsenic, but their actual output must depend largely on the plans of two smelting companies that contemplate reducing ores and speiss directly for their content of arsenic. At Toulon, near Lovelock, Nev., arsenical ores were reported to have been successfully treated and to have yielded some white arsenic in 1922. The owners of this plant expect that it will produce considerable arsenic in 1923. The American Arsenic Co., at Gold Bar, Wash., was producing red arsenic (realgar) in commercial quantities in 1922, according to a report from the company's engineer. The milling plant on the property has been equipped with a flotation unit and turns out over a ton of powdered realgar a day. The Salt Lake Insecticide Co. is erecting at Salt Lake City a plant for making arsenical compounds directly from ore. The owners estimate that the plant will make a daily output of about 15 tons of calcium arsenate. All the ore to be treated is to be mined at Gold Hill, Utah, from the largest known deposit of basic iron arsenate in the United States.

Wood Chemicals Quoted at New High Levels in the New York Market

A 25 Per Cent Advance on Methanol and a Corresponding Increase on Formaldehyde Feature an Otherwise Colorless Market

PRODUCERS of methanol announced another sharp advance in prices, due, it was stated, to higher producing costs in the face of an increasing demand. The new level represents the highest price of the year and shows a net gain of 62c. per gal. since January, 1922. Along with the advance in alcohol came a corresponding rise in formaldehyde. Prices showed a gain of 1¾c. per lb. and brought the price up to the highest level of the year. The producers report a well sold up condition at the works and all indications point to even a higher market before the turn of the year.

Heavy Chemicals Show Firmness

Trading, in general, was along moderately active lines, probably on account of the approaching holiday season and inventory period. Prices throughout the list, however, showed every sign of firmness, and leading producers were convinced that the new year will bring higher prices on many commodities. White powdered arsenic continued along former strong lines without any evident sign of relief. Spot supplies are very scarce and producers report they are heavily sold ahead through April and May, 1923. Imported material has been quite slow to arrive. Although barium chloride, prussiate, bichromates, permanganate of potash, oxalic acid and nitrite of soda have undergone very little change, prices are fractionally easier in several instances. The alkali market remained quotably unchanged during the interval.

High Spots in the Market

Alcohol—Several large producers announced a new increase in methanol. The 95 per cent product is quoted at $1.23@$1.25 per gal. in barrels, with 97 per cent held around $1.25@$1.27 per gal. Demand is very strong. Denatured and ethyl remain quotably unchanged.

Arsenic—Round lots on spot are exceedingly difficult to locate. Several odd-lot transactions were reported among second hands at 14¾@15c. per lb. Goods afloat were heard around 14¾c. per lb. The two leading producers announced that their production was under contract at prices considerably less than 10c.

Bichromate of Soda—Prices remained unaltered during the week at 7⅞@7½c. per lb. on spot. Contracts for 1923 were quoted around 7½c. per lb. f.o.b. works.

Carbonate of Potash—A slightly easier market prevailed in the calcined 80-85 per cent material. Quotations ranged around 5¾c. per lb. Hydrated 80-85 per cent was somewhat firm at 7c. per pound.

Caustic Potash—Demand has slackened considerably and prices were fractionally lower on spot. Imported 88-92 per cent goods were quoted at $6.25 per 100 lb. Shipments were at the same level.

Caustic Soda—The export market showed signs of easing off, due to the lack of interest. Standard brand goods were held around $3.50@$3.60 per 100 lb. Domestic material continued quite firm at $3.75@$4 per 100 lb. ex-store. Producers quote contracts at $2.50 per 100 lb., basis 48 per cent f.o.b. works, carload lots. Demand for contracts was reported very strong.

Fluoride of Soda—Imported material was quoted down to 9c. per lb. Lack of interest from consumers and competition were directly accountable for the low figure.

Formaldehyde—Large producers announced a new price of 16c. per lb. in carloads and 16½c. per lb. for lesser quantities f.o.b. works. Higher producing costs were responsible for the latter advance. Resale lots were around the market at 15c. per pound.

Permanganate of Potash—An easier tendency featured this market and prices were quoted down to 15c. per lb. on spot. The general range was around 15@16c. per pound.

Sal Ammoniac—Several sales for

white granular were recorded at 6½c. per lb. on spot. Gray material continued quite scarce at 8¼c. per lb. Domestic producers quote the white material at 7¼c. per lb. and the gray at 7⅞c. per lb. f.o.b. works.

Coal-Tar Products

Coal-tar crudes and intermediates continued along moderately active lines and producers were very optimistic regarding the general volume of business transacted. Spot supplies of toluol and benzol were practically inexistent and producers report a heavily sold up market. Manufacturers of cresylic acid reported material sold up as far ahead as March, 1923, and refused to quote for shipment. Phenol, aniline oil, beta naphthol and salicylic acid are showing considerable activity and prices continued very steady.

Prices Advance in Firm Market at St. Louis

Volume of Business Slackening Off, However, as Inventory Season Approaches

St. Louis, Mo., Dec. 14, 1922.

Further advances in prices on a number of the more important chemicals have taken place since our last report, and in general the market has maintained the very firm tone which has prevailed for some time. The activity of the market is about the same as it was 2 weeks ago; however, a slackening off in business would not prove at all surprising, as it is generally expected at this time of the year which is influenced by the approach of the inventory season.

Alkalis Keenly Competitive

Keen competition for business has shown its effect in the alkali market by a decline in prices. Both *caustic soda* and *soda ash* have suffered a decline due to the too earnest desire for business on the part of the producers. *Caustic soda* is now being quoted at $3.90 for solid and $4.25 for flake in 5-drum lots delivered to the consumers' door. Only routine business is being done even at these low prices. *Soda ash* 58 per cent light in bags sells at $2.05 and barrels at $2.30 in 5-bbl. or bag quantities, delivered. *Bicarbonate of soda* is holding firm at $2.25 per 100 lb. and considerable trading is reported. *Sal soda* is in good demand and prices are firm at $1.65 per 100 lb. in barrels.

General and Special Chemicals

The heavy mineral acids are holding their own, and *sulphuric acid* particularly is quite active. Prices remain about the same. The demand for *citric acid* is routine and supplies are more readily procurable. There is still a tremendous scarcity of *white arsenic* in this market. An advance in *carbon tetrachloride* has taken place since our last report and the demand is along routine lines. The *copperas* situation has eased a bit, but prices still remain very firm. There has been no change in the *cream of tartar* and the *tartaric acid* situation since our last report. *Glycerine* contracts are being made now and one large producer is advising the trade that protected contracts for 3 months are the most advantageous to the buyer at this time, since a decline in price is looked for within the next 3 months. Some contracts have been made for 6 months on a flat basis of 18c. with no protection against decline, but most business is for 3 months at 18½c. with protection. A good volume of business is being transacted. *Yellow prussiate of potash* is still in the same tight position it was in a few weeks ago, and very little spot goods are available. *Sulphur* is very quiet at present, with no price change and only routine business being transacted. The *zinc dust* market has improved a great deal during the past 2 weeks. *Zinc sulphate* is maintaining a very active position and prices remain unchanged, the market being very firm.

Oils, Naval Stores and Paint Materials

Castor oil is moving in good volume and prices remain firm at 13½c. in drums for No. 1 grade. *Linseed oil* has not changed in price and is still being quoted at $1 per gal. for single-barrel lots, and 92c. in 5-bbl. lots for the raw oil with the usual differential of 2c. per gal. for boiled over raw. *Turpentine* has suffered a further decline and is now quoted at $1.42 in 5-bbl. lots and $1.48 in single barrels. This is a decline of 10c. per gal. over quotations 2 weeks ago.

Barytes, *blanc fixe* and *whiting* remain firm and in good demand. No price changes have been reported. *Zinc oxide* has been in active demand due to buyers trying to cover requirements against an advance in price which is daily expected. Heavy buying in imported dry earth colors is reported. This, too, is due to an expected price advance that is sure to come with the advance in foreign exchange.

Steady Market for Steel as Output Continues High

December Production Shows Slight Increase Over November and October—Steel Prices Unchanged

Pittsburgh, Dec. 15, 1922.

Steel ingot production in November was at the same rate as in October, about 40,000,000 tons per annum. Thus far this month there seems to have been, on the whole, a slight increase. The current production is fully absorbed. No steel is accumulating at mills and with better car supplies the relatively small tonnages accumulated some time ago are nearly all moved. It is normal for buyers to prefer shipments to be decreased in December on account of the annual inventory, but there is no evidence of any such desire this year. In the case of some commodities a considerable portion of the current deliveries is at prices below those now ruling, and if customers should request postponement of delivery in such cases the rejoinder of the mill would be a suggestion of cancellation.

The finished steel market is quite steady on the whole. Pipe and wire mill products are not merely steady, they are strong, merchant pipe being at 66 per cent basing discount, wire at 2.45c. and nails at $2.70. Tin plate is firm, quantity differentials, from the basis price of $4.75, being smaller than usual. Sheets are fairly steady at 2.50c. for blue annealed, 3.35c. for black and 4.35c. for galvanized. Here and there a mill may be shading slightly, but the market as a whole is quotable at the figures named.

The Steel Corporation's unfilled obligations decreased by 62,045 tons in November, against increases of 210,680 tons in October and 741,502 tons in September. The bare figures do not reflect the trade condition. The showing for September and October was swelled by the heavy business done in rails and track fastenings for shipment to the middle of next year, while November witnessed much heavier shipments, at about 81 per cent of capacity, against 76 per cent for October and 67 per cent for September. Counting out rails and track materials, actual bookings were not much less in November than in either of the two months preceding.

Lower Coke Prices

Connellsville coke has continued to decline. Consumption has increased but little in the past few weeks. Production increased rather sharply until 2 or 3 weeks ago, when it appeared that there was an excess and there were reports that merchant operators intended to curtail. This they do not seem to have done, however. In November producers were making predictions that market prices would advance in December, because snowstorms and bad weather would slow down railroad movement, but the weather has not co-operated. Furnace coke, quotable a week ago at 6.75@$7, a decline of 50c., is now down to the point of being easily obtainable at $6.50 if not at less, while foundry coke is off 50c., at $7@$7.50. There is little demand. Furnaces in general are covered to the end of the year, at considerably higher prices.

There has been a small-sized buying movement in foundry iron in the past 10 days, after an entirely one-sided market had existed for a long time. The decline at last went far enough to interest foundries in a moderate way, and there was partial covering of first quarter requirements by several important interests. Valley foundry iron went at $25 furnace. Both sellers and buyers felt that they were doing backlog business, sellers expecting their later sales to average up and buyers expecting their later purchases to average down. There was little business done in basic. The market is quiet again, with bessemer at $27.50, basic at $25 and foundry at $25 to $26, f.o.b. valley furnaces, freight to Pittsburgh being $1.77.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride, 85 per cent	lb.	—	$0.39 – $0.41
Acetone	lb.	$0.21 – $0.21½	.21¼ – .22
Acid, acetic, 28 per cent	100 lb.	3 00 – 3.60	3.65 – 4.00
Acetic, 56 per cent	100 lb.	7.00 – 7.15	7.20 – 7.50
Acetic, glacial, 99½ per cent, carboys,	100 lb.	14.00 – 14.25	14.30 – 14.50
Boric, crystals	lb.	.11½ – .11¾	.12 – .13
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	—	.50 – .52
Hydrochloric, 18 deg	100 lb	.90 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg.	100 lb.	1.00 – 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11¾ – .12
Lactic, 44 per cent tech	lb.	.11 – .11¼	.11½ – .12
Lactic, 22 per cent tech	lb.	.05 – .05½	.05¾ – .06
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg.	lb.	.05½ – .05¾	.06 – .06½
Nitric, 42 deg.	lb.	.06 – .06¼	.06½ – .07
Oxalic, crystals	lb.	.13½ – .13¾	13¾ – .14½
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08¼ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	—	1.55 – 1.65
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	—
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	—
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	—
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	—	—
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	—
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	—	.70 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	—	.30½ – .31
Tartaric acid, imported, powdered	lb.	—	.31 – .32
Tartaric acid, domestic	lb.	—	— .32
Tungstic, per lb. of WO	lb.	—	1.20 – 1.30
Alcohol, ethyl (Cologne spirit)	gal.	—	4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	—	.39 – .41
Alcohol, denatured, 188 proof No. 5	gal.	—	.38 – .40
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03¼ – .03½	.03¾ – .04
Alum, chrome lump	lb.	.05 – .05½	.05¾ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.09 – .09½	.09¾ – .10
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amylacetate tech	gal.	—	2.35 – 2.60
Arsenic, white, powdered	lb.	.15 – .15½	.15½ – .15¾
Arsenic, red, powdered	lb.	.13½ – .14	.14½ – .15
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	90.00 – 92.00	93.00 –100.00
Barium dioxide (peroxide)	lb.	.18 – .18½	.19 – .20
Barium nitrate		.08½ – .08¾	.09 – .09¼
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	—
Blanc fixe, pulp	ton	45.00 – 55.00	—
Bleaching powder	100 lb.	2.25 – 2.35	2.40 – 3.50
Blue vitriol (see copper sulphate)			
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.50 – 3.60	3.65 – 3.75
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	—	1.40 – 1.50
Calcium phosphate, tribasic	lb.	—	.15 – .16
Camphor	lb.	—	.95 – .96
Carbon bisulphide	lb.	.07 – .07¼	.07½ – .08
Carbon tetrachloride, drums	lb.	.10 – .10¼	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	—	.60 – .75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	—
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	—
Chalk, precip.—imported, light	lb.	.04½ – .05	—
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05½ – .06	.06¼ – .06½
Chloroform	lb.	—	.35 – .38
Cobalt oxide	lb.	—	2.10 – 2.40
Copperas	ton	25.00 – 27.00	27.50 – 30.00
Copper carbonate, green precipitate	lb.	.20 – .20½	.21 – .22
Copper cyanide	lb.	—	.50 – .55
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.	—	.25½ – .26
Epsom salt (see magnesium sulphate)			
Ether, U.S.P. 100 drums	lb.	—	.13 – .14
Ethyl acetate com. 85%	gal.	—	.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	—	.90 – .95
Formaldehyde, 40 per cent	lb.	.15 – .15½	.15½ – .16½
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	—
Fullers earth—imported powdered	net ton	30.00 – 32.00	—
Fuse oil, ref.	gal.	—	3.00 – 3.50
Fuse oil, crude	gal.	—	2.00 – 2.25
Glauber's salt (see sodium sulphate)			
Glycerine, c.p. drums extra	lb.	—	.18 – .18½
Iodine, resublimed	lb.	—	4.50 – 4.60
Iron oxide, red	lb.	—	.12 – .18
Lead acetate, white crystals	lb.	—	.12 – .12½
Lead arsenate, powd.	lb.	.18 – .18½	.18½ – .19
Lead nitrate	lb.	—	.18 – .22
Litharge	lb.	.09½ – .09½	.09¾ – .10
Magnesium carbonate, technical	lb.	.07 – .07½	.07½ – .08
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.	—	1.20 – 1.85
Methanol, 95%, bbls.	gal.	—	1.23 – 1.25
Methanol, 97%	gal.	—	1.25 – 1.27
Nickel salt, double	lb.	—	$0.10 – $0.10½
Nickel salt, single	lb.	—	.11 – .11½
Phogene (see carbonyl chloride)			
Phosphorus, red	lb.	—	.35 – .40
Phosphorus, yellow	lb.	—	.30 – .35½
Potassium bichromate	lb.	$0.09½ – .10	.10½ – .10¾
Potassium bromide, granular	lb.	—	.17 – .23
Potassium carbonate, U. S. P.	lb.	.10 – .10½	.11 – .15
Potassium carbonate, 80–85%	lb.	.05¾ – .06	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07¼ – .08	.08½ – .09
Potassium cyanide	lb.	—	.47 – .50
Potassium hydroxide (caustic potash)	100 lb.	6.25 – 6.50	6.60 – 6.75
Potassium iodide	lb.	—	3.55 – 3.65
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.15 – .15½	.16 – .17
Potassium prussiate, red	lb.	—	.93 – .95
Potassium prussiate, yellow	lb.	.39 – .39½	.39¾ – .40
Rochelle salts (see sodium potas. tartrate)			
Salammoniac, white, granular	lb.	.06½ – .06¾	.07 – .07½
Salammoniac, gray, granular	lb.	.08 – .08¼	.08½ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	—
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07¾	.08 – .08½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04¾	.04¾ – .05¼
Sodium chlorate	lb.	.06½ – .07	.07¼ – .07½
Sodium chloride	long ton	12.00 –13.00	—
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09¼	.09½ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.60	3.65 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03¼	.03½ – .04
Sodium nitrite	lb.	.08½ – .09	.09¼ – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03¾ – .04	.04¼ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	—	.18 – .21
Sodium prussiate, yellow	lb.	.20¼ – .21	.21¼ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 – 1.30	1.35 – 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04¾	.05 – .05½
Sodium sulphite, crystals	lb.	.03¾ – .03⅞	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05¼ – .06
Sulphur, crude	ton	18.00 –20.00	—
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	—	2.50 – 3.15
Sulphur, roll (brimstone)	100 lb.	2.15 – 2.20	2.25 – 2.75
Talc—imported	ton	30 00 –40 00	—
Talc—domestic powdered	ton	18 00 –25.00	—
Tin bichloride	lb.	.10½ – .10¾	.11 – .11½
Tin oxide	lb.	—	.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07¾ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha naphthol, refined	lb.	1.05 — 1.10
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.16½ — .17
Aniline salts	lb.	.24 — .25
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70
Benzaldehyde U.S.P.	lb.	1.35 — 1 40
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.85 — .90
Benzidine sulphate	lb	.75 — .80
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Cresylic acid, 97%, resale	gal.	1.00 — 1 05
Dichlorbenzene	lb.	.07 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.39 — .41
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.22 — .23
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.34 — .36
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.25 — .30
Dipnenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.95 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.05½ — .06
Naphthalene, flake	lb.	.06 — 06

Naphthalene, balls	lb.	$0.06½	$0.07
Naphthionate of soda	lb.	.58	.65
Naphthionic acid, crude	lb.	.60	.65
Nitrobenzene	lb.	.10	.12
Nitro-naphthalene	lb.	.30	.35
Nitro-toluene	lb.	.15	.17
N-W acid	lb.	1.20	1.30
Ortho-amidophenol	lb.	2.25	2.30
Ortho-dichlor-benzene	lb.	.17	.20
Ortho-nitro-phenol	lb.	.85	.90
Ortho-nitro-toluene	lb.	.12½	.14
Ortho-toluidine	lb.	.14	.16
Para-amidophenol, base	lb.	1.15	1.20
Para-amidophenol, HCl	lb.	1.20	1.25
Para-dichlorbenzene	lb.	.17	.20
Paranitroaniline	lb.	.75	.80
Para-nitrotoluene	lb.	.55	.65
Para-phenylenediamine	lb.	1.50	1.55
Para-toluidine	lb.	.85	.90
Phthalic anhydride	lb.	.40	.50
Phenol, U. S. P., drums	lb.	.34	.35
Pyridine, domestic	gal.	1.60	1.75
Pyridine, imported	gal.	1.40	1.60
Resorcinol, technical	lb.	1.50	1.55
Resorcinol, pure	lb.	2.00	2.10
R-salt	lb.	.55	.60
Salicylic acid, tech., in bbls	lb.	.35	.37
Salicylic acid, U. S. P	lb.	.40	.42
Solvent naphtha, water-white, in drums, 100 gal	gal.	.37	.40
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.22	.24
Sulphanilic acid, crude	lb.	.20	.22
Tolidine	lb.	1.20	1.30
Toluidine, mixed	lb.	.30	.35
Toluene, in tank cars	gal.	.35	.37
Toluene, in drums	gal.	.40	.43
Xylidines, drums, 100 gal	lb.	.40	.45
Xylene, pure, in drums	gal.	.45	.50
Xylene, pure, in tank cars	gal.	.45	....
Xylene, commercial, in drums, 100 gal	gal.	.40	.42
Xylene, commercial, in tank cars	gal.	.30	....

Waxes

Prices same as previous week

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.25	....
Rosin E-I	280 lb.	6.35	....
Rosin K-N	280 lb.	6.45	$7.00
Rosin W. G.-W. W	280 lb.	7.75	8.25
Wood rosin, bbl	280 lb.	6.25	....
Spirits of turpentine	gal.	1.39	1.40
Wood turpentine, steam dist	gal.	1.35	....
Wood turpentine, dest. dist	gal.	1.25	....
Pine tar pitch, bbl	200 lb.	.....	6.00
Tar, kiln-burned, bbl. (500 lb.)	bbl.	.....	12.50
Retort tar, bbl	500 lb.	.....	11.00
Rosin oil, first run	gal.	.43	....
Rosin oil, second run	gal.	.51	....
Rosin oil, third run	gal.	.53	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.60	3.65
Blood, dried, f.o.b., N. Y	unit	4.60	....
Bone, 3 and 50, ground, raw	ton	42.00	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10	3.20
Nitrate of soda	100 lb.	2.47½	2.50
Tankage, high grade, f.o.b. Chicago	unit	4.50	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50	4.00
Tennessee, 78-80%	ton	7.00	8.00
Potassium muriate, 80%	ton	35.75	38.50
Potassium sulphate	unit	1.00	....

Crude Rubber

Para—Upriver fine	lb.	$0.25½	.25½
Upriver coarse	lb.	.17½	.17½
Upriver caucho ball	lb.	.20½	.20½
Plantation—First latex crepe	lb.	.27¾	.28
Ribbed smoked sheets	lb.	.27¾	.28
Brown crepe, thin, clean	lb.	.23	.23¼
Amber crepe No. 1	lb.	.23	.23¼

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12	$0.12½
Castor oil, AA, in bbls	lb.	.12½	.13
China wood oil, in bbls	lb.	.12½	.12¾
Cocoanut oil, Ceylon grade, in bbls	lb.	.08¾	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09	.09¼
Corn oil, crude, in bbls	lb.	.10¼	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08¾	....
Cottonseed oil, summer yellow	lb.	.10	.10¼
Cottonseed oil, winter yellow	lb.	.11	.11½
Linseed oil, raw, car lots (domestic) bbls	gal.	.90	.91
Linseed oil, raw, tank cars (domestic)	gal.	.86	.87
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.92	.93
Olive oil, denatured	gal.	1.05	1.12
Palm, Lagos	lb.	.07½	.07½
Palm, Niger	lb.	.07	.07½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.12	.12½
Peanut oil, refined, in bbls	lb.	.13½	.14
Rapeseed oil, refined in bbls	gal.	.79	.80
Rapeseed oil, blown, in bbls	gal.	.86	.87
Soya bean oil (Manchurian), in bbls. N. Y	lb.	.11	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09½	.09¾

FISH

Light pressed menhaden	gal.	$0.60	....
White bleached menhaden	gal.	.64	.65
Blown menhaden	gal.	.68	.69
Whale Oil, No. 1, crude, tanks, coast	lb.	.06	.06½

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$650.00	$700.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	60.00	80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00	17.00
Barytes, ground, white, f.o.b. mills	net ton	16.00	20.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	24.00
Barytes, crude f.o.b. mines	net ton	8.00	9.00
Casein	lb.	.10	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	14.00	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00	20.00
China clay (kaolin), imported, lump	net ton	14.00	20.00
China clay (kaolin), imported, powdered	net ton	40.00	45.00
Feldspar, No. 1 pottery grade	long ton	5.50	7.00
Feldspar, No. 2 pottery grade	long ton	4.00	5.50
Feldspar, No. 1 soap grade	long ton	7.00	7.50
Feldspar, No. 1 Canadian, for mill	long ton	20.00	21.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05	.05½
Graphite, Ceylon chip	lb.	.04	.04½
Graphite, high grade amorphous crude	ton	35.00	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	....
Kieselguhr, f.o.b. N. Y	per ton	50.00	55.00
Magnesite, crude, f.o.b. California mines	per ton	15.00	20.00
Pumice stone, imported	lb.	.03	.05
Pumice stone, domestic, lump	lb.	.05	.05
Pumice stone, domestic, ground	lb.	.06	.07
Shellac, orange fine	lb.	.76	.77
Shellac, orange superfine	lb.	.78	.79
Shellac, A. C. garnet	lb.	.77	.78
Shellac, T. N	lb.	.74	.75
Silica, glass sand, f.o.b. Indiana	per ton	1.75	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	17.00	17.50
Silica, building sand, f.o.b. Pa	per ton	2.00	2.75
Soapstone, coarse, f.o.b. Vermont	ton	7.00	8.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00	17.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11	.11½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.11½	.12
Ferromanganese, 78-82% Mn, Atlantic seaboard duty paid	gross ton	100.00	105.00
Spiegeleisen, 19-21% Mn	gross ton	38.00	39.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00	2.25
Ferrosilicon, 10-15%	gross ton	38.00	40.00
Ferrosilicon, 50%	gross ton	75.00	80.00
Ferrosilicon 75%	gross ton	115.00	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.85	.95
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50	4.00

Ores and Semi-finished Products

Prices remain quotably unchanged

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00–14.125
Aluminum, 98 to 99 per cent	22.00–23.00
Antimony, wholesale lots, Chinese and Japanese	6.40
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	37.375
Lead, New York, spot	7.10
Lead, E. St. Louis, spot	6.90
Zinc, spot, New York	7.35
Zinc, spot, E. St. Louis	7.00

OTHER METALS

Silver (commercial)	oz.	$0.64
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	60.00
Mercury	75 lb.	71.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

TARRANT CITY—The National Cast Iron Pipe Co. has tentative plans under way for the erection of an addition to its foundry, work to commence early in the coming year. Arrangements are being perfected for an increase in capital from $500,000 to $1,000,000 for general expansion.

Arkansas

LITTLE ROCK—The Independence Mineral Co., A. G. McGill, president, has plans under way for the development of sperrylite ore properties in Independence County, where a tract of more than 100 acres of land has been secured. It is purposed to install a plant for the production of platinum. T. W. Berr is manager.

California

LOS ANGELES—The Blue Tank Pipe Line & Refinery Co., Long Beach, has acquired a tract of about 15 acres of land at Wilmington, Los Angeles harbor, as a site for the construction of a new refining plant, estimated to cost in excess of $750,000, with machinery. The work will include an oil pipe line, pumping plants and a large tank farm.

STOCKTON—The National Paper Products Co. has awarded a contract to the Davis-Heller-Pearce Co., Delta Bldg., for the erection of an addition to its plant on Church St., near McDougall St., estimated to cost approximately $125,000, with equipment.

TEHACHAPI—The Blue Diamond Materials Co. has arranged for the operation of a local limestone plant for raw material supply.

SACRAMENTO — The Sacramento Pipe Works, Inc., R St., near 7th St., manufacturer of wrought steel pipe, has plans in progress for the construction of a new plant in the vicinity of B and 16th Sts., consisting of a number of buildings, with main structure, 150x230 ft.

SANTA ANA—The Shell Oil Co., 343 Sansome St., San Francisco, is planning for the establishment of a new storage and distributing plant on local site, to consist of a number of buildings, with capacity of 100,000 bbl.

Connecticut

NORWICH—The local mill of the Ironsides Board Corp. has been acquired at public sale by James E. Smith, an official of the Chesapeake Paper Board Co., Woodall and Claggett Sts., Baltimore, Md., for a consideration said to be $195,000. The property includes paper mills, warehouses, mechanical buildings and other structures, and will be remodeled and improved for a branch plant. Additional equipment will be installed to replace certain machinery exempted from the sale.

Delaware

WILMINGTON—J. E. Rhoades & Sons, 11th St. and the Baltimore & Ohio R.R., manufacturers of leather products, have awarded a contract to J. A. Bader & Co., Lackey Bldg., for the erection of a 1-story addition to their tannery, totaling about 5,500 sq.ft. of floor space.

Idaho

LEWISTON—The city water department, E. G. Wagner, superintendent, has preliminary plans under way for the installation of a filtration plant at the municipal waterworks, to cost about $500,000, with equipment.

Illinois

TAYLORVILLE—The Hopper Paper Co. will soon take bids for the erection of a 2-story addition, 80x160 ft., estimated to cost close to $65,000. Billingham & Webb, Press Bldg., Kalamazoo, Mich., are architects.

CHICAGO—The United States Industrial Alcohol Co., 27 William St., New York, N. Y., has commenced improvements to the property at Archer and Western Aves., recently acquired for its local branch works, to include the erection of a number of buildings, estimated to cost about $100,000. Eugene C. Acker & Associates, Chicago, are contractors.

CHICAGO—The Advance Pattern & Foundry Co., 2734 West 36th Place, has superstructure work under way on a new 1- and 2-story foundry addition, to cost approximately $50,000.

Indiana

SHELBYVILLE — The Kennedy Paper Co. has plans under way for the erection of a new local plant, 1-story, 50x130 ft., and will break ground at an early date. Rubush & Hunter, American Central Life Bldg., Indianapolis, are architects.

Kentucky

LOUISVILLE—The J. F. Kurfees Paint Co., Market and Floyd Sts., has acquired property adjoining its plant, 61x200 ft., as a site for the erection of a new 5-story addition, estimated to cost approximately $200,000, with machinery. It is purposed to double the present capacity.

Louisiana

MONROE—The Sterling Gas Products Co., St. Louis, Mo., will commence the immediate erection of new carbon and gasoline plants, with complete refining facilities, estimated to cost in excess of $1,000,000, with machinery. The B. W. Rumberger Engineering Co., Monroe, is engineer and contractor.

Maine

PORTLAND—Frank B. Converse & Co., 27 South St., Boston, Mass., has acquired the tanning plant of the Casco Tanning Co., Forest Ave., Deering Park section, for a consideration said to be $150,000. The new owner plans for extensions and improvements, and will soon resume production at the tannery, operating in conjunction with its other such plants.

Maryland

BALTIMORE—The Holtite Mfg. Co., Warner and Ostend Sts., manufacturer of rubber specialties, has filed plans for the erection of a 1-story and basement addition, 50x155 ft., estimated to cost about $15,000, exclusive of machinery.

Massachusetts

MALDEN — Wadsworth, Howland & Co., 139 Federal St., Boston, Mass., manufacturer of paints, varnishes, etc., has superstructure work in progress on a new 5-story building at its local plant, 53x190 ft., and plans to occupy the structure at an early date.

Michigan

RIVER ROUGE—The Ford Motor Co., Highland Park, Mich., will commence the immediate erection of its proposed new glass plant, with gas producer plant here, with main building 258x360 ft., estimated to cost approximately $1,500,000. The general contract has been awarded to the Everett Winters Co., Book Bldg., Detroit; Albert Kahn, 1000 Marquette Bldg., Detroit, is architect and engineer. The company is also considering the erection of a new cement plant at River Rouge, to cost in excess of $500,000. Albert Kahn is likewise engineer for this structure.

MONROE—The Monroe Paper Co. is considering tentative plans for the rebuilding of the portion of its plant, destroyed by fire, Dec. 3, with loss estimated at $50,000.

DETROIT—The Charles B. Bohn Foundry Co., 733 Hart Avenue, manufacturer of brass, bronze and other metal castings, has plans under way for the erection of a new addition. Christian W. Brandt, 1114 Kresge Bldg., is architect.

Minnesota

HIBBING—The Oliver Iron Mining Co. is perfecting plans for enlargements in its local plants to cost in excess of $130,000, to include the installation of a new crushing and screening plant at the Hull Rust mine, estimated to cost about $98,000, with machinery; extensions and improvements in the crushing and screening plant at the Morris mine; mechanical buildings and shops.

Nevada

EUREKA—The Eureka Smelting & Refining Co. has plans under way for the construction of a new smelting plant, with capacity of about 2,500 tons per day, estimated to cost about $1,200,000. F. L. Torres is president.

New Jersey

PERTH AMBOY — The United Lead Co., Maurer, has work nearing completion on a new 1-story plant addition at its local works, 300x300 ft., and plans to occupy the structure at an early date.

NEWARK—J. H. Armitage & Sons, 240 Thomas St., manufacturers of hatters' glaze, etc., have filed plans for the erection of a new 1-story plant addition. Charles P. Baldwin, 45 Clinton St., is architect.

CHATHAM—The Franken Color Works, Inc., Summit Ave., is planning for the rebuilding of the portion of its plant recently destroyed by fire. An official estimate of loss has not been made.

ELIZABETH — The Bullet Proof & Non-Shatterable Glass Corp., 47-55 South Spring St., manufacturer of special laminated glass, has preliminary plans in progress for enlargements in its plant. A sale of stock is being arranged to carry out the work.

JERSEY CITY—The National Air Cell Co., Henderson St., manufacturer of asbestos products, will commence the immediate rebuilding of the portion of its plant recently destroyed by fire.

PERTH AMBOY — Henry Maurer & Son, Maurer, near Perth Amboy, manufacturers of fire brick and other refractory products, has acquired a tract of property totaling about 10 acres in East Brunswick Township, to be used in connection with expansion in operations.

NEWARK—Fire recently destroyed a portion of the plant of the Fernando C. Mesa Co., Chancellor Ave. and Coit St., Irvington, manufacturer of electrical porcelain products, with loss estimated at about $70,000.

New York

PORT RICHMOND—The American Linseed Co., 297 4th Ave., New York, will soon take bids for the erection of a 2-story addition to its local plant, 60x110 ft., estimated to cost about $30,000.

NEW YORK—The Sterling Products Co., 690 10th Ave., is concluding negotiations for the purchase of the plant and properties of the Charles H. Phillips Chemical Co., 128 Pearl St., for a consideration said to be close to $5,000,000. The Sterling Company plans for the sale of stock issue of about the amount noted to finance the acquisition, including proposed extensions and improvements.

BROOKLYN—Fire, Dec. 6, destroyed a portion of the experimental laboratory of the Brooklyn Rapid Transit Co., 85 Clinton St., at 500 Kent Ave., with loss approximating $10,000, including instruments, chemicals, oils, greases, etc. It will be rebuilt.

DUNKIRK—The Atlas Steel Corp. is planning for the immediate rebuilding of the portion of its plant recently damaged by fire, with loss estimated at about $12,000.

BUFFALO — The Williams Gold Refining Co., 2978 Main St., has completed plans and will soon break ground for the erection of a 3-story addition, 22x50 ft., to be used as a factory and laboratory for refining and assaying. R. H. Williams is head.

BROOKLYN — The Star Cork Co., 175-77 North 9th St., has filed plans for extensions and improvements in its plant.

North Carolina

ROXBORO—The council is having plans prepared for the installation of a filtration plant at the municipal waterworks to cost about $75,000. Bids will be called during the coming spring. The Ludlow Engineering Co., Wadlovia Bank Bldg., Winston-Salem, N. C., is engineer.

Ohio

ZANESVILLE — The Columbia Chemical Division of the Pittsburgh Plate Glass Co., Frick Bldg., has plans near completion for the construction of a new cement and chemical plant at White Cottage, about 7 miles from Zanesville. It will consist of 11 buildings, 1- and 2-story, and is estimated to

cost in excess of $1,500,000, with machinery. The engineering department of the company, address noted, is in charge.

Oregon

PORTLAND—The Cascade China Co., Vancouver Ave., is planning for the erection of a 1-story addition to its pottery.

Pennsylvania

YORK HAVEN—The Conewago Felt & Paper Co., recently organized under Maryland laws with capital of $300,000, has preliminary plans in progress for the erection of a new paper mill, with adjoining plant for the production of dry saturating felt for use in the production of prepared roofing, estimated to cost close to $100,000, including machinery. A site on Conewago Creek, about 1 mile from the city has been selected, and work will be commenced late in February. E. E. Brunner, president of the York Haven State Bank, heads the company.

PHILADELPHIA—The Pennsylvania Brick & Tile Co. will commence the immediate erection of a new plant at the foot of Westmoreland St. and the Delaware River, for the manufacture of cement brick. It will consist of a number of buildings, equipped for an initial output of 150,000 bricks per day, with automatic machinery for conveying and handling. The works will include a chemical department for the production of an "accelerator" to insure rapid drying and production, and will be ready for service early in March. The estimated cost is placed at $100,000, exclusive of realty. Louis F. Drucker is president.

ST. MARY'S—The Elk Graphite Milling Co., recently organized by officials of the Speer Carbon Co., operating a local plant, as a subsidiary organization, has plans in progress for the erection of a new graphite works in the Rettger section. It is proposed to have the structure equipped, ready for service, early in the spring.

JEANNETTE—The American Window Glass Co., Farmers' Bank Bldg., Pittsburgh, plans for the immediate erection of a 1-story addition to its local plant, comprising a second story on existing 1-story structure, to be used primarily as a cutting department and providing for the employment of about 180 additional operatives. It is expected to be ready for occupancy early in the spring.

PHILADELPHIA—H. M. & C. B. Siner, Church and Tacony Sts., manufacturers of brick, will commence the immediate erection of a new addition to their plant at Devereaux and Langdon Sts., including power house.

PHILADELPHIA—The North American Foundries Corp., now being organized, will soon take title to the plant of the Thurlow Steel Co., 4th St., Chester, recently acquired at a receiver's sale for about $75,000. The works will be remodeled for a foundry for the manufacture of steel and semi-steel castings, and is expected to be ready for service early in February. Edwin H. Gackenbach of Gackenbach & Co., Inc., Widener Bldg., investment securities, has purchased the plant for the new company and is interested in the project.

PHILADELPHIA—Fire, Dec. 7, damaged a portion of the plant of the Atlantic Refining Co., Point Breeze, 33rd and Ritner Sts., manufacturer of refined oils. An official estimate of loss has not been made.

LEWISTOWN—The American Refractories Co., Union Arcade, Pittsburgh, has made additional purchases of property in this section, securing a total of 287 acres of land, to be used in connection with its proposed plant.

Tennessee

CHATTANOOGA—The Industrial Department of the local Chamber of Commerce, Henry Longley, secretary, is interested in a project for the establishment of a local graphite plant for the manufacture of lead pencils and other products. It is purposed to select a site at an early date.

Texas

AMARILLO—The United States Zinc Co., 120 Broadway, New York, has commenced surveys for a new smelting plant on tract of about 40 acres of land near the city recently acquired, to be of 5-block type, and estimated to cost about $400,000. Plans for the structure are nearing completion and ground will soon be broken. The smelter will be operated with natural gas.

SAN ANTONIO—The San Antonio Portland Cement Co. has awarded a contract to the Elder Construction Co., San Antonio, for the erection of an addition to its mill at Cementville, near San Antonio.

NACOGDOCHES—The Yuba Oil Co. has tentative plans under consideration for additions in its local refining plant, recently acquired from the Carolina Oil Co., for a consideration in excess of $100,000, including oil lands. The capacity of the refinery will be considerably increased. C. C. Chappell is manager.

Virginia

ROANOKE—The Nortenga Copper & Chemical Corp., 324 MacBain Bldg., recently organized, has acquired property in Cherokee County, N. C., and plans for immediate development. It is purposed to construct a plant at an early date. The company is capitalized at $300,000. E. A. Schubert is president.

NORFOLK—The Scott Terminal Corp. will commence the immediate erection of a new dehydration plant, in connection with storage terminal, 80x450 ft., estimated to cost about $375,000, including machinery.

Washington

FREEPORT—The Concrete Pipe Co., Kelso, is considering plans for the construction of a new plant in this vicinity, where large contracts for reinforced-concrete pipes have been secured.

Capital Increases, Etc.

THE INTERSTATE REFINERIES, INC., Kansas City, Mo., operating oil refineries, has filed notice of increase in capital from $52,500,000 to $101,000,000 for general expansion.

THE SCIENTIFIC CHEMICAL CO., 141 West 36th St., New York, N. Y., has arranged for an increase in capital from $100,000 to $3,000,000 for proposed expansion.

THE J. T. BAKER CHEMICAL CO., Phillipsburg, N. J., has filed notice of increase in capital from $150,000 to $500,000.

THE WEST DISINFECTING CO., 411 5th Ave., New York, N. Y., has filed notice of increase in capital from $250,000 to $2,500,000.

THE ACME CEMENT CORP., Catskill, N. Y., has arranged for an increase in capital from $1,350,000 to $2,800,000, for proposed expansion.

THE WILCOTT OIL CO., Shreveport, La., has increased its capital to $150,000 for proposed expansion.

THE THREE-IN-ONE OIL CO., Rahway, N. J., has filed notice of increase in capital from $100,000 to $1,000,000 for general expansion. The company specializes in lubricating oils.

THE CHELSEA FIBRE MILLS, INC., 212 5th Ave., New York, N. Y., manufacturer of fibre products, has increased its capital from $2,000,000 to $2,600,000.

THE GOSHEN RUBBER & MFG. CO., Goshen, Ind., has filed notice of dissolution under state laws.

THE STANDARD OIL CO. OF KENTUCKY, Louisville, Ky., has called a special meeting of stockholders, Dec. 21, to arrange for an increase in capital from $12,000,000 to $17,500,000, a portion of the proceeds to be used for extensions.

THE OSBORN PAPER CO., Goshen, Ind., has arranged for an increase in capital from $75,000 to $600,000 for proposed expansion.

THE GLIDO OIL & CHEMICAL CO., Buffalo, N. Y., has filed notice of increase in capital from $25,000 to $75,000.

New Companies

THE NATIONAL GLASS CO., INC., Bridgeport, Conn., has been incorporated with a capital of $50,000, to manufacture and deal in glass products, mirrors, etc. The incorporators are Harry Schwartz and Mitchell L. Stone, 18 Highland Ave., Bridgeport.

THE ACME ALUMINUM FOUNDRY CO., 814 West 75th St., Chicago, Ill., has been incorporated with a capital of $15,000, to manufacture aluminum, brass and other kindred metal castings. The incorporators are Harry L. Ferguson, Daniel J. Kelly and Robert C. Fingal.

THE STANHOPE CHEMICAL CO., Brooklyn, N. Y., care of E. A. Deutschman, 44 Court St., Brooklyn, representative, has been incorporated with a capital of $15,000, to manufacture chemicals and chemical byproducts. The incorporators are C. G. Unger, M. Kempfer and M. L. Nathanson.

THE FRIEDLANDER PAPER CO., New York, N. Y., care of Speiser & Speiser, 170 Broadway, New York, representatives, has been incorporated with a capital of $30,000, to manufacture paper products. The incorporators are B., L., and S. Friedman.

THE BELL CREEK BY-PRODUCTS CO., Montgomery, W. Va., has been incorporated with a capital of $50,000, to manufacture petroleum byproducts. The incorporators are F. E. Smart, J. E. Wilkerson and G. C Humphreys.

THE KYLOID CO., Grand Haven, Mich., has been incorporated with a capital of $100,000, to manufacture composition products. The incorporators are C. R., R. R. and Lionel Heap, all of Grand Haven.

THE AMERICAN WEEVIL EXTERMINATOR CO., Atlanta, Ga., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $100,000, to canufacture disinfectants, fungicides, chemicals, etc. The incorporators are H. G. Bickmore, Henry Eyers and H. K. Smith, Atlanta.

THE ANCHOR OIL CO., Jersey City, N. J., care of the United States Corporation Co., 15 Exchange Place, Jersey City, representative, has been incorporated with a capital of $2,250,000, to manufacture petroleum products and byproducts.

THE ISLAND RIVER FLUORSPAR CO., Providence, Ky., has been organized under state laws to operate fluorspar properties and operate a commercial spar reduction plant. The incorporators are J. C. Cannaday, S. K. Holland and Thomas O. Long, Providence.

THE FEDERALOID CORP., Hoboken, N. J., has been incorporated with a capital of 10,000 shares of stock, no par value, to manufacture celluloid and other composition products. The incorporators are Busmarch C. Moore, Abraham Lieberman and Richard W. Gutheil, 15 Newark St., Hoboken. The last noted represents the company.

THE TENNESSEE RUBBER CO., Murfreesboro, Tenn., has been incorporated with a capital of $25,000, to manufacture rubber products. The incorporators are W. S. Winn, Albert D. McKnight and James M. Butler, all of Murfreesboro.

THE WHITE STAR CHEMICAL CO., New York, N. Y., care of W. J. Carey, 220 Broadway, representative, has been incorporated with a capital of $30,000, to manufacture chemicals and chemical byproducts. The incorporators are H. K. Copeland and J. H. Ennis, Jr.

THE CRESCENT TANNING CO., Boston, Mass., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture leather products. Benjamin J. Kaplan, 209 Highland Ave., Winchester, Mass., is president and treasurer.

THE OHIO PORTLAND CEMENT CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $3,000,000 to manufacture cement.

THE CANTON REFRACTORIES CO., Canton, O., has been incorporated with a capital of $15,000, to manufacture firebrick and other refractory products. The incorporators are Frank E. Bamberger and Frank H. Haldeman, both of Canton.

THE W. H. GAGE GLUE CO., St. Louis, Mo., has been incorporated with a capital of $75,000, to manufacture glue and other adhesives. The incorporators are W. H., C. A. and L. F. Gage, all of St. Louis.

THE MIDWAY CITY GLASS CORP., Huntington, W. Va., has been incorporated with a capital of $50,000, to manufacture glass products. The incorporators are B. W. Walton and R. Taylor Morris, Huntington; and Daniel Howard, New Cumberland, W. Va.

THE CONTINENTAL CORK CO., Brooklyn, N. Y., care of W. N. Veceland, 150 Nassau St., New York, representative, has been incorporated with a capital of $35,000, to manufacture cork products. The incorporators are D. Blois and S. A. Germino.

J. B. CHAPPELL, INC., Philadelphia, Pa., care of Louis Freyling, Ridge and Conarroe Sts., Philadelphia, representative, is being organized under state laws to manufacture paints, oils, varnishes, etc. Application for a state charter will be made on Jan. 2. The company is headed by William H. Chappell and Walter Boshart.

THE GENERAL SUPPLY & CHEMICAL CO., 28 Woolverton St., Trenton, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals, chemical byproducts, etc. The incorporators are Henry M. Tobin and Barnard A. Leyson.

THE SLICK SHINE CO., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $500,000, to manufacture chemicals and chemical byproducts.

THE LASCO SHELLAC CO., Bush and Severn Sts., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture shellac, varnish, paints, etc. The incorporators are Louis A. Stabler, H. Pierce Brawner and E. C. Frank.

THE MASSEY OIL & REFINING CO., Scottsville, Ky., has been incorporated with a capital of $100,000, to manufacture refined

petroleum products. The incorporators are W. E. Massey, G. M. Gausch and E. E. Shephard.

THE EMPIRE TIRE & RUBBER CORP., Trenton, N. J., has been incorporated with a nominal capital of $10,000, to manufacture tires and rubber goods, succeeding the company of the same name now operating a plant at North Clinton and Mulberry Sts. The incorporators are W. Hall Appar, 36 East State St., Trenton; William N. Cooper and Thomas H. Bradeley.

Industrial Developments

CERAMIC—Following a strike since Oct. 1 for a wage increase of 7 per cent, general ware operative potters have agreed to return to work at the former wage scale, and all chinaware plants at East Liverpool, O., Trenton, N. J., and other prominent pottery districts are reopening. At Trenton, eight plants are affected, giving employment to more than 1,500 workers, including the International Pottery Co., Maddock Pottery, Cook Pottery Co., Lenox, Inc., Mercer Pottery Co., Anchor Pottery Co., and two plants of the Greenwood China Co.

Following a 2 months' shut-down due to the operatives' strike, the Atlas China Co., Niles, O., has resumed manufacture, giving employment to about 250 men. During the idle period the company has made repairs in the operating machinery and a number of plant improvements.

Chinaware plants at Newell, W. Va., and vicinity are resuming production at full capacity following the termination of the strike of operatives. Orders on hand at the majority of the plants insure this basis of production for an indefinite period.

Despite the strike of the sanitary ware pottery workers, a number of plants at Trenton, N. J., in this line are maintaining production, and a number are declaring for an open shop. The Thomas Maddock's Sons Co. is increasing production and is now giving employment to about 50 per cent of the regular working force. The Trenton Potteries Co. is also advancing manufacture, and has served notice that unless former employees return to their work at once new operatives will be installed in their places permanently.

LEATHER—The Continental Leather Co. is increasing production to a full-capacity basis at its plants at Elkton, Va., and Bridesburg, Pa., following the destruction of its third tannery, at Augusta Springs, by fire on Dec. 2. The first two plants mentioned having been running under partial output and will now take care of the work of the Augusta Springs tannery until it is rebuilt.

Glazed kid plants at Wilmington, Del., are increasing production and plan to add to the present working forces.

The Castle Kid Co., Camden, N. J., is advancing operations at its local plant and is now running on a basis of about 800 dozen cabrettas and kids daily.

OIL—The Sinclair Consolidated Oil Corp. has completed a new casinghead gasoline plant at its properties in the Burbank field, Okla., and will place the unit in operation at once on a basis of 8,000 gal. per day.

Refineries in the Wichita Falls, Tex., district, heretofore discontinuing operations in cold weather, are maintaining full production at the present time and expect to so operate for a number of weeks to come.

The Pennok Oil Co., Tulsa, Okla., is increasing production at its properties.

The White Eagle Oil & Refining Co., Wichita, Kan., is advancing production at its oil refinery and will give employment to a larger working force.

IRON AND STEEL—The Mahoning Valley Steel Co., Niles, O., has arranged for capacity production, and will run the entire 8 mills at its plant for an indefinite period.

The Empire Steel Co., Niles, O., has placed 8 mills in service at its local plant and is adding to the working force.

A number of companies are suspending blast-furnace operations in the Youngstown, O., district. The Shenango Furnace Co. has blown out its 200-ton unit, leaving only one of three furnaces of this company in operation. The Brier Hill Steel Co., has discontinued at its Tod furnace.

The Woodward Iron Co., Woodward, Ala., is continuing capacity operations at its furnaces, and has placed one of the stacks on basic iron to supply heavy orders for this material recently received.

The Falcon Steel Co., Niles, O., has placed another mill in operation at its local plant, making five such units now in service.

The Donaldson Iron Co., Emaus, Pa., is continuing capacity production at its local works, and has recently advanced the wages of operatives 25 cents a day.

The Sloss-Sheffield Steel & Iron Co., Birmingham, Ala., has blown in the fifth blast furnace at its plant, following a short shut-down for repairs.

The Youngstown Sheet & Tube Co., Youngstown, O., has blown in its Hubbard furnace. The unit has been out of blast for a number of weeks past. It will run on basic iron.

Following its proposed schedule, the Reading Iron Co., Reading, Pa., has resumed operations at its puddle mill at Birdsboro, Pa., following a suspension for about 2 years. Employment will be given to about 125 men.

The Republic Steel & Iron Co., Youngstown, O., is maintaining full operations at its local plant, with eight mills in service on the new side.

The Slatington Rolling Mill Co., Slatington, Pa., has resumed operations at its plant, following a short suspension due to fuel shortage.

METALS—The Anaconda Copper Mining Co., Butte, Mont., has resumed operations at its Berkeley property, giving employment to about 400 men.

The Davies & Thomas Foundry Co., Catasauqua, Pa., has resumed production at its plant, following about a week's shutdown due to machinery breakage.

The International Nickel Co. is maintaining capacity operations at its Port Colborne, Ont., refining plant. The rolling mills at Huntington, W. Va., are also running under a heavy production schedule.

The American Smelting & Refining Co. has adopted a capacity schedule at its East Helena, Mont., works for the first time in about 24 months. Employment is being given to close to 500 men.

The United Verde Extension, Jerome, Ariz., is advancing production at its local plant. Since August the rate of increase in output has run from 250,000 to 300,000 lb. of copper per month.

MISCELLANEOUS—The Grasselli Chemical Co. has resumed operations at its plant at Terre Haute, Ind., following curtailment for a number of months past. Employment will be given to about 200 men at the present time, and this number will be increased at an early date. The company has adopted a rule to employ only American labor at the factory.

The West Virginia Chemical Co. has resumed operations at its sulphuric acid plant at Fairmont, W. Va., on a full-capacity basis, following part-time production for a number of weeks past. Practically all former employees are again at the works and it is expected to maintain the present schedule for an indefinite period.

New Publications

BOOKS

PETROLEUM: WHERE AND HOW TO FIND IT. By *Anthony Blum*. 367 pages. Published by the Modern Mining Books Publishing Co., Chicago. Price, $2.

The author of this book is a geologist and petroleum engineer, who for "a third of a century" has been "engaged in the location, development and operation of mines, in working out oil-bearing geologic structure, locating oil wells, drilling and equipping them and in the production of petroleum." He has had, therefore, an unusual experience to draw on for the preparation of this book, which purports to present the practical aspects of the oil business in a way that will interest the layman. The first part of the book deals with four general phases of petroleum—geologic, constructive, operative and commercial. The purely business aspects are to be found in Part V, under the heading of "Fiscal Features."

THE BUREAU OF MINES: ITS HISTORY, ACTIVITIES AND ORGANIZATION. By *Fred Wilbur Powell*. Institute for Governmental Research, Service Monographs of the U. S. Government, No. 3. Published by D. Appleton & Co., New York.

This is the third of a series prepared according to a uniform plan and in which will be described all of the principal services of the federal government. The purpose is to give, first, the history of the establishment and development of the service; second, its functions, described not in general terms, but by detailing its specific activities; third, its organization for the handling of these activities; fourth, the character of its plant; fifth, a compilation of, or reference to, the laws and regulations governing its operations; sixth, financial statements showing its operations, expenditures and other data for a period of years; and finally, a full bibliography of all the sources of information bearing on the service and its operations. These studies are wholly descriptive—no effort being made to discuss critically conditions and developments within the service. The present volume of 162 pages is a very interesting story of the Bureau of Mines.

A TEXTBOOK OF FIRE ASSAYING. By *Edward E. Bugbee*. 254 pages. Published by John Wiley & Sons, Inc. Price, $3.

The author states in his preface that this book is the outgrowth of a set of mimeographed notes prepared for use in the course in fire assaying at the Massachusetts Institute of Technology. While intended primarily as a college textbook, it is not entirely elementary in character and might well find its place in many industrial laboratories. Written on the assumption that a course in fire assaying is the logical place to introduce the study of metallurgy, the author has laid special emphasis on all of the metallurgical principles involved, such as the thermochemistry of the metals and their oxides, the nature and physical constants of slags, the characteristics of refractories and fuels and the behavior and properties of metallic alloys.

COLORIMETRIC ANALYSIS. By *F. D. Snell*. 150 pages. Published by D. Van Nostrand Co., New York. Price, $2.

It was the endeavor of the author of this book to supply students and practical workers in colorimetrics with all of the important methods and tests which they are likely to meet with in their work. The first chapters deal with the theory, apparatus and its use and the figuring of results. Important quantitative and qualitative determinations such as those for iron, copper, carbon, lead, aluminum, nickel, chromium, cobalt, etc., form the subjects of the other chapters.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold a meeting Dec. 26 to 30 in Boston, Mass.

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1923.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 15 and 16, 1923.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City; Jan. 5 — American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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CHEMICAL & METALLURGICAL ENGINEERING

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The Centenary of Louis Pasteur

ON DEC. 27, one hundred years ago, LOUIS PASTEUR was born at Dôle, France. His father, JOHN JOSEPH, like his grandfather and great-grandfather, was a tanner. He had also served as sergeant-major under NAPOLEON in the Peninsular campaign, and for it he bore the Cross of the Legion of Honor. There is a legend that he made his own gunpowder in the mountains of Spain, and that old men and women and children followed him and acted as his scouts against the dreadful guerilla commander ESPOZ Y MIÑA. JOHN JOSEPH married JEANNE ETIENNE ROQUI; and of her people, who were plumbers and lampmakers at Salins, it is said that they lived in such amity and good will in their families that "to love like the Roqui" became proverbial.

Their son LOUIS was a good boy. He was deeply religious throughout his life, following ardently the Roman Catholic faith. A deep student, his father frequently urged him not to endanger his health by studying too hard.

But what was the key to his greatness? He showed no sign of brilliancy as a boy. Like JOHN JOSEPH, LOUIS had a taste for drawing and painting, but he was in no way unusual. Many persons are pious and good, although there was only one LOUIS PASTEUR. We think the key to his greatness lay in his passion for work and in the principle which he often repeated: "In the field of observation, chance favors only those who are prepared." He prepared for chemistry by studying and digesting mathematics, physics and crystallography. He urged constantly the aid of physics and crystallography in chemistry—which sounds modern.

Let us follow his work on tartaric and paratartaric or racemic acids. Early as a student of organic chemistry he had been interested in MITSCHERLICH'S work on these bodies and the problem that even that scientist could not solve. The acids seemed identical in the nature, number and arrangement of their atoms, and yet tartaric acid rotated the plane of polarized light, while paratartaric acid remained inactive. Later PASTEUR learned from his friend LAURENT that crystals of very pure sodium tungstate proved, on microscopic examination, to be of three different forms. He published a paper on the rotary polarization of liquids and one on dimorphism, and returned after the interruption of the revolution of '48 to the tartaric acid study. Finally he observed that crystals of tartaric acid and of the tartrates had little faces which theretofore had escaped the attention of observers. They existed on only half the edges or similar angles of the crystals; they were hemihedral in form. He reasoned that this would account for the deviation to the right of the plane of polarization as caused by the tartartes. On the paratartrates he expected to find none of these faces. But alas! close observation proved the paratartrate crystals also to be hemihedral, which was a sore disappointment. Right here we may note the quality of PASTEUR'S genius. He did not stop; and he was prepared. The paratartrate crystals were indeed hemihedral, but the faces of some of the crystals were inclined to the right and of others to the left! Then he sorted them out, one by one, and proceeded with their respective solutions in his polarizing apparatus—and the problem was solved. The hitherto incomprehensible constitution of racemic acid was explained. There was the right-hand tartaric acid, which is the same as that obtained from grapes, and a left-hand acid. The two acids have equal but opposite rotatory powers which neutralize each other when, reduced to an aqueous solution, they are present in equal quantities. There was MITSCHERLICH'S problem solved and the real beginning of stereochemistry.

When we think that in addition to this PASTEUR gave us our understanding of ferments, which promises even greater economies in organic chemical industry; that he discovered the underlying principles of vaccination; that he was the father of biology; that he saved the wine and silk industries of France, put an end to chicken cholera, gave us a vaccine for anthrax and conquered rabies, there is little wonder that a hundred years after his nativity the banners are waving in his honor and we meet to sound his praise.

Absence of Gas Casualties In Military Hospitals

A LARGE part of the propaganda that has been used to create sentiment against chemical warfare has dealt with mysterious gases that have not yet been used, but to which the most deadly character is ascribed. Alleged authorities who, in our opinion, are quite incompetent are quoted in support of the assumption that future methods of warfare will be quite as ruthless as the gases are deadly, and that non-combatants in defenceless towns will be asphyxiated by the million while they sleep. Apparently there is no limit to the imagination of those who draw these gruesome pictures. They wholly disregard the probability that non-combatants will be quite as safe from gas attacks as they now are from long-range artillery and that due warning probably would be given for the evacuation of cities before wholesale destruction was attempted. In short, our friends are creating needless worry for themselves and are crossing bridges long before they are reached.

There are more salient features of chemical warfare to be observed in the casualties of the late war. The argument has frequently been made that chemical warfare was more humane, or, better, less inhumane, than the older and recognized methods. In support of this contention we commend to our anti-chemical warfare enthusiasts a study of the war casualties still receiving attention in military hospitals. The number of gas cases will be found so small as to be negligible, while

the great majority will bear direct testimony to the horrible and inhumane effects of gunfire—shrapnel, high-explosive shells, machine gun and rifle bullets. Eliminate explosives from warfare, and most of the mutilation and maiming of human bodies will disappear. Whatever may be its demerits, gas warfare will not fill post-war hospitals with the casualties of armed conflict. Today there are approximately 20,000 men under treatment in government institutions due to war wounds or disability in military service, but an insignificant and negligible number of these cases are the consequence of gas warfare.

Asking for Bread And Getting a Stone

IT WOULD be impossible as well as futile to pay serious attention to all of the examples of newspaper science that come to our notice, either personally or through the interest of our readers. Most of the specimens merely exhibit laughable ignorance on the part of the reporter or the omniscient conductor of the question and answer column. Occasionally, however, we run across an instance that, in the sheer interest of public safety, calls for exposure and condemnation. We can remain undisturbed or only mildly amused when a newspaper reader is told that sulphuric acid is used largely as an anæsthetic in surgical operations, because we know that the overworked editor strayed into the wrong paragraph in his book of handy reference on scientific subjects. But when an anxious inquirer asks how to make a home-made fire extinguisher and is given a recipe for gunpowder, we protest that the joke is being carried too far.

Being more than merely curious to discover how such misinformation could be dispensed through the columns of reputable newspapers, we pushed the inquiry to a final conclusion. It seems that a central "information bureau" established in the national capital syndicates its service to a number of newspapers in answer to queries that are forwarded to it. The bureau receives several thousand queries a week for information of various sorts. Answers are prepared by a corps of young ladies who depend largely upon government sources of information. But occasionally it is much easier and requires far less time to consult a handy reference work than to make a trip to a government office or try to extract the information by telephone. This is exactly what happened in the gunpowder-fire extinguisher incident. Reference was made to a popular cyclopedia of formulas, and the unsuspecting inquirer was advised to procure "potassium nitrate, 60 oz.; sulphur, 36 oz.; charcoal, 4 oz., colcophar of rouge, 1 oz. Powder separately, dry and mix. This powder is used by placing it in 5-lb. pasteboard boxes, through an orifice in which a fuse is inserted. An extinguisher so made is intended for use in a closed room. It is supposed to act automatically by absorbing oxygen." In the interest of accuracy it must be recorded that the cyclopedia in announcing the formula, stated that "by a slight modification of it we have a recipe for making gunpowder," a bit of information omitted by the newspaper. But even with this saving grace the item is about as useless a piece of information as can be imagined. It is to be hoped that the one who made the inquiry has not yet attempted to use the extinguisher, because if he does he is likely to accelerate rather than extinguish a fire.

No doubt many such examples of newspaper science and misinformation occur in a year, though probably few of them are fraught with possible consequences as dangerous as this one. Chemists and engineers generally should be on the lookout for such items and report them to responsible heads of newspapers publishing them. Conversely newspapers should be encouraged to use the maximum amount of reliable scientific information and advised that local scientists will be glad to assist them in avoiding ludicrous or costly errors.

A Working Balance In Industry

IN ONE of its recent editorials our friend and contemporary *Canadian Chemistry and Metallurgy* very skillfully likens the long-standing controversy of the practical versus the technically trained man in industry to the famous question that Gulliver put to the Lilliputions—viz., Which is the more important end of an egg, the little end or the big end? And just as the conflicting armies of Lilliput forgot that the important thing is the egg itself and not its physical details, so the two parties involved in the other quarrel have lost sight of the fact that they are interdependent and that neither the practical nor the technical man is self-sufficient. Industry depends on both of them and its particular problem is to maintain the sort of balance that promotes co-operation and progress.

We are reminded of a large company in one of our industries that has given serious study to this special phase of human relations. As a result the company boasts of a number of unusual features in its organization. In the first place, its president is a chemist whose name is known to every worker in the industry. So, too, are the general manager of the company's largest works and many of the department heads. Perhaps this is one of the contributing reasons why in the past the company has found it difficult to keep its chemists in the research and control laboratories, so great has been the temptation to enter into operating and executive work. As more and more men left the laboratory it was evident that many of the practical men who had come up from the ranks were being crowded out of positions for which their experience had well qualified them. It was then that the company took notice of this situation and evolved a plan of maintaining what might be called a sort of working balance in industry.

It was decreed that in each department of the plant control should rest with a committee of three men, the superintendent and the two assistant superintendents. One of these men must be a chemist, one must be a practical man drawn from the department's operating personnel and the third must be a mechanical engineer, since in this particular industry much depends upon the construction and maintenance of complicated engineering equipment and apparatus. Instead of crowding out the non-technical man, as previously was the case, this plan opens up a definite pathway for him. He has the opportunity not only to become head of his department but by promotion he may be raised to general manager of the plant or perhaps even to the head of the great organization itself. Likewise the chemist is given a chance to come out of his laboratory shell and to compete for the real plums of his industry.

From the company's viewpoint much is to be gained. The practical man puts to use valuable knowledge and experience gained by hard work and close contact with production. The technically trained man brings a knowledge of basic scientific principles and, more than that, a broadened viewpoint that helps to apply these principles of science to industry. When the proper bal-

ance is reached and these viewpoints are mixed in the right proportion, the industry must prosper. And if we are to judge the effectiveness of this plan by the success of the Standard Oil Company of Indiana, then there are many companies in our industries that would do well to follow this example.

Numbering Of Steel

SPURRED by the activities of the American Engineering Standards Committee, men representing a wide variety of interests recently met in Washington to consider whether it was possible to designate steels by code numbers. That some such scheme would be desirable is generally admitted. In the good old days of straight carbon steels, it was very nice to call them No. 1 temper, No. 2 temper and so on—carbon was the important, the only alloy.

"No. 4 temper" failed to mean anything much when 3 per cent of nickel was added to the metal, so the Society of Automotive Engineers has devised a system of numbering which includes information on the amount of principal alloying element. Such a steel under its nomenclature would be S.A.E. steel 2340. The system is of great value, as is proved by its wide use. So it is rather idle to argue that the steel might better be called 3N40.

But steels of constantly increasing complexity are being offered. The logical system rapidly becomes unmanageable for nickel-chromium steels, with variations in three essential alloys, or for tool steels with four or more. Here lies the advantage of the arbitrary class number adopted by the S.A.E. Nickel-chromium steels are class 3, and tungsten steels are class 7. But even such an artifice has its limitations. Designation 3240 indicates about 2 per cent nickel and 0.40 carbon, but to get any idea of the third essential element, reference to the specification itself must be made.

In passing, it might be remarked that a similar difficulty exists in non-ferrous metallurgy. It is easy to designate deep-drawing brass by 70:30 or naval gun metal by 88:10:2. These are relatively simple combinations of common alloying elements. Several such alloys are standard articles of commerce under well-known names such as admiralty metal or sterling silver—we almost said nickel silver, but reference to a recent list of alloys showed no less than 165 varieties of this! If there is as much difficulty in the designation of time-honored combinations, what is the manufacturer of modern quaternary alloys to do except invent and trademark some word or symbol like duralumin, lynite, 17-S, or Y?

If a logical code indicating the chemical composition of steels and alloys has so far eluded discovery, how much more difficult will it be to devise one which in addition will denote that physical property which, after all, is what is desired and which the chemical composition indicates only dimly. For instance, a steel with 3 per cent nickel (usually $3\frac{1}{2}$ to $3\frac{3}{4}$) and carbon 0.35 to 0.45 is used for heavy forgings, propeller shafts and gun tubes, for gears of moderate size, connecting rods for locomotives, steam and gas engines, and for rolled structural shapes and bars for long span bridges.

There may not be room for argument that S.A.E. 2340 is a neater way to designate this particular composition than 49S2e, class HG, favored by the U. S. Navy. But proponents of simplified practice in metallurgy should always remember that 3Ni-45C-etc. is only incidental. What an ordnance constructor wants is not a chemical analysis, but a gun tube, and reference to his specification shows that the important thing he is after is high strength and ductility in a direction transverse to the "fiber." Bridge engineers, on the other hand, insist on considerable strength and toughness and reliability in a direction *with* the "fiber"—parallel to the rolling. An automotive engineer designing a gear would be interested in toughness, but probably more in resistance to wear and machinability. Finally, the master car builders or mechanical engineer interested in locomotive connecting rods would require stiffness and resistance to fatigue.

How are you going to get all this into one code without resorting to Chinese characters? The point we are driving at, of course, is that the only known way to describe a steel is in a detailed specification, and even that leaves a great deal to such indefinable items as "judgment" and "good practice." So it makes no great difference whether a steel is called S.A.E. 2340, Navy Department 49S2e, or A.S.T.M. A 8-21, as long as the specification is definite and workable. All of the steels might be indistinguishable chemically; but as one might remark, "Good steel is more than low phosphorus and sulphur."

A Lesson From the A.S.M.E. Convention

DOUBTLESS the readers of *Chem. & Met.* are not accustomed to look to the American Society of Mechanical Engineers for constructive thoughts or helpful ideas in the conduct of the chemical and related industries. It is well, however, to remember that the mechanical engineer is so intimately associated with industry in general that the trend of thought in his national organization is likely to merit the careful consideration of industry as a whole. Witness the campaign of two years ago for the elimination of waste in industry, the keynote of which was sounded at an A.S.M.E. convention. At this year's meeting the keynote was "Economics for Engineers," the A.S.M.E. having joined with the American Economic Association in directing the attention of engineers to the study and application of the broad general principles of the science of economics.

Has this intimate relationship any significance for us as chemical engineers? Does it mean only a combination of mechanical engineering and economics, or does it include engineering in its broadest and most inclusive sense? Obviously the latter. The mechanical engineers are merely giving belated recognition from their branch of engineering to the fact that engineers and economists have many interests in common and that both must contribute to the real end of engineering, which is "the art of organizing and directing men and controlling the forces and materials of nature for the benefit of the human race." With this fact clearly in mind, the mechanical engineers have set about recasting their mode of thinking so that the principles of economic science may be given proportionate weight in the solution of engineering problems.

The importance of recognizing this relationship is as great in the chemical and related industries as in any other field of human endeavor. The present need of industrial management here as elsewhere is the recognition of fundamental economic truth, and however belated we may be in realizing this condition, it behooves us to bear the point in mind and encourage economics and technology to travel side by side.

Readers' Views and Comments

Chemists in Public Life

To the Editor of Chemical & Metallurgical Engineering

SIR:— In your note following the letter on "Appreciation of the Engineer" in *Chem. & Met.* of Nov. 29, when noting the versatility of the engineer and chemist, you fail to recall any noteworthy instance where they have become well known in religious activities. It is well worth mentioning that Dr. Jesse H. Holmes, professor of philosophy and religion of Swarthmore College, received his doctorate in chemistry, with minors in biology, physics and mineralogy, and until 1900 Dr. Holmes spent a number of years in teaching these sciences. Since 1900 he has been teaching philosophy and history of religions, including the study of the Bible.

A. E. MAZE.

East Orange, N. J.

Why Not Get Away From Traditions?

To the Editor of Chemical & Metallurgical Engineering

SIR:—Why not get away from traditions? Because they are the instruments used in constructing the framework of our social, economic and industrial structures. They are experience.

To the outsider the reason many things are done in industry is obscure. Usually digging deep enough will uncover a sound reason, based probably on experience. Neither the workman himself nor anyone immediately available may be able to give the real reason. Likely as not if asked he will give a wrong explanation.

I presume in the case of the reel oven mentioned in your issue of Nov. 29, it was built with the object of giving what the baker terms a "solid heat." One does not read of "solid heat" and "flash heat" in works on thermodynamics, but they are important nevertheless.

I knew of a reel oven built for breadmaking which had a steel shell covered with insulation; no brickwork at all. In using this it was demonstrated beyond doubt that in order to have the finished loaves weigh the same as exactly the same kind of loaf baked in the ordinary oven of heavy brickwork, it was necessary to allow from a half to one ounce additional weight of dough to each loaf when scaling. And at this time one big bakery was operating at a net profit of one mill per loaf. The significance of this is apparent.

Now as to apparent conservatism. A few years ago the proprietor of one of the big bakeries in the United States said to me, referring to a new type of oven he had installed about a year before: "I'm tearing them out. They're one of the best ovens I ever had, but I can't get them run properly. I have had nothing but trouble with them since I installed them. I can get plenty of men to run the older type as they should be run and I'm going back to them." Here was an instance of a simple type, less efficient, actually producing more satisfactory results than a more efficient one requiring greater skill to produce the best results.

Few industries have made greater advances in the past 40 years than the baking industry. From a trade where mechanical equipment was practically unknown, it has developed until the manufacturing end of a modern baking plant is almost automatic. In at least one year of recent date, statistics show that the baking industry showed a greater return per dollar invested than any other industry in the United States. This affords a pretty fair indication that it has measured up to its opportunities.

The outsider frequently can and does suggest valuable improvements because the man inside is too close to his work to view it in the proper perspective. But sometimes the man inside looks out. A progressive baker wished to eliminate unsightly cracks which, in his eyes, marred the surface of one line of his goods. What suggested a remedy? His observation of the practice of anealing bottles in a glass factory.

Treat that man with suspicion who can "see at a glance" opportunities for improvement. By no means disregard him, but discount him heavily. Improvements can be effected in any plant at any time. Many such which at first sight appear promising prove on closer acquaintance impracticable. Against this appears the unaccountable psychological fact that the same suggestion for improvement that is refused when advanced by the insider is given consideration and executed when put forward by an outsider. Truly a prophet is not without honor save in his own country.

Why does the operating staff in some chemical plants today feel that a specially warm place in the hereafter is reserved for the engineer who designed and built the plant? Isn't it, oftener than not, because the engineer tried to get away from traditions? And when the plant is turned over to the operating crew, where is the engineer? Gone elsewhere, getting away from some more traditions, probably.

"Tradition," says Webster, "hands down the practical arts with more precision and fidelity than they can be transmitted by books." Nothing could be clearer than that. As a rule in the arts the one who really knows cannot and does not express himself in writing. Conversely, the one who writes seldom does so from experience.

Don't try to get away from traditions. They are the tools which countless hands have forged and striven to improve down through the centuries. Master the use of them. With an intimate knowledge of them will come an appreciation of their value. Then, if you can, add to their beauty and utility.

Whitby, Ont. MUNGO E. NASMITH.

Rate of Settling of Clay Suspensions

The rate of settling of clay is thought to be an important matter in connection with the use of clays as a filler in papermaking. The rate of settling of clay in a medium is to a certain extent dependent on the hydrogen-ion concentration of the suspending medium. The rate of settling of six clays has been studied over a wide range of hydrogen-ion concentrations. For each clay-water mixture, there is a definite hydrogen-ion concentration at which the rate of settling will be a maximum, and also a definite concentration at which this rate is a minimum. In the purification of clay, these two points should be known in order to effect the separation of clay particles from quartz and mica particles most efficiently.

Art and Science of Leather Manufacture—II

By F. L. Seymour-Jones

Preliminary Wetwork: Soaking, Sweating, Loosening Hair by Enzymes, Acids and Liming, Sharpening Agents, Unhairing, Fleshing, Deliming, Drenching, Puering and Bating, Scudding, Pickling—Rounding—Splitting*

IN WHATEVER WAY a hide or skin enters a tannery, the first step is to restore it to as near its original condition as possible. In olden times this was accomplished by pegging down the hides in the tannery brook and permitting them to remain there until sufficiently softened. River pollution laws and the loss of hide substance in such a process have caused this method to be abandoned.

Washing or Soaking to Restore Original Condition

Fresh hides are washed in several changes of cold, fresh water, to remove all blood and dirt and to cleanse the hide thoroughly, no special treatment being necessary. A few hours is sufficient; long soaking, or the use of warm or stale water, leads to putrefaction and much damage.

Salted hides require longer soaking, not only to remove the salt but also to plump the fiber so that it may regain its original condition after the dehydration effected by the salt. Longer soaking is possible, owing to the antiseptic powers of the salt. Usually 3 to 4 days' soaking, changing the water at least daily, and preferably with frequent handling (i.e., hauling the hides out and replacing) is adequate. Frequently the soaking is completed by running the hides in a wash wheel—an open-sided drum, through which a stream of water passes—for a few minutes. Salt is, of course, readily soluble in water, and will diffuse the more rapidly the more often the water is changed or the hides handled.

Dry salted and dry hides require more drastic treatment, and are frequently very difficult to soak back into suitable condition. Putrid or stale soaks were largely used, and are still occasionally to be found. In these the dissolved organic hydrolysis products from the hides are permitted to accumulate, and exert—probably by providing suitable nutriment for bacteria—a softening action on the hide. Naturally the danger of damage by bacterial action is great, and hides so treated are liable to much loss of valuable leather-forming hide substance.

Putrid soaks have largely been replaced by the use of chemicals. A great variety have been suggested. Probably the best are dilute organic acids (e.g., formic) or sulphurous acid up to 2 per cent strength. The hides are treated in these liquors for 1 or 2 days, whereby they are swollen and well plumped. Caustic soda (0.1 per cent) and sodium sulphide (up to 0.5 per cent) are largely used, and exert also a preliminary liming effect.

Mechanical Softening

The chemical softening is frequently accompanied also by mechanical softening. For hides the faller stocks are used, kneading and pounding the hide. Skins are frequently "worked on the beam"—i.e., stretched and worked with a blunt knife on a curved-surface table. Both hides and skins may also be tumbled in water in a revolving drum, the mechanical action greatly facilitating the softening (Fig. 5).

The chief danger in soaking, apart from too violent stocking, lies in bacterial action in the soak waters. As previously mentioned, the majority of common disinfectants are barred owing to their tanning action. Sulphurous acid, very dilute phenol, and borax are used as antiseptics here. Even with dilute carbolic acid, the subsequent liming is slowed down considerably. Borax is somewhat costly.

Methods of Removing Hair or Wool

The hides and skins having been brought back to a softened condition, the next operation is to remove the hair or wool. While hair is a byproduct of only small value, the wool of sheepskins is normally of considerably greater value than the pelt, and consequently more care is taken in preserving it than in looking after the skin.

The oldest method of removing hair or wool is that known as sweating, in which a mild putrefaction develops. The hides or skins are hung up in a closed chamber, known as a sweat pit, maintained at an even temperature by double walls or other suitable means. The temperature is kept at 15 to 20 deg. C. by means of steam pipes below the lattice floor, and cold water sprinklers so placed that they do not play on the hides. The air is thus kept saturated with moisture. There is practically no ventilation, and the ammonia liberated by the putrefaction plays a considerable part in loosening the hair. The stench from sweat pits in full operation is terrific, and here lies one cause why tanning in many countries is classed as an offensive trade.

Wool skins (sheep) are treated in a similar manner, a somewhat higher temperature being used. The proc-

FIG. 5—WASHING GREEN HIDES IN DRUMMING WHEELS

*The first article of this series appeared in *Chem. & Met.*, vol. 27, No. 23, p. 1110, Dec. 6, 1922.

FIG. 6—HIDES ROPED TOGETHER OR TOGGLED PRIOR TO REELING IN LIMES

ess is then known as staling. The whole process necessitates very careful supervision to insure that hides are removed before putrefaction has gone too far; otherwise irreparable damage to the grain ensues. In some cases much damage to pelts has been caused by nematode worms during the staling of sheepskins.

While with very careful control sweating offers the advantage, for heavy leather at least, that comparatively little hide substance is lost, its merits are greatly outweighed by the danger of damage to the goods and the excessive and close supervision necessary. Consequently it has very largely been abandoned, and is now used only occasionally for heavy hides, though still to a large extent for sheepskins.

One recent scientific innovation for unhairing is the use of enzymes. A preparation, in which trypsin is the active constituent, has been placed on the market under the name of Arazym. It works quite effectively, though further investigation is necessary to elucidate the nature of enzyme unhairing. Trypsin readily dissolves the young keratin of the hair roots and lower portion of the epidermis, but does not so readily attack the collagenous matter of the true skin unless present in fairly large concentration. Work is in progress along these lines in several laboratories at present, and interesting results may be expected in the course of the next year. Dr. H. C. Ross, working in England, recently patented the use of thrombase for unhairing. Since thrombase is an enzyme developed naturally in the skin itself, this process promises to be of much interest. It is still too recent to permit of any discussion of its practical value.

Another old method of unhairing, which has spasmodically attracted the attention of chemists in recent years, is by the use of dilute acids. A hundred and fifty years ago it was common to unhair in spent, fermented tan liquors, or in barley or grain mash. The process was superseded by the more simple and foolproof method of liming. Acid unhairing is effective, but there is danger that the grain membrane may also be split off from the skin in the form of blisters. The proper conditions for its safe working have not yet been developed.

The standard method of depilation consists in the use of solutions of lime, with or without sharpening agents such as sodium sulphide, sodium hydroxide, arsenic sulphide, etc. Straight limes (i.e., saturated solutions of slaked lime) unhair very slowly under sterile conditions, and there is no doubt that bacteria in the limes, together with degradation products from the hydrolysis of the keratins of the skin (also those from the hide substance), play an important part in unhairing.

There are endless ways of working the limeyard, of which one or two typical may be outlined. The three-pit system is perhaps the most common. In this the hides pass first into an "old" lime liquor (twice before used), then to a medium lime (once used) and finally to a fresh lime. The liquors are always kept saturated, an excess of solid calcium hydroxide being in the pit. The hides are placed in the pit flat, and are hauled (drawn out) and set (replaced) at frequent intervals to hasten the process. Frequently they are roped together, end to end, and reeled over a pulley from one pit to the next. (Fig. 6.) A limeyard in which the packs of hides are handled with an electric traveling crane is shown in Fig. 7.

In another method one pit only is used; the liquor is bettered from time to time by the addition of fresh lime. In this way hydrolysis products tend to accumulate in the lime, providing a fertile culture medium for those bacteria which flourish in lime liquors. Formerly such pits were rarely cleaned out. The three-pit system offers distinct advantages in that the spent liquor is run off after three packs.

Sodium sulphide is now almost universally added to hasten the unhairing action. In water this substance hydrolyzes to form equimolecular proportions of sodium hydrosulphide and hydroxide. Stiasny showed 16 years ago that so long as the proportion of hydroxyl ion to hydrosulphide ion exceeded unity, the unhairing action was good, the optimum being at unity. Where hydrosulphide ion is in excess, unhairing is poor. Consequently when used alone the water used must be soft; otherwise part of the hydroxyl ions are removed in softening the water, and the ratio $[OH]^-:[SH]^-$ becomes less than one, and unhairing is slow.

Sodium sulphide used alone has a very powerful solvent action on the epidermis and hair, and further draws the grain up into rucks. Its use in this respect is usually confined to cheap classes of skins. These are either dipped for a few minutes into a very concentrated solution, or a lime-sulphide paste is swabbed on the flesh side, and the skins piled. The hair can then be brushed off—the brush being made of fiber—or washed off in a wash wheel.

Used in conjunction with lime, the sulphide is employed in dilute solution, 2 oz. per hide being usually sufficient. It is impossible to give exact quantities, as practice varies so enormously.

The use of arsenic sulphide is almost entirely confined to goatskins and the finer quality of sheep. It is

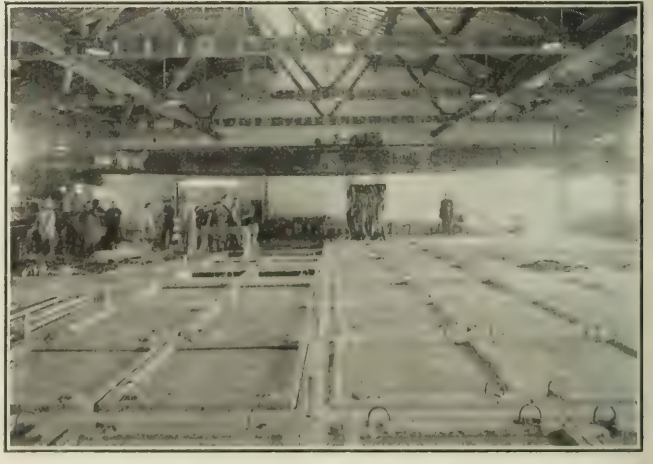


FIG. 7—LIMEYARD WITH ELECTRIC TRAVELING CRANE

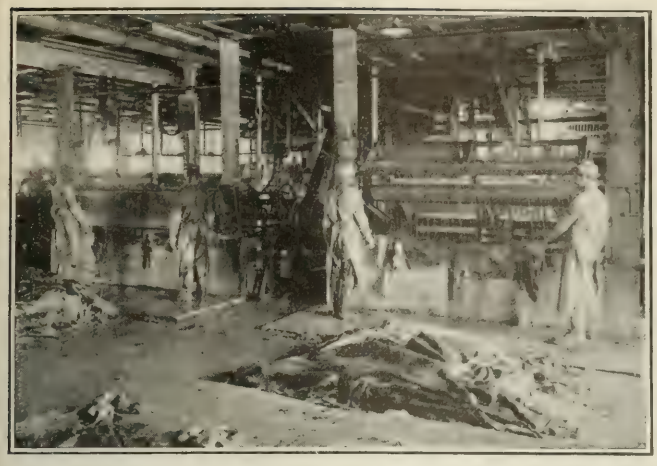


FIG. 8—UNHAIRING WHOLE HIDES

slaked in with the lime, the reaction being highly complicated and the products variable, according to the amount of arsenic used, temperature of slaking, etc. There is no doubt that it provides a finer grain for glazed kid and similar leathers. But it is probable, in the light of recent research, that the result might be obtained by other and cheaper means. The object is to insure that calcium, rather than sodium collagenate, is formed in the limes, by combination between the kation and the skin protein, in accordance with Loeb's work.

Other alkalis can be used for unhairing. Sodium hydroxide swells and plumps (renders firm) the pelt, but unhairing is slow unless the solution is concentrated,

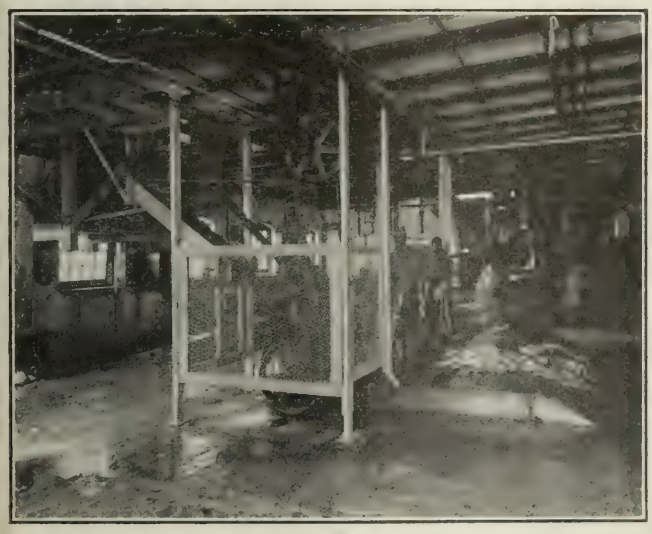


FIG. 9—FLESHING

when the hair is dissolved off. Ammonia readily unhairs, but does not swell or plump the hide. Lime is in general the most suitable. It has very limited solubility and consequently excess can be used with little danger of subsequent damage. It is as near a foolproof material as is possible under technical conditions, although it is by no means difficult to ruin goods in the limeyard.

Stiasny's work showed that liming effects depended largely on the concentration of hydroxyl ion. Consequently anything which can, by interaction with the lime, increase this, will act as a sharpening agent—e.g., sodium oxalate, sulphate, thiosulphate, etc.

The time and nature of liming vary according to the nature of product desired. For sole leather, where a plump, firm product is the object, liming is short and sharp, to loosen the hair and plump the goods. For dressing and harness leather, more mellow liquors are used, to open up the goods to a greater extent. Generally the time varies from 1 week to 3 weeks.

Sheepskins, if they come from a fellmonger (wool puller), have usually been preserved in "gathering limes" after the removal of the wool. Consequently the time of liming will vary according to the amount they have previously received.

FIG. 10—TRIMMING ON THE BEAM

Temperature also plays a part in liming. Although lime is more soluble in cold water than in hot, this is offset by its increased action at higher temperatures. From this a liming process has been devised. Hides are given a very short liming in a lime-sulphide liquor, then pass to warm water (35 to 45 deg. C.) for 12 hours or so, after which they can readily be unhaired.

An ingenious chemical method was devised by Pullman and Payne. The hides are treated first in a sodium hydroxide liquor, followed by a calcium chloride liquor, the object being the formation of lime in the skin. Unless the goods have been treated in a putrid soak, they will not unhair by this method. This process is advantageously used for tanning skins with the hair or fur on.

Various mechanical devices have been brought for-

FIG. 11—INSPECTION BEFORE TANNING

FIG. 12—DELIMING IN DRUMS

ward for hastening liming. A revolving paddle below a false bottom is effective, though likely to be choked by the excess of solid lime. Circulating the liquor with air blast (Forsare process) and suspending the hides combined with a rocking motion (Tilston-Melbourne process) are recent innovations and have met with some application in England. At the limeyard shown in Fig. 6 each vat is thoroughly stirred or plunged with compressed air just before reeling in a string of hides.

From the foregoing it will be seen that liming accomplishes more than merely loosening the hair. With sharp, caustic limes, the hide is swollen and plumped, and the fibers opened up to receive the tan more readily. Long mellow liming tends to remove the interfibrillary substances, and hence to soften the pelt. Greasy skins, such as pig and sheep, have part of their grease converted into lime soaps, whence it is removed by subsequent scudding. There is much to justify the saying that good leather is made before it enters the tanyard.

Unhairing, Fleshing and Deliming

The loosened hair is removed by hand, with a blunt knife over the beam, or, more generally, by machine. One common type consists of a revolving roller fitted with spiral knives which sweeps down a rubber or pneumatic bed on which the hide is laid. Fine hairs are often deep rooted and resistant, and frequently have to be removed afterward by going over the hide with the hand knife. Fig. 8 illustrates the unhairing of the whole hides by machine.

Fleshing may precede or follow liming. In this process all flesh, fat and tissue adhering to the flesh side of the hide are removed, either by hand over the beam with a knife or by machinery. Various types of machines have been developed. All have spiral knifed rollers, against which the hide is pressed by a pneumatic roll, a semi-cylindrical beam, etc. It is usually necessary to finish this operation by hand on the beam. (Fig. 10.) A thorough inspection often follows (Fig. 11) before the hides enter the tanning liquors.

Since all tanning is carried out in an acid medium, and lime precipitates nearly all tannins, it is necessary to remove lime from the skins before proceeding further. For sole leather a surface deliming is often sufficient, while for lighter leathers all lime must be removed to reduce the swelling of the skins and render them soft and flaccid.

The straight chemical process consists in the use of acids. The hides or skins are first washed with water, but removal of lime by this means is slow and always far from complete. Boric acid is used to a limited extent; it is very safe and suitable but somewhat expensive. The common mineral acids, sulphuric and hydrochloric, find most application, but have to be used with care. Excessive concentration of acid (even "dilute" acid) gives a very strong and undesirable swelling. The stock is usually suspended, drummed or paddled, and the acid added very slowly. Organic acids, acetic, lactic, formic, butyric, etc., are being increasingly used with advantage, the chief objection to them being their cost. Even these must not be used in excess. Where skins are being tanned to last for many years (e.g., bookbinding leather), it is essential that *all* treatment with mineral acid be avoided. In the course of time these rot and decay the leathers, leading to that peeling and rubbing away of leather-bound books so familiar today. Many acids of the aromatic series have been suggested, and have a certain antiseptic action, but they have met with little general application. Sulphuric acid, used with caution, is still the most general.

The use of drums and paddles is illustrated in Figs. 12 and 13 respectively. Fig. 13 also gives a closer view of the crane shown in Fig. 7.

Drenching, Bating and Puering

Drenching, though it usually follows (and occasionally replaces) bating, is strictly a deliming process. The drench consists of a fermented infusion of bran, the active agents being *bacterium furfuris* α and β, isolated by J. T. Wood. The cerealin of the bran produces glucose from the starch present, which is in turn attacked by these bacteria. Much gas is evolved, chiefly hydrogen, together with carbon dioxide and nitrogen. Lactic and acetic together with smaller amounts of formic and butyric acids are formed, and these exert the deliming action.

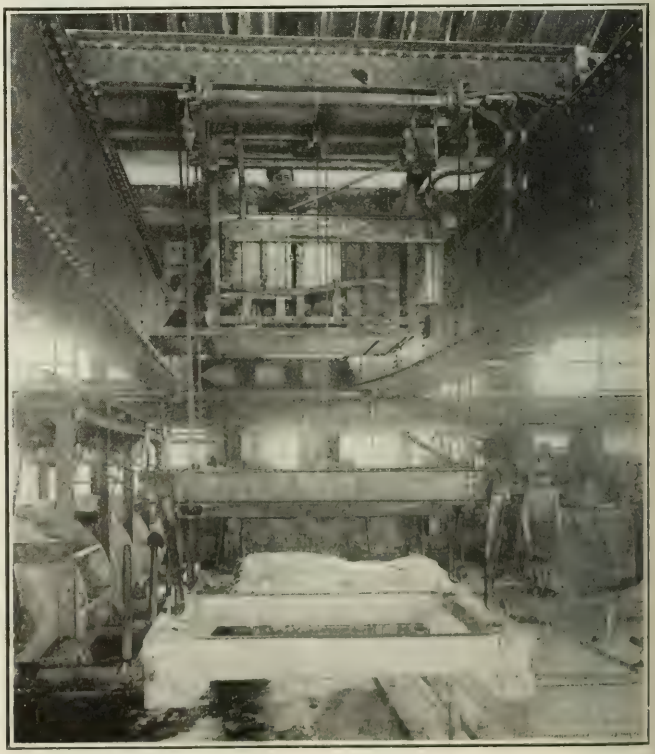


FIG. 13—DELIMING WITH PADDLES

The process is confined to skins, which are drenched in pits, being permitted to rise to the surface, and paddled or poled down again. The temperature is kept about 30 deg. C., and the process lasts 12 to 24 hours. The bran particles have a scouring and cleaning effect on the pelt.

Drenching must not be carried too far, otherwise small blisters form on the grain of the skin, due to the evolution of gas *in* the skin substance. In thundery and sultry weather the drench is apt to sour very rapidly. Some noxious fermentation sets in, and the skins rapidly become glassy and fall to pieces. The cause of this is still obscure.

In no process in the whole of leather manufacture has science done more to improve matters than in bating. Strictly speaking, bating consists in treating hides with infusions of fermented hen and pigeon dung, and puering in similar treatment with dog dung. Both processes are identical in principle, and bating is commonly used in this country to cover not only these two but also the modern method of using artificial (enzyme) bates.

Bating proper, with hen and pigeon dung, is confined to harness and dressing leather, where a mild softening action is required. The strength of the bate varies considerably with the choice of the tanner, the nature of the materials and the effect desired. It is carried out either in the cold by suspending the hides in the bate liquor for 4 to 8 days, or by paddling and drumming the hides at a temperature of about 35 deg. C. The excreta are usually fermented in water for a week, and strained through rough cloth to remove dirt and sediment before use. This process is now largely superseded by the more hygienic enzyme bates.

Puering with dog dung is still extensively used for certain classes of goods, goat and to a lesser degree sheep. The dog dung is mixed to a paste with water and kept in the dark as much out of contact with air as possible. The paste is diluted with water as required, and is strained before use. The skins remain in the liquor for several hours, at a temperature of 20 to 40 deg. C. according to type of stock, and are occasionally stirred or paddled. The completion of puering can be determined only by the feel of the pelt; it should be soft, flaccid and in a completely fallen condition.

Enzyme Bates

During the course of the last 30 years J. T. Wood has made extensive studies of bating and finally traced the main activity of bate liquors to the presence of enzymes. Since that time various enzyme bates have been put on the market, notably "oropon" and "pancreol," consisting usually of trypsin, together with ammonium chloride and a filler of woody fiber or other suitable material. The latter is supposed to furnish a greater surface for the enzyme, as Wood found that the activity of a puer liquor was greatly diminished by filtration, and increased again on the addition of an inert powdery material.

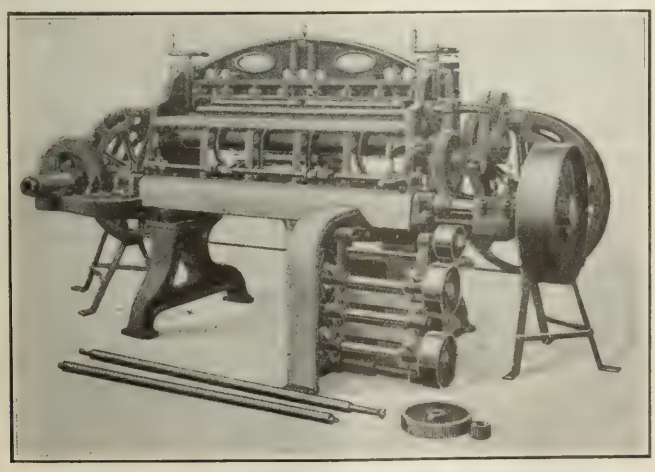


FIG. 14—BELT KNIFE SPLITTING MACHINE

What happens in bating has only recently come to light. It is now known that trypsin hydrolyzes the elastic fibers of the skin, thus loosening the skin structure and removing the binding material of the collagen fiber bundles. This is not all, for skins can be bated without removal of elastin, the finished product being apparently identical in feel and nature. Recent work by J. A. Wilson indicates that commercial bates do *not* digest elastin, while trypsin does; this may be due to absorption of the enzyme by the filler. Probably also the enzyme removes the interfibrillary matter of the skin.

Many patent and secret bates have been put on the market, frequently consisting of various mixtures of fermented or fermentable matter. In general most of these are more of the nature of drenches, but they have met with some application in practice.

Puering is of especial importance in the manufacture of glove leather, to obtain the necessary "stand"—i.e., the skin will not spring back on being stretched. Since the elastic fibers are confined to the grain layer of the skin, it has been suggested that puering may be more effectively carried out by applying a trypsin paste to the grain.

Scudding

Though rarely carried out in this country, the process of scudding usually follows bating in foreign countries. For greasy stock, especially that from animals fed on artificial feeds, it is necessary to remove as much of the skin fats as possible after puering. It is carried out either by hand, over the beam with a blunt knife, or by machine. The machines used are either of the spiral blade type, or, for sheepskins, consist of a number of small, stiff, revolving brushes.

Pickling Prior to Chrome Tanning

Prior to chrome tanning the stock is pickled in a bath of sulphuric acid and salt, followed by a brine bath, just as in the preservation of skins for export by pickling, described in the previous article.

Plumping, Rounding and Splitting

Where hides have been unhaired by enzyme action or by sweating, it is necessary to plump them for purposes where firm leather is required, such as sole. This is accomplished by swelling them in a dilute bath of sulphuric acid.

Hides are frequently rounded prior to tanning—i.e., the offal (bellies and shoulders) is removed, leaving the butt, which may be further divided along the line of the backbone into two bends. The offal, being of less value and looser texture, receives a cheaper tannage.

Hides and skins may be split out of lime or after a preliminary tannage. The split is horizontal, leaving a grain and a "skiver" or flesh. This is usually done on a band knife machine. (Fig. 14.) The knife runs over two pulleys, like an endless belt, and the hide is fed in between two series of rollers, these being adjusted to get the thickness of split desired. Other types of machine, oscillating knife, etc., are also in use. Hide fleshes and

grains are largely used for upholstery, automobile, and bag leathers. Sheepskin skivers are oil tanned for chamois leather, the grains going for hat linings, pocket books, etc.

ACKNOWLEDGMENT

Illustrations for this article were made available through the courtesy of the J. H. Ladew Co., Newark, N. J. (Figs. 5, 6, 8, 9, 10, 11 and 12); Pawling & Harnischfeger, Milwaukee, Wis. (Figs. 7 and 13); Turner Tanning Machinery Co., Peabody, Mass., through the Newark office (Fig. 14).

(Other articles on the art and science of leather manufacture will be printed in subsequent issues.)

Legal Notes

BY WELLINGTON GUSTIN

Junghaus Patent for Luminous Compound Invalid

The U. S. Circuit Court of Appeals has affirmed a decree against the American Radium Co. in its infringement suit against the firm of Hipp, Didisheim & Bro., Inc., and others. Plaintiff is assignee of the Junghaus patent, No. 911,401, covering, as it claims, "certain new and useful improvements relating to improved luminous substance for indicators containing radium for the indicating members of clocks, speed gages, and the like." (279 Federal, 1016.)

Passing over the legal technicalities arising in this case, the patent's validity will be considered. The court found that radium paint, or the luminous material here employed, was old. Phosphorescent paints had long been employed on the hands and dials of clocks, but they were not self-luminous. But it was not long after Mme. Curie discovered radium in 1889 that radium paint appeared. The court says it might well be questioned whether it was invention to apply radium paint, instead of phosphorescent paint. But two distinguished students of radium did apply radium paint before Junghaus, and there was put in evidence the Hammer clock and the Kunz watch.

In 1903 Dr. George F. Kunz, the inventor of a radium paint (letters patent No. 789,912), applied radium paint to the hands and dial of his watch, and that watch was in evidence. Major Hammer put radium paint on his clock in 1903, in much the same way as shown in the Junghaus patent. The court said there was a long list of prior art patents and scientific publication on the subject which might invite discussion, but for these two devices.

OBTAINING HIGH ILLUMINATION BY INCREASING BULK OBVIOUS STEP

Plaintiff contended that Hammer did not think of constructing the dial on his clock so that the luminous substance would be imbedded in the figures on the dial, or that the figures would be imbedded in the luminous substance. Much was argued as to the imbedding of the radium paint. It was contended that the problem which Junghaus was called upon to solve was to apply to the hands of a watch a substantial bulk of a luminous compound, consisting of radium and a radio-responsive material, so as to obtain high illumination, and so that the luminous compound will not extend above the hand, and to apply to the hands of a watch this luminous compound, so that it would extend substantially the full length of each hand, and to obtain this illumination near the indicating divisions on the dial, so that the watch might be readily read in the dark as well as in the daytime.

But there was nothing in the claims about "bulk," and the court concluded that no great importance could have been attached to this feature, else it would have appeared in the claims. The patent states simply: "Preferably the substance is present in some considerable bulk where a high illumination is required."

Obviously to apply the substance in considerable bulk did not require knowledge beyond that of one skilled in the art. This the court says was a mere incidental feature which certainly could not be said to have required inventive genius.

Of course, says the court, it is true that many simple devices have exhibited invention, but on the question of invention a patent case in one art is rarely of much help in deciding whether invention exists in another art. Each case is necessarily controlled by its own facts, and in the case at bar there was nothing left for Junghaus to invent.

Further, the court says that while the decisions of foreign courts are not controlling and often not persuasive, because of a different attitude or a different record, it is sometimes comforting to know that other judicial bodies have come to practically the same conclusion as itself, and the fact that the German and Swiss courts, familiar as they must be with the watch industry, have decided adversely to Junghaus is of special interest.

Cargo Owner Not Entitled to Recover on Policy to Ship Owner

In a suit in admiralty brought by the Virginia Carolina Chemical Co. against the Chesapeake Lighterage & Towing Co. and Fireman's Friend Insurance Co. a decree was had in the U. S. District Court against the insurance company and in favor of the chemical company. On an appeal this decree has been reversed and the case remanded with directions to dismiss the suit, by the Circuit Court of Appeals. (279 Fed., 685.)

The suit as against the Chesapeake company proceeded on the theory that it agreed on due consideration to procure insurance for claimant shipper covering a shipment of kainit. It was admitted this company fulfilled its obligation by procuring or maintaining the Fireman's Friend policy. Therefore the suit shifted to one of damages on insurance. But the court held that a contract by a carrier to obtain insurance for the benefit of the cargo owner is not maritime, and a suit for its breach is not within the Admiralty jurisdiction.

Again, it holds that to entitle a cargo owner to maintain a suit on a maritime policy issued to the carrier he must, under the terms of the contract, have become the insured, when the cargo went on board the carrier's vessel.

And a marine policy issued to a ship owner covered any property on which the insured had agreed with the shipper to provide insurance, and also its legal liability where it had not so agreed, but provided it should not cover "where the assured, or any carrier or other bailee, has insurance which would attach if this policy had not been issued." Here the court held that a cargo owner could not recover on such policy for loss of cargo as "the assured," where it had other insurance, nor through liability of the shipowner where the latter was not charged with any fault.

The Graphical Study Of Operating Efficiency

The Description of a System of Graphs Which Were Developed to Analyze Labor Costs, and Which in Addition Reveal Lack of Smoothness in Operating and the Causes for Lost Time

By A. R. Blakey

IN THIS ARTICLE we shall discuss some recent studies in the field of cost accounting and plant development work, rather as an aid to the operating heads and supervisors than as a help to the accounting department. The studies were designed to indicate opportunities for improving costs by bringing some of the salient facts graphically before the operating executive. The following description is therefore given more to explain the time card and graphic representation of plant troubles than as a significant contribution to cost finding.

The industry under consideration was of the continuous process type and the finished products of several plants were quite similar in percentage consumption and size of containers. The problem as originally faced by the company was to determine at various major points the cost of operation and compare the costs of the several plants with the view of establishing, by comparison, friendly competition for lowest costs and bringing to light those methods which produced the best operating results.

Standardizing Nomenclature and Cost Procedure

Naturally the first step was the standardization of cost procedure and nomenclature. Consequently a very detailed flow sheet of all operations was constructed. It showed them in a logical order and included flow lines for transportation and handling into and through the plant. Following this, a very definite set of rules was laid out and a standard nomenclature adopted for all plants in referring to costs. There was a good deal of discussion as to whether the operations should be numbered according to some systematic code. The decision was finally affirmative, because it would much simplify the recording of time in the field to use a number rather than a word description. Therefore the next step was an examination of the flow sheet and the writing in of numbers to cover all operations represented thereon according to some definite system. The rules adopted in assigning code numbers are given in large part in the footnote.[1]

To make the code numbers available, large placards about 3 ft. square carrying both the description of the work and the several code numbers applicable to it were placed in each department or location where such work was carried out.

A Simple Yet Comprehensive Time Card

Now we have nomenclature, how shall we get the true facts coming in and how shall we visualize them? The answer to question No. 1 is Time Cards, and to question No. 2 Plant Graphs, both of which are described herewith. To anyone who has had field experience with the ordinary time card, the idea of having the individual workman fill out a daily card appeals about as much as ice cream for breakfast. It just doesn't work well. Therefore it was perhaps to be predicted that the regular payroll time cards which were distributed at first, showing total hours worked, together with so-called distribution cards one for each code worked under on which to be written name, payroll number, date, occupation number plus hours spent, etc., were doomed to failure. Cards were lost, torn and soiled, and the men hated them naturally. The clerical work was excessive. The difficulties were somewhat intensified by the awkward plant layout, which was not compact and prevented a centralized distribution of cards.

The time card which finally was worked out and proved very successful combined the ordinary payroll card with the distribution information necessary. The card was designed also to minimize clerical effort by the operator. The time spent on a task could be chalked off on the card directly and at the time of the change of assignment rather than waiting until the end of the day and estimating the time spent on the several codes.

With this card we obtained not only the duration of the task but its sequence in the day's work. We obtained the exact time and duration of such and such a shut-down and what its effects were on the following operation, and how the time of its occurrence was related to some necessary or inherent shut-down of operations or to transportation upon which it was depending. In this way we could look up and down the line and see graphically its cause and effect. The card used is shown herewith. It is divided into two main parts, the upper portion acts as the man's payroll card, the lower portion has the clock spread out upon which he chalks off sequence and duration of events for distribution purposes opposite the proper code.

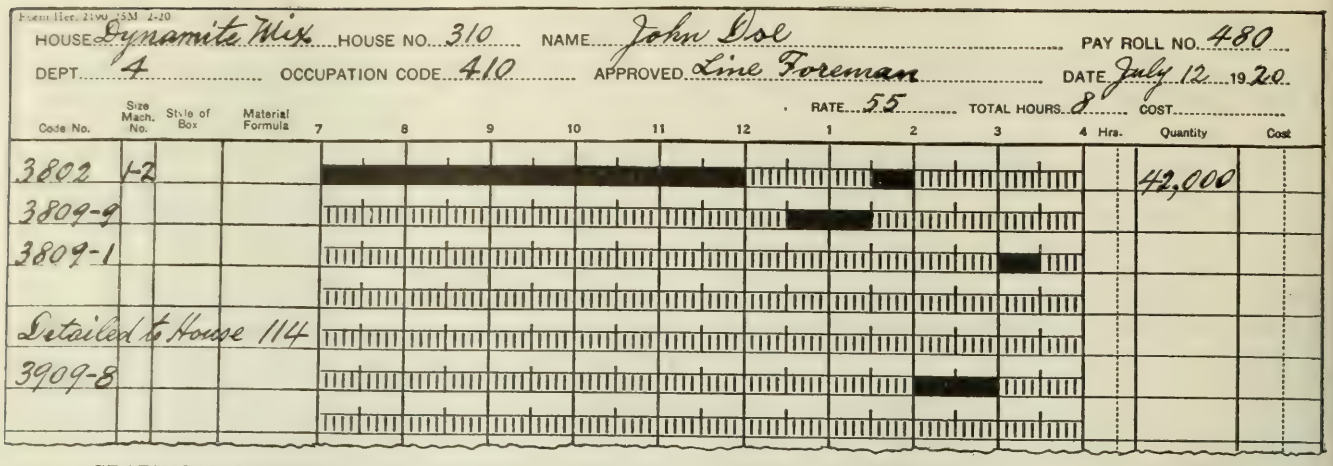
All extensions and arithmetic were done by the office force, and the operator simply chalks off that portion of the clock used in the performance of a given task opposite its code number.

On the reverse side of this card is the "overtime" side, which is quite similar to the straight time side except that it does not repeat name, etc., and the Time Lines begin with 3 instead of 7 o'clock.

How the Executive Gets His Information

So the information was collected on the time consumed in a given task, the ordinary labor charges for the cost accountant. The next step was to portray graphically the workings of the whole plant in one concise picture for the executive and at the same time retain all details of each individual worker. This was accomplished by projecting vertically each individual's time card in its proper place on a "flow sheet" of the

[1]Some of the rules used in assigning the code numbers were as follows:
Use definite groups of numbers for different departments.
All major codes to end in even hundreds as: 100, 200, 300, etc.
All major codes ending in one (1) represent transportation to that operation.
All major codes ending in 2, 3 4, 5, 6, 7 and 8 represent sub-operations at major points.
All major codes ending in 9 represent indirect or non-productive labor, the nature of which may be serialed as 209-2, etc.
All major codes ending in 50 represent repairs, the nature of which to be shown by serial, the serial corresponding to the number painted on machine or part repaired, as 250-5, etc.


HOUSE Dynamite Mix HOUSE NO. 310 NAME John Doe PAY ROLL NO. 480
DEPT. 4 OCCUPATION CODE 410 APPROVED Line Foreman DATE July 12 1920
RATE 55 TOTAL HOURS 8 COST
Code No. Size Mach. No. Style of Box Material Formula
7 8 9 10 11 12 1 2 3 4 Hrs. Quantity Cost
3802 4-2 42,000
3809-9
3809-1
Detailed to House 114
3909-8

GRAPHICAL TIME CARD SHOWING BOTH TIME CLOCK DATA AND DISTRIBUTION TO CODE NUMBERS

plant, allowing one horizontal line for each time card and having the vertical lines representing time lines for the day. The graph given herewith is such a plant picture.

At first sight it might seem rather a laborious task, but the actual construction of the chart was accomplished by a young grammar school graduate during the forenoon, during which time he also completed the distribution of the payroll.

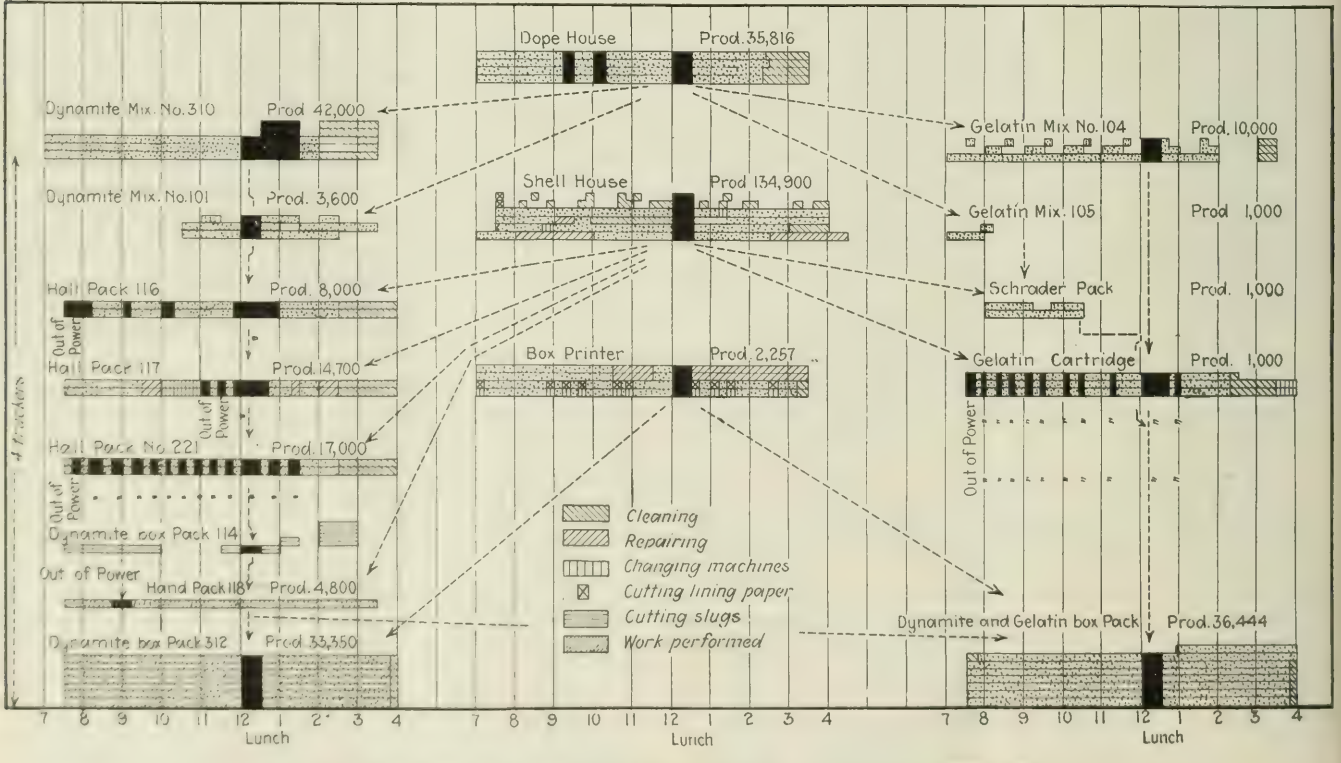
In further explanation of this plant graph and method of plotting, let us consider the Dynamite Mixing House. Here we find there were three men engaged in mixing dynamite from 7 o'clock a.m. until noon without any interruptions. After lunch there were no empty hods for conveying the mixed powder to the packing machines, so the house was idle and the two truckers were there waiting for a delivery until 1:30 p.m. The house then produced until 2 p.m., when they began to clean up, spending one hour and a half at this, during which time the truckers also helped. From 2 to 3 you will note two of the men left the operation and assisted in cutting slugs in Dynamite Box Pack No. 114 and returned at 3 o'clock to their original station and helped in cleaning up.

In Dynamite Box Pack No. 312 you will note there were seven men working without any hold-up except lunch and the clean-up at end of day. From this it is seen that for each man in the house there is a distribution line, and laid off on this line are the intervals as shown on the distribution half of his time card. In making a composite plot of a house these man lines are built one on top of the other corresponding in number to the number of men. The truckers who delivered from building to building appear on the graph only when actually in the house helping the operator with his work.

The time card shown represents the work done by one of the men in Dynamite Mix House No. 310.

In studying these graphs from day to day, the tendencies of the plant are clearly visualized.

The idle intervals showing up in the Gelatin Cartridge are caused by the fact that the Mixing House just


Dope House Prod. 35,816
Dynamite Mix. No. 310 Prod 42,000
Dynamite Mix. No. 101 Prod. 3,600
Shell House Prod 134,900
Hall Pack 116 Prod. 8,000
Out of Power
Hall Pack 117 Prod. 14,700
Box Printer Prod. 2,257
Hall Pack No. 221 Prod. 17,000
Out of Power
Dynamite box Pack 114
Out of Power
Hand Pack 118 Prod. 4,800
Dynamite box Pack 312 Prod 33,350
4 Truckers
Gelatin Mix No. 104 Prod. 10,000
Gelatin Mix. 105 Prod 1,000
Schrader Pack Prod. 1,000
Gelatin Cartridge Prod. 1,000
Out of Power
Dynamite and Gelatin box Pack Prod. 36,444
Cleaning
Repairing
Changing machines
Cutting lining paper
Cutting slugs
Work performed
7 8 9 10 11 12 1 2 3 4
Lunch

PLANT GRAPH. THE EXECUTIVE'S SUMMARY OF DAILY OPERATIONS

ahead is under capacity for the cartridge machine. When the reserve Mixing House is thrown in and the cartridge machine kept at capacity, then we have idle intervals in the Mixing House, showing that this section of the line has a poor capacity balance.

Extension of the System Possible

The above system is quite flexible and can be made as detailed or as simple as desired. Instead of having each individual worker make out his distribution, the foreman can make it out for the whole house as the day progresses, where there are not many workers—exactly as each house is here represented. The usual method is for the foreman to write up his house report at the end of the day, giving production figures, time of shutdowns, man-hours, etc., but it is largely guesswork except the production figures; besides, the present house reports are usually such that they do not lend themselves to a continuous record of the events of the day.

If the lower half of each house report had the "time lines" laid off on it so the exact time and duration of these events could be chalked up for each house as they occur, a much more intelligent study with very little work could be made of the average plant which does not care to go into much detail. These house reports could then be assembled quite similarly to the graph shown and the salient points of operation could be quickly noted.

Kenvil, N. J.

The Hygroscopicity of Tetryl and Tetranitraniline

By L. Grier Marsh
Assistant Explosive Chemist, Pittsburgh Station, U. S. Bureau of Mines

THIS WORK is for the main part a continuation of the study of the hygroscopic properties of organic explosives, which on the suggestion of Dr. Charles E. Munroe, chairman of the committee on explosives investigations of the National Research Council, was begun by Huff in his determination of the hygroscopicity of TNT[1] and continued by the author in a previous work on the hygroscopicity of picric acid.[2] The procedure followed in all cases is essentially the same and involves a study of the hygroscopicity from the calculated vapor pressures of saturated aqueous solutions of the substances investigated, and also experimentally determined data on the amount of moisture taken up by each compound by methods previously outlined in detail and briefly summarized below.

The hygroscopicity of TNA has been given by Flurscheim[3] as 0.12 per cent for a material made on a laboratory scale and exposed in an atmosphere of 85 per cent humidity for a week. The uncrystallized material was found to absorb under the same conditions about 0.023 per cent. Constant weight with 0.13 moisture was obtained on a sample of (green) commercial material that had been completely dried in the laboratory at 95 deg. C. A more finely divided yellow TNA became constant after 32 days with 0.19 per cent moisture.[4] The solubility of TNA in water was given as one part in 50,000 at 13 deg. C.

Comparatively little work has been published on the properties of tetryl. Flurscheim states that pure tetryl takes on about 0.30 per cent of moisture at constant weight determined under the same conditions as TNA and that the uncrystallized material attains constant weight with an increase of about 0.024 per cent. Taylor and Rinkenbach, in the Bureau of Mines Explosives Chemical Laboratory, are at present investigating the solubility of tetryl and TNA, and they find the solubility of the pure tetryl in water at 32 deg. to be 0.0088 gram per 100 grams of water. The TNA used had a solubility of 0.0175 part per 100 grams of water.

Calculated Hygroscopicity

Assuming the existence of a close relationship between the hygroscopicity of compounds not forming crystalline hydrates and the vapor pressures of their saturated aqueous solutions and the applicability of Raoult's law to the compounds in question, for the purpose of comparison, the vapor pressure of a saturated aqueous solution of tetryl at 32 deg. can be calculated and a measurement of its hygroscopicity correspondingly determined. From Raoult's law

$$\frac{P_1 - P_2}{P_1} = \frac{n}{N + n}$$

where the solubility of tetryl in water at 32 deg. is taken as 0.0088 per cent and the vapor tension of water at the same temperature as 35.372 mm. of mercury,[5] the vapor pressure of a saturated aqueous solution of tetryl in water at 32 deg. is found to be 35.3718 mm. of mercury, or 99.9994 per cent of that of pure water. The TNA solution had a vapor pressure of 35.3716 mm. of mercury, which is 99.9988 per cent of that of pure water.

TABLE I—VAPOR PRESSURES OF SATURATED SOLUTIONS

	Vapor Pressure of Saturated Aqueous Solutions, Mm. of Mercury	Ratio to Vapor Tension of Pure Water, Per Cent
Picric acid	35.3265	99.872
TNT	35.371427	99.9983
Tetryl	35.371804	99.9994
TNA	35.371591	99.9988

The difference in vapor pressures is so slight that either compound can be only slightly hygroscopic. A comparison between the vapor pressures of saturated aqueous solutions of the different compounds at 32 deg. C. is shown in Table I.

Materials

The experimental work was carried out on both the pure tetryl and TNA and also on two commercial grades of each material containing the ordinary impurities characteristic of each compound.

The purified tetryl was prepared by the following method: Commercial material was dissolved in hot benzene, the solution filtered and permitted to cool. The mother liquid was then decanted and the crystals permitted to air dry. The dried tetryl was then dissolved in hot alcohol, the solution cooled and filtered, the tetryl redissolved in hot alcohol and thrown out of solution by the addition of an equal volume of cold water. The product thus obtained was filtered off, washed once with cold water, twice with cold alcohol, and permitted to dry in a sulphuric acid desiccator for a week.

The pure TNA was prepared by dissolving commer-

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[1] Huff, W. J., "The Hygroscopicity of TNT," *Chem. & Met.*, vol. 21, No. 11, p. 570, Oct. 29-Nov. 5, 1919.

[2] Marsh, L. G., "The Hygroscopicity of Picric Acid," *J. Ind. Eng. Chem.*, vol. 14, No. 4, p. 321, April, 1922.

[3] Flurscheim, B. J., *Z. ges. Schiess-Spreng-stoffw.*, vol. 8, p. 185 (1913).

[4] Flurscheim, B. J., "Some Properties of TNA," *J. Soc. Chem. Ind.*, vol. 40, p. 97t to 107t, May 31, 1921.

[5] Broche and Weibe, Van Nostrand's Chemical Annual, 1918, p. 532.

TABLE II—PROPERTIES OF TETRYL

	Pure Tetryl	Commercial L-364	Commercial M-2356
Melting point (deg. C.)	130.4 to 130.6	127.1 to 129	127.5 to 129.2
Solidification point (deg. C.)	128.6	125.6	126.1
Moisture (per cent)	0.00	0.00	0.00
Insoluble matter (per cent)	0.176	0.713	0.294
Sulphates (H_2SO_4) (per cent)	0.00735	0.00569	0.00541
Ash (per cent)	0.055	0.125	0.14

TABLE III—PROPERTIES OF TNA

	Pure TNA	Commercial L-228	Commercial M-2357
Melting point (deg. C.)	210 to 220	200 to 210	200 to 210
Moisture (per cent)	0.00	0.00	0.00
Insoluble matter (per cent)	0.00	0.112	0.588
Sulphates (H_2SO_4) (per cent)	0.00756	0.0315	0.0834
Ash (per cent)	0.00	0.03	0.300

TABLE IV—HYGROSCOPICITY OF TETRYL AND TNA

	Hours	Grams Increase in Weight: Sample	Grams Increase in Weight: Blank	Per Cent Moisture Absorbed By Sample
2 grams weight pure tetryl	5	0.0029	0.0021	0.04
	17	0.0031	0.0030	0.00
	24	0.0046	0.0047	0.00
	41	0.0059	0.0052	0.03
	48	0.0062	0.0058	0.02
	72	0.0063	0.0062	0.01
Commercial tetryl L-364	5	0.0119	0.0024	0.47
	17	0.0228	0.0030	0.99
	24	0.0279	0.0027	1.26
	41	0.0379	0.0048	1.65
	48	0.0391	0.0062	1.65
	72	0.0462	0.0064	1.99
Commercial tetryl M-2356	5	0.0047	0.0021	0.13
	17	0.0073	0.0030	0.22
	24	0.0078	0.0047	0.16
	41	0.0091	0.0052	0.20
	48	0.0121	0.0058	0.32
	72	0.0156	0.0062	0.47
Pure TNA	5	0.0024	0.0022	0.01
	17	0.0027	0.0027	0.00
	24	0.0038	0.0027	0.06
	41	0.0043	0.0045	0.01
	48	0.0063	0.0065	0.01
	72	0.0066	0.0061	0.03
Commercial TNA L-228	5	0.0128	0.0022	0.53
	17	0.0272	0.0027	1.22
	24	0.0301	0.0027	1.37
	41	0.0336	0.0045	1.46
	48	0.0386	0.0065	1.62
	72	0.0518	0.0061	2.28
Commercial TNA M-2357	5	0.0153	0.0024	0.65
	17	0.0342	0.0030	1.56
	24	0.0428	0.0027	2.01
	41	0.0541	0.0048	2.47
	48	0.0568	0.0062	2.53
	72	0.0738	0.0064	3.37

cial TNA in hot glacial acetic acid, filtering the solution, crystallizing in the cold, washing the product three times with cold glacial acetic acid and drying in an oven at a temperature from 45 to 50 deg. C. for three days.

The analyses of the different materials are given in Tables II and III.

The determination of the insoluble matter in TNA was made by the use of hot benzene as a solvent, while acetone was used for tetryl.

Experimental

The method used was that designed by Taylor and Cope and given in detail in a previous paper.[6] The essential features of this method involve the determination of the increase in weight of two gram samples of each material after intervals of 5, 17, 24, 41, 48 and 72 hours, where the material is exposed in open porcelain crucibles over water in sealed quart jars, and the jars submerged under water in a large thermostat at a temperature of 32 deg. C. automatically controlled, within a range of 0.10 deg. C. Blank tests on empty crucibles were run in conjunction with the regular tests.

These blanks are necessary especially with materials of low hygroscopicity, as there is a small gain in weight due to the deposition of a film of moisture.[7] This condensation is due to the slight fluctuations in temperature.

The results obtained are shown in Table IV.

Conclusions

The results obtained show that both pure tetryl and TNA are non-hygroscopic and that the ordinary commercial products are slightly hygroscopic, due to the impurities present.

Explosives Chemical Laboratory,
Chemical Division,
Pittsburgh Experiment Station,
Bureau of Mines.

[6] "Hygroscopic Properties of Sodium Potassium and Ammonium Nitrate, Potassium Chlorate and Mercury Fulminate," *Chem. & Met.*, vol. 15, No. 3, p. 140, Aug. 1, 1916.

[7] Huff, W. J., "Hygroscopicity of TNT," *Chem. & Met.*, vol. 21, No. 11, p. 570, Oct. 29-Nov. 5, 1919.

Wood Distillation in 1921

Reports made to the Bureau of the Census show a decrease in the activities of the establishments engaged primarily in wood distillation during 1921, as compared with 1919. The total value of products reported amounted to $9,258,500 in 1921, and to $32,545,300 in 1919, a decrease of 71.6 per cent.

Of the 90 establishments reporting products valued at $5,000 or more for 1921, 35 were located in Pennsylvania, 17 in New York, 12 in Michigan, 4 in Louisiana, 3 each in Alabama, Florida, Georgia, New Jersey and Wisconsin, 2 each in Mississippi and North Carolina, and 1 each in Kentucky, Tennessee and West Virginia. Of the active establishments in 1919, 20 were idle in 1921.

The decrease in production has been accompanied by decreases in number of persons employed, in the total amount paid during the year in salaries and wages, and in the cost of materials.

The returns indicate that the combined output of all establishments was approximately 34 per cent of the maximum capacity, based upon a demand requiring full running time; 44 establishments with 36 per cent of the products being above the said average, and 46 with 64 per cent below.

Detailed statistics of products of the wood-distillation industry for the years 1921 and 1919 are given in the following table:

	1921	1919	Per Cent of Decrease
Products—total value	$9,258,500	*$32,625,300	71.6
Wood alcohol:			
Crude, gal.	5,684,500	9,104,000	37.6
Gal.	5,009,300	6,980,700	28.2
Value	$2,307,500	$5,593,500	58.7
Average unit value, gal.	$0.46	$0.80	....
Made and consumed, gal.	675,200	2,123,300	68.2
Refined, gal.	1,111,700	7,391,000	85.0
Gal.	995,300	6,984,700	85.8
Value	$727,500	$8,381,900	91.3
Average unit value, gal.	$0.73	$1.20	....
Made and consumed, gal.	116,400	406,300	71.4
Acetate of lime, lb.	57,927,000	168,956,000	65.7
Lb.	53,563,000	153,910,000	65.2
Value	$736,100	$2,682,200	72.6
Made and consumed, lb.	4,364,000	15,046,000	71.0
Chemicals, in order named as to value: Acetic acid, formaldehyde, methyl acetone, acetone, and acetone oil	$411,000	$2,023,300	79.7
Turpentine (from wood):			
Gal.	441,800	1,534,300	71.2
Value	$233,200	$1,207,700	80.7
Rosin (from wood):			
Bbl. (280 lb.)	52,400	234,000	77.6
Value	$199,400	$2,742,500	92.7
Charcoal†:			
Bushels	19,990,000	48,056,000	58.4
Value	$4,049,500	$8,221,400	50.7
Other wood products and derivatives‡	$588,700	$1,220,200	51.8
All other products	$5,600	$552,600	98.1

* Includes byproducts from other industries to the amount of $79,991.

† Does not include products of the charcoal (other than wood distillation) industry to the value of $447,234 for 1921; and $589,418 for 1919.

‡ Includes for 1921: Tar, 1,569,186 gal., $185,450; tar oils, 400,414 gal., $92,400; wood creosote, 92,916 lb. $15,100, and miscellaneous wood products, $295,750.

The Production of Nitrogen and Hydrogen for Synthetic Ammonia Manufacture*

By Hugh S. Taylor
Professor of Physical Chemistry, Princeton University

The Production of Nitrogen and Hydrogen for Synthetic Ammonia Represents at Least 75 Per Cent of the Cost of Production of Ammonia and Yet It Has Had but Little Attention in the Literature—The Efficiencies of Various Methods of Production and Their Future Developments

THE production of 1 ton (2,000 lb.) of fixed nitrogen, as ammonia, involves the theoretical consumption of approximately 430 lb., or more than 82,000 cu.ft., of hydrogen, measured at ordinary temperatures and pressures. One-third of this volume of nitrogen is also required, which may be in part produced simultaneously with the hydrogen or may be wholly supplied from a nitrogen-producing plant. The German synthetic ammonia plants in 1918 had a capacity of 650 metric tons per day. The process is now operated on a technical scale in the United States (at Syracuse, N. Y.) and is being developed in France, England and Norway. The importance of this division of gas technology is, therefore, readily grasped.

The gas mixture is required for the synthetic operation in a high state of purity. Inert gases, such as the argon group and methane, act as diluents and, in a circulatory system, necessitate a periodical blowing-off and loss of gas in order that the inert constituents do not accumulate beyond a working maximum. Water vapor, oxygen, carbon dioxide and carbon monoxide are catalyst poisons which when present continuously in concentrations of 0.01 to 0.1 per cent lower the efficiency of the synthesis quite markedly. Hydrogen sulphide and sulphur compounds are permanent catalyst poisons, cumulative in effect and eventually necessitating, if permitted to intrude, a renewal of the ammonia-making catalyst.

As a result of the large volume requirements of gas and the high purity essential to successful synthesis, the problem of preparation of the gas mixture is the most important in the cycle of operations from elementary nitrogen to fixed nitrogen product, whether this be ammonia, nitric acid, oxides of nitrogen, ammonium sulphate or other fertilizer compound. It has been computed[1] that the preparation of the compressed nitrogen-hydrogen mixture involves as much as 75 per cent of the total cost of the ammonia produced. The attention which has been paid in past discussions to the actual synthetic operation as compared to the gas preparation is out of all proportion to its relative importance and cost in the cycle of reactions. Recent literature abounds in discussion and reports of the ammonia-making processes. Scant attention has been paid to hydrogen and nitrogen technology.

A Review of Existing and Possible Processes

The Liquefaction Process

The earliest synthetic ammonia plant, the Badische Co., at Oppau, operated on hydrogen obtained from water gas at 20 atmospheres pressure by liquefaction of the carbon monoxide in a liquefaction system of the Linde type, diagrammatically shown in Fig. 1. The nitrogen was obtained by fractionation of the liquid air, *h*, *i*, boiling under a partial vacuum, used to establish the low temperature (—205 deg. C.) necessary for the separation of the carbon monoxide from the hydrogen. The carbon monoxide was employed, after being vaporized, to drive a gas engine and thus produce the power requisite for compression of the water gas and of the air employed in the liquid air cooling system. Also the power requirements for a pressure water scrubber to remove carbon dioxide and an ammonia refrigeration system to remove water vapor were supplied from the same source.

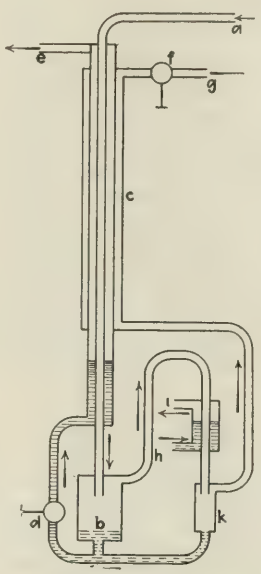


FIG. 1
LINDE LIQUEFACTION SYSTEM FOR HYDROGEN PURIFICATION

The normal purity of the hydrogen obtained corresponds closely to a gas of the following composition: $H_2 = 97$ to 97.5; $CO = 2$ to 1.7; $N_2 = 1$ to 0.85 per cent. Approximately 40 per cent by volume of the original water gas is received in this form from the liquefaction system. This gas, before use in ammonia synthesis, must be freed from the residual carbon monoxide, this being achieved of late by the Badische Co. by solution in ammoniacal cuprous formate under a pressure of 200 atmospheres. In the earlier stages of the process the carbon monoxide was absorbed at 200 atmospheres in hot caustic soda solution with the formation of alkali formates. Thus purified, the hydrogen residue contains less than 0.1 per cent carbon monoxide and admixed with the theoretical ratio of nitrogen from the liquefaction system was so used in the synthetic operation.

The Water Gas Catalytic Process

The liquefaction process was discarded at Oppau in favor of the water gas catalytic process. In essentials this process consists of the oxidation at 500 deg. C. of the carbon monoxide in water gas by steam in the presence of a catalyst (oxide of iron), the reaction occurring being representable by the equation

$$H_2 + CO + H_2O = 2H_2 + CO_2$$
Water gas

The reaction is an equilibrium process and the final composition of the gas is dependent on the steam-water gas ratio, the temperature of operation and the efficiency of the catalyst. Furthermore, by using water gas admixed with semi-water gas (a gas containing the

*Paper read before the American Institute of Chemical Engineers, Buffalo, N. Y., June, 1922.

[1]Nitrogen Products Committee Report, British Munitions Inventions Department.

products of both air-blow and steam-run in the water gas process) a product may be obtained containing the bulk of the nitrogen required in the subsequent synthesis requiring only small amounts of nitrogen from the liquefaction of air for purposes of exact ratio adjustment. Details of plant, materials, engineering and operation of this process have already been discussed before this society[2], so it is not necessary to recapitulate such in this article. Fig. 2 shows the process diagrammatically. Emphasis only need be laid on the factor which accounted for the change from the liquefaction process to the catalytic process. The factor involved is the water gas: hydrogen ratio or, in other words, the ratio of fuel consumption to hydrogen yield in the two processes. Whereas somewhat less than 40 per cent by volume of the original water gas is received as hydrogen in the liquefaction process, the yield in the catalytic process, as can readily be seen from the previous equation, is equal theoretically to that of the water gas consumed. In actual practice it is possible to receive unit volume of hydrogen by the expenditure of 1.25 volumes of water gas. The fuel bill, therefore, should be just one-half that obtaining in the liquefaction process. The purity of the product corresponds approximately with that from the liquefaction process, so that no advantages accrue to the catalytic process in that respect.

The Steam-Iron Process

The industry of oil hydrogenation for the production of soap stock and of edible fats has made but little use of hydrogen from either of these two sources. This should, in the main, be attributed to the nitrogen and carbon monoxide present in the hydrogen so obtained. In ammonia synthesis nitrogen is a reactant; in oil hardening it is a troublesome inert, present to the extent of several per cent, depending on the nitrogen content of the original water gas. Until recently the methods technically developed for the removal of 2 to 4 per cent carbon monoxide have been operated at 100 atmospheres pressure or upward, generally at the working pressure of the ammonia synthesis operation. Such pressures are entirely unnecessary in technical hydrogenation and therefore involve unnecessary compression costs.

Operation of the carbon monoxide purification processes at lower pressures is less satisfactory. Hence the additional objections to these two processes of hydrogen manufacture for hydrogenation work. The chemical method of hydrogen production for the oil-hardening industry has therefore been what is variously known as the steam-iron process or the iron-contact process. It consists in the production of hydrogen by the interaction of steam and iron at temperatures in the neighborhood of 700 deg. C. The contact mass is regenerated by reduction of the iron oxide in a stream of a suitable reducing gas, normally water gas, whereupon the cycle of operations may be repeated. The hydrogen thus produced is easily obtained in a high state of purity. The gas can leave the producing system containing less than 1 per cent impurity, of which the bulk is carbon dioxide, easily removable, with but small fractions of 1 per cent of carbon monoxide and nitrogen. With special precautions these impurities can be diminished still further, even in the production process. As will be shown, also, newer methods of purification are capable of easy and cheap removal of carbon monoxide not in excess of 1 per cent, even in the presence of several per cent of carbon dioxide. The steam-iron process, therefore, without special refinement, is capable of yielding hydrogen of a purity sufficient for ammonia synthesis purposes.

The non-utilization of the steam-iron process in nitrogen fixation work is to be attributed to three main factors, (*a*) the fuel cost, (*b*) the intermittency of the process and consequent high operating cost and (*c*) the high cost of plant and of renewal of plant. These factors merit detailed consideration.

The fuel cost is high, since in the best practice hitherto attained in this process at least 2.5 volumes of water gas have been normally consumed in the production of 1 volume of hydrogen. The process at present, as regards fuel cost, ranks on a parity with the liquefaction process and is considerably inferior to the catalytic process. I have attempted elsewhere[3] to show that the high ratio of water gas consumed to hydrogen produced was to be attributed to the equilibrium relationships in the essential reactions of the process in both steaming and reducing phases. These reactions may be formulated by means of the following reversible equations:

$$3Fe + 3H_2O = 3FeO + 3H_2$$
$$3FeO + H_2O = Fe_3O_4 + H_2$$
$$3Fe + 3CO_2 = 3FeO + 3CO$$
$$3FeO + CO_2 = Fe_3O_4 + CO$$

Accepting the most recent and reliable data obtained by a single investigator covering these several equilibria[4], I have computed the following tables of hydrogen and carbon monoxide consumption at equilibrium and the consequent water gas: hydrogen ratio deduced upon the assumption of such equilibrium conditions in the reducing phase.

Fe_3O_4-FeO Reaction

Temperature	Per Cent H_2 Consumed	Per Cent CO Consumed	Water Gas:H_2
570	27	47	2.7
650	41	55	2.1
750	58	67.5	1.6
850	75	75	1.33

FeO-Fe Reaction

Temperature	Per Cent H_2 Consumed	Per Cent CO Consumed	Water Gas:H_2
570	27	47	2.70
650	30	44	2.70
750	35	40	2.66
850	38	36	2.70

From these figures it is evident that, assuming equilibrium, only by operating at high temperatures and on the Fe_3O_4-FeO cycle alone, a ratio of water gas consumed to hydrogen produced equal to that yielded by the water gas catalytic process would be attained. The disadvantage of working on the Fe_3O_4-FeO cycle is made apparent by referring to the preceding equations, whence it is clear that only one-quarter of the output per unit of contact mass is obtained as compared with that yielded by the complete Fe_3O_4-Fe cycle.

Peculiar Conditions at the Start of Steaming and Reducing Periods

Recent investigations by Richardson, Vibrans and Bell[5] on actual plant operations as well as in laboratory trials have shown that in the first minutes of either the reducing phase or alternatively of the steaming period the conversion of the reacting gases is greater than that calculable from the above equilibrium figures or from

[2]Tour, *Chem. & Met.*, vol. 26, p. 245, *Trans.*, Am. Inst. Chem. Eng., vol. 13, Part II, p. 273.

[3]"Industrial Hydrogen," A.C.S. Monograph; Chem. Catalog Co., 1921.

[4]Chadron, *Annales de Chemie*, 1921, vol. 16, p. 221.

[5]A.C.S. spring meeting, Birmingham, Ala., 1922.

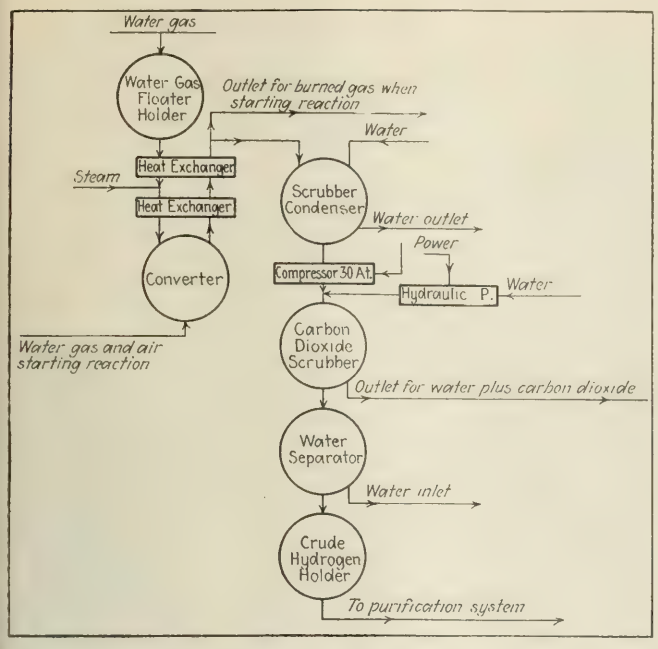


FIG. 2—FLOW SHEET OF THE WATER GAS-CATALYTIC PROCESS

any such data to which a degree of reliability can be assigned. It was found that the oxidation of the water gas to carbon dioxide and steam was much more nearly quantitative than the equilibrium figures would suggest. The implication of these results is that under conditions such as prevail in the first moments of the respective reactions it should be possible to obtain almost unit volume of hydrogen by the expenditure of a unit volume of water gas. For every molecule of water gas oxidized in the reducing phase a molecule of hydrogen accrues in the steaming phase. With such a water gas: hydrogen ratio, the steam-iron process is immediately on a parity with the catalytic process as regards fuel consumption. In addition, the gas purity and ease of purification of such hydrogen give to it a measure of importance worthy of serious consideration.

The explanation of the divergence between experimental results and theoretical equilibrium data is deserving of attention. At the moment, I incline to the view that complete consumption of the hydrogen and carbon monoxide of the water gas is approached in the early moments of the run, because in those moments the experimental conditions are such that the criteria for equilibria are not fulfilled. In any of the reactions involved as, for example,

$$Fe_3O_4 + CO = 3FeO + CO_2$$

it may readily be shown that, for a definite equilibrium ratio between the two gases, it is demanded by the phase rule that *two* solid phases shall be present. At the outset of a run this condition is apparently not fulfilled; the gas in its travel through the retort system is then continually in contact with only one solid phase. At the beginning of the reducing phase this is the ferrous-ferric oxide Fe_3O_4. Only when the two solid phases Fe_2O_3 and FeO are present should the equilibrium be established. With only Fe_3O_4 present, oxidation of the carbon monoxide continues until either the carbon monoxide is completely converted to the dioxide or reduction of the ore is carried to the stage throughout the contact mass at which equilibrium relationships are possible.

The direction which development work in the steam-iron process should take is, therefore, obvious. Work should be directed toward devising working conditions such that the circumstances prevailing in the earlier moments of the process as at present conducted could be continuously maintained. The reorganization of the steam-iron process which such a study would involve would undoubtedly bring with it many improvements in the chemical engineering aspects of this industrial process, which hitherto has been left far too much in the hands of the empiricist, without attention from scientifically trained men. Diagrams of the multiple and single retort units as now operated are shown in Figures 3 and 4 respectively. In such a reorganization, the intermittency of the process, which is quite unnecessary, could be eliminated. Operating costs should thereby be lowered. Cost of plant and of plant renewal would also receive attention. It is not too much to hope that the steam-iron process technologist would profit, in respect to plant and plant renewal, by the experiences of others in the matter of heat-resisting alloys and the economies resulting from their substitution for cast iron.

Given a steam-iron process so modified as to give a fuel:hydrogen ratio comparable with that now attainable in the water gas catalytic process, the advantages would all be with the steam-iron process. The expensive

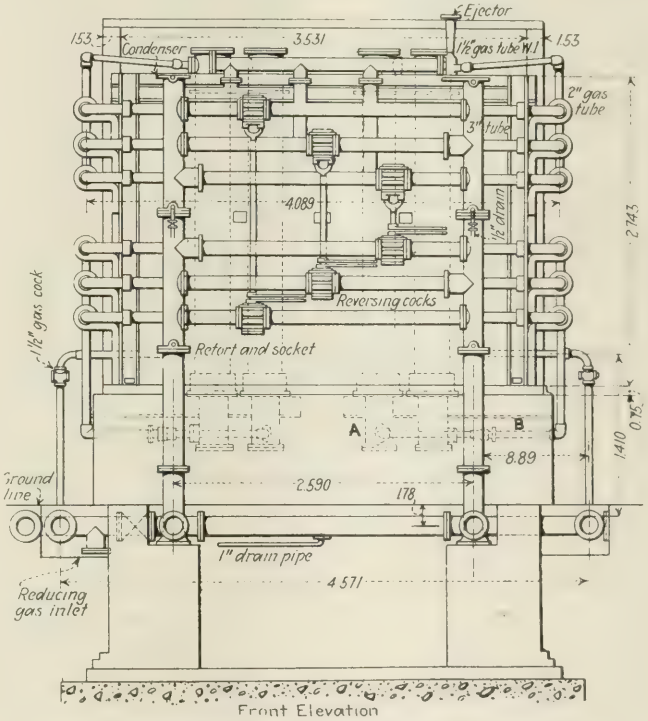


FIG. 3—MULTIPLE UNIT RETORT FOR STEAM-IRON PROCESS FOR HYDROGEN (From *Engineering*)

items in the water gas catalytic process are the purification processes. The removal of upward of 30 per cent carbon dioxide and a residual 2 to 4 per cent carbon monoxide is attained only at an expense somewhat greater than that involved in the production of the hydrogen-rich gas containing these impurities. Steam-iron process hydrogen, on the other hand, contains but 2 to 4 per cent total impurities, of which 1 to 2 per cent is carbon dioxide, 0.1 to 0.5 per cent carbon monoxide and residual sulphur compounds and nitrogen. The Harger-Terry process[6] of preferential combustion of carbon monoxide in hydrogen has solved the problem of purification of steam-iron process hydrogen satisfac-

[6]Brit. Pat. 127,609 (1917); U. S. Pat. 1,366,176.

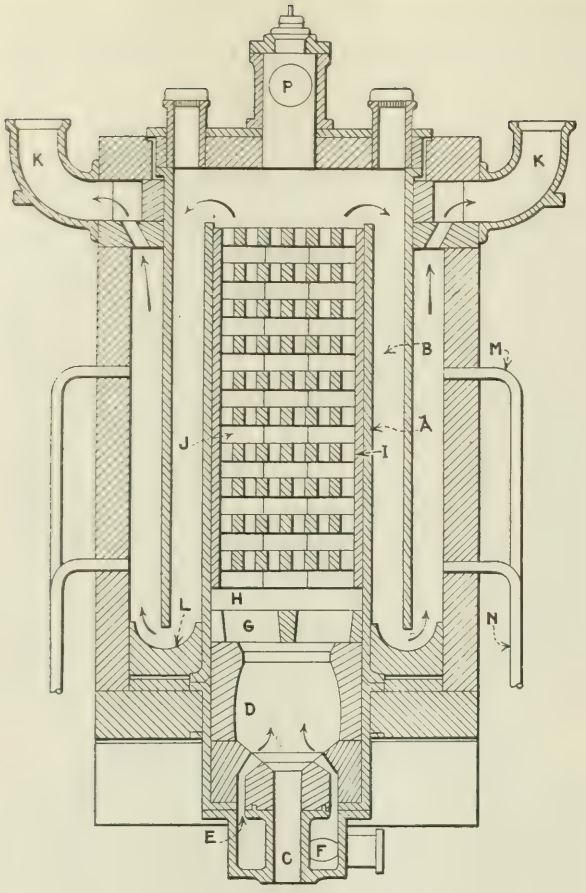


FIG. 4—SINGLE UNIT RETORT FOR STEAM-IRON PROCESS FOR HYDROGEN

torily and cheaply. It has now been operated successfully on a large technical scale in the United States. The process as now operated is applied to the gas leaving the iron oxide box system used to remove hydrogen sulphide from the gas issuing from the retorts. The sulphur-free gas so obtained is admixed with a small percentage of steam and oxygen sufficient to burn twice the theoretical quantity of carbon monoxide present. The mixture is raised to 200 deg. C. by a heat exchanger system and passed over a modified iron oxide catalyst containing suitable promoters at a temperature within the interval 200 to 250 deg. C. In actual practice, on a technical scale a gas containing 0.5 per cent carbon monoxide has been purified so that less than 0.03 per cent of this impurity is left after the passage of the gas through the catalyst system. The carbon dioxide so produced, together with that originally present in the gases leaving the steam-iron process retorts, may be removed in the normal manner. In American practice this usually consists in scrubbing with caustic soda solution in coke-filled towers. In England lime boxes have been mainly used. The gases leaving such a purification system are practically exclusively hydrogen, the impurities, with the exception of nitrogen (which also can, if desired, be kept quite low in concentration), never exceeding in such case more than a small fraction of 0.01 per cent. The product is therefore eminently suitable for ammonia synthesis purposes. A contrast of the purification process involved, carried out wholly at atmospheric pressure, at slight cost, with simple apparatus, with that involved with water gas catalytic process hydrogen, at once establishes its worth. Therefore, the steam-iron process still deserves the most thorough attention of the hydrogen technologist.

Electrolytic Hydrogen

At sources of cheap electrical power the electrolytic method of generating the gas will always be primarily considered. It is for this reason that in developments of ammonia synthesis in Norway electrolytic hydrogen is contemplated. This hydrogen is so pure that many of the problems of ammonia catalysis, bound up with the impurities in chemically prepared hydrogen, disappear. In such places as Norway, power costs are relatively less important. Plant cost, however, represents still quite an item in the economy of the hydrogen production. In America, even the electrical energy from water power is more costly than in Norway. Hence in America, even with water power, and more so with steam power, the electrolytic hydrogen industry for ammonia synthesis must meet competition from other types of hydrogen in both power costs and plant costs.

The electrolytic hydrogen problem must be considered as a hydrogen problem, as estimates of hydrogen costs based upon assumptions of a market for byproduct oxygen will be fictitious. The byproduct oxygen resulting from electrolytic production of the hydrogen will far exceed the extreme *present* oxygen-consuming capacity of any reasonable radius of industrial territory. It is necessary therefore to assume the oxygen wasted to the atmosphere.

The interdependence and variability of power charge, output and capital cost of an electrolytic plant make a complete analysis of the problem diffcult. An excellent effort in this direction has recently been made by Allan[7] based upon the use of off-peak power and of cells with higher than usual amperage. Allan predicates that in many hydro-electric plants off-peak power "could be sold for as low as one mill per kilowatt-hour and probably would not exceed 2.5 mills per kilowatt-hour under the most unfavorable conditions." For successful competition in ammonia synthesis the power costs must be within the above maximum.

The tendency toward high-amperage cells for higher operating efficiency at lower costs as indicated by Allan will certainly be followed in successful efforts to produce hydrogen for ammonia synthesis by the electrolytic method. Indeed it may be stated that the figure quoted by Allan of 1,350 amperes as the normal current capacity of his cell will probably be greatly exceeded. During the war period experiments in the building of 10,000-ampere units were successfully engineered. It was found that a unit of such size could be operated with a voltage drop of 2.5 volts. With an overload, giving a cell operating at 15,000 amperes, a potential of 3 volts per unit was required. Wide flexibility of operating range with minimum variation in working efficiency will constitute an important factor in the design of such cells. It has been stated that the initial cost of such high amperage cells is not at all proportionate to that of the number of 500- to 1,000-ampere cells required to yield the same gas output. Hence a proportionate diminution in initial cost and therefore in interest, depreciation, wear and tear should result. Initiation of electrolytic manufacture of hydrogen for ammonia synthesis will constitute a bold experiment—if successful it will lead to industrial developments far outside the range of ammonia synthesis alone, by reason of the simultaneous oxygen production, uses for which would inevitably be sought.

[7] *Trans.*, Am. Elect. Soc., Baltimore, Md., May, 1922. Preprint No. 10.

The Problem of Carboy Closure

Review of the Manufacturing Chemists' Association Report on the Use of Neck Grinding Machines for Carboy Closure

AS PART of a comprehensive program of study in connection with the difficult problem of carboy closure, a sub-committee of the Manufacturing Chemists' Association of the United States has submitted a report entitled "Carboy Neck Grinding Machines and Their Application to Carboy Closure."

In their preliminary study they found it extremely difficult to provide an efficient and suitable closure for carboys with chipped or cracked necks. Many materials have been used to seal the closure, such as plaster of paris, Pecora cement and many special mixtures, but all were found to be unsatisfactory in some respects. It therefore became necessary to eliminate if possible the cracked or chipped necks in carboys. During a general discussion of the subject it was suggested that it might be possible to grind down the necks that were chipped or cracked. Mr. Gayner, of the Gayner Glass Works, said that such a machine was in use in his works, but that it was scarcely sufficiently developed for ordinary use. He nevertheless offered the use of his ideas and experience.

Experimental Work by Merrimac Chemical Co.

Mr. Callahan, of the Merrimac Chemical Co., a member of the sub-committee, undertook an investigation of the proposal. He constructed preliminary machines and after the expenditure of considerable time and money brought the machine to a point of efficiency where it can be considered commercially practicable. A side elevation of the machine finally developed at the Merrimac Chemical Co. is shown in Fig. 1. This diagram reveals the essential principle—that of supporting the carboys on a horizontal carriage and bringing them in contact with rotating cast-iron disks. Two carboys may be ground at the same time by an unskilled laborer and it is reported that the power consumed is relatively small.

Grinding off the chipped neck gives a smooth surface on which to seat a gasket and should eliminate leakages that have been due to chipped or cracked necks. There is a distinct saving in the expense of effecting good closure, because the quantity of plaster of paris is very much diminished. A cleaner and better closure is also obtained.

Machine Eliminates Buyer-Seller Disputes

A factor not to be neglected in connection with the use of this machine is the elimination of all controversy as to the chipping or breaking of the necks of carboys. Frequently a distinctly unpleasant controversy is the result of shipping out carboys with chipped necks. Consumers often claim full credit for returning carboys in good condition when the necks are chipped and the producer is very frequently hard put to know whether he had chipped the carboy necks or whether the consumer actually was responsible. This leads to compromises which are not satisfactory to either side. Under the new régime, if necks were all sent out smooth, then any return carboys which are chipped must be due to improper treatment by the customer or the transportation company.

Several other points about the operation of the machine are worthy of note. In the first place, the carriage on which the carboy rests is given a cross-motion so that the wear is comparatively even over the surface of the grinding disk. In addition the longitudinal movement of the carriage is automatic, which greatly facilitates operating. Finally, the actual grinding is done with a cast-iron disk which is fed with a mixture of sand, emery and water directed on to the disk at the point of contact with the carboy. It is also distinctly worth noting that the machine will grind down the neck of a carboy at the average rate of half an inch in 5 minutes and at an average cost of less than 10 cents per carboy.

Formal Recommendations of the Committee

The following series of recommendations were adopted by the committee and submitted as a preliminary to the more complete report on carboy closure:

1. That glass carboys used for the shipment of corrosive liquids must have an even surface around the

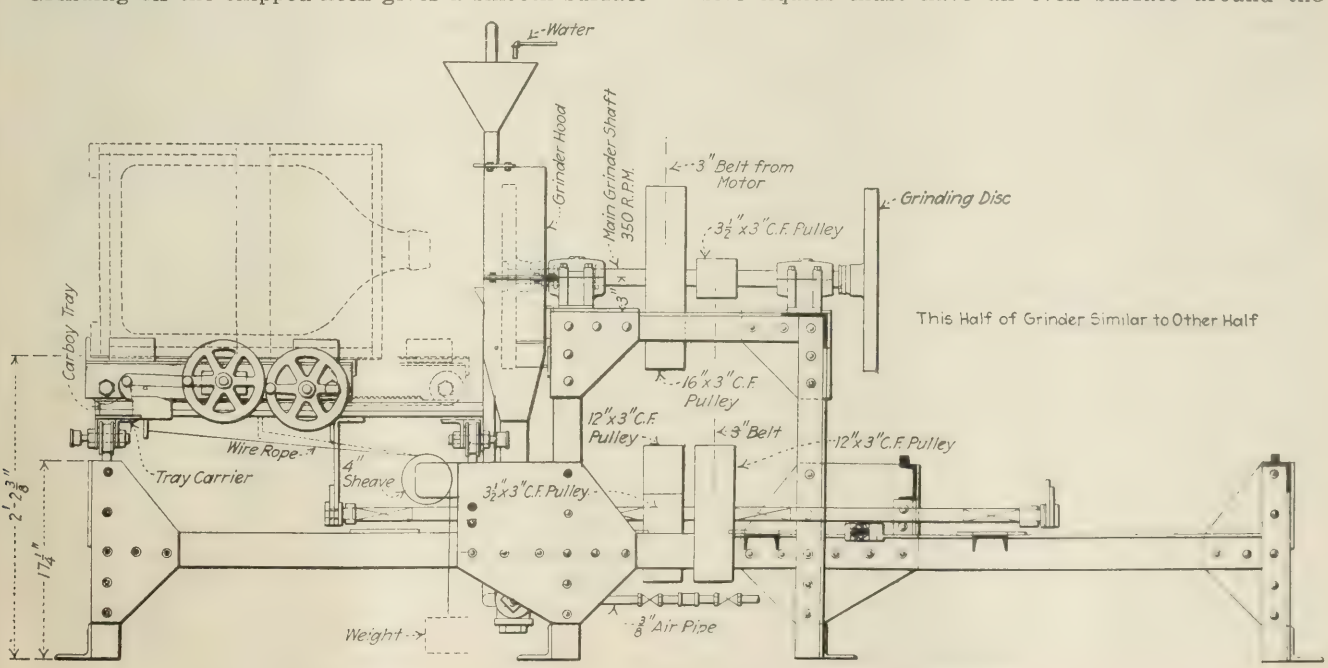


FIG. 1—SIDE ELEVATION OF CARBOY NECK GRINDING MACHINE

mouth on which to seat the gasket; this surface must be at least $\frac{1}{4}$ inch in width for carboys of 7 to 13 gal. capacity and at least $\frac{3}{16}$ inch in width for carboys of less than 7 gal. capacity.

2. That immediate action be taken to advise all users of carboys as to the undesirability of using carboys with chipped and cracked necks, pointing out the practicability of reconditioning such carboys and supplying them with blueprints of the carboy neck grinding machine as developed up to the present time.

3. That the Bureau of Explosives be requested to take appropriate action at some future date such that all concerned will have ample opportunity to prepare themselves for the change, to make the provisions of recommendation 1 obligatory and effective throughout the United States and Canada.

To anyone who has dealt with the problem of carboy closure, this report will appeal as being statesmanlike and progressive. The Manufacturing Chemists' Association is to be commended for furthering such work.

Defects in Baked Enamels

Peculiar Lines on the Otherwise Bright Surface Prove to Be Scratches Caused by a Brass Nozzle—Eliminated by Using an Iron Nozzle

By G. W. Walker
Hupp Motor Car Corporation

CERTAIN peculiar defects having appeared in enameled automobile fenders, an investigation was made to determine, if possible, the cause of these defects. Not all the fenders in the same lot showed the defects—which consisted of lines, some long, others short, in the otherwise bright and uniform surface of the enamel. Along these lines the enamel was "dead"—that is, without luster—and had an appearance as if a thread had been drawn over the wet enamel. These defects appeared through two coats of enamel when baked on.

When the enamel was carefully removed from such lines by use of a solvent, no defect could be found in the metal beneath even on magnification. It was suggested that the metal was "porous," but photomicrographs failed to reveal any pores.

It was noted that these defects generally appeared on certain parts of the fenders and more generally near the crown.

On following through the various operations preparatory to enameling, it was found that an air hose with a brass nozzle was used in the final cleaning operations just previous to enameling. At times the workman would touch the fender with this nozzle, sometimes drawing it along the surface. To test the matter, a fender was selected and the nozzle was drawn several times across the surface. All of these lines appeared in the finished fender, showing through two coats of enamel, with the same appearance as before noted.

The same results were obtained in laboratory experiments. When the corner of a piece of brass was drawn with comparatively light pressure across a piece of sheet metal, which was afterward enameled and baked, the lines appeared through the enamel.

It would appear that small particles of brass worn off by abrasion against the harder sheet metal were sufficient to cause the above defects, but a magnification of 150 diameters failed to reveal any particles. However, when an iron nozzle was substituted for the brass one, the above defects disappeared.

Manufacture of Explosives in 1921

The Department of Commerce announces that the reports made to the Bureau of the Census show a decrease in the activities of the establishments engaged primarily in the manufacture of explosives during 1921 as compared with the year 1919. The total value of products amounted to $59,174,600 in 1921, and to $92,474,800 in 1919, a decrease of 36 per cent. Of the 109 establishments reported for 1921, 24 were located in Pennsylvania, 10 in Ohio, 9 in Oklahoma, 8 in Illinois, 7 in New Jersey, 6 in West Virginia, 5 in Kentucky, 5 in Missouri, 4 in Kansas, 4 in Texas, 3 in California, 3 in New York, 2 each in Alabama, Colorado, Indiana, Michigan, Tennessee, Washington and Wisconsin and 1 each in Arkansas, Iowa, Massachusetts, Minnesota, Montana, Utah and Wyoming. Of the establishments reporting in 1919, 11 were idle or out of business in 1921, 2 new plants being reported for the latter year.

The statistics for 1921 and 1919 are summarized in the following statement. The figures for 1921 are preliminary and subject to such change or correction as may be necessary from a further examination of the original reports.

	1921	1919	Per Cent of Decrease*
Number of establishments	109	118	7.6
Persons engaged	7,926	15,429	48.6
Proprietors or firm members	22	28	...
Salaried employees	2,426	6,152	60.6
Wage earners (average number)	4,478	9,249	51.6
Salaries and wages	$13,610,200	$25,749,200	47.1
Salaries	7,000,000	13,244,200	47.1
Wages	6,610,200	12,505,000	47.1
Paid for contract work	.....	30,500	...
Cost of materials	30,644,300	45,911,000	33.3
Value of products	59,174,600	92,474,800	36.0
Value added by manufacture†	28,530,300	46,563,800	38.7

* Percentage omitted where base is less than 100.
† Value of products less cost of materials.

Detail statistics of production for the years 1921 and 1919 are given in the following table:

	1921	1919	Per Cent of Decrease*
Products, total value	$59,174,600	$92,474,800	36.0
Explosives:			
Lb.	407,374,400	506,138,800	19.5
Value	$55,753,800	$85,668,200	34.9
Dynamite:			
Number of establishments	26	27	...
Lb.	167,258,300	212,529,700	21.3
Value	$28,457,300	$37,230,700	23.6
Permissible explosives:			
Number of establishments	19	15	...
Lb.	36,819,200	30,622,900	†20.2
Value	$6,379,000	$5,499,200	†16.0
Blasting powder:			
Number of establishments	42	44	...
Kegs (25 lb.)	7,340,768	7,406,991	0.9
Value	$12,544,900	$12,168,500	†3.1
Gunpowder, black:			
Number of establishments	5	7	...
Lb.	990,700	11,730,100	91.6
Value	$227,400	$2,096,600	89.2
Nitroglycerine:			
Total production, lb.	45,855,400	56,361,200	18.6
Sold as such:			
Lb.	172,600	714,700	75.8
Value	$160,700	$301,900	46.8
Made and consumed in shooting wells, (included in totals):			
Number of establishments	39	...	...
Lb.	3,418,700	7,621,900	55.1
Amount received for contract work, shooting wells	$3,234,400	$3,434,800	5.8
Made and consumed in the manufacture of dynamite:			
Lb.	42,264,100	48,024,600	12.0
Other explosives, in order of value, 1921, smokeless powder, nitrostarch, fuse powder:			
Lb.	15,195,700	57,744,700	73.7
Value	$4,750,100	$24,936,600	81.0
All other products	$3,420,800	$6,806,600	49.8

* Percentages omitted where base is less than 100.
† Increase.

Accelerated Reactions in Pulsating Gaseous Currents

Utilization of Pulsations and Vibrations of Appropriate Amplitude to Accelerate Physical Interchanges and Chemical Reactions Between Gases and Vapors in Checkerworks, Labyrinths, or Piled-up Solids

By Jules Deschamps* and J. F. Shadgen†

MECHANICAL improvements in the design and construction of rotating machines are enabling them gradually to displace similar devices having reciprocating movement. This is particularly true of pumps used for moving liquids or gases. Turbo pumps are supplanting plunger pumps everywhere and fan blowers are becoming more popular than compressors. Ejectors and injectors based on continuous kinetic expansion of gases are even more favored for the entire absence of moving parts. Uniformity of flow has always been considered a desideratum, and gas currents of constant intensity are preferred in all apparatus for blowing or circulation purposes and even in all problems of combustion, condensation, cooling and drying.

The main advantages of all rotary machines are simplicity and cheapness of construction. This is mostly due to the fact that no account need be taken of complications or forces due to inertia. But the efficiency of the rotary machines is usually lower than those built for alternating movement.

It is interesting to observe that nature, with its many complex machines, seldom uses continuous movements. Most physical and chemical actions of life are reciprocating or pulsating, from the walk of the animals to the flight of the birds and insects, from the respiration of the lungs to the circulation of blood in veins and arteries.

Use Continuous Flow for Transportation of Fluids

For the transportation of fluids in pipes there is no doubt that uniformity of flow is quite desirable. No one can contradict the superior advantage of a constant difference in pressure when liquids are to be moved. But if fluids when flowing through chambers are put in contact with other bodies in order to react physically or chemically or to be subjected to any transformation during the circulation, the optimum conditions may be altogether different.

In studying most engineering problems, average results have been derived from the tests of working machines and the solution of new problems based on simplified hypothetical considerations. Consequently the calculated results differ from the actualities. In order that we may approach the test results more closely, the designer uses many coefficients in his empirical equations, paying due regard to the peculiarities of each problem. This is especially true of working formulas used in computing the hydraulics of rivers and streams. Furthermore, when studying a gas within a given space, it is commonly accepted that within that volume both pressure and temperature are uniform at all points. This does not correspond to the conditions really existing; it is merely a gross approximation. For if the theory of probabilities is applied, the proportions of molecules having the same velocity can be calculated and the result leads to the inevitable conclusion that both temperatures and pressures differ considerably from one point to another. Considering that a lack of uniformity exists in simple gas analyses, it is easily understood that outside influences such as light waves or sound vibrations can modify the direct application of the law of Maxwell and consequently the whole equilibrium in the mass, as well as the reactions possible between its constituent elements or between them and other bodies at their natural contacts.

Let us consider some of the effects that can be produced by vibrations of about the velocity and amplitude of sound waves and also by pulsations of more moderate velocity. It is necessary to distinguish between these two types of periodic disturbances. The slow pulsations (produced by an alternative movement of a piston and of the order of one per second) create an increase of pressure, followed shortly afterward by a reduction, acting upon a considerable portion of the gas upon which they are impressed. On the other hand, the quick vibrations, measured by hundreds per second, change the relative distance between neighboring points sometimes no farther apart than the distance between adjacent molecules. Evidently no absolute line of separation exists between the two types of vibrations. Study of one type explains the other just as slow motion pictures illustrate the nature of rapid movements.

Take for instance a cooling or absorption tower filled with inert solids piled up regularly or irregularly. A fine rain of liquid sprays this packing material and drops toward the bottom. A gas or vapor rises from the bottom to the top. Contact between ascending gas and descending spray may produce physical effects such as cooling or solution, or on the other hand a chemical reaction may ensue.

Continuous Flow Produces "Dead Spaces" in Reactors

It is a common observation that there is an economical limit to the height of such towers beyond which the results are not increased in proportion to the expense involved. In other words, two towers of half the height will give a better efficiency than one very tall tower. This is explained by the fact that the descending liquid gathers in large drops after having passed through several layers of fillings no matter how fine and uniform is the original spray. These drops have a tendency to coalesce and the liquid finally streams along certain preferred channels, leaving large areas "dead." To counteract these conditions the tower packing would be divided in successive layers with a free space between them; the shape of the checkerwork has been carefully studied as well as the method of

*Paris, France.
†New York City.

piling. The results of all these palliatives has been disappointing, since the liquid eventually flows over the surfaces of the checkerwork while the gases ascend in the voids offering the least resistance. Hence bad contact and poor efficiencies result.

When a vapor or a gas is drawn through such tower by a constant difference in pressure, a certain equilibrium is established in the flow. All the gas does not rise from the bottom to the top with the same velocity through the various passages of the same horizontal cross-section, because the resistance due to friction on the walls or due to the downpouring liquid differs at these various channels, while the difference of pressure at top and bottom remains the same. Another cause responsible for variable speed in the various channels is the difference in effective cross-sectional area at various heights due to the shape of the piled-up bodies which in turn inevitably creates whirls and eddies.

If we consider a channel such as in Fig. 1 through which passes a stream of gas, it is apparent that the velocity in the sections *x*, *y* and *z* is different from those in the smaller sections *m*, *n*, *o* and *p*. It is doubtful that full expansion follows each restricted area and the equilibrium of flow will probably correspond to the dotted lines, thus illustrating that considerable portions of the contact surfaces are not at all well fed.

Again, consider a pile of irregular solids such as shown in Fig. 2. Two channels, 1-2-3, and 4-5-6 will have quite different average velocity. However, the pressure will be approximately the same at various heights. Consequently there will be little or no flow in the cross-channels 7, 8 or 9, particularly if they connect sections of a different area. Flow channels and surrounding eddies will form and the surfaces along cross-channels will be dead areas with small effect.

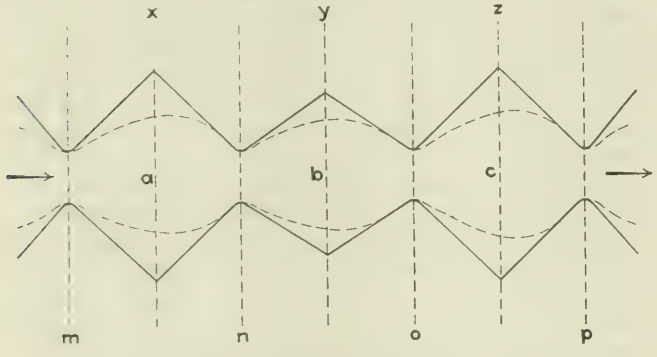


FIG. 1—FLOW OF GAS THROUGH A CHANNEL OF VARYING CROSS-SECTION

Analyze now in a similar way the phenomena produced by a variation of pressure, whether periodic or not, between the top and the bottom of the pile. By suddenly producing a greater difference in pressure any existing balance in the flow channels is overthrown. Channel 4-5-6 has fewer restrictions; therefore the pressure increase will be transmitted through it more easily than in channel 1-2-3. Consequently there will be produced a slight difference in pressure at the points 1 and 4, 2 and 5, and 3 and 6, which in turn will promote cross-currents sweeping through the transverse ways and supply them with fresh gas for reaction or absorption. Further, these lateral flows will also create whirls upon meeting the upward flow. If before these effects die out we suddenly produce a decrease in pressure, the same results will be created in the reverse direction. It follows that no real equilibrium can exist if the speed and amplitude of vibration is correctly chosen.

Every increase in pressure will force the gas into the tightest corners and at the opposite crest of the pulsation wave the products of the reaction will stream out of these dense parts. As these corners and labyrinths are the most drenched by a descending liquid or are those offering the largest surface of contact, the ultimate result will unquestionably be a much higher efficiency in the tower.

This analysis applies to cooling, volatilizing, concentrating or distilling operations—purely physical operations—as well as those chemical phenomena where gases or vapors react with each other in the presence of inert solids. If the gases or vapors passing through the shaft react chemically with the solids themselves (as in gas producers or blast furnaces), further consideration will indicate that the effects will be very similar. In such apparatus a continuous injection at constant pressure will create channels of least resistance through which the most of the gas will stream. But as the gases attack the solids in proportion to their contact surfaces, any restricted area will be widened very quickly. Lateral passages will then be even more ineffective than indicated in the diagram (Fig. 2); furthermore, the vertical channels may become coated by ashes or slags, offering strong resistance to further attack. If these chimneys or channels reach the top of the fuel bed in a gas producer, the air passes through and burns some of the gas already formed.

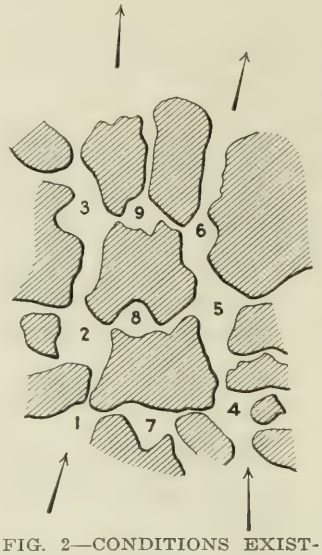


FIG. 2—CONDITIONS EXISTING IN A PILE OF IRREGULAR MATERIAL

To prevent this trouble these channels must collapse. Many recent improvements in producer design aim to favor these collapses by mechanical means (i.e., by stirring or plowing). If air streams up one or more of these large chimneys and if the piled-up solids between these channels are attacked to but a small degree, the zone of combustion is displaced, a poor gas with too much carbon dioxide is generated and coal is lost unburned in the ashes. Widespread disturbances in a blast furnace follow like causes. In order to avoid such bad effects, operators are forced to reduce the rate of blowing with consequent loss of production.

Pulsations in the air supply would force the air to penetrate into the whole mass of piled-up solids. Gases formed in the producer, such as CO and H, consequently cannot stay in the pockets, and corners and channels are not so easily produced. The solids are attacked from all sides simultaneously and the pile collapses by natural shrinkage. Hence producers will operate more regularly and with greater output when operating with pulsating current or blast.

If the solids to be attacked are of a porous nature, gas pulsations will produce additional advantages, since reactions inside the pores will be stimulated. In water-gas producers, for instance, steam is blown through hot

coke periodically. It can be reasonably expected that a pulsating jet will result in more rapid generation of hydrogen, and the correct object may be obtained by a steam injection of shorter duration.

A mixture of steam and air is injected into ordinary producers generating heating gas. By a pulsating current one may send the steam-laden air into the mass of hot coal at various pressures or, better, inject successively a current of dry air and a jet of air supersaturated with steam and give to these impulses variable durations. This latter method of operation will give the steam a better chance to act on the fuel superheated by the injection of dry air. It follows that periodic changes of pressure also create periodic variations of temperature. One may inject gas or vapor by different pulsations into many other industrial processes. If several constituents enter into the reaction, they can act successively or in variable proportions at periodic intervals. Favorable results can be foreseen for pulsations of relatively high frequency, even if the gases react on each other in the presence of catalytic solids.

In large industrial apparatus where gas is injected through several openings or tuyeres, such as an iron blast furnace, variation of pressure inside the mass and a change in the upward paths taken by the blast can be facilitated by dampening the tuyeres for intervals in rotation, thus producing an alternating movement in the gas in the reacting zones. This device may be superimposed on one which actually varies the pressure on the blast main.

Scope of the Process

It is obvious that each industrial application will require individual study to fix the amplitude and frequency of the pulsation promising best results. Attention may, however, be drawn to the fact that in several industries (such as when cooling of coke-oven gas) a sequence of towers is utilized. Pulsating devices attached to each tower may be operated in synchronism or not as seems desirable. By proper regulation, the towers can be operated like a set of lungs that are filled and emptied periodically.

An enormous field is thus laid open and remarkable combinations are made possible. Preliminary investigations on a commercial scale promise most interesting results. Pulsations of moderately long duration have been studied already. Rapid vibrations cannot be transmitted through a checkerwork because the height of an unobstructed channel must be in proportion to the period. In an ordinary tower, short vibrations create mutual interferences and the action is annulled when pressure changes move at different speed through various pathways. Pulsations must be of a duration to produce pressure differences throughout the entire mass; their frequency has to be in proportion to the time required by the gas to flow through the entire checkerwork. That is why the pulsations in gas producers should not be restricted to the steam alone, as the quantity of vapor blown is small as compared to the quantity of air entering the apparatus. Therefore a steam injection would be of too short duration to be of value.

To summarize, it may be said that the nature of the pulsations desired depends upon the effective height of the checkerwork or filling, upon the dimensions of the solids or bricks, and upon the speed of reaction characteristic to the chemical and physical phenomena involved.

The Story of the Production and Uses of Ductile Tantalum*

Within the Past Year Metallic Tantalum Has Been Produced Which Is Ductile and Malleable—Its Production Described and Its Possible Uses Forecast

By Clarence W. Balke
Fansteel Products Co., Inc.

IN THE year 1801 Hatchett discovered the oxide of a new metal in a black mineral which he obtained from the British Museum. He named the metal columbium and the mineral columbite, because the mineral originally came from Massachusetts. A year later Eckeberg made a similar discovery while working with some new minerals from Sweden, and he named the new metal which he discovered tantalum. Subsequently a number of other investigators announced the discovery of new metals in tantalum- and columbium-bearing ores which were all shown to be mixtures of these two, and in 1866 Marignac developed his classical method for their separation, which depends upon the difference in solubility of their double fluorides with potassium.

The first mention of tantalum in the metallic form is that obtained by Berzelius. In 1824 he obtained a very impure product containing not over 60 per cent of metal and having a specific gravity of 10 by reducing potassium tantalum fluoride with potassium. In 1902 Moissan produced a very hard and brittle form of tantalum high in carbon and having a specific gravity of about 12.8. In 1903 Dr. W. von Bolton, working in Germany, developed a process for the production of tantalum of sufficient purity to make it possible to produce drawn filament wire for incandescent lamps, and during the years 1905 to 1911 probably over one hundred million of these lamps were produced. This material as a filament wire was then replaced by tungsten.

About twenty years ago the writer became interested in these elements and devoted a number of years to the study of their various compounds and to the determination of their atomic weights. More recently, believing in the commercial value of this metal, an investigation was begun with the idea of producing the metal in commercial quantities. During the present year this investigation was brought to a successful conclusion and it is now possible to produce tantalum characterized by high purity and capable of being worked into sheet, rod or wire.

Occurrence of Tantalum

The elements tantalum and columbium are usually found associated with each other in their ores. The most important minerals containing these elements are columbite and tantalite, which are really iron salts of columbic and tantalic acids. Usually a part of the iron is replaced by manganese, and small amounts of titanium, tin and tungsten are almost always present. To lesser extent it occurs with rare earths in samarskite and other minerals.

For the production of metallic tantalum tantalite is the most desirable ore and should contain at least 60 per cent of the oxide and only a few per cent of columbium oxide.

The first step involved in the production of metallic tantalum is the extraction of pure compounds of tanta-

*Paper, slightly abridged, presented at the Richmond meeting of the American Institute of Chemical Engineers, Dec. 6-9, 1922.

lum from the mineral tantalite. This involves the separation of the columbium which may be present.

There are a number of methods available with which to attack this ore. As the most suitable method for the separation of tantalum from columbium is through the difference in solubility of the potassium double fluorides, the method employed should be directed toward the easiest method of production of these compounds. The pulverized ore may be fused with potassium bisulphate. On leaching this fusion, the acids of tantalum and columbium remain insoluble and can be dissolved in hydrofluoric acid and treated with potassium fluoride, or the mineral may be fused with acid ammonium fluoride and the tantalum precipitated from the solution of the melt by means of potassium fluoride.

A method which is more easily carried out on a large scale is the fusion of the finely pulverized ore with potassium hydroxide, which converts the tantalum and columbium into soluble columbates and tantalates. The filtered solution containing these salts may be treated with a mineral acid, preferably nitric or sulphuric acid, which precipitates the insoluble acids of tantalum and columbium. After washing, these are dissolved in hydrofluoric acid and the solution is treated with sufficient potassium fluoride to produce the double fluorides K_2TaF_7 and $K_2CbOF_5H_2O$. These two salts are readily separated by crystallization, inasmuch as the columbium salt is about twelve times as soluble as the tantalum double fluoride.

The oxide of tantalum can be produced from this double fluoride by treating the solution of the salt with ammonia, precipitating the acid, which can be washed and then ignited to oxide.

Production of Metallic Tantalum

It is perfectly evident at the present time that the early attempts to produce metallic tantalum, involving such methods as the reduction of the oxide with carbon in an electric furnace, the reduction of tantalum oxide with aluminum by the Thermit process or the reduction of the oxide by means of misch metal (mixed cerium earth metal), could not have given a product characterized by any degree of purity, and most certainly a metal which could not be subjected to any mechanical working.

Metallic tantalum powder can be produced by the reduction of the double fluoride with metallic sodium or potassium. It is impossible by this process to produce a powder characterized by high purity. For best results by this method the reaction should be carried out in a vacuum, the boats or crucibles containing the mixture of double fluoride and metallic sodium or potassium being placed in a tube or furnace which can be evacuated before the mixture is raised to the reaction temperature.

The product from this reaction can be treated with water and mineral acids in order to free the metal powder as completely as possible from adhering salt and other impurities. This powder is then compressed into bars and subjected to heat-treatment and finally fusion in a vacuum furnace, the high temperature of fusion eliminating the impurities which may be present. If this process has been completely successful, the fused metal will be found to be ductile and susceptible to mechanical working.

The most characteristic chemical property of tantalum is its unusual resistance to chemical corrosion. It is not attacked by hydrochloric or nitric acids or by aqua regia, either hot or cold. It is not attacked by dilute sulphuric acid at ordinary or more elevated temperatures, but appears to be slowly attacked by boiling concentrated sulphuric acid. Solutions of caustic alkalis do not attack the metal. Hydrofluoric acid seems to be the only chemical agent which will will attack it, and in the case of very pure metal and very pure hydrofluoric acid the action is very slow. A mixture of hydrofluoric and nitric acids will attack the metal with avidity, causing it to go into solution as tantalum fluoride.

If tantalum is heated in the air, the surface becomes blue at a temperature of about 400 deg. C. and at a somewhat higher temperature nearly black. Above a dull red heat the white oxide is produced and the metal gradually burns. This metal combines with avidity with hydrogen, oxygen or nitrogen. It will take up seven hundred and forty times its own volume of hydrogen, producing a very coarse-grained brittle product.

Tantalum containing dissolved gases will be harder than the pure metal and if their quantity is appreciable the metal may even be brittle, so that all annealing or heating operations with tantalum must be carried out in a vacuum. Tantalum burns readily when heated in chlorine gas, producing the volatile pentachloride. Solutions of chlorine, however, are without any action on the metal. Tantalum is not affected by any of the chemicals or antiseptics used in dentistry or surgery probably without exception.

Physical Properties of Tantalum

It has been possible to produce metallic tantalum of an exceedingly high degree of purity, and to produce it in commercial quantities, having a purity of at least 99.5. The pure worked material resembles platinum very much in color and appearance. Its melting point may at present be taken as 2,850 deg. C. The specific gravity of the worked metal is 16.6. The pure metal is characterized by toughness and by its great ductility and malleability.

It has been found possible to reduce a bar of tantalum about $\frac{3}{8}$ in. in diameter to wire of only a few mils in diameter without any intermediate heating to the annealing or equiaxing temperature, although the material is subject to strain hardening, resembling the more common metals such as silver or copper in this respect. Tantalum, however, resembles tungsten and molybdenum in that they may all be worked severely at temperatures below their equiaxing temperatures. Copper and silver may be worked at room temperature, but these metals become quite rapidly strain-hardened so that a further reduction makes it necessary to anneal the metal. Tungsten and molybdenum must be worked at elevated temperatures in the early stages and if they are to be worked at room temperature in the finer sizes any operation corresponding to ordinary annealing must be avoided. Tantalum may be worked at room temperature to a remarkable extent without annealing.

The tensile strength of drawn tantalum wire may reach 130,000 lb., which is considerably more than that of hard drawn copper, nickel or platinum, but less than that of molybdenum or tungsten.

The linear coefficient of expansion is more than that of molybdenum or tungsten and only slightly less than platinum. For this reason it is possible to seal tantalum into glass.

The electrical resistance is quite high, about eight times that of copper and about three times that of tungsten. The accompanying table gives the physical prop-

	Tungsten	Tantalum	Molybdenum	Platinum	Copper	Nickel
Density	19.6	16.6	10.2	21.4	8.80	8.84
Atomic value	9.4	10.9	8.8			
Tensile strength, lb. per sq.in.	490,000	130,000	260,000	Hard 54,000 An'l'd 42,000	62,000 35,000	120,000 70,000
Compressibility, kg. per sq.cm	0.28×10^{-6}	$.50\times10^{-6}$	0.47×10^{-6}		0.76×10^{-6}	
Young's modulus of elasticity, kg. per sq.mm.	42,000	19,000				22,000
Melting point, deg. C.	3,350	2,770	2,550	1,755	1,083	1,452
Boiling point, deg. C.			3,617	3,907	2,310	
Specific heat, cal. per gram per deg.	0.034	0.0365	0.072	0.0323	0.0936	0.1084
Linear co-efficient of expansion per deg. C.	4.3×10^{-6}	7.9×10^{-6}	5.15×10^{-6}	8.84×10^{-6}		13×10^{-6}
Thermal cond. in cal. per cc.	0.35	0.130	0.346	0.1664	0.7198	0.140
Temp. coefficient of expansion	0.0051	0.00335	0.005	0.0039	0.00393	0.0066
Elec. resistance, microhm per cc. at 25 deg., annealed	5.2	14.6	4.8	9.97	1.87	6.4

erties of tantalum as far as they are at present known, and also those of a number of other metals in comparison.

High Chemical Resistivity Gives It Many Uses

In considering the possible uses for this metal we must take into account its high melting point, its resistance to chemical corrosion and its tendency to absorb all of the common gases. We must also remember that we are limited by its relatively low temperature of oxidation. Tantalum seems to be a very desirable metal for the manufacture of certain dental instruments and dental spatulas, and undoubtedly for other dental and surgical tools or instruments. The metal is not attacked by any of the antiseptics or chemicals used and can be readily sterilized by heat. A surface film of hard material about as hard as agate can be produced on the metal by proper heat-treatment. It will probably be found possible to harden the material throughout, thus combining all the advantages of tempered steel with absolute chemical inertness.

It has been suggested for use in the manufacture of pens and analytical weights. Its use in chemical laboratories and in the chemical industries as containers, parts of pumps and other equipment will undoubtedly depend upon the cost at which the metal can ultimately be produced.

Tantalum is suitable for cathodes in electrochemical analysis. In some respects it is more suitable than platinum. For instance, zinc may be plated directly upon the tantalum, as it does not alloy with the metal. Gold or platinum can be deposited upon the metal, as they can be removed by aqua regia without attacking the electrode.

Undoubtedly tantalum in the form of sheet, wire or ribbon will find application in the manufacture of radio sending and receiving tubes. The property of tantalum of absorbing gases would seem to make the metal its own "getter" in vacuum tubes, and would tend to maintain the high vacuum required, particularly in the sending tubes. It would seem that some part of the lamp made of tantalum could be so constructed that at all times a portion of the metal would be at the proper temperature to absorb gas and would, therefore, tend to maintain a vacuum equilibrium within the bulb.

Use of Tantalum as an Electrolytic Valve

Tantalum has interesting possibilities on account of its property of acting as an electrolytic valve.

If two plates of bright tantalum metal are placed in an electrolyte and the two plates connected to an electric battery, there is an instantaneous flow of current similar to that between plates of the better known metals. Within a few seconds the current flow will drop to a very small comparative value, providing the battery voltage is not too high. The order of the current flow will become that of 1 milli-ampere and less with impressed direct current voltage up to 75 volts when sulphuric acid of the strength ordinarily used for storage batteries is the electrolyte. This drop in current flow will be accompanied by the formation of a film on the tantalum anode, presumably of tantalum oxide. This film often shows beautiful iridescent colors.

If a tantalum plate and a lead plate are placed in an electrolyte and a source of alternating current of the usual commercial frequency is connected to the tantalum and lead plates, the current flow in one direction will be almost entirely shut off and a pulsating direct current will be obtained. In such a set-up this flow of current is accompanied by electrolytic action with evolution of hydrogen gas at the tantalum and oxygen at the lead. The action of the tantalum is, therefore, such that electrons are permitted to flow from the tantalum to release hydrogen ions but are prevented from passing from oxygen ions into the tantalum.

The current derived from this apparatus may be utilized for charging storage batteries, for the electrodeposition of metals, and various other electrochemical actions requiring a direct current.

It is possible, by using two tantalum electrodes in a single cell, so to rectify the current that both half waves of alternating current pass in the same direction. This current may be smoothed out by a suitable series of inductances and capacities to give what is practically a constant direct current.

The efficiency of tantalum as a valve with respect to leakage of the current varies with the impressed voltage, with the electrolyte, current density, etc. Due to the fact that tantalum is very inert toward the chemical action of solutions, there is a wide choice of electrolytes and the life of the tantalum appears practically unlimited.

For a charging set-up with a 6- to 8-volt battery the energy efficiency is approximately 33⅓ per cent, which compares favorably with rectifiers of the hot and cold electrode type and the mechanically vibrating rectifiers.

The tantalum battery charging rectifier is noiseless in operation, has no moving parts and requires attention in only one matter, which it has in common with the storage battery itself—that of distilled water being added to replace evaporated and decomposed water of the electrolyte.

In addition to functioning directly as a rectifier for obtaining continuous current, apparatus built along similar principles may be used for electrolytic condensers and electrolytic detectors and possibly lightning arresters.

Among other metals which have this property of valve action more or less in common with tantalum are magnesium and aluminum. However, owing to the ready susceptibility of both these metals to chemical corrosion, they have not proved very suitable as sources of direct current. Condensers and lightning arresters for high potential transmission lines are commercially used with aluminum plates.

Recent Chemical & Metallurgical Patents

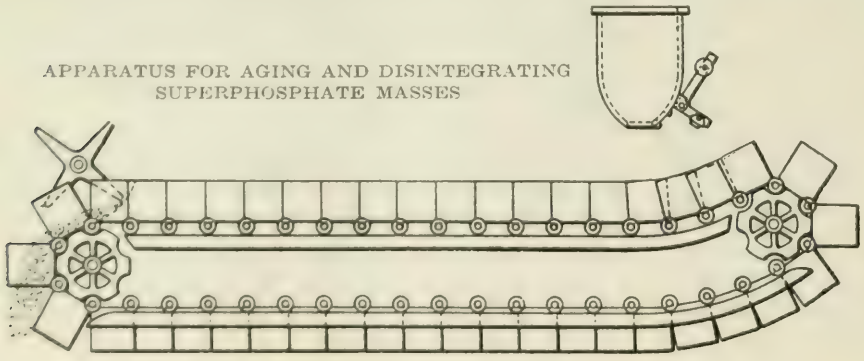
Drying Nitrogen and Hydrogen Prior to Synthesizing Ammonia—F. W. de Jahn of Norway has patented the use of alkali amides such as sodamide as a drying agent for nitrogen and hydrogen gases prior to ammonia synthesis. This is a corollary of his general patent (Serial 200,047) on the synthetic production of ammonia under pressure of 1,400 lb. The drying of the gases takes place at this pressure and no temperature control is necessary. (1,436,949. Nov. 28, 1922. Assigned to Atmospheric Nitrogen Corp. of N. Y.)

Elimination of Phosphorus From Refractory Metals—Ira Paul of Brooklyn has assigned to the Metal & Thermit Co. a patent by which, it is claimed, phosphorus can be separated from vanadium, chromium, uranium and molybdenum and other so-called refractory metals. The process consists in bringing the ore into solution by one of the usual methods and acidifying the filtrate with mineral acid. Alkali is then added until siliceous material is precipitated. After filtration more alkali is added until the solution is only very slightly acid. Alum is then added, and an oxidizing agent such as nitrate, chlorate, etc. The desirable metals are precipitated and may be filtered away from the solution, which contains all the phosphorus in combination with aluminum. (1,437,191. Nov. 22, 1922.)

Process for Aging and Disintegrating Superphosphate Masses—G. A. Bruhn has assigned to the Krupp Co., of Germany, a method for disintegrating and aging superphosphate masses. At present, it is customary to age superphosphate in aging chambers, which permits the crude phosphate and sulphuric acid, after mixing in suitable kettles, to stand for some time. The figure given shows the principle upon which the new apparatus works. The trough conveyor receives the charge from the mixing kettle and allows the material to set in relatively small quantities and the aging thus takes place more quickly than under the old system. It will be noted that as the mix comes down from the kettle onto the conveyor it is forced to spread in the direction in which the conveyor moves, due to the elevation of the charging end. When the mass reaches the discharge end of the conveyor, it is cut with knives or wires and is then ready for storage prior to final mixing. (1,430,621. Oct. 3, 1922.)

Calcium Arsenate Manufacture—C. B. Dickey, assignor to the Pittsburgh Plate Glass Co., has developed an improvement in the manufacture of calcium arsenate. At present arsenic acid is added to a milk of lime suspension and the calcium arsenate thus produced often contains as high as 2 per cent soluble salts of calcium. These are undesirable, inasmuch as they poison the cotton or other plants on which the substance is used as an insecticide. In order to prevent this formation of soluble salt, ordinary salt from 1 to 5 per cent is added to the milk of lime suspension, which produces a suspension of lime containing a concentration of calcium hydrate in actual solution (solution concentration) higher than normal for that temperature of solution. The soluble arsenate is thus reduced to less than 0.5 per cent and if 0.5 per cent of the soluble salt is permitted to remain in the product, it seems to prevent the formation of soluble calcium salt upon standing. In a subsequent patent, No. 1,428,946, issued Nov. 7, 1922, the process of eliminating soluble calcium salt from calcium arsenate already prepared by the usual method is described and consists essentially in adding to the suspension of the calcium salt some ordinary salt. This, as before, increases the solution concentration of $Ca(OH)_2$ and eliminates soluble arsenates. The basic patent was issued Sept. 12, 1922, No. 1,428,650.

APPARATUS FOR AGING AND DISINTEGRATING SUPERPHOSPHATE MASSES



American Patents

Issued Dec. 12, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,438,183—Conveying Apparatus.
1,438,190—Grate for Stokers.
1,438,194—Extraction of Grease From Solids.
1,438,221—Manufacture of Linoleum.
1,438,258—Retort Bench and Process of Operating Same.
1,438,342—Reverberatory Furnace.
1,438,357—Extraction of Uranium and Radium.
1,438,421—Oil-Shale Retort.
1,438,471—Wood Impregnation.
1,438,502—Concentrating Liquid Containing Organic Matter.
1,438,537—Separation of Coke From Slag.
1,438,542—Process for Producing Carbon Black.
1,438,558—Recovery of Caffeine.
1,438,565—Recovery of Gaseous Constituents of Oils, etc.
1,438,581—Manufacture of Compressed Hydrogen.
1,438,643—Recovery of Zinc.
1,438,710—Purification of Naphthalene.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Artificial Silk—A spinning bath for use in the manufacture of artificial threads from viscose consists of an aqueous solution of the acids obtained by sulphonating the condensation products prepared by reacting with phenols on aldehydes and ketones, especially ketoses, aldoses, and more especially the various carbohydrates. The bath may also contain mineral acids or the salts of mineral acids and the soluble salts of the sulphonated acids. With these baths, satisfactory results are obtained even with entirely unripened viscose. In an example, a bath for use in making threads of about 2 deniers contains 10 per cent sulphuric acid, 8 per cent Neradol and 10 per cent sodium sulphate; the bath is maintained at 18 deg. C., and a spinning length of 40 cm. with a normal speed of drawing is employed. (Br. Pat. 184,449; not yet accepted. A. Kämpf. Premnitz. Oct. 4, 1922.)

Artificial Silk—Another bath consists of an aqueous solution of the acids obtained by sulphonating the resinous condensation products prepared by reacting with phenols on wood in the presence of acid catalysts. To the bath, mineral acids may also be added, or the acid may be partly neutralized, or to the bath may be added the salts of mineral acids or of the sulphonated acids above referred to; with these baths, satisfactory results are obtained with entirely unripened viscose. In an example, the bath contains 10 to 12 per cent sulphuric acid, 5 per cent sulphonated acid and 15 per cent sodium sulphate; and a spinning speed of 50 meters and a length of bath of 50 cm. are employed. (Br. Pat. 184,450; not yet accepted. A. Kämpf, Premnitz. Oct. 4, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Bureau of Chemistry Emphasizes Achievements

Work of Color Laboratory, Carbohydrate Laboratory and Naval Stores Division of Benefit to Important Industries

IN THE MATTER of appropriations for scientific and technological work, Congress is demonstrating less parsimony than was the case a year ago. Practically all of the technical and scientific bureaus are being allowed small increases.

In justifying the appropriations, representatives of the various bureaus have appeared before the appropriations committee to point out the results of their investigations and to indicate the need for continuing the work. W. G. Campbell, the acting chief of the Bureau of Chemistry, laid emphasis on the importance of the work being done in the Bureau's color laboratory. "One of the greatest difficulties confronting the industry in color manufacture," Mr. Campbell told the committee, "is some means by which there can be a definite and correct identification made of colors. We have been working upon methods of identification by which, upon proper analysis, definite colors can be identified and the extent of the impurities made known." He pointed out that some of the work of the color laboratory "has effected tremendous economy in the manufacture of some of these color products or the basic material from which they are made." He cited the work on phthalic anhydride. He also described in detail the efforts being made to develop a stable biological stain. With regard to the manufacture of synthetic thymol.

"This product has been brought exclusively from abroad, but we have found it possible to manufacture from cymene a synthetic thymol which seems to have every attribute of the product upon which we have depended heretofore. Thymol now sells for $4.50 a pound. We calculate it can be made in this synthetic fashion for $2.50 a pound. When it is considered that two million gallons of cymene are wasted each year in the paper factories of this country and of Canada, the economic significance of that work is apparent."

Research on Sugar

H. S. Paine, in charge of the carbohydrate laboratory, told the committee in detail of the very extensive work which the Bureau has done in the development of more effective methods in the manufacture of sugar and syrups. The Bureau has made possible, he said, the use of invertase in the manufacture of cane syrup by methods devised to prevent fermentation on one hand and crystallization on the other. These methods have been seized upon enthusiastically in the cane syrup-producing sections, it was stated. In addition the Bureau is working on a number of the technological difficulties with which the sugar manufacturing interests are confronted. In co-operation with the producers a uniform grade for cane syrup is being developed. Methods also are being developed whereby more sugar can be obtained from the final beet-sugar molasses. "We have been studying this problem and have been making considerable progress," said Mr. Paine. "We hope before long to develop means of making the process practically 100 per cent efficient."

Naval Stores

Dr S. P. Veitch told the committee of the work being done on naval stores. "Rosin," he declared, "is being substituted more and more largely for fossil resins in the manufacture of varnishes and paints. This is due to the fact that these resins are becoming scarcer and are selling for higher prices. Then too, we are learning to use rosin more successfully, modifying it to take the place of resins."

The work of the Bureau also deals with the question of adulteration and misgrading in both rosin and turpentine. In regard to the turpentine situation, Dr. Veitch said: "Turpentine is selling around $1.50 a gallon in the South. By the time the individual user buys it he pays $2 or more a gallon for it. That induces adulteration with material which costs twenty or thirty cents a gallon. Adulteration is increasing some in the South but most of it is taking place in the paint-using districts. In some states I have found, in asking for turpentine, that I have been delivered mineral oil without a bit of turpentine in it. The high prices have driven turpentine from the market in places."

Sodium Nitrate for Sale

The government has called for bids for 10,017 tons of sodium nitrate held in storage at Nitro, W. Va. The material is offered in lots of 100 tons or more. Bids will be received by the Ordnance Salvage Board, Army Building, 39 Whitehall Street, N. Y., until noon, Jan. 8.

Contemplate New Survey of Chemical Schedule

The Tariff Commission is considering a complete survey of the chemical, agricultural and several other schedules of the new tariff act, affecting which several applications for changes in rates of duty have been filed under the flexible tariff section. Decision as to whether this policy shall be pursued by the Commission will be made after the first of the year.

Several members of the Commission are said to feel that to take up first one application and then another, without regard to the schedule affected, and decide their merits individually without reference to the other paragraphs of the same schedule which might be affected would throw the schedules out of balance.

It has been suggested that the schedules in which the greatest number of applications for changes have been made—chemical and agriculture—be surveyed as a whole, with the applications in mind and also with the purpose of detecting other possible weaknesses which might be disclosed by such a survey and corrected on the initiative of the Commission itself.

The objection to this suggested system of handling the flexible tariff section is that a complete survey of any one schedule would consume months of time and that all relief in specific cases would thereby be held up.

Increase in Helium Appropriation Approved by House Committee

An indication of the value attached to helium for Army and Navy use is had in the approval by the Committee on Appropriations of the House of Representatives of the $6,290,000 appropriation from which the funds are drawn for the operation of the helium plant. This is an increase over the amount allowed in the last Navy appropriation bill and will permit of the continuous operation of the Fort Worth plant during the next fiscal year. The plan includes the production of 12,000,000 cu.ft. of helium. Admiral Moffett, testifying before the committee, declared it is essential to have a larger helium supply as it would not be wise to make any further use of hydrogen in the larger ships at this time, as another accident would deal a heavy blow to the whole lighter-than-air program. At the present time the combined helium stocks of the Army and Navy is 1,822,000 cu.ft.

Annual Meeting of the New Jersey Clay Workers Association

Session Is Signalized by a Symposium on the Casting of Ceramic Bodies and a Discussion on the Oil Firing of Kilns for Textile Porcelain, Tile and Terra Cotta

THE ANNUAL meeting of the New Jersey Clay Workers Association and Eastern Section of the American Ceramic Society was held in the assembly room at the new Ceramics Building, Rutgers College, New Brunswick, Dec. 12. More than 100 members and guests were present from all parts of the state, with visitors from other sections.

The morning session was given over to a symposium on the casting of ceramic bodies, and the afternoon to a similar discussion on the oil firing of kilns, both being particularly pertinent topics at this time with labor troubles and difficulty in obtaining coal.

Following regular routine business, President R. H. Minton, General Ceramics Co., Metuchen, N. J., gave an interesting presidential address in the form of a paper dealing with the ceramic history of New Jersey.

Casting of Ceramic Bodies

The symposium was opened by Andrew Foltz, president of the Lambertville Pottery Co., manufacturer of sanitary ware. He described the installation for handling the slip at this plant, the particular departure being in the use of an air compressor for moving the body from the tank to the shops instead of a pump. There is no agitator in the tank and the natural supposition that the slip would be full of air in its flow through the pipes to the shop apparently does not hold; it has worked with entire success.

The tank is operated by air at about 85 lb. pressure. It is provided with an arrangement for blowing the slip back into the blunger, instead of through the fly pipe to the shop, where such is necessary. The tank, below the floor level, is provided with a float or gage to show the amount of slip it contains. The ceramic body used for the manufacture at this plant runs as high as 18 per cent ball clay.

The next speaker, C. S. Maddock of the Thomas Maddock's Sons Co., likewise a manufacturer of sanitary ware, explained the system used at this plant. It employs the Wainford-Darling equipment, with the addition of a pressure valve and return system, both of which have proved very advantageous.

The pipe runs through the shop and there is a common return to the agitator. The slip is delivered to every man by a hose. An overflow system has been installed and many previous troubles have been eliminated, principally pump action regulated and full supply of slip to the men at all times.

Mr. Maddock spoke of the difficulty in casting wares over 1 in. thick, through balling of the body, which causes cracks, and urged that suitable research be carried out in this direction.

Following this speaker, Eric W. Turner, Trenton Flint & Spar Co., read a brief paper on the casting of grog bodies. He said that a cast sagger will carry the load better than either a hand-made or machine-made sagger. It will probably cost a little more, but is well worth it. In the preparation of the grog slip for this service, sodium silicate and carbonate are used as electrolytes, and the proportions depend upon the physical properties of the clay.

A grog slip, it was pointed out, cannot be handled in pipes on account of the friction, and it must be carried to the molds in a suitable vessel and there poured. The molds are of plaster. With regard to the time element, it was stated that shapes up to 1½ in. in thickness may be cast in the same mold every 6 hours, while those from 4 to 6 in. thick require from 16 to 24 hours.

T. A. Klinefelter, Trenton Fire Clay & Porcelain Co., outlined briefly his experience in casting electrical porcelain. He said that it had been found very quickly that the ordinary high-tension body for jiggering was not a good body for casting; on the contrary, it was a very poor one. Pieces to be cast, as a rule, were of very difficult design, such as bushings with heavy corrugations and the like—material that would hang in the mold. Sanitary bodies were tried, but of course these were too porous to stand up under the necessary electrical test. The balling effect in pieces over 1 in. thick, referred to by Mr. Maddock, was another trouble encountered. With such unsatisfactory results, the casting method, he said, was discontinued.

Calcining Solves Difficulties

In commenting upon the last speaker's difficulties, T. A. McDougal, Champion Spark Plug Co., said that a solution to the problem was the calcining of the porcelain body; it is then ground and introduced into the slip to be used for casting. The matter of calcining, he set forth, was being carried out successfully in the spark plug industry, 45 to 50 per cent of the body being so treated and reduced to pass through a 120-mesh.

Frank Dinsmore, Imperial Porcelain Works, Inc., manufacturer of electrical porcelain, said that this plant was casting wares with complete success, the pieces being 2 to 2½ in. thick, and with practically no loss through cracking. An open mold is used for this work. Additionally, pieces 7½ to 8 in. in diameter and 25 to 26 in. long are also being cast, some of these being quite intricate, with corrugations the entire length. In concluding his remarks, Mr. Dinsmore said that the open mold casting method is the only one which will handle the variations in thickness satisfactorily and bring the desired results.

Presentation of Picture for Ceramics Building

Prior to the adjournment for luncheon, Ross C. Purdy, general secretary, American Ceramic Society, presented a large picture of Edward Orton, Jr., the dean of the ceramic industry, to the Rutgers ceramic department. This picture, mounted in an attractive gold frame, was obtained through subscriptions from the former pupils of Dr. Orton, and will hang in the assembly room.

Election of Officers

Officers were elected for the coming year as follows: Andrew Foltz, Lambertville Pottery Co., president; Charles W. Crane, the Crossman Co., vice-president; Prof. George H. Brown, director of the department of ceramics at Rutgers College, secretary and treasurer; the latter has held this office for a number of years.

Kiln Firing and Relative Fuel Values

Following a luncheon, served in the basement of the Ceramics Building, the afternoon session was opened with President-elect Foltz in the chair, the first address being on the subject of "Kiln Firing and Relative Fuel Values," by Francis W. Walker, Jr., Beaver Falls Art Tile Co.

Mr. Walker explained that owing to the disturbed fuel markets, his company had experimented with coal, gas and oil, and had made careful tabulations of the results obtained from each fuel and its relative value in actual operating service. The success with any fuel, he pointed out, depends largely upon the character of furnace and its design, as well as upon the equipment used. For instance, in the case of gas, the consumption is proportionally greater in the up-draft kiln than in those of the down-draft type. The average coal consumption for seventy-three 16-ft. down-draft kilns was 12.8 tons, whereas the gas consumption for these same kilns averaged 360,000 cu.ft., which if expressed in B.t.u., figuring coal at 14,000 B.t.u. per lb. and gas at 1,000 B.t.u. per cu.ft., shows a thermal variation of less than one-half of one per cent.

Taking typical figures for a month, this being September, 1922, it was shown that the total cost of coal firing was $13.14 per ton, including the price per ton, labor cost, maintenance and sagger breakage; in the same month the cost of gas firing, using 28,000 ft. of gas at 45 cents per thousand, was $15.10; and the cost of oil firing, using 197 gal. of oil at 6¼ cents, was $15.69. These results, expressed in terms of percentage, were as follows:

	Coal	Gas	Oil
Fuel	46.2	83.5	78.2
Labor	20.4	6.9	6.6
Maintenance	10.8	1.6	5.5
Sagger breakage	22.6	8.0	9.7
	100.0	100.0	100.0

NEW JERSEY CLAY WORKERS ASSOCIATION AT NEW BRUNSWICK

The average cost of firing with the respective fuels are as follows, showing oil to be the most expensive: Coal, $12.84; gas, $15.25; and oil, $16.59. The problem in the case of gas and oil is one of purchasing economically, while in the matter of coal, all items must be considered, especially that of labor, on account of the disagreeable nature of the work and the overlapping of responsibilities caused in the different working shifts of 8 to 12 hours each, as the case may be.

The application of pyrometric equipment becomes of utmost necessity, particularly when firing with coal. If but a single record is taken, only limited control is possible, and it becomes necessary for the fireman to judge his work in the other parts of the kiln by comparison. Where possible, this should be overcome with the use of either the optical pyrometer or a four-point recorder, a couple in each quarter of the kiln, or both. With regard to the effect of the fuels upon the quality of the ware, Mr. Walker said that he was firmly of the opinion that with very few exceptions equal results can be secured with each character of fuel.

Oil Firing for Textile Porcelain

John A. Williams, Mitchell-Bissell Co., the next speaker, set forth that the use of oil fuel had proved highly successful at his company's plant, which has been operating by this method since early in 1920. The company specializes in the production of porcelain guides for textile mill service.

He said that all equipment had been purchased in duplicate to avoid any possibility of shut-down through failure of apparatus. This includes two oil pumps, two air blowers, two strainers, and so on. Each kiln at the plant is provided with six burners, with air piping, air gage, valves, etc., costing about $300.

The product is a highly vitrified one; it is fired to cone 12 in one burn—that is, the body and glaze are handled all at one time—and results are being obtained with oil fuel that could not, in Mr. Williams' opinion, be duplicated with coal. One man is handling three kilns at this pottery. Two different size tips are used on the oil burners, the smaller one being employed at the beginning of the burn and until its near-maximum is reached, at which time the change to the larger one is made.

On a 13-ft. kiln, using six burners, with an average burning of 44 hours, about 1,760 gal. of oil was consumed for each burn over a period of a year; on a 14-ft. kiln, with eight burners, the average is from 2,300 to 2,400 gal. of oil per burn of 42 or 44 hours. At the present time a price of 7 cents a gallon is paid for the highest grade fuel oil, 36 to 40 deg. Baumé, delivered at the plant. Four pyrometer tubes are installed in each kiln, one in each quarter; also, an indicating instrument is placed in the kiln shed for the guidance of the fireman at all times.

Oil Firing for Tile

Donald Hagar, Mosaic Tile Co., gave a comprehensive outline of the installation for oil burning at this plant, utilizing a low-pressure system, or with air pressure never exceeding 2½ oz., volume, rather than pressure, being relied upon to supply the necessary air for combustion. The pressure on the oil varies from 30 to 45 lb., as the conditions warrant.

All the burners are fitted with mixers for admitting auxiliary air, providing a further regulation for lengthening or shortening the flame. A rotary pump delivers the oil from the storage tank through a heater and thence to a 1-in. circular pipe which surrounds each kiln, and then to the burners through ⅜-in. outlets in each pipe.

Two important factors to be considered were mentioned, these being the atomization of the oil and the amount of air admitted to the burners. The effect of poor atomizing is to facilitate the formation of carbon in the fireboxes and to produce incomplete combustion. This condition can be prevented by controlling properly the temperature and the pressure. With respect to air supply, it was pointed out that the amount of air supplied to the burners bears a distinct relation to the amount of oil consumed. A deficiency in air produces incomplete combustion, while an excess will shorten and intensify the flame, thus using more oil than necessary.

In speaking of the advantages of using fuel oil, Mr. Hagar listed these as a comparison with coal, enumerating as follows: (1) Produces a more intense heat, thus cutting down the burning time; (2) the kiln is regulated more easily, affording a more uniform burn; (3) less labor is required; (4) less space required around the kilns; (5) makes for a cleaner kiln shed; (6) smaller storage space required; and (7) no strikes to interfere with the supply.

With regard to cost, he stated that a rough estimate would show that it cost about $10 more to burn the bisque kilns at the plant with oil than with coal. On the other hand, the cost is reversed in favor of the oil in the same ratio in the glaze kilns.

Oil Firing for Terra Cotta

G. M. Tucker, New York Architectural Terra Cotta Co., gave a brief résumé of the installation at the plant of his company and the results being secured through the use of oil fuel. One of the greatest advantages, he said, was the ease of control of the fires at any stage of the burn, giving a pyrometric curve that is very regular, without the peaks and depressions as found in the case of coal.

The equipment at his plant consists of five depressed oil reservoirs, varying from 10,000 to 25,000 gal. capacity, small duplex pump, and auxiliary piping and apparatus. The oil burner used is of the internal mixer type, in which the oil and air or steam mix before leaving the nozzle. Compressed air is used as the atomizing agent, and the oil employed varies from 18 to 20 deg. Baumé. Mention was made of the advisability of installing equipment in duplicate for emergency service.

The last speaker in the symposium was C. F. Geiger, of the Carborundum Co., who gave a digest of the use of the refractories manufactured by this company for various character of oil-burning service.

Among the speakers of the afternoon session, Ross C. Purdy, general secretary of the American Ceramic Society, tendered an interesting address on the value of technical research, saying that for every dollar so expended many fold return came to manufacturers of ceramic products and the industry as a whole. Mr. Purdy also spoke briefly on the work and aims of the American Ceramic Society.

Denaturing Provisions Make Prohibition Enforcement Easier

Specifications of Benzol Required for Denaturing Alcohol for Rubbing Purposes

With the new regulations affecting changes in formulas for denaturing alcohols for rubbing purposes in operation, the prohibition unit of the Treasury Department believes that practically all has been done that can be safely done to relieve the industrial alcohol business from any possibility of connection with the illicit liquor traffic.

The new regulations, prepared by Dr. Doran of the industrial alcohol division of the prohibition unit, provide that three-eighths of one per cent of benzol shall be mixed with alcohol intended for rubbing purposes. The benzol is difficult to remove and it is easily detected by taste, yet does not injure the alcohol for rubbing purposes.

"Benzol sends its own warning through the sense of taste," said Dr. Doran. "Of course the easiest way to denature alcohol is by use of wood alcohol, but this is both odorless and tasteless and it is this fact which leads to death and injury when chances are taken. The object of denaturization, as we conceive it, is not to murder but to warn."

The specifications for benzol which hereafter must be used in the three formulas of odorless alcohol affected by the order are:

SOLUBILITY

When 10 c.c. of benzol are shaken with an equal volume of water in a glass-stoppered cylinder, divided into tenths of a cubic centimeter, and allowed to stand five minutes to separate, the upper layer of liquid must measure not less than 9.5 c.c.

BOILING POINT

When 100 c.c. of benzol are subjected to distillation in the same manner as described for the boiling point of wood alcohol, not more than 1 c.c. should go over at 77 deg. C., and not less than 95 c.c. at 85 deg. C.

This order, which went into effect December 6, removes the last of the major causes of complaint that industrial alcohol was being denatured and used for purposes violative of the prohibition amendment, according to Dr. Doran.

RECOGNIZE EFFORTS OF INDUSTRY TO CONFORM WITH LAW

The industrial alcohol interests have been striving earnestly to remove their business from any connection with the illicit liquor traffic. Of the approximately 70,000,000 proof gallons of industrial alcohol produced in the United States last year, something more than 50,000,000 proof gallons were completely or partially denatured by the more than 70 formulas, and there were withdrawals of only approximately 3,000,000 proof gallons of the class which caused the trouble to the prohibition unit, and only a small fraction of this was used fraudulently.

ENFORCEMENT BECOMING EASIER

Wholesale and retail druggists are co-operating with the prohibition unit, through their associations, to help drive out the undesirables, the officials report. It is being made more difficult for so-called wholesale druggists to start business in order to become wholesale whiskey dispensers. When the prohibition amendment first became operative, there was considerable trouble with such camouflaged concerns, which started up business in all sections of the country. For the first time, the drug stock jobber made his appearance in the United States. Also, some of the new firms sold drugs at cost, or less, to encourage their liquor business.

These things are being overcome, the prohibition unit reports, and legitimate druggists are assuming command of the situation and following the law closely.

This, with the general improvement in the industrial alcohol situation, is making administration of the prohibition laws much easier and at the same time placing legitimate business on a plane safe from the business pirates who threatened it.

Bureau of Standards Bids Stratton Farewell

A farewell reception in honor of Dr. Samuel W. Stratton, director of the Bureau of Standards and president-elect of Massachusetts Institute of Technology, was held at the Bureau on Dec. 14.

The formal reception, in the industrial building, was followed by a trip through the various laboratories. A collection of exhibits from other buildings had been assembled on the third floor and attracted many of the visitors from the floor below where the U. S. Marine Band was furnishing splendid dance music.

Dr. Stratton has been Director of the Bureau since its establishment in 1901. The sentiment of his staff is well expressed by the following words of appreciation.

> The Bureau is an enduring monument to Dr. Stratton and those who through the early years of development stood for high standards of effort and attainment. Nations and industries, inspired by the Bureau, are founding similar institutions. Endowed research and industrial standardization have grown apace with the Bureau. Within its walls hundreds have been trained. From its staff industry recruits experts, and they carry the spirit of creative research which it is our privilege to cherish. In leaving us, our chief will prize most our assurance that we shall keep burning steadily and pass on undimmed the torch of inspired effort. That torch gives energy and enlightenment—two essentials of life and industry.

E. C. Franklin Elected President of A.C.S.

Bancroft and Hoskins Chosen as Directors—Four Councilors-at-Large Also Elected

Edward C. Franklin, professor of organic chemistry of Leland Stanford Junior University, has been elected president of the American Chemical Society, succeeding Edgar F. Smith of the University of Pennsylvania.

Wilder D. Bancroft of Cornell University was reelected a director of the society and William Hoskins, consulting chemist of Chicago, was made a new director of the society. The following councilors-at-large for the period from 1923 to 1925 also were elected: Roger Adams, University of Illinois; G. N. Lewis, University of California; Ralph H. McKee, Columbia University, and Dr. William McPherson, Ohio State University.

Dr. Franklin, the new president, was born at Geary City, Kansas, in 1862. He was graduated from the University of Kansas in 1888 and received his master's degree in 1890. He was a student at the University of Berlin in 1890 to '91 and received his Ph. D. at Johns Hopkins University in 1894.

He was a member of the advisory board of the Bureau of Mines in 1917 to '18; physical chemist of the Bureau of Standards and consulting chemist of the ordnance bureau of the Army during the war. Dr. Franklin's work on liquid ammonia as an electrolytic solvent is familiar to all chemists. In addition to his university work, he was in industrial work for a number of years, having had experience in the sugar industry and also in the gold mining industry. In the latter work he was stationed at Miramar, Costa Rica, in 1897.

Dr. Franklin was chosen from the four nominees for president of the Society who received the largest number of votes. The choice among these four was determined by a vote of the councilors of the society. The three other leading candidates were James F. Norris of Massachusetts Institute of Technology, Samuel S. Parr of the University of Illinois, and Charles L. Reece, of E. I. du Pont de Nemours & Co.

Canadian Atmospheric Nitrogen Plant Will Resume Operation

Plans are being formulated for the further development of an atmospheric nitrogen products industry in British Columbia. A plant was established four years ago on the site of the British Columbia Electric Railway Company's plant at Lake Buntzen by an American company which operated throughout 1920 and a part of 1921, using the surplus energy generated by the electric company. Operations are about to be resumed with a daily output of about five tons of sodium nitrate and nitric acid. The plant will operate twenty-four hours a day and employ thirty-five men for the present, but should plans materialize the industry will be developed on a large scale.

American Metric Association Plans Meeting in Cambridge

The annual meeting of the American Metric Association is to be held on Dec. 30, at Massachusetts Institute of Technology, Cambridge. United States and Canadian Government departments, industrial and commercial organizations and corporations interested in metrology are especially invited to have representatives present.

The addresses and discussions at all sessions will be confined chiefly to those actually engaged in commerce or industry. Those primarily interested in education, public welfare, and co-operation between nations, are regarded as natural allies in the metric movement.

The Decimal Association of London, working in England for decimal currency and metric weights and measures, has requested the co-operation of the American Metric Society in urging the abandonment of the British and American gallons and the adoption in their place of the international liter as their common unit of capacity.

The liter is less than the Imperial quart and greater than the American quart, and its adoption would thus—in effect—strike an average between the existing British and American practices.

Ask Fertilizer Man's Aid to Relieve Car Shortage

Efforts by Shippers to Sell Carload Lots and Deliver in Off Seasons Would Improve Conditions

A plea for the use of cars during other months than those of the late summer and fall has been made to the National Fertilizer Association by M. J. Gormley, the chairman of the car service division of the American Railway Association. It is a reply to the various complaints which have been lodged with his organization by numerous fertilizer manufacturers who have suffered from their inability to obtain enough cars. While the association is willing to admit that shippers have an important responsibility in obtaining the prompt release of cars, there is a feeling that the great losses entailed by the annual car shortage is so much greater than the relatively small loss resulting from cars being unemployed during certain months that some steps must be taken to increase the amount of equipment available when the freight movement is heaviest.

Mr. Gormley pointed out that from January, 1912, to November, 1922, the country has passed through 87 months of car surplus and 43 months of car shortage. Surplus cars ranged as high as 486,000 averaged monthly, with shortages of about 166,000 cars. During these periods only 64 per cent of the capacity of freight cars was utilized. Car loading reached its peak during the fall of 1920 and figures indicate that approximately 2,250,000 fewer cars would have been used during the year 1921 to handle the same amount of tonnage provided the cars had been as heavily loaded during the entire year of 1921 as they were during the last quarter of 1920. The loading per car of many commodities for the first 6 months of 1922 had declined under the 1921 basis, hence it is timely from both the standpoint of the carrier and the shipper to stress the necessity for greater effort in this regard.

Relief Measures

Directly related to the more efficient use of equipment and the spreading out of the distribution of the seasonal movement of commodities is the willingness and ability of the purchaser to place his orders for full carloads, not in fixed quantities as may be governed by set tariff minimums or trade units. Furthermore, the purchaser should be induced to place his orders in advance of his immediate necessities and wherever possible to carry a stock of the products which will allow the producer to make shipments during periods of the year when transportation facilities are least congested and when thousands of cars or locomotives are normally available to effect quicker dispatch.

New Italian Ambassador to Be Welcomed by Fellow Engineers

American engineers are planning a big reception to Prince Gelasio Caetani, Italian Ambassador to Washington, now on his way to this country. A dinner, at which engineers from all parts of the country will be present, will be given in honor of the new diplomat, himself an engineer, by the American Engineering Council of the Federated American Engineering Societies in Washington on the evening of Jan. 12.

"Joyfully returning to states which have been my second home," said a cable message from Prince Caetani to Colonel Arthur S. Dwight, member of the executive board of the American Engineering Council and president of the American Institute of Mining and Metallurgical Engineers. "Ready to devote myself to the good of both countries. I am looking forward with intense pleasure to meeting old friends at dinner kindly offered. Expect to arrive Dec. 20."

Personal

Ernest G. Jarvis, superintendent of foundries and rolling mills for the McNab & Harlin Mfg. Co., Paterson, N. J., has resigned, effective Jan. 1, 1923. Mr. Jarvis expects to take a much needed rest for a few months and about Jan. 15 will sail for a cruise of South and Central America. After his return he will resume his metallurgical activities in a consulting way.

Dr. Charles F. Kettering, president of the General Motors Research Corporation, addressed the Harvard Medical Society at the Harvard Club, New York, on Dec. 15, on the subject "An Engineer's Perspective of Modern Science."

Dr. Irving Langmuir gave a series of three lectures at the Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 27, 28 and 29, on recent discoveries in electron emission and current control.

A. E. Marshall has resigned as president of Marshall Rieha, Inc., and will in future devote his attention solely to plant design, consultation and report work for the chemical industry. His office is at 3034 St. Paul St., Baltimore, Md.

David J. Price, engineer in charge of development work of the Bureau of Chemistry of the U. S. Department of Agriculture, recently in addressing the Safety Bureau of the Chamber of Commerce, Buffalo, N. Y., declared there is no such thing as a spontaneous explosion and called attention to the danger of dust explosions in various kinds of industrial plants and discussed the methods of prevention that have proved effective.

Dr. J. W. Reedy was recently elected chairman of the University of Illinois section of the American Chemical Society. Prof. A. M. Buswell was chosen vice-chairman, Dr. D. M. Engles secretary and Edith H. Nason treasurer.

Franklin H. Smith, former assistant secretary of the National Lumber Manufacturers' Association, has become associated with the U. S. Tariff Commission as chief of its Forest Products Division. Mr. Smith was for many years connected with the U. S. Forest Service.

Dr. Samuel Wesley Stratton was the guest of honor at a farewell reception at the Bureau of Standards on Thursday, Dec. 14. The program included a most elaborate display of interesting work of the bureau and a visit to a number of the industrial laboratories. Dr. Stratton was presented with a fine silver service from the members of the staff of the bureau.

Hugh S. Taylor has been promoted by the trustees of Princeton University to a full professorship in the department of chemistry, with the title of professor of physical chemistry.

Dr. John E. Teeple expects to sail for London on Jan. 2.

Stanley Woodward, formerly director of purchases for The Barrett Co. and W. B. Harris, formerly general sales manager of the same organization and later assistant to the president, have resigned. Together with T. M. Rianhard, formerly president of The Barrett Co., they expect to engage in the roofing business in Baltimore.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Guessing About Credits

Most Business Failures Are Caused by Lack of Discretion on the Part of Selling Houses

It must be admitted that there is no substitute for good judgment in business, but the average business man can profitably spend a considerably larger share of his time in analyzing the problems of production and distribution. A phase of the latter subject which, according to a recent statement of the National Association of Credit Men, has not received the attention it deserves, has to do with credit matters. The association declares that in the field of credits there is too much guessing and too little critical investigation. In part, the statement is as follows:

"When conceding that a large proportion of commercial failures are accounted for by the indiscretions of the selling houses, then surely the thesis cannot be successfully contested that in credits too much is taken for granted and the surface is too frequently regarded as indicative of the entire situation.

"When serious wastes may happen—and they have happened with us frequently because of these defects—then it is high time for us to become economic observers, closer students of markets, with more individual ability to forecast the future and to appraise the real qualities of a credit risk.

"We cannot regard excessive bad debt losses without conceding that critical investigation was lacking.

"Waste is deplorable, especially when it need not happen, and we appeal to the commercial and credit workers of the nation to increase their powers of economic observation; to develop a critical ability that will insure a proper flow of commodities and a volume of credits that will liquidate with a small amount of loss."

Chemical Exports Holding Their Own

Total Shipments for 10 Months Valued at $87,901,236, Only One-Half Per Cent Less Than in 1921

Exports of chemicals and allied products for the 10-month period, January-October, 1922, compared with the corresponding period in 1921, indicate that chemicals are holding their own, according to C. Concannon, acting chief of the Chemical Division of the Department of Commerce. Total exports for the period were $87,901,236 in 1922, which is not quite one-half of one per cent less than in the corresponding 10 months of 1921.

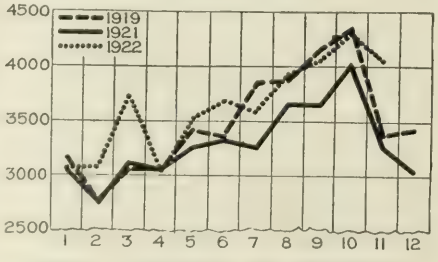
While the percentage of increases in certain classes in 1922 over 1921 are not as high as during the previous period, January-September, the percentage of decreases in others are lower. Of the sodium compounds exported, caustic soda showed a gain of 244 per cent; borax, 190 per cent; sodium silicate, 21 per cent; and soda bicarbonate, 11 per cent; while soda ash recorded a loss of 24 per cent. Sal soda decreased 15 per cent in value, but gained 3 per cent in quantity.

Of the other chemicals recording marked improvement, nitric acid was the most important, advancing over 120 per cent in value, from $18,906 (122,794 lb.) in 1921 to $41,863 (630,646 lb.) in 1922. Shipments of wood and denatured alcohol increased from 344,853 gal., valued at $400,056, to 1,028,181 gal., valued at $735,473; glycerine from 1,411,223 lb., valued at $231,698, to 2,594,808 lb., valued at $381,543; acetate of lime from 15,139,051 lb., valued at $331,960, to 24,653,025 lb., valued at $501,325; bleaching powder from 12,815,794 lb., valued at $363,589, to 33,188,418 lb., valued at $545,483, and copper sulphate from 3,132,306 lb., valued at $196,382, to 4,675,115 lb., valued at $224,647. Benzol, carbolic acid and sulphuric acid all showed decreases in 1922.

A Year of Business Expansion

Freight Car Loadings During 1922 Clearly Indicate the Improvement Over 1920 and 1921

Freight car loadings represent distribution of commodities and therefore constitute an accurate index of the movement of general business. If the total monthly loadings of revenue freight are compared for the years



TOTAL LOADINGS OF REVENUE FREIGHT BY MONTHS, 1919, 1921, AND 1922
(Unit: 1,000 cars)

"Chem. & Met." Weighted Index of Chemical Prices

Base — 100 for 1913-14

This week	168.35
Last week	168.73
December, 1921	145
December, 1920	245
April, 1918 (high)	286
April, 1921 (low)	140

The principal changes reported among the index commodities were for cottonseed and linseed oils. The former was ¼c. per lb. lower than last week, while linseed oil showed a gain of 3c. per gal. Ammonium sulphate showed a net gain of 5c. on the 100 lb.

1919, 1921 and 1922, some interesting information is disclosed. In the first place, it is scarcely necessary to show that 1921 was a year of depression. But it is interesting to note that except for the one month of April (the first of the coal strike) loadings during the current year have exceeded those of 1921 and have very closely approximated the records of 1919. The peak in both cases was reached about the middle of October, but the seasonal drop during November has been less abrupt during 1922 than in 1919.

This indisputable evidence of business expansion is shown graphically in the accompanying chart, which has been copyrighted by the Harvard University Committee on Economic Research.

Alcohol Statistics for 1922

Annual Report of Internal Revenue Commissioner Reviews Production and Distribution of Alcohol

The industrial alcohol and chemical division of the Bureau of Internal Revenue has recently prepared an interesting summary of its operations during the year ended June 30, 1922. At the close of the last fiscal year, it reports, there were seventy-three industrial alcohol plants, seventy-eight bonded warehouses and seventy-four denaturing plants qualified to operate for the production, storage and denaturation of alcohol, respectively, under Title III of the national prohibition act. During the year nine industrial alcohol plants, ten bonded warehouses and twelve denaturing plants were established, while six industrial alcohol plants, eight bonded warehouses and three denaturing plants were discontinued, resulting in a comparatively small net increase over the number qualified on June 30, 1921. For the production of distilled spirits for nonbeverage purposes, other than alcohol, there were operated during the year

two grain distilleries, two rum distilleries and thirty-three fruit distilleries.

Distilled Spirits — During the fiscal year ended June 30, 1922, there was produced 79,906,101.51 proof gallons of alcohol, a decrease of 5,162,674.82 proof gallons compared with the quantity produced during the preceding fiscal year.

There was withdrawn from warehouse on payment of tax 16,363,301.85 proof gallons of alcohol, and there was withdrawn for tax-free purposes, including withdrawals for denaturation, for export and for use of the United States hospitals, laboratories, colleges and other educational institutions, a total of 63,147,767.22 proof gallons of alcohol.

There was withdrawn, tax paid, from distillery, general and special bonded warehouses 2,724,363.4 taxable gallons of distilled spirits (including brandy) other than alcohol, a decrease of 6,352,782.1 gal. compared with the quantity withdrawn tax paid during the preceding year.

Denatured Alcohol — The number of bonded manufacturers using specially denatured alcohol at the end of the fiscal year 1922 was 3,287, compared with 1,761 such manufacturers at the end of the fiscal year 1921. The increase of 1.526 was due to the qualification of many permittees heretofore using pure alcohol. During the same period of time sixty-seven permits to use specially denatured alcohol were revoked by the department.

During the fiscal year 1922 there was withdrawn from bond, free of tax, for denaturation 59,549,919.6 proof gallons of alcohol and rum, against 38,812,138.7 proof gallons withdrawn for this purpose during the previous year.

There was 33,345,747.91 wine gallons of denatured alcohol produced during the past fiscal year, of which 16,193,523.60 wine gallons was completely denatured and 17,152,224.31 wine gallons was specially denatured, compared with 22,388,824.92 wine gallons of denatured alcohol produced during the previous fiscal year, of which 12,293,595.02 wine gallons was completely denatured and 9,996,229.90 wine gallons was specially denatured.

Less Oleomargarine in 1922

In order to exact the internal revenue tax on oleomargarine it is necessary for the government to keep an accurate record of production and consumption of this commodity. The Commissioner of Internal Revenue in his annual report for the fiscal year 1922 has presented some interesting statistics on this industry.

During the year ended June 30, 1922, there were seventy-two oleomargarine factories in operation. Nine factories closed during the year, leaving sixty-three in business on June 30, 1922. The seventy-two factories produced 6,603,981 lb. of colored and 184,346,392 lb. of uncolored oleomargarine, compared with 11,600,319 lb. of colored and 269,481,195 lb. of uncolored oleomargarine in the fiscal year 1921, a decrease of 43.1 and 31.6 per cent, respectively.

Babson's Views on Linseed Oil

The Babson statistical organization has recently been advising its clients against laying in heavy stocks of linseed oil. Apparently precautions should be taken to insure adequate supplies for the next few months, but it is not considered advisable to build up any considerable inventories. The *Buyer's Bulletin* for Dec. 12 contains the following statement: "We do not advocate heavy inventories of linseed oil, because supplies of this commodity are undoubtedly adequate to meet the prospective demand. The domestic flaxseed crop is the largest since 1918, estimated at 12,101,000 bushels—a marked increase over the 1921 crop of only 8,112,000 bushels. Then again Argentina is growing a tremendous amount of this commodity. Recent estimates place this season's crop at 60,000,000 bushels, as against only 30,000 000 last year. It is true that there is a tariff on the seed, but it is not sufficiently high to keep foreign seed out of the country. Imports of linseed oil prior to the tariff were extremely heavy, being six times as large as those of last year. The probable demand is fairly good, but we feel that it is discounted by current prices, which are 50 per cent above pre-war levels."

Cost Studies a Legitimate Activity of Trade Associations

Trade associations or groups interested in cost accounting may meet solely for the purpose of the study of costs, the detection of errors and the improvements of their methods without contravention of law, in the opinion of Commissioner Nelson B. Gaskill, of the Federal Trade Commission.

"I have previously expressed my firm belief," said Commissioner Gaskill, "that cost accounting is a legitimate trade association activity, and subsequent consideration has merely strengthened this conviction. Collective analytical study of the results of cost accounting furnishes an invaluable supplement to the individual cost accounting work. Comparison of results, analysis of results and the study and discussion of these results lead to the improvement of methods and the increase of efficiency. To prohibit collective study of costs for the purpose of their analysis, the detection of errors, and the improvement of methods, is to shackle educative progress.

"Of course the legal situation is confused by reason of the decisions in the hardwood lumber case and the linseed oil case, and it will be some time before this confusion will be cleared by any additional authoritative decisions. Trade associations must therefore determine as accurately as they can the legitimate field of proper endeavor and having so taken counsel, should, without hesitation, resting upon their legal advice and the clear consciousness of the propriety of their efforts, proceed without fear, willingly inviting the test of the courts' consideration of their conduct."

Solvents at Higher Levels in New York Market

Formaldehyde, Arsenic and Methanol Are Also Firmly Maintaining Recent Advances

Manufacturers of fusel oil, ethyl acetate and amyl acetate have announced a new advance in prices. The demand has become more pronounced of late and sellers have not been eager to book round lot business. The new price of fusel oil represents the high mark for 1922 and shows a net advance of $1 per gal. since January. Although producers of acetic acid, acetone and calcium acetate have not yet raised their prices, it is generally agreed in the trade that some revisions will be announced before the turn of the new year. Resale lots of formaldehyde are being quickly disposed of and the market is rapidly coming into the hands of the producer. Arsenic still continues along very steady lines, with demand very strong from the insecticide and calcium arsenate manufacturers. Manufacturers report a completely sold up condition at the works. Methanol retained its recent advance.

The approaching holidays seemed to have a quieting effect on the general list and aside from the rise in solvents the market showed no special features. Carbonate of potash was somewhat weaker and prices were fractionally lower. Lead arsenate, on the other hand, showed a very strong tendency and prices recorded an advance of 6c. per lb. during the interval. The alkali market continued along moderately active lines, with domestic consumers showing considerable interest in future developments. Contracts over 1923 have gone through in far better volume than a year ago and producers are quite satisfied with the general trend.

High Spots in the Market

Arsenic—Producers are not quoting and second hands report a very light supply on the spot market. Small quantities were recorded around 15c. per lb. Future shipments are held at 14½@14¾c. per lb., N. Y.

Bleaching Powder — Manufacturers reported a strong demand from consumers for contracts over 1923. Carload lots were quoted at $1.90 per 100 lb., f.o.b. works. Spot goods were held around $2.25 per 100 lb. in large drums.

Barium Chloride—Imported material was somewhat lower, due to the lack of consuming interest and prices were quoted down to $90@$95 per ton. Domestic factors quoted goods at the works at $95 per ton.

Ethyl Acetate—Leading producers announced a new price advance due to increased production costs. New prices range from 80@85c. per gallon.

Formaldehyde—Second hands were not eager to quote at lower than producers' prices and the market is very strong. January shipments were quoted for carloads at 16c. per lb., and less than carloads at 16½c. per lb. Spot goods were quoted around 15¾@16c. per pound.

Fusel Oil—Producers reported another increase in prices. Spot material is being held around $3.55 per gal. This represents the highest level of the year and shows a gain of $1.05 per gal. since January, 1922.

Lead Arsenate—Manufacturers announced a sharp advance due to the increased production costs and heavy demand from consuming quarters. Late figures ranged around 20c. per lb., showing an advance of 6c. per lb. within an interval of one week.

Prussiate of Potash—Yellow material showed some signs of weakness and prices were fractionally lower on spot. The general range was 38½@39c. per lb. Red prussiate showed no new features of interest and prices remained around 92@95c. per lb.

Soda Ash—Export business was quiet during the past week, but domestic consumers were buying for contract requirements. Spot material in bags, carload lots, held around $1.75 per 100 lb. Contracts for over 1923 were being made at $1.20 per 100 lb., basis 48 per cent, f.o.b. works, carload lots.

Good Prospects for 1923 in Chicago Market

Current Business, However, Slackens Off for Holidays

CHICAGO, Ill., Dec. 22, 1922.

The outlook for next year's business in the Chicago market was reported as exceptionally good and a general feeling of optimism prevailed throughout the trade. Due to the approaching holiday season and the inventory period, however, the chemical market has been very quiet. No business of any consequence was reported from most quarters, but the condition was thought to be only temporary. Prices held firm, as it was quite evident that lower prices would not stimulate the market.

CAUSTIC SODA FIRMER

Firm prices were the feature of the *caustic soda* market during the past 2 weeks and a fair amount of spot business was reported. The solid 76 per cent material was quoted in ton lots at $3.50 per 100 lb. and the ground in like lots of a similar quality at $4.25. *Caustic potash* was in rather poor demand, with only supplies of the foreign material available. The general quotation for small or moderate lots of the 88-92 per cent material was 7½c. per lb. *Soda ash* was unchanged in price and a satisfactory volume of business was reported at $2.25 per 100 lb. for material in cooperage.

Alums were quiet, with no change reported in the list. Foreign *potash alum* was quoted at 4½@5c. per lb. for the lumps and 5½@6c. for the powder. *Sal ammoniac* was firm at 8c. per lb. for either the domestic or foreign article. *Ammonium carbonate* was in light supply on spot and what was available was held for 11@12c. per lb. *Barium chloride* was in fair request and small lots were quoted at $110 per ton. *Barium carbonate* was quiet, with only odd lots offered at $90@$95 per ton. *White arsenic* was practically off of the market, with only a few kegs available at 16@18c. per lb. *Copper sulphate* continued to move in a fair way and the price was firm at 6c. per lb. for small or moderate lots. *Carbon bisulphide* was in fair demand, but spot supplies were still light. Single drums were quoted at 7@7½c. per lb. *Carbon tetrachloride* was firm after the recent advance and 10½c. per lb. for large drums was the generally quoted price. Formaldehyde was advanced in price again due to the higher level on *methanol*. The new price was 17c. per lb. for less than 5-bbl. lots and dealers reported a fair volume of business at that figure. *Glycerine* was firm at 18½c. per lb. for the c.p. material in drums, but the movement was not very heavy.

Cyanide of potash was in poor demand, but due to the scarcity of supplies the price of 55c. per lb. was maintained. *Red prussiate of potash* was still very scarce, with only small lots available at 95c.@$1 per lb. *Permanganate of potash* was slightly easier and U.S.P. crystals were quoted for immediate delivery at 17½c. per pound.

LINSEED OIL AND TURPENTINE

Linseed oil was very quiet, with dealers reporting little or no business. The boiled oil is quoted at 93c. per gal. in single-drum lots and the raw in similar lots at 91c.

Like linseed oil, *turpentine* was very quiet, with practically nothing moving. The quotation is $1.46 per gal. for single-drum lots.

Iron and Steel Stronger Than Expected

The Usual Slump for Inventory and Holidays Has Apparently Been Avoided

PITTSBURGH, Dec. 22, 1922.

The steel market is proving stronger and more active, at this time of year, than was commonly expected. It is habitual with the market to be quiet in December, but there is on the whole a very fair turnover. As to production, in turn, buyers usually prefer shipments to be light in December, to relieve inventory, but in general steel production is maintained and of course the product is all being shipped.

FROM SELLERS' TO BUYERS' MARKET

Approximately from April 1 to Oct. 1 there was a sellers' market in steel products, at first with merely a slight stiffening in prices and afterward, as high fuel costs were fastened upon the industry, with some fairly sharp advances. In the latter part of the period deliveries were very difficult to arrange in many cases, and delivery premiums developed in several lines, including bars, shapes, plates and sheets. All such delivery premiums disappeared some time ago. Of late there has been a buyers' market in place of a sellers' market. The change has altered the aspect of market affairs so that the market has appeared quieter and with less underlying strength than has really been the case. The feature of there being a buyers' market applies to deliveries, it being possible to arrange without difficulty almost any delivery desired, except in wire products and pipe in which lines the mills are still far in arrears. There being a buyers' market does not, however, apply to prices, for steel prices are well maintained. There had been no expectation that prices of pipe, wire products, sheets or tin plate would decline, but there were many predictions, a month and more ago, that the end of the year would see a lower market on bars, shapes and plates, perhaps a 1.75c. price. The outcome, however, is that these heavy rolled products are still quotable steady at 2c. Concessions may be made occasionally, but only in exceptional circumstances, and probably to no greater extent than they were being made a month and more ago. Some large interests occupy the strategic position of having no regular or official price, so that they are free to meet price cuts at any moment, and this situation has tended to discourage other mills from cutting.

COKE AND PIG IRON PRICES

Since the buying movement in foundry iron, whereby a fairly large tonnage was put under cover for first quarter, the market has been quiet and furnaces have advanced prices. In the valley market the price is $25 furnace, and all makers are now squarely on a basis of $26 valley. Basic iron did not move to any extent, for the double reason that consumers are not so sure of their requirements in first quarter as are the foundries that bought—largely radiator and sanitary ware makers—and they have more sources from which to draw, since many if not the majority of steel interests are willing to sell basic iron. Few of them can make foundry iron to advantage. Basic has sold in two or three instances at $24.25 valley, but all makers now seem to be firm at $24.50, some of them having an asking price of $25. Bessemer has been moving in carload lots at $27.50 valley.

Connellsville coke has had a complete upset, advancing the market in the neighborhood of $3 a ton and putting it out of the reckoning with blast furnaces. The occasion was a sudden rush of buying by Eastern distributors of domestic fuel. A few thousand of tons difference in the relation between demand and supply in a week has had distinct results in making market prices. Late last week buying orders from the East appeared, in lots of 25 or 50 carloads at a time. All floating supplies were absorbed, and some prospective production as well. Early last week furnace coke was a trifle weak at $6.50, with free offerings, while this week $9 has been paid by Eastern buyers. The furnaces are nonplussed, as they were about to negotiate for first quarter supplies and expected to buy at less than the recently going spot market, $6.50@$7.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride, 85 per cent	lb.	—	$0.39 – $0.41
Acetone	lb.	$0.21 – $0.21½	.21½ – .22
Acid, acetic, 28 per cent	100 lb.	3.50 – 3.60	3.65 – 4.00
Acetic, 56 per cent	100 lb.	7.00 – 7.15	7.20 – 7.50
Acetic, glacial, 99½ per cent, carboys,	100 lb.	12.80 – 13.00	13.25 – 13.50
Boric, crystals	lb.	.11½ – .11¾	.12 – .13
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.	—	.50 – .52
Hydrochloric, 18 deg	100 lb.	.80 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg	100 lb.	1.00 – 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech	lb.	.11 – .11¾	.11½ – .12
Lactic, 22 per cent tech	lb.	.05 – .05½	.05½ – .06
Muriatic, 20 deg. (see hydrochloric)			
Nitric, 40 deg	lb.	.05½ – .05¾	.06 – .06½
Nitric, 42 deg	lb.	.06 – .06¼	.06½ – .07
Oxalic, crystals	lb.	.13½ – .13¾	13¾ – .14½
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08½ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	—	1.55 – 1.65
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	—
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	—
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	—
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	—	—
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	—
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	—	.70 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	—	.30½ – .31
Tartaric acid, imported, powdered	lb.	—	.31 – .32
Tartaric acid, domestic	lb.	—	— .32
Tungstic, per lb. of WO	lb.	—	1.20 – 1.30
Alcohol, ethyl (Cologne spirit)	gal.	—	4.75 – 4.95
Alcohol, methyl (see methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	—	.39 – .41
Alcohol, denatured, 188 proof No. 5	gal.	—	.38 – .40
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03¼ – .03½	.03½ – .04
Alum, chrome lump	lb.	.05 – .05½	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¼
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.09 – .09½	.09½ – .10
Ammonium nitrate	lb.	.07¾ – .07½	.07½ – .08
Amylacetate tech	gal.	—	2.80 – 3.05
Arsenic, white, powdered	lb.	.15½ – .16	.16½ – .16½
Arsenic, red, powdered	lb.	.13½ – .14	.14½ – .15
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	90.00 – 92.00	93.00 – 100.00
Barium dioxide (peroxide)	lb.	.18 – .18½	.19 – .20
Barium nitrate		.08½ – .08¾	.09 – .09½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	—
Blanc fixe, pulp	ton	45.00 – 55.00	—
Bleaching powder	100 lb.	2.25 – 2.35	2.40 – 3.50
Blue vitriol (see copper sulphate)			
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)			
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.50 – 3.60	3.65 – 3.75
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	—	1.40 – 1.50
Calcium phosphate, tribasic	lb.	—	.15 – .16
Camphor	lb.	—	.95 – .96
Carbon bisulphide	lb.	.07 – .07½	.07½ – .08
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	—	.60 – .75
Caustic potash (see potassium hydroxide)			
Caustic soda (see sodium hydroxide)			
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	—
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	—
Chalk, precip.—imported, light	lb.	.04½ – .05	—
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05¾ – .06	.06¼ – .06½
Chloroform	lb.	—	.35 – .38
Cobalt oxide	lb.	—	2.10 – 2.40
Copperas	ton	25.00 – 27.00	27.50 – 30.00
Copper carbonate, green precipitate	lb.	.20 – .20½	.21 – .22
Copper cyanide	lb.	—	.50 – .55
Copper sulphate, crystals	100 lb.	6.00 – 6.25	6.30 – 6.50
Cream of tartar	lb.	—	.25½ – .26
Epsom salt (see magnesium sulphate)			
Ether, U.S.P. 100 drums	lb.	—	.13 – .15
Ethyl acetate com. 85%	gal.	—	—
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	—	.90 – .95
Formaldehyde, 40 per cent	lb.	.15½ – .16	.16¼ – .16½
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	—
Fullers earth—imported powdered	net ton	30.00 – 32.00	—
Fuse oil, ref	gal.	—	3.55 – 4.05
Fusel oil, crude	gal.	—	2.30 – 2.40
Glauber's salt (see sodium sulphate)			
Glycerine, c.p. drums extra	lb.	—	.18¼ – .18½
Iodine, resublimed	lb.	—	4.50 – 4.60
Iron oxide, red	lb.	—	.12 – .18
Lead acetate, white crystals	lb.	—	.12 – .12½
Lead arsenate, powd	lb.	.20 – .20½	.20½ – .21
Lead nitrate	lb.	—	.18 – .22
Litharge	lb.	.09¼ – .09½	.09½ – .10
Magnesium carbonate, technical	lb.	.07 – .07½	.07¾ – .08
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.	—	1.20 – 1.85
Methanol, 95%, bbls	gal.	—	1.23 – 1.25
Methanol, 97%, bbls	gal.	—	1.25 – 1.27
Nickel salt, double	lb.	—	$0.10 – $0.10½
Nickel salt, single	lb.	—	.11 – .11½
Phogene (see carbonyl chloride)			
Phosphorus, red	lb.	—	.35 – .40
Phosphorus, yellow	lb.	—	.30 – .35½
Potassium bichromate	lb.	$0.09½ – .10	.10½ – .10½
Potassium bromide, granular	lb.	—	.17 – .23
Potassium carbonate, U. S. P.	lb.	.10 – .10½	.11 – .15
Potassium carbonate, 80-85%	lb.	.05½ – .05¾	.06 – .06½
Potassium chlorate, powdered and crystals	lb.	.07¾ – .08	.08¼ – .09
Potassium cyanide	lb.	—	47 – .50
Potassium hydroxide (caustic potash)	100 lb.	6.25 – 6.50	6 60 – 6 75
Potassium iodide	lb.	—	3.55 – 3.65
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.15 – .15½	.16 – .17
Potassium prussiate, red	lb.	—	.92 – .95
Potassium prussiate, yellow	lb.	.38½ – .39	.39¼ – .39½
Rochelle salts (see sodium potas tartrate)			
Salammoniac, white, granular	lb.	.06½ – .06¾	.07 – .07½
Salammoniac, gray, granular	lb.	.08 – .08¾	.08½ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 – 27.00	—
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2 35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07¾	.08 – .08½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08¼
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼ – .04½	.04½ – .05½
Sodium chlorate	lb.	.06½ – .07	.07½ – .07½
Sodium chloride	long ton	12 00 – 13 00	—
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09¼	.09½ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.60	3.65 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03¼	.03½ – .04
Sodium nitrite	lb.	.08¾ – .09	.09½ – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	—	.18 – .21
Sodium prussiate, yellow	lb.	.20½ – .21	.21½ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 – 1.30	1.35 – 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04¾	.05 – .05½
Sodium sulphite, crystals	lb.	.03½ – .03⅝	.03½ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 – 20.00	—
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	—	2.50 – 3.15
Sulphur, roll (brimstone)	100 lb.	2.15 – 2.20	2.25 – 2.75
Talc—imported	ton	30 00 – 40 00	—
Talc—domestic powdered	ton	18.00 – 25.00	—
Tin bichloride	lb.	.10½ – .10¾	.11 – .11½
Tin oxide	lb.	—	.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14¾ – .15½
Zinc chloride, gran	lb.	.07 – .07½	.07¾ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08¼ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.05 — 1.10
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.16½ — .17
Aniline salts	lb.	.24 — .25
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70
Benzaldehyde U S P	lb.	1.35 — 1.40
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.85 — .90
Benzidine sulphate	lb	.75 — .80
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Cresylic acid, 97%, resale	gal.	1.00 — 1 05
Dichlorbenzene	lb.	.07 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.39 — .41
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.22 — .23
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.34 — .36
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.25 — .30
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.95 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls	lb.	.05½ — .06
Naphthalene, flake	lb.	.06 — .06½

Naphthalene, balls	lb.	$0.06½ —	$0.07
Naphthionate of soda	lb.	.58 —	.65
Naphthionic acid, crude	lb.	.60 —	.65
Nitrobenzene	lb.	.10 —	.12
Nitro-naphthalene	lb.	.30 —	.35
Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.85 —	.90
Ortho-nitro-toluene	lb.	.12½ —	.14
Ortho-toluidine	lb.	.14 —	.16
Para-amidophenol, base	lb.	1.15 —	1.20
Para-amidophenol, HCl	lb.	1.20 —	1.25
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.75 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.50 —	1.55
Para-toluidine	lb.	.85 —	.90½
Phthalic anhydride	lb.	.40 —	.50
Phenol, U. S. P., drums	lb.	.34 —	.35
Pyridine, domestic	gal.	1.60 —	1.75
Pyridine, imported	gal.	1.40 —	1.60
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.35 —	.37
Salicylic acid, U. S. P	lb.	.40 —	.42
Solvent naphtha, water-white, in drums, 100 gal	gal	.37 —	.40
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.22 —	.24
Sulphanilic acid, crude	lb.	.20 —	.22
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.35 —	.37
Toluene, in drums	gal.	.40 —	.43
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.45 —	.50
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	40 —	.42
Xylene, commercial, in tank cars	gal.	30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.28 —	$0.30
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.39 —	.40
Candellila, wax	lb.	.34 —	.35
Carnauba, No. 1	lb.	.39 —	.40
Carnauba, No. 2, North Country	lb.	.23 —	.24
Carnauba, No. 3, North Country	lb.	.17½ —	.18
Japan	lb.	.15 —	.15½
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04¾
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	.02¾
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03¾ —	.03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¾
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09¾
Stearic acid, double pressed	lb.	.09½ —	.09¾
Stearic acid, triple pressed	lb.	.10 —	.10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.25 —	....
Rosin E-I	280 lb.	6.35 —	....
Rosin K-N	280 lb.	6.45 —	$7.00
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.39 —	1.40
Wood turpentine, steam dist	gal.	1.35 —	....
Wood turpentine, dest. dist	gal.	1.25 —	....
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.43 —	....
Rosin oil, second run	gal.	.51 —	....
Rosin oil, third run	gal.	.53 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pine wood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.65 —	3.75
Blood, dried, f.o.b., N. Y	unit	4.60 —	
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.55 —	2.60
Tankage, high grade, f.o.b. Chicago	unit	4.65 —	4.75
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	35.75 —	38.50
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0.25½ —	.25½
Upriver coarse	lb.	.17½ —	.17½
Upriver caucho ball	lb.	20½ —	.20½
Plantation—First latex crepe	lb.	.27½ —	.27½
Ribbed smoked sheets	lb.	.27½ —	.27½
Brown crepe, thin, clean	lb.	.23 —	.23½
Amber crepe No. 1	lb.	.23 —	.23½

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12½ —	.12½
Coconut oil, Ceylon grade, in bbls	lb.	.08⅝ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09½
Corn oil, crude, in bbls	lb.	.10½ —	.10¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½ —	....
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.11 —	.11½
Linseed oil, raw, car lots (domestic) bbls	gal.	.90 —	.91
Linseed oil, raw, tank cars (domestic)	gal.	.86 —	.87
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.92 —	.93
Olive oil, denatured	gal.	1.05 —	1.12
Palm, Lagos	lb.	.07⅜ —	.07½
Palm, Niger	lb.	.07 —	.07½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.12 —	.12¼
Peanut oil, refined, in bbls	lb.	.13¾ —	.14
Rapeseed oil, refined in bbls	gal.	.79 —	.80
Rapeseed oil, blown, in bbls	gal.	.86 —	.87
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09½ —	.09¾

FISH

Light pressed menhaden	gal.	$0.60 —	....
White bleached menhaden	gal.	.64 —	.65
Blown menhaden	gal.	.68 —	.69
Whale Oil, No. 1, crude, tanks, coast	lb.	.06 —	.06½

Miscellaneous Materials

Prices remain same as previous week

Ferro-Alloys

Quotations remain unchanged

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, c.i.f. Atlantic seaboard	ton	18.50 —	19.00
Coke, foundry, f.o.b. ovens	net ton	8.00 —	8.50
Coke, furnace, f.o.b. ovens	net ton	7.50 —	8.00
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	17.50 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	21.50 —	22.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	
Manganese ore, chemical (MnO_2)	net ton	75.00 —	80.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.70 —	.75
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	lb.	.06 —	.08
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.11½ —	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.11½ —	.12
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.50 —	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	7.50 —	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 —	3.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.65
Aluminum, 98 to 99 per cent	22.00 23.00
Antimony, wholesale lots, Chinese and Japanese	6.35
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	38.00
Lead, New York, spot	7.25
Lead, E. St. Louis, spot	7.05
Zinc, spot, New York	7.30
Zinc, spot, E. St. Louis	6.95

OTHER METALS

Silver (commercial)	oz.	$0.62¾
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$118.00
Iridium	oz.	240.00@275.00
Palladium	oz.	60.00
Mercury	75 lb.	71.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

MARGERUM—The Alabama Rock Asphalt Co., Florence, Ala., recently organized with a capital of $500,000, has acquired a tract of local property, consisting of about 700 acres, with extensive asphalt deposits. Plans are under way for immediate development, to include the erection of a plant for commercial production at an early date. C. W. Ashcraft is president and general manager.

BIRMINGHAM—The Lehigh Portland Cement Co., Allentown, Pa., has awarded a contract to the Bethlehem Steel Co., Bethlehem, Pa., for the construction of its proposed cement mill on site near the city, known as Tarrant City. It will have a maximum capacity of 1,000,000 bbl. per year, and is estimated to cost more than $2,000,000, including machinery.

MONTGOMERY — The Massey Concrete Products Corp., 122 South Michigan Ave., Chicago, Ill., has tentative plans under consideration for the erection of a new branch plant on local site, estimated to cost in excess of $50,000, with equipment.

Arizona

SUPERIOR—The Magna Copper Co. is arranging a fund of about $3,500,000 for extensions and improvements in its local properties. The work will include a new smelting plant with capacity for handling about 700 tons of material per day; concentrating plant with output of approximately 600 tons; and the installation of additional machinery at its copper mines.

GLOBE—The American Ores & Asbestos Co. will discontinue operations at its plant in the Sierra Ancha Mountains, near Globe, for the mining of asbestos, and will dismantle the local furnace. It is proposed to operate in another district at a later date.

PRESCOTT—The Verde Valley Fruit & Produce Association plans for the installation of a mechanical drying plant at its proposed packing house at Cottonwood, near Prescott.

Arkansas

EL DORADO—Fire, Dec. 9, destroyed a portion of the local storage and distributing plant of the North American Oil Co., with loss estimated at $200,000, including equipment and stock. It is planned to rebuild.

California

EMERYVILLE—The Paraffine Co., Inc., has purchased property adjoining its local plant, totaling about 40 acres, and plans for the erection of additions for considerable increase in capacity. Plans will be prepared at an early date.

Georgia

HAWKINSVILLE—The Ocmulgee Brick & Tile Co. has tentative plans under consideration for extensions in its plant, to include the installation of additional equipment for brick production, and expansion for the manufacture of hollow tile. It is purposed to commence work early in the spring. J. E. and O. R. Jelks head the company.

Illinois

CHICAGO—The Evans Fibre Box Co., 4734-60 South Spaulding Ave, has filed plans for the erection of a new 1- and 2-story plant, 101x127 ft., and 21x483 ft., at location noted, estimated to cost about $150,000, including equipment.

TAYLORVILLE—The Hopper Paper Co. has taken out a state charter with capital of $350,000, to build the new paper mill on local site recently announced. The company is headed by Kenneth M. Fiske and Richard Y. Hoffman. Plans for the plant are nearing completion and bids will soon be called. It will cost $65,000.

CHICAGO—The Inlander-Steindler Paper Co., 11-13 North Green St., will erect a new 4-story building on the present site, 50x120 ft., estimated to cost in excess of $45,000.

CHICAGO—Following the recent acquisition of the John J. Crooke Co., 1649 Warren Ave., manufacturer of tinfoil, by the Midland Metal Co., same address, manufacturing tin and lead foil, plans are said to be in progress for general expansion in operations. The Crooke plant will be taken over by the Midland company and continued in service, and general improvements made. The property was secured for a consideration reported at $100,000.

Indiana

CANNELTON—The Cannelton Sewer Pipe Co., manufacturer of vitrified pipe, is taking bids for the erection of a new 4-story plant addition, to be equipped for general manufacture.

FORT WAYNE—The Fort Wayne Corrugated Paper Co., Barr and Murray Sts., has plans in progress for the erection of a 2-story addition. Bids will be called at an early date. Mills, Rhines, Bellman & Nordhoff, Toledo, O., are architects.

Kentucky

LOUISVILLE—The Pfeiffer Insecticide Co. has acquired the building at Floyd and A Sts., and plans for the installation of a new plant for the manufacture of insecticides and other chemical specialties. Equipment will be installed at an early date. F. B. Ayres, manager of the Louisville Industrial Foundation, is interested in the project.

Louisiana

LAFAYETTE — John J. Kean, formerly manager of the plant of the Lafayette Salt Co., at Anse Labutte, is organizing a new company, to be known as the Star Salt Corp., and plans for the installation and operation of a new local plant. Application for a state charter will be made in the near future.

MONROE—The Monroe-Louisiana Carbon Co. has tentative plans under consideration for the construction of a new plant at Ladel, near Monroe, to cost about $250,000, including machinery.

SWARTZ—The Atlas Oil Co. has commenced the construction of a new gasoline-extraction plant on the site of its former works, to cost about $100,000. Complete refining equipment will be installed and the previous plant capacity considerably enlarged.

MONROE—The Keystone Carbon Co. has been organized with a capital of $150,000, to construct and operate a local plant for the production of carbon black and affiliated specialties, for which plans are now well under way. The plant is estimated to cost about $75,000, with equipment, and will be of 2-unit type. C. K. Williams and J. P. Ehrhart, both of Easton, Pa., are president and vice-president, respectively, of the new company.

Maryland

BALTIMORE—The Consolidated Gas, Electric Light & Power Co., Lexington Bldg., has tentative plans under consideration for the construction of a new artificial gas plant on property recently acquired in the Turner's Station district, totaling about 50 acres. The proposed plant will cost approximately $500,000. Herbert A. Wagner is president.

BALTIMORE—The Petroleum Export Co., 638 Equitable Bldg., recently organized, is planning for the construction of a new oil-refining plant on local site, estimated to cost in excess of $300,000, including machinery. Walter B. Brooks heads the company.

EASTON—At a special election, approval was given to a plan to purchase the local artificial gas plant, to be operated in the future as municipal property. Extensions and improvements are contemplated. The local Board of Public Works is in charge.

BALTIMORE — The American Oil Co., American Bldg., has filed plans for the construction of a new storage works at Hawkins Point, to include the installation of a number of steel tanks and auxiliary operating equipment.

HAGERSTOWN—The Hagerstown Lime & Chemical Co., recently organized, is planning for the installation of a new grinding and pulverizing plant on a tract of about 40 acres of lime marl property. Bids for equipment will be asked at once. The company will operate with a capital of $30,000. J. S. Myers is president.

Massachusetts

WALTHAM—The Lockwood-Bracket Co., Boston, manufacturer of soap products, is arranging for the location of its entire plant in the building at Clematis Brook, Waltham, heretofore occupied by the Motor Specialties Co., which will soon remove its works to another location. The structure will be improved and equipment installed for soap manufacture.

Michigan

IRON MOUNTAIN—The West Chapin Mining Co., recently reorganized, has work in progress on a new blast furnace at its local properties, to have an initial capacity of 100 tons per day. Other plant extensions are contemplated. J. S. Edmundson is manager.

CALUMET—In connection with a proposed merger of the Calumet & Hecla Mining Co., with a number of its subsidiaries, including the Osceola, Centennial, Ahmeek and Allouez Mining companies, plans are being considered for extensions in the different copper properties and plants, to provide for greater output.

New Jersey

CAMDEN—Fire, Dec. 13, destroyed a portion of the plant of the John R. Evans Leather Co., with loss estimated at about $25,000, including equipment. It is planned to rebuild.

BAYONNE — The Vacuum Oil Co., 61 Broadway, New York, has awarded a contract to the Turner Construction Co., 242 Madison Ave., New York, for the erection of a 2-story storage and distributing plant at its local refinery, 75x190 ft.; work will be placed under way at once.

TRENTON — The Electric Poreclain Co., New York Ave., has filed plans for the erection of a 1-story addition to its plant.

JERSEY CITY—Graham & Zenger, 104 5th Ave., New York, manufacturers and importers of crockery and chinaware, have purchased the 2-story factory at Golden and Fremont Sts., Jersey City, totaling about 10,500 sq.ft. of floor space, for a new plant. It is planned to occupy at an early date.

New Mexico

ELIZABETHTOWN — The Ideal Mining & Milling Co. has commenced the erection of a new reduction plant at its properties, to be equipped for an output of about 50 tons per day. Considerable additional equipment will be installed at the present works, including air compressor, 200-ft. steam-operated hoist and auxiliary machinery.

New York

BUFFALO—Fire, Dec. 11, destroyed a portion of the local storage and distributing plant of the Sinclair Oil Refining Co., foot of Alabama St., with loss estimated at about $25,000. Early rebuilding is under consideration.

NEW YORK—The Pan-American Petroleum & Transport Co., 120 Broadway, has plans maturing for the development of Government oil properties in California, in accordance with agreement recently made with the Naval Department, Washington, D. C., covering Naval Reserve District No. 1. The work will include plants and equipment estimated to cost in excess of $10,000,000 for the initial operations, and more than $50,000,000 for ultimate development.

Ohio

AKRON—The Crouse Clay Products Co., manufacturer of brick, has commenced the construction of an addition to its plant, designed to increase the present capacity about 25 per cent. The machinery installation will be arranged at an early date.

CLEVELAND—The city council is considering an ordinance for a bond issue of $3,380,000, the proceeds to be used for the installation of a new filtration plant at the Baldwin reservoir. A. B. Roberts, municipal utilities director, is in charge.

CAMBRIDGE—The Universal Sanitary Mfg. Co., New Castle, Pa., manufacturer of

sanitary earthenware products, has acquired the local plant of the Florentine Pottery Co., at a bankruptcy sale, for a consideration said to be $100,000. The new owner is organizing a subsidiary company to be known as the Cambridge Pottery Co., to operate the local plant for a line of sanitary products. Improvements will be made and operations resumed shortly after the first of the year. The Universal company also has plans under consideration for extensions in its New Castle works, to double, approximately, the present capacity. C. J. Kirk is president.

ZANESVILLE — The Kerns-Korsuch Glass Co., a subsidiary of the Hazel-Atlas Glass Co., Wheeling, W. Va., has commenced the construction of a new plant of tract of 137 acres of land, lately acquired for this purpose. A large portion of the new works will be given over to the development of other hollowware products than those heretofore made. Extensions and improvements will also be carried out at the present plant. To provide funds for the expansion, the company his disposed of a bond issue of $800,000, and practically the entire amount will be so utilized.

Oklahoma

OKMULGEE—The Products Gasoline Co. has plans under way for the construction of a new gasoline extraction plant on local site. W. E. Pine is president.

CUSHING—The Home Gas Co. is planning for the erection of a new 2-unit plant for the production of gasoline from casinghead gas. It will cost about $35,000.

PONCA CITY—The Marland Refining Co. has tentative plans under consideration for enlargements in its local oil refinery.

Oregon

HUNTINGTON—The Sun Portland Cement Co., recently organized with a capital of $1,000,000, will break ground at once for a new cement-manufacturing plant, to be equipped for an initial daily output of about 1,000 bbl. of material. A power house, machine shop and other buildings will also be erected. H. A. Ross is president.

Pennsylvania

EASTON—Fire, Dec. 13, destroyed a portion of the local plant of the General Chemical Co., known as the West Easton Works, with loss approximating $22,000. It is planned to rebuild.

PHILADELPHIA — The Royal Veterinary Products Co. has leased property at 3041 Salmon St., for the establishment of a local works for the manufacture of chemical specialties. Immediate occupancy is being arranged.

PITTSBURGH—The Night Hawk Peninsular Mines, Ltd., James R. Dodworth, 323 4th Ave. (Pittsburgh-Hanover Coal Co.), chairman of the board, has plans under way for extensions and improvements in its plant and properties in the Porcupine district. A new mill will be constructed for metal reduction, with electric power plant and other mechanical buildings. To provide funds for the expansion, the company is disposing of a stock issue of $300,000.

SUSCON—Fire, Dec. 9, caused by an explosion, destroyed a number of buildings at the local plant of the Black Diamond Powder Co. It is said that the loss included one of the main mills. An official estimate of loss has not been made.

Tennessee

CHATTANOOGA—Gregg & Co., 165 Broadway, New York, engineers, have plans in progress for the construction of a new reduction plant on local site, for a company now being organized. The plant will be used for the grinding and pulverizing of non-metallic ores, including kaolin, feldspar, mica, limestone and affiliated specialties. It will have an initial production of about 50 tons per day and is estimated to cost approximately $100,000. Arrangements for equipment will be perfected soon.

Texas

PALESTINE — The Ligel Chemical Co., Houston, has acquired the lignite properties of the Anderson County Coal Co., near Palestine, and plans for the erection of a new plant for dehydrating work, including byproducts coal production. A feature will be made of the production of carbon. It is planned to commence operations at an early date.

ORANGE—The Port Vernon Oil Co. is said to be planning for the rebuilding of the portion of its local oil-refining plant, recently destroyed by fire. New equipment will be installed.

Industrial Developments

OIL—The Standard Oil Co. is increasing production at its Bayway refining plant, Elizabeth, N. J., and adding to the working force. Employment is being given to 3,000 men, or approximately the normal quota. More than 100 men have been added to the force since the first of the month.

The Haskell Oil Co. has completed a new refinery at Sigler, near Vernon, Tex., and will soon place the unit in service on a capacity basis, or about 100 bbl. of crude oil per day. This is the first oil-refining plant to locate in this district, and will be devoted to straight-run gasoline, as well as fuel oil and kerosene.

The Simms Petroleum Co. is increasing operations in the Smackover, Ark., field, and adding to its storage plant. It is proposed to develop the tankage to a maximum of 4,100,000 bbl.

The Mexico Oil Co. is planning for an early resumption of operations at its properties in the San Miguel, Mexico, district.

The National Products Co. is advancing operations at Terlton, Okla., and will soon commence the installation of a new 3-unit casinghead gasoline plant.

CEMENT—The Coplay Cement Mfg. Co., Coplay, Pa., has closed its local mill for the holidays for necessary repairs to equipment. It is proposed to resume production on Jan. 2 on a full-capacity basis.

Cement mills in the Lehigh Valley section of Pennsylvania are continuing operations at a maximum schedule. The annual shutdown periods at this time for machinery repairs will be deferred at 90 per cent of the mills, and it is not expected to curtail until plant conditions absolutely necessitate.

The Alpha Portland Cement Co. is maintaining full production at its La Salle, Ill., mill and will continue on this basis for an indefinite period. A full working force is employed. Work is in progress on additional storage at the plant, comprising a reinforced-concrete structure, 70x125 ft.

Cement mills at Birmingham, Ala., and vicinity are holding to a capacity schedule, with normal working forces. The plants are closing the best and biggest year in their history. Alabama mills have produced and sold close to 50 per cent of the 5,500,000 bbl. manufactured in the South in 1922. The largest mill in the state has shipped 1,500,000 bbl. during the last 12 months, this being the Atlas Portland Cement Co., at Leeds.

CERAMIC—About 170 potters have returned to the plant of the H. P. Wyllie China Co., Huntington, W. Va., as a result of the termination of the strike, and production at the pottery has been resumed.

The Summit China Co., Akron, O., has reopened its pottery on a full-production basis, following the return of 250 men who have been out on strike.

Lenox, Inc., Trenton, N. J., manufacturer of high-grade chinaware, has announced that the plant will be conducted as an open shop in the future. Only a portion of the men recently out on strike will be reemployed by the company.

The 10 weeks' strike in the general ware branch of the pottery industry, just closed, is estimated to have lost from 600 to 700 kilns of glost and bisque ware valued at $2,000 to $2,500 a kiln, and from 2,800 to 3,000 decorating kilns of varying valuation. The loss in wages is officially stated at $1,500,000, and with the estimated production loss, the total is $5,000,000.

IRON AND STEEL—The Alliance Steel Co. is planning for immediate operations at its new mill at Ottawa, Ill., comprising the former plant of the Central Steel Co.; it has been inactive for more than 8 years past. Production will be on a basis of 1,200 tons per month. The working force is being recruited.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., a subsidiary of the United States Steel Corp., is running full at its Ensley furnaces, giving 100 per cent production of pig iron.

The Witherbee, Sherman Co., New York, is making improvements at its blast furnace at Port Henry, N. Y., including the installation of a new skip hoist. It is expected to have the unit ready for blowing in late in February. Shortly thereafter, in April, the new 400-ton furnace now being built at the plant will be ready, giving a total production of 750 tons per day for the two stacks.

The Thomas Steel Co. has 6 of its 12 mills in service at the Mahoning Valley works, near Niles, O.

The Gulf States Steel Co., Birmingham, Ala., is running full at its mills, and will maintain this schedule for an indefinite period. Employment is being given to a normal working force.

The American Steel & Wire Co. has resumed operations at its mill at Anderson, Ind., following a shut-down of about 4 months. Employment will be given to approximately 400 men in the different departments.

METALS—The Butte Copper & Zinc Co., Butte, Mont., is operating on a basis of 250 tons per day, and plans to bring this output up to an average of 300 to 400 tons daily at an early date.

The Wolverine Copper Co., Calumet, Mich., is developing a production of about 900 tons per day, and purposes to increase this in the near future.

The Ray-Hercules Mines Co., Ray, Ariz., is making ready to place its new mill in service at an early date. The plant has been constructed in three units, with rated daily output of 600 tons per unit. Only one unit will be run at the present time, the others to be held ready for operation when required.

The American Zinc Co. is planning to place the new mill in service at its Silver Dike, Mont., property late in January. The plant is nearing completion, and has a rated output of 450 tons per day. The company will extend its zinc-oxide production, and has commenced improvements at its plant for this purpose.

MISCELLANEOUS—The United States Industrial Alcohol Co. will reopen its Peoria, Ill., plant at once. A full working force will be employed to develop 100 per cent capacity.

The Dunlop Tire & Rubber Corp. of America, Buffalo, N. Y., is arranging for the early reopening of its large plant on the River Road, which has been inactive for a number of months past. About 5,000 workers will be employed for initial production, and this force will be increased to 10,000 men and women at an early date.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE is holding a meeting Dec. 26 to 30 in Boston, Mass.

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1923.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 15 and 16, 1923.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City; Jan. 5 — American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.

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